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Risk factors and predictive modeling of exclusive breastfeeding failure in mothers separated from their infants

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Abstract

This study explored factors contributing to exclusive breastfeeding failure in mothers separated from their infants and developed a predictive nomogram model. Clinical data from 258 such mothers admitted to the First Affiliated Hospital of Soochow University between June 2023 and June 2024 were analyzed. Among them, 119 experienced breastfeeding failure. Prolonged separation, lack of breastfeeding knowledge, inverted nipples, maternal anxiety, and depression were identified as independent risk factors. The nomogram model showed good predictive performance, with an AUC of 0.739 and positive net benefit across a wide range of threshold probabilities. This model could support targeted interventions in clinical practice. *(Afr J Reprod Health 2025; 29 [6]: 29-39).*

Keywords: Exclusive breastfeeding; maternal-infant separation; risk factors; prediction model; nomogram

Résumé

Cette étude a exploré les facteurs contribuant à l'échec de l'allaitement maternel exclusif chez les mères séparées de leur nourrisson et a développé un modèle de nomogramme prédictif. Les données cliniques de 258 mères admises au Premier Hôpital affilié de l'Université de Soochow entre juin 2023 et juin 2024 ont été analysées. Parmi elles, 119 ont connu un échec d'allaitement. La séparation prolongée, le manque de connaissances sur l'allaitement, les mamelons inversés, l'anxiété maternelle et la dépression ont été identifiés comme des facteurs de risque indépendants. Le modèle de nomogramme a montré une bonne performance prédictive, avec une ASC de 0,739 et un bénéfice net positif sur une large plage de seuils de probabilité. Ce modèle pourrait soutenir des interventions ciblées en pratique clinique. *(Afr J Reprod Health 2025; 29 [6]: 29-39.*

Mots-clés: Allaitement maternel exclusif ; séparation mère-enfant ; facteurs de risque ; modèle de prédiction ; nomogramme

Introduction

Breastfeeding is widely recognized by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) as the optimal source of nutrition for newborns. It provides essential nutrients while significantly reducing the risk of neonatal infections, allergies, obesity, and metabolic disorders[1,2]. Beyond its nutritional advantages, breastfeeding fosters mother-infant bonding, strengthens the infant immune system, and positively contributes to maternal mental health, including a reduced risk of postpartum depression[3]. Despite its well-established benefits, exclusive breastfeeding rates remain suboptimal globally. WHO reports that only about 48% of infants under six months are exclusively breastfed, with rates dropping below 30% in some developing countries[4]. Similarly, a study by Zhao *et al*. found that the exclusive breastfeeding rate among infants under six months in China is merely 29.2%, underscoring the urgent need for enhanced breastfeeding promotion efforts[5].

Maternal-infant separation is recognized as a significant barrier to exclusive breastfeeding success[6]. This separation occurs when mothers and newborns are unable to establish immediate skin-to-skin contact or initiate timely breastfeeding in the early postpartum period, often due to medical interventions, maternal health complications, or hospital policies[7]. The WHO and the UNICEF strongly advocate for rooming-in and the "early contact, early suckling" approach, recommending that newborns be breastfed within the first hour after birth to enhance milk production, strengthen maternal-infant bonding, and improve exclusive

breastfeeding rates[8]. Despite these recommendations, maternal-infant separation remains prevalent in clinical practice, influenced by differences in healthcare policies, resource availability, and cultural beliefs[9].

Numerous studies have examined the association between maternal-infant separation and breastfeeding failure. Evidence suggests that maternal-infant separation can disrupt the physiological and emotional bond between mother and infant, reducing oxytocin secretion and subsequently impairing milk production[10]. Additionally, reduced infant suckling frequency due to separation may further inhibit lactation and elevate the risk of breastfeeding failure[11]. Nyqvist et al. reported that mothers who experienced maternal-infant separation within the first 48 h postpartum had a significantly shorter duration of exclusive breastfeeding than those who remained with their infants[12]. While research has consistently shown that maternal-infant separation increases the likelihood of breastfeeding failure, considerable individual differences in breastfeeding outcomes remain[13]. This indicates that, beyond maternal-infant separation itself, other factors may also contribute to breastfeeding failure. However, current studies predominantly focus on the occurrence of maternal-infant separation, with limited investigation into the underlying mechanisms and additional contributing factors influencing exclusive breastfeeding failure.

This study not only investigates the impact of maternal-infant separation on breastfeeding failure but also explores the key factors contributing to breastfeeding difficulties in separated mothers. Several potential risk factors were analyzed, including separation duration, insufficient breastfeeding knowledge, inverted nipples, and maternal psychological distress. Univariate and multivariate logistic regression analyses were performed to assess their roles in breastfeeding failure. Furthermore, a nomogram predictive model was developed based on the identified independent risk factors and was subsequently validated for its predictive accuracy. These findings contribute to filling the research gap between maternal-infant separation and breastfeeding failure while offering valuable data to inform clinical nursing practices and breastfeeding support policies.

Method

General information

This retrospective study analyzed clinical data from mothers experiencing maternal-infant separation and their infants admitted to the First Affiliated Hospital of Soochow University between June 2023 and June 2024. Participants were categorized into two groups based on exclusive breastfeeding outcomes: 119 mothers who experienced breastfeeding failure were assigned to the failure group, while 139 mothers who successfully maintained exclusive breastfeeding were included in the success group.

Prior to data collection, the study protocol was reviewed and approved by the Ethics Committee of the First Affiliated Hospital of Soochow University (Approval Number: 2024000, Date: July 1, 2021). Although the study was retrospective, all mothers had been informed about the potential use of their anonymized clinical data for research purposes at the time of hospital admission, and written consent was obtained and archived. All procedures were conducted in compliance with the ethical standards of the institutional and national research committees and with the Declaration of Helsinki.

Inclusion and exclusion criteria for mothers and infants

Inclusion criteria: (1) mothers and infants who met the clinical indications for maternal-infant separation; (2) availability of complete clinical records for both mother and infant, with no missing data, loss to follow-up, or unclear documentation; (3) mothers who voluntarily agreed to participate.
Exclusion criteria: (1) no medical contraindications to breastfeeding for either the mother or infant; (2)mothers with diagnosed psychiatric disorders; (3) pregnancies conceived through assisted reproductive technologies; (4) twin or multiple pregnancies; (5) cases involving transfer to another hospital due to medical conditions, loss to follow-up, or infant mortality

Exclusive breastfeeding definition

This study adheres to the WHO definition of exclusive breastfeeding, which is defined as an infant receiving only breast milk for the first six months of life, with no intake of formula, juice, solid foods, or other supplementary nutrition sources. However, the use of oral rehydration salts (ORS), medications, vitamins, and mineral supplements (administered as drops or syrups) is allowed[14].

Infant clinical data collection

For each infant, data on sex, birth weight, disease type, and maternal-infant separation time were recorded.

Maternal clinical data collection and assessment

Maternal data included age, gestational week, education level, average monthly household income per capita, previous breastfeeding experience, insufficient breastfeeding knowledge, inverted nipples, maternal anxiety and depression, perinatal complications, decreased appetite, mastitis, and mode of delivery.

(1) Breastfeeding knowledge assessment: Maternal breastfeeding knowledge was measured using the Breastfeeding Knowledge Questionnaire, developed by Ouyang et al. This 18-item questionnaire has a total score range of 0~18, with higher scores indicating greater breastfeeding knowledge and proficiency. A score of ≥12 was used as the threshold for adequate breastfeeding knowledge[15].

(2) Maternal anxiety assessment: Maternal anxiety levels were assessed using the Hamilton Anxiety Rating Scale (HAMA), a 14-item tool with a total score range of 0~56. Higher scores indicate greater anxiety severity. A HAMA score of ≥14 was considered indicative of clinically significant maternal anxiety[16].

(3) Maternal depression assessment: The 17-item Hamilton Depression Rating Scale (HAMD) was used to assess maternal depression. The total score ranges from 0 to 52, with higher scores reflecting more severe depressive symptoms. A score of ≥17 was used to identify cases of maternal depression[17].

Statistical analysis

All statistical analyses were performed using SPSS 22.0. The Kolmogorov-Smirnov test was used to assess data normality, confirming that continuous variables followed a normal distribution. These variables were expressed as mean ± standard deviation ($\bar{x}\pm s$) and compared between groups using an independent *t*-test. Categorical variables were presented as frequencies (n, %) and analyzed using the χ^2 test or Fisher's exact test, as appropriate. Statistical significance was set at $P < 0.05$. Univariate and multivariate logistic regression analyses were conducted to identify independent risk factors. A nomogram predictive model was developed based on multivariate logistic regression results. The model's predictive accuracy and clinical utility were assessed using calibration curves, receiver operating characteristic (ROC) analysis, and decision curve analysis (DCA).

Results

Comparison of clinical characteristics between infants with exclusive breastfeeding success and failure

This study included 258 mother-infant pairs, with an exclusive breastfeeding failure rate of 46.1% (119/258). Compared to the successful breastfeeding group, infants in the failure group experienced a significantly longer maternal-infant separation time ($P<0.05$). However, there were no significant differences between the two groups in terms of sex, birth weight, or disease type ($P>0.05$) (Table 1).

Comparison of maternal clinical characteristics between exclusive breastfeeding success and failure groups

Mothers in the exclusive breastfeeding failure group had significantly higher rates of insufficient breastfeeding knowledge, inverted nipples, anxiety, and depression compared to those in the success group ($P<0.05$).

Table 1: Comparison of clinical characteristics between infants with exclusive breastfeeding success and failure

	Failure group (n=119)	Success group (n=139)	t/χ^2	*P*
Sex			0.067	0.795
Male	64 (53.8)	77 (55.4)		
Female	55 (46.2)	62 (44.6)		
Birth weight (g)	2089.1±287.4	2122.2±315.4	0.877	0.382
Disease type				0.165*
Respiratory system diseases	47 (39.5)	62 (44.6)		
Hyperbilirubinemia	42 (35.3)	59 (42.5)		
Neurological disorders	19 (16.0)	12 (8.6)		
Cardiovascular diseases	6 (5.0)	3 (2.2)		
Others	5 (4.2)	3 (2.2)		
Maternal-infant separation time (d)	11.4±2.3	10.7±1.9	2.599	0.010

*Fisher's exact tests.

Table 2: Comparison of maternal clinical characteristics between exclusive breastfeeding success and failure groups

	Failure group (n=119)	Success group (n=139)	t/χ^2	*P*
Age	28.6±4.5	27.8±4.3	1.289	0.198
Gestational week	38.0±1.6	38.4±1.7	1.747	0.082
Education level			1.107	0.575
Middle school	30 (25.2)	43 (30.9)		
High school	53 (44.5)	59 (42.5)		
College/university	36 (30.3)	37 (26.6)		
Average monthly household income per capita (Yuan)			0.836	0.361
<5000	45 (37.8)	45 (32.4)		
≥5000	74 (62.2)	94 (67.6)		
Previous breastfeeding experience			3.376	0.066
No	103 (86.5)	108 (77.7)		
Yes	16 (13.5)	31 (22.3)		
Insufficient breastfeeding knowledge			16.273	<0.001
No	33 (27.7)	73 (52.5)		
Yes	86 (72.3)	66 (47.5)		
Inverted nipples			7.847	0.005
No	102 (85.7)	133 (95.7)		
Yes	17 (14.3)	6 (4.3)		
Maternal anxiety			10.908	0.001
No	23 (19.3)	53 (38.1)		
Yes	96 (80.7)	86 (61.9)		
Maternal depression			5.891	0.015
No	109 (91.6)	138 (99.3)		
Yes	10 (8.4)	1 (0.7)		
Perinatal complications			0.862	0.353
No	93 (78.1)	115 (82.7)		
Yes	26 (21.9)	24 (17.3)		
Decreased appetite			3.043	0.081
No	30 (25.2)	49 (35.2)		
Yes	89 (74.8)	90 (64.8)		
Mastitis			2.856	0.091
No	104 (87.4)	130 (93.5)		
Yes	15 (12.6)	9 (6.5)		
Mode of delivery			0.475	0.491
Vaginal birth	66 (55.5)	83 (59.7)		
Cesarean delivery	53 (44.5)	56 (40.3)		

Table 3: Univariate logistic regression analysis of exclusive breastfeeding failure

	β	S.E	*P*	OR (95%CI)
Sex				
Male				1.000 (Reference)
Female	0.065	0.251	0.795	1.067 (0.653 ~ 1.745)
Birth weight (g)	-0.000	0.000	0.380	1.000 (0.999 ~ 1.000)
Disease type				
Respiratory system diseases				1.000 (Reference)
Hyperbilirubinemia	-0.063	0.280	0.822	0.939 (0.543 ~ 1.624)
Neurological disorders	0.737	0.416	0.077	2.089 (0.924 ~ 4.724)
Cardiovascular diseases	0.970	0.733	0.186	2.638 (0.627 ~ 11.100)
Others	0.788	0.755	0.297	2.199 (0.500 ~ 9.665)
Maternal-infant separation time (d)	0.159	0.062	0.011	1.172 (1.037 ~ 1.324)
Age	0.037	0.028	0.198	1.037 (0.981 ~ 1.097)
Gestational week	-0.131	0.075	0.082	0.877 (0.757 ~ 1.017)
Education level				
Middle school				1.000 (Reference)
High school	0.253	0.304	0.406	1.288 (0.710 ~ 2.336)
College/university	0.333	0.334	0.319	1.395 (0.725 ~ 2.683)
Average monthly household income per capita (Yuan)				
<3000				1.000 (Reference)
≥3000	-0.239	0.262	0.361	0.787 (0.471 ~ 1.315)
Previous breastfeeding experience				
No				1.000 (Reference)
Yes	-0.614	0.337	0.069	0.541 (0.279 ~ 1.048)
Insufficient breastfeeding knowledge				
No				1.000 (Reference)
Yes	1.059	0.266	<0.001	2.882 (1.711 ~ 4.855)
Inverted nipples				
No				1.000 (Reference)
Yes	1.307	0.493	0.008	3.694 (1.406 ~ 9.705)
Maternal anxiety				
No				1.000 (Reference)
Yes	0.945	0.291	0.001	2.572 (1.456 ~ 4.546)
Maternal depression				
No				1.000 (Reference)
Yes	2.538	1.056	0.016	12.661 (1.597 ~ 100.382)
Perinatal complications				
No				1.000 (Reference)
Yes	0.292	0.316	0.354	1.340 (0.722 ~ 2.486)
Decreased appetite				
No				1.000 (Reference)
Yes	0.479	0.276	0.082	1.615 (0.941 ~ 2.773)
Mastitis				
No				1.000 (Reference)
Yes	0.734	0.442	0.097	2.083 (0.877 ~ 4.951)
Mode of delivery				
Vaginal birth				1.000 (Reference)
Cesarean delivery	0.174	0.253	0.491	1.190 (0.725 ~ 1.954)

Table 4: Multivariate logistic regression analysis of exclusive breastfeeding failure

	β	S.E	P	OR (95%CI)
Insufficient breastfeeding knowledge				
No				1.000 (Reference)
Yes	1.171	0.290	<0.001	3.225 (1.828 ~ 5.689)
Inverted nipples				
No				1.000 (Reference)
Yes	1.426	0.533	0.008	4.162 (1.463 ~ 11.839)
Maternal anxiety				
No				1.000 (Reference)
Yes	0.756	0.309	0.014	2.129 (1.162 ~ 3.900)
Maternal depression				
No				1.000 (Reference)

However, there were no significant differences between the two groups in terms of age, gestational week, education level, average monthly household income per capita, previous breastfeeding experience, perinatal complications, decreased appetite, mastitis, or mode of delivery (P>0.05) (Table 2).

Univariate logistic regression analysis of exclusive breastfeeding failure

To identify potential risk factors for exclusive breastfeeding failure, we conducted a univariate logistic regression analysis, using exclusive breastfeeding failure as the dependent variable and various maternal and infant clinical indicators as independent variables.

The analysis revealed that maternal-infant separation time (OR=1.172, 95% CI: 1.037~1.324, P=0.011), insufficient breastfeeding knowledge (OR=2.882, 95% CI: 1.711~4.855, P<0.001), inverted nipples (OR=3.694, 95% CI: 1.406~9.705, P=0.008), maternal anxiety (OR=2.572, 95% CI: 1.456~4.546, P=0.001), and maternal depression (OR=12.661, 95% CI: 1.597~100.382, P=0.016) were significantly associated with an increased risk of exclusive breastfeeding failure (P<0.05) (Table 3).

Multivariate logistic regression analysis of exclusive breastfeeding failure

To identify independent risk factors for exclusive breastfeeding failure, a multivariate logistic regression analysis was performed using exclusive breastfeeding failure as the dependent variable. Independent variables were selected from the univariate logistic regression analysis (Table 3), including only those with P<0.05. The analysis identified maternal-infant separation time (OR=1.198, 95% CI: 1.051~1.366, P=0.007), insufficient breastfeeding knowledge (OR=3.225, 95% CI: 1.828~5.689, P<0.001), inverted nipples (OR=4.162, 95% CI: 1.463~11.839, P=0.008), maternal anxiety (OR=2.129, 95% CI: 1.162~3.900, P=0.014), and maternal depression (OR=12.967, 95% CI: 1.518~110.766, P=0.019) as independent risk factors for exclusive breastfeeding failure (Table 4).

Construction of a nomogram predictive model for exclusive breastfeeding failure

A nomogram predictive model was developed based on independent risk factors identified through multivariate logistic regression analysis, including maternal-infant separation time, insufficient breastfeeding knowledge, inverted nipples, maternal anxiety, and maternal depression. Each variable was assigned a score proportional to its contribution to the risk of exclusive breastfeeding failure, allowing for personalized risk assessment by calculating the total score (Figure 1).

Evaluation of the nomogram predictive model for exclusive breastfeeding failure

The Hosmer-Lemeshow goodness-of-fit test confirmed that the nomogram model exhibited strong calibration and model fit (P=0.075) (Figure 2-A). In predicting exclusive breastfeeding failure, the model demonstrated high diagnostic accuracy, with an area under the ROC curve (AUC) of 0.739 (95% CI: 0.678~0.799).

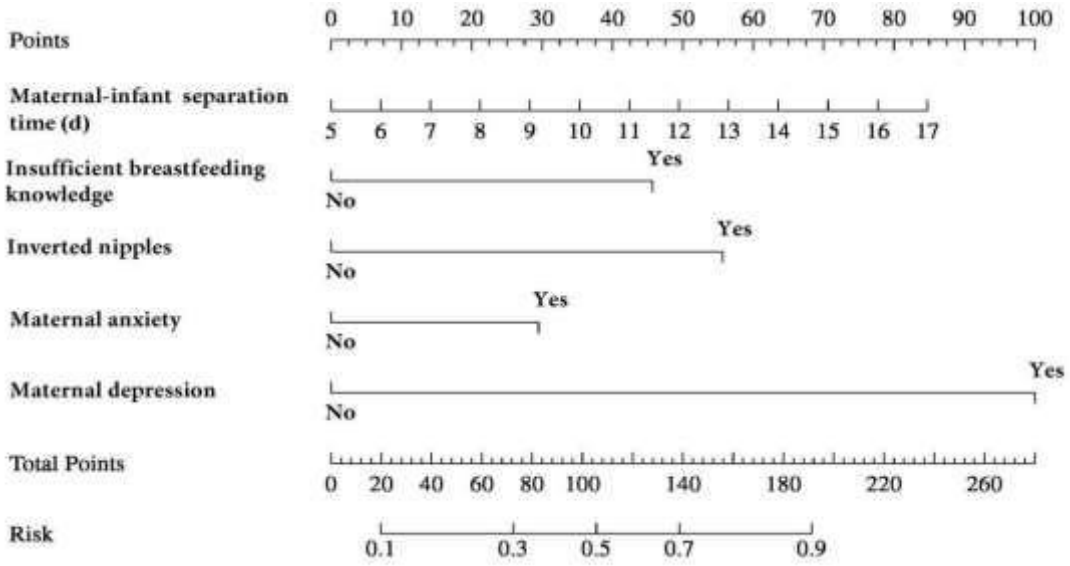

Figure 1: Construction of a nomogram predictive model for exclusive breastfeeding failure.

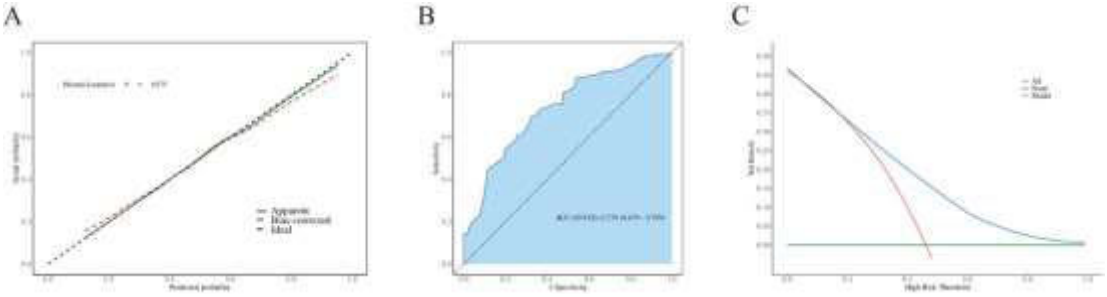

Figure 2: Evaluation of the nomogram predictive model for exclusive breastfeeding failure. A: Calibration curves; B: ROC curves; C: DCA.

The model achieved a sensitivity of 0.676, a specificity of 0.697, and an overall accuracy of 68.6% (Figure 2-B). Furthermore, DCA indicated that across a threshold probability range of 0.05 to 1, the net benefit remained positive, supporting the clinical utility of the nomogram-based risk prediction model (Figure 2-C)

Discussion

Maternal-infant separation is widely recognized as a critical determinant of exclusive breastfeeding success, influenced by healthcare policies, maternal health status, and cultural factors. Variations in separation protocols and breastfeeding support systems across different countries and regions may contribute to disparities in breastfeeding outcomes among mothers experiencing separation[18]. This study found that the exclusive breastfeeding failure rate among mothers with maternal-infant separation was 46.1%, consistent with previously reported rates of 43.0%~52.2%, indicating an elevated risk of breastfeeding failure in this population[19,20]. Univariate and multivariate logistic regression analyses identified prolonged maternal-infant separation, insufficient breastfeeding knowledge, inverted nipples, maternal anxiety, and maternal depression as independent risk factors for exclusive breastfeeding failure. Additionally, the nomogram predictive model developed in this study demonstrated strong predictive accuracy. Its robust performance and clinical utility provide a valuable tool for early risk assessment, supporting the implementation of personalized intervention strategies to improve exclusive breastfeeding outcomes among separated mothers.

Maternal-infant separation time as a key determinant of exclusive breastfeeding success. Early maternal-infant contact and skin-to-skin interaction play a crucial role in initiating breastfeeding, while separation significantly disrupts this natural process[21]. Evidence suggests that prolonged maternal-infant separation reduces the frequency of postpartum nipple stimulation, leading to suppressed lactation and an increased risk of exclusive breastfeeding failure[22]. Beyond its physiological impact, maternal-infant separation can also affect maternal psychology, contributing to diminished confidence in breastfeeding[23]. Sirico et al. found that mothers in separation wards were more likely to resort to mixed feeding or completely abandon breastfeeding compared to those in standard maternity wards[24]. However, some mothers actively counteract the effects of prolonged separation by frequently expressing milk and making efforts to re-establish breastfeeding[25]. Importantly, kangaroo mother care (KMC) has been widely recognized as an effective intervention to mitigate the adverse effects of maternal-infant separation[9]. In cases where separation is medically necessary due to prematurity or maternal-infant health conditions, breast milk storage and lactation support can help reduce the risk of exclusive breastfeeding failure[26]. Therefore, minimizing unnecessary maternal-infant separation, promoting rooming-in, and encouraging early suckling are critical strategies to enhance exclusive breastfeeding success rates.

Insufficient breastfeeding knowledge is a significant risk factor for exclusive breastfeeding failure. Many first-time mothers facing breastfeeding difficulties tend to attribute their struggles to low milk supply or nipple pain, rather than recognizing that these issues can often be mitigated through proper breastfeeding techniques and lactation management[27]. Breastfeeding is not merely a biological process; it is also a learned behavior that requires adaptation. Research indicates that mothers who receive structured breastfeeding education are more likely to seek professional guidance and adjust their feeding strategies when encountering difficulties. In contrast, those lacking breastfeeding knowledge are more prone to discontinuing breastfeeding due to low confidence or misinformation[28]. Additionally, traditional misconceptions—such as the belief that colostrum is impure or that lactation does not begin until several days postpartum—can mislead mothers, leading to inadequate early suckling stimulation and compromised milk production[29]. To improve exclusive breastfeeding outcomes, clinical interventions should prioritize comprehensive breastfeeding education, incorporating both hands-on lactation training and evidence-based guidance. By fostering accurate breastfeeding perceptions, mothers can make informed decisions, effectively address challenges, and sustain successful breastfeeding practices[30].

Inverted nipples are a significant anatomical factor influencing exclusive breastfeeding. While the breast is physiologically capable of adapting to infant suckling, abnormal nipple morphology can hinder effective latch and suckling, making it difficult for the infant to generate sufficient negative pressure for milk extraction, ultimately leading to milk flow obstruction. Additionally, ineffective latch may cause nipple pain, further compromising the breastfeeding experience[31]. To address these challenges, some mothers use nipple shields or traction devices, but persistent discomfort or ongoing feeding difficulties may lead some to discontinue breastfeeding altogether[32]. However, research suggests that not all mothers with inverted nipples face significant breastfeeding challenges, as some can successfully establish exclusive breastfeeding once their infants adapt[33]. These findings indicate that while nipple morphology plays a role in breastfeeding outcomes, its impact is influenced by maternal tolerance, infant latching ability, and the availability of breastfeeding support. Thus, prenatal nipple assessment, postnatal lactation counseling, and the use of appropriate assistive devices are critical interventions to help mothers with inverted nipples overcome early breastfeeding difficulties and achieve successful exclusive breastfeeding[34].

The psychological impact on breastfeeding has received increasing attention, particularly in relation to anxiety and depression, which are highly prevalent among postpartum women. Anxious mothers often experience excessive concerns about milk supply adequacy and infant weight gain, resulting in heightened psychological stress. This

stress may inhibit oxytocin secretion, thereby impairing the milk ejection reflex and potentially disrupting breastfeeding success[35]. However, anxiety does not always negatively affect breastfeeding. Some mothers, due to heightened concern for their infant's well-being, become more committed to exclusive breastfeeding and actively seek strategies to enhance their lactation experience. Consequently, the influence of anxiety on breastfeeding is bidirectional, with outcomes largely determined by maternal coping mechanisms and the availability of social support systems[36]. In contrast, maternal depression is more consistently associated with negative breastfeeding outcomes. Depressed mothers often exhibit diminished interest in mother-infant interactions, making them more likely to discontinue breastfeeding prematurely rather than seek solutions to overcome challenges. Feelings of inadequacy and self-doubt, exacerbated by depressive symptoms, may lead some mothers to perceive themselves as incapable of breastfeeding, ultimately prompting early weaning. This not only shortens breastfeeding duration but may also negatively impact maternal-infant bonding and attachment[3]. Given these psychological influences, postpartum care should extend beyond breastfeeding education to include targeted psychological interventions for mothers experiencing anxiety or depression. Enhancing maternal confidence through individualized counseling and structured support networks can foster a more stable and sustained breastfeeding experience[37].

The breastfeeding failure prediction model for mothers experiencing maternal-infant separation, developed in this study, demonstrated strong predictive accuracy. Unlike previous models that primarily focused on individual risk factors, this model integrates multiple predictors to provide a comprehensive assessment of the likelihood of exclusive breastfeeding failure. One notable strength of this study lies in its use of real-world clinical data and a relatively large sample size, which enhances the internal validity of the model. Moreover, the inclusion of variables readily accessible in clinical settings increases the model's feasibility for frontline healthcare providers. Beyond its predictive capability, the model offers high clinical utility, enabling healthcare teams to efficiently conduct early risk stratification and implement tailored interventions, especially for vulnerable mothers facing separation. From a policy and practice perspective, the model could inform the development of breastfeeding support protocols in NICUs and maternal health units, guiding resource allocation toward high-risk populations and shaping early postpartum care strategies to promote breastfeeding continuity.

However, several limitations should be acknowledged. Despite incorporating multiple key predictors, certain potential influencing factors—such as social support, maternal personality traits, and breastfeeding attitudes—were not accounted for. Future studies should refine variable selection to enhance the model's comprehensiveness and predictive accuracy. Additionally, the study was limited by its single-center design, and the model has not yet undergone external validation, which may restrict its generalizability. To improve robustness and applicability, future research should incorporate larger and more diverse samples, including data from multiple healthcare settings across different regions. Conducting external validation will be crucial in ensuring the model's reliability and effectiveness across broader populations and contexts.

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