Incidence and Factors Associated with Breastfeeding at Six Months in Very-Low-Birthweight Infants: A Single-Center Prospective Study

Nutchayavaree Limpivilas, M.D.[1], Pongwut Tanaanunmongkol, M.D.[1], Vichsinee Chumuang[2], Pitiporn Siripattanapipong, M.D.[1], Ratchada Kitsommart, M.D.[1,*]

[1]Division of Neonatology, Department of Pediatrics, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand, [2]Nursing Division, Department of Pediatrics, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand.

ABSTRACT

Objective: Primary objective was to determine success rate of breastfeeding (BF) at 6-month-postnatal age (PNA). Secondary objective was to explore factors associated with unsuccessful BF at 6-month-PNA in very-low-birth weight (VLBW) infants.

Materials and Methods: Single-center, prospective, observational study was conducted. Inclusion criteria were discharged VLBW infants and maternal desire for BF. We conducted telephone interviews to assess feeding type and volume every 2 months until 12-month-PNA and reasons for BF cessation.

Results: Eighty-nine VLBW infants were included. Mean (±standard deviation) maternal age was 31.4 ± 6.5 years. Median [P25, P75] gestational age was 29.0 [28.0, 31.5] weeks. At 6-month-PNA, 22 infants (24.7%) were exclusively breastfed (EBF), which decreased to 2 infants (2.2%) by 12 months. Rate of successful BF at 6 months was 55.1%. After controlling for potential confounders, factors associated with unsuccessful BF at 6 months were male [aOR (95% CI) 3.2 (1.1, 9.4), p = 0.04], longer hospitalization stays [aOR 1.0 (1.0, 1.1), p = 0.02], born via cesarean section [aOR 4.1 (1.1, 15.4), p = 0.04], maternal education below bachelor's degree [aOR 4.0 (1.1, 14.0), p = 0.03], and introduction of additional feeding types at hospital discharge [aOR 3.8 (1.2, 12.2), p = 0.03]. Main reason for unsuccessful breastfeeding at 6 months was inadequate milk supply (77.5%).

Conclusion: 55% of VLBW infants retained successful BF at 6 months. Main reason for unsuccessful BF was inadequate milk supply.

Keywords: Breastfeeding; cesarean section; maternal education; hospital discharge; very-low-birth weight infants (Siriraj Med J 2024; 76: 473-479)

INTRODUCTION

Breastfeeding (BF) is recognized as the gold standard for feeding infants.[1] Several studies have shown a correlation between extended BF and lower rates of infant morbidity and improved neurodevelopmental outcomes.[2-4] The World Health Organization and the American Academy of Pediatrics advocates exclusively breastfeeding until an infant is at least six months of age.[5,6] The advantage of human milk is particularly important for infants with very-low-birth weight (VLBW),[7,8] with studies indicating reduced incidences of severe conditions such as necrotizing enterocolitis, sepsis, and retinopathy of prematurity, as well as a lower mortality risk.[9-11] Furthermore, BF is associated with positive long-term developmental outcomes.[12] Therefore, it is important for hospitals to establish policies that promote BF in preterm infants

**Corresponding author: Ratchada Kitsommart*
E-mail: ratchada.kit@mahidol.ac.th, rkitsommart@hotmail.com
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ORCID ID:http://orcid.org/0000-0002-7592-9899
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to improve short- and long-term outcomes. However, the success of BF depends on various factors, including the health conditions of both the infant and mother, BF techniques, and other support systems.

The prevalence of exclusive breastfeeding (EBF) (percentage of children under 6 months old fed only breast milk without any other liquids in the past 24 hours) varies across different regions. From 2015 to 2021, the average EBF rate in Southeast Asian countries was 48% compared to 26% in North America. In Thailand, the rate was only 14%.[13] At our institution, the rate of BF at 6 months reached 62%. Given that prematurity and low birth weight infants are linked to decreased rates of postnatal BF,[14] it can be inferred that the rate of EBF in VLBW infants would likely be even lower.

National or social culture can also influence the sustainability of BF. Several studies have demonstrated factors linked to successful BF at 6 months of age, including maternal intention,[15] supportive hospital policies,[16] psychological support,[17] socioeconomic status,[15,18] and social and workplace support.[19,20] These factors become more complicated for mothers of premature infants. Preterm infants typically suffer from various conditions from birth and require extended hospitalization stays, which can hinder adequate milk production and mother-infant bonding due to maternal stress and the complexities of postnatal care. Studied have found that milk expression volumes are lower in the absence of infants.[21] Additionally, the small size of their oropharyngeal structures and limited endurance complicate the establishment of BF. Some infants may also need fortification or supplemental formula to ensure proper nutrition and growth. Furthermore, the duration of maternity leave is often reduced by the extended hospital stay required at birth, making it more difficult to continue EBF for the recommended 6 months.

Given the relatively low rate of exclusive breastfeeding in Thailand, our study aimed to assess our specific context and investigate the factors leading to unsuccessful breastfeeding in VLBW infants up to 6 months postnatal age (PNA). The primary objective was to identify the rate of successful BF at 6 months. The secondary objective was to explore factors associated with unsuccessful BF at 6 months and the rate of successful BF at 12 months in VLBW infants.

MATERIALS AND METHODS

We conducted a prospective observational study at the Neonatal Division, Department of Pediatrics, Faculty of Medicine Siriraj Hospital in Bangkok, Thailand. Our institutional policy for BF in preterm infants follows the "Ten steps for promoting and protecting breastfeeding for vulnerable infants.[22] All preterm infants undergo an assessment for BF readiness once they are clinically stable, and their postmenstrual age reaches 32 weeks of gestation. The nursing staff provides education to mothers on BF techniques and assesses readiness until the infant is discharged from the hospital. Infants experiencing breastfeeding difficulties are referred to the lactation clinic for further evaluation and practice until mother feel confident in their BF ability. After hospital discharge, regular follow-up appointments at the lactation clinic are scheduled to ensure continued BF success.

The study's inclusion criteria included: 1) birth weight less than 1,500 g; 2) discharge before 4 months of PNA; 3) mothers with the intention to BF who were educated and assessed on BF techniques prior to discharge; and 4) maternal written consent. Infants were excluded if they had contraindications for BF, severe congenital anomalies or any conditions that could potentially impact BF, such as craniofacial anomalies or neurological conditions. Following hospital discharge, the study team made follow-up telephone calls using standardized questionnaires every two months up to 12 months of PNA. During these calls, information about the infants' current feeding types and experiences were collected from the mothers or primary guardians. Caregivers provided estimates of the type and volume of feedings. Missing data from any time point were excluded from the analysis.

Definitions

Exclusive breastfeeding (EBF) refers to a feeding practice in which the infant receives only breastmilk, whether directly from breastfeeding or through expressed breastmilk, with no additional infant formula.

Exclusive infant formula (EIF) refers to a feeding practice where the infant is fed solely with infant formula.

Predominant breastfeeding (PBF) refers to a feeding practice where breastmilk is more than half of the infant's total daily milk intake.

Predominant infant formula (PIF) refers to a feeding practice where infant formula accounts for more than half of the infant's total daily milk volume.

We defined successful BF as infants who were either EBF or PBF at the age of 6 months.

Statistical analysis

To estimate the required sample size, we used our overall EBF rate at 6 months which was 62%. With a type I error of 0.1, and using a Z-score of -1.65 with a margin of error of 0.1, we determined that a total of 91 VLBW infants were needed.

For the analysis of the incidence and rates of categorical

variables, we employed counts (percentage), mean±standard deviation (SD), or median [25th percentile, 75th percentile; P25, P75] depending on the nature and distribution of each variable. To explore factors associated with unsuccessful BF (either PIF or EIF), logistic regression analysis was used, with results presented as odds ratios (ORs) and 95% confidence intervals (95% CIs). Variables with a *p*-value <0.2 were further analyzed using multivariate logistic regression analysis and presented as adjusted odds ratios (aORs) with 95% CIs. All statistical analyses were performed using SPSS Statistics version 18.0 (SPSS, Inc., Chicago, IL, USA). A *p*-value <0.05 was considered statistically significant.

RESULTS

The study's protocol was approved by the institutional research ethics board, and maternal written consent was obtained prior to hospital discharge. Recruitment commenced in September 2018 but was prematurely concluded in August 2021 after 89 VLBW infants were enrolled. This early termination was the result of changes in hospital policy regarding maternal stays and visits during the COVID-19 pandemic, which influenced BF policy and maternal BF education. Table 1 demonstrates the demographic characteristics of mothers and infants involved in the study. The median [P25, P75] gestational age (GA) was 29.0 [28.0, 31.5] weeks. Among the infants, 13 (14.6%) were born before reaching 28 weeks GA. The median [P25, P75] birth weight (BW) was 1,150.0 g [970.0, 1,285.0], and 23 infants (25.8%) had a BW <1,000 g. The mean hospitalization duration was 65.9 ± 23.1 days, and 61 infants (68.5%) were breastfed at discharge. Out of all the mothers, 44 (54.3%) were primigravida, while 16 (19.8%) were pregnant with twins.

At 6 months postnatal age, 22 infants (24.7%) were EBF, but this decreased to just two infants (2.2%) by 12 months. Successful BF (either EBF or PBF) was accomplished by 49 infants (55.1%) at 6 months, and this rate subsequently decreased to 13 infants (14.6%) by the 12-month mark. The distribution of feeding types across the 12 months PNA is illustrated in Fig 1.

Table 2 outlines factors linked to unsuccessful BF at 6 months. Compared to infants who were successfully BF, those with unsuccessful BF outcomes had notably lower BW (1105.0 g [905.0, 1227.5] versus 1200.0 g [1045.0, 1310.0], $p = 0.02$), a higher incidence of being small-for-gestational age (SGA) (37.5% vs 18.4%, $p = 0.04$), longer hospitalization duration (71.9 ± 23.3 versus 61.0 ± 22.0, $p = 0.03$), a lower prevalence of mothers with bachelor's degrees (55.0% versus 32.7%, $p = 0.03$), and a greater frequency of introducing an additional type of feeding at hospital discharge (45.0% versus 20.4%, $p = 0.01$). However, after adjusting for potential confounders through multivariate logistic regression analysis, the factors significantly associated with unsuccessful BF at 6 months included male sex [aOR (95% CI) 3.2 (1.1, 9.4), $p = 0.04$], longer hospitalization stays [aOR 1.0 (1.0, 1.1), $p = 0.02$], born via cesarean section [aOR 4.1 (1.1, 15.4), $p = 0.04$], maternal education below a bachelor's degree [aOR 4.0 (1.1, 14.0), $p = 0.03$], and the introduction of an additional feeding type at hospital discharge [aOR 3.8 (1.2, 12.2), $p = 0.03$]. Table 3 presents maternal reasons for unsuccessful BF at 6 months, with the predominant reason being insufficient milk supply (77.5%), followed by concerns about the infant's health problems (10%).

DISCUSSION

While BF is considered the best option for preterm or low-birthweight infants, the likelihood of achieving and maintaining BF is typically lower for preterm infants compared to term infants.[14] This discrepancy can be attributed to potential postnatal illnesses and physiological immaturity, which leads to delayed initiation of BF, and longer time and effort required. At our center, despite an overall EBF rate of 62% at 6 months, the rate among VLBW infants was only 24.7%. Even when including both EBF or PBF as indicators of successful BF, the rate of 55% for VLBW infants is still lower than the overall rate. Therefore, despite efforts by the team to support BF, among this group, additional strategies are needed to promote the success rate of BF in VLBW infants.

The success of BF is associated with both infant and maternal factors. Characteristics such as male sex and being born via cesarean section have been identified as unmodified risk factors.[23] This may be due to male infants' higher susceptibility to hospital morbidities.[24] Our finding suggest that infants introduced to supplementary feeding type at discharge were also 3.8 times more likely to experience unsuccessful BF at 6-month mark. Moreover, a longer hospital stay, often indicative of a complicated illness, has been linked to challenges in establishing EBF after hospital discharge.[25] Therefore, infants facing significant health issues that prolongs their hospital stay and hinders BF before discharge require early and focused support from caregivers to encourage BF as a key part of discharge planning.[14] Interestingly, maternal education has a positive correlation with successful BF, which reinforces findings from previous studies.[14,18] Factors such as lower maternal socioeconomic status, maternal attitudes towards BF, and the level of social support have all been multifacetedly linked to BF outcomes at 6 months.[18] The most frequently cited reason for discontinuing BF was

TABLE 1. Maternal and infant demographic characteristics

Maternal (N=81)	
Age (years)	31.4 ± 6.5
Primigravida	44 (54.3)
Multifetal pregnancies	16 (19.8)
Cesarean section	58 (71.6)
Education below the bachelor's degree	34 (42.0)
Occupations	
Company employee	14 (17.3)
Self employed	40 (49.4)
Government official	6 (7.4)
Housewife	17 (21.0)
Parental income less than 15,000 THB/month	33 (40.7)
Live in Bangkok metropolitans (n=79)	68 (86.1)
Infant (N= 89)	
Gestational age (weeks)	29.0 [28.0, 31.5]
Birth weight (grams)	1150.0 [970.0, 1285.0]
Male sex	42 (47.2)
Twins	24 (27.0)
Small-for-gestational age	24 (27.0)
5-minute Apgar scores	9.0 [7.5, 9.0]
Days of hospitalization	65.9 ± 23.1
Feeding type at hospital discharge	
Breast feeding	61 (68.5)
Cup or spoon feeding	15 (16.9)
Tube feeding	8 (9.0)
Bottle feeding	5 (5.6)

Data is presented as mean±standard deviation, number (percentage), median [25th percentile, 75th percentile]

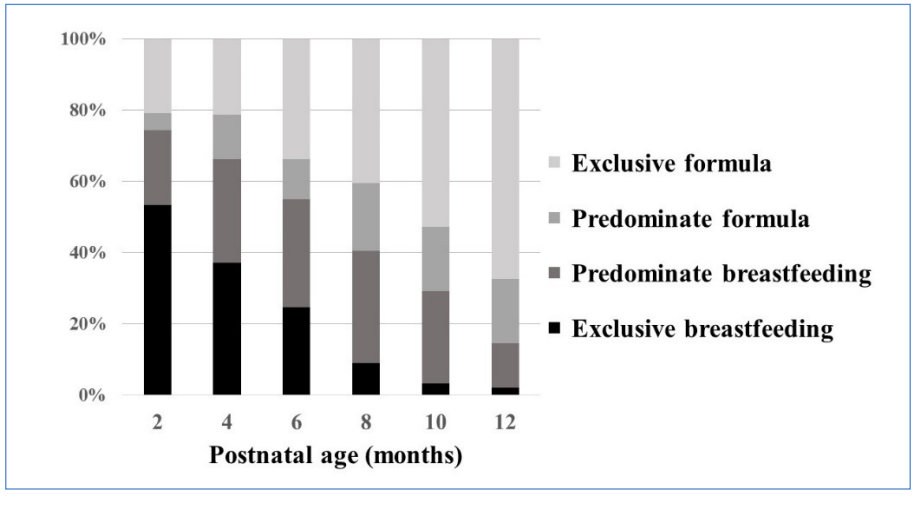

Fig 1. The proportion of feeding types over 12 months postnatal age (PNA)

TABLE 2. Factors associated with unsuccessful breastfeeding at 6 months of age (N=89)

	Unsuccessful BF (n=40)	Successful BF (n=49)	*p*	OR (95%CI)	Adjusted OR (95%CI)	*p*
Male sex	23 (57.5)	19 (38.8)	0.08	2.1 (0.9, 5.0)	3.2 (1.1, 9.4)	0.04*
Gestational age	29.5 [28.0, 31.0]	29.0 [28.5, 32.0]	0.61	0.9 (0.8, 1.1)		
Twins	11 (27.5)	13 (26.5)	0.92	1.1 (0.4, 2.7)		
Birth weight (grams)	1105.0 [905.0, 1227.5]	1200.0 [1045.0, 1310.0]	0.02*	1.0 (1.0, 1.0)	1.0 (1.0, 1.0)	0.74
Small-for-gestational age	15 (37.5)	9 (18.4)	0.04*	2.7 (1.0, 7.0)	2.5 (0.6, 10.8)	0.23
5-minute Apgar score	9.0 [8.0, 9.0]	8.0 [7.0, 9.0]	0.31	1.2 (0.9, 1.5)	1.4 (1.0, 1.9)	0.07
Days of hospitalization	71.9 ± 23.3	61.0 ± 22.0	0.03*	1.0 (1.0, 1.0)	1.0 (1.0, 1.1)	0.02*
Maternal age (years)	30.8 ± 6.5	31.3 ± 6.3	0.67	1.0 (0.9, 1.1)		
Cesarean section	32 (80.0)	31 (63.3)	0.08	2.3 (0.9, 6.1)	4.1 (1.1, 15.4)	0.04*
Multi-gravida	19 (47.5)	21 (42.9)	0.66	1.2 (0.5, 2.8)		
Occupation other than housewife	29 (72.5)	41 (83.7)	0.20	0.5 (0.2, 1.4)		
Maternal education below the bachelor's degree	22 (55.0)	16 (32.7)	0.03*	2.5 (1.1, 6.0)	4.0 (1.1, 14.0)	0.03*
Parental income >15,000 THB/month	21 (52.5)	17 (34.5)	0.09	2.1 (0.9, 4.9)	1.1 (0.3, 3.7)	0.85
Additional type of feeding at discharge	18 (45.0)	10 (20.4)	0.01*	3.2 (1.3, 8.1)	3.8 (1.2, 12.2)	0.03*
Living in Bangkok/Bangkok metropolitans	34 (85.0)	41 (87.2)	0.76	0.8 (0.2, 2.8)		

Unsuccessful breastfeeding (BF) was defined as a condition in which the infant received infant formula for at least a half of the total milk volume each day. Data is presented in numbers (percentage); odds ratio and 95% confidence interval, OR (95%CI). *p-value <0.05 was statistically significant.

TABLE 3. Maternal reasons of unsuccessful breastfeeding at 6 months of age (n =40)

Inadequate milk supply	31 (77.5)
Infant medical health problems	4 (10.0)
Stay at a different place	3 (7.5)
Return to work	2 (5.0)

inadequate milk supply, although no direct correlation was found with the mother's occupation or income. Therefore, caregivers should put more effort into early and regular pumping to maintain milk supply.

We prospectively determined successful BF in VLBW infants with a prespecified sample size. Despite concluding the study earlier than planned, we manage to recruit 98% of the required sample size and with no drop-outs over a 12-month period, which strengthens the internal validity of our results. Our approach to managing maternal breastfeeding in infants with metabolic bone diseases continues to prioritize maternal milk as the primary source of nutrition. We supplement other necessary minerals appropriately for each infant, whether through fortification or providing calcium and phosphate supplements, without resorting to formula to replace maternal milk. Consequently, the overall volume of maternal milk received within the 2-month study period remains dependent on maternal lactation capacity and other relevant factors we have investigated. However, we realize there were several limitations within our study. First, the potential for subjective assessment and recall bias could compromise the validity of our results, however, we chose a 2-month epoch for assessment to minimize any such bias. Second, our study included only infants whose mothers had expressed a desire to BF, which introduced a selection bias that could result in an overestimation of successful BF rates in general VLBW infants. Third, the requirement for mandatory consent meant that mothers were aware they would be subject to regular monitoring, which raised the possibility of ascertainment bias. However, we addressed this issue by discussing with mothers or primary caregivers at the time of consent and during each follow-up visit. We believe our extended long follow-up period should help nullify this effect and maintain our study's internal validity. It is also important to note that the study was conducted in a super tertiary care center equipped with a robust system and dedicated team to support BF before and after hospital discharge. Concurrently, there was an observed trend towards encountering infants with complex issues. Notably, infants with severe congenital anomalies or severe neurological deficits necessitate distinct nutritional management compared to generally VLBW infants. Factors such as breastfeeding techniques, volume, or frequency may influence maternal breastfeeding success or even maternal attitudes. Therefore, infants in this subgroup were designated as exclusion criteria to ensure that this study's outcomes represent the broader landscape of VLBW infants, thereby enhancing the generalizability of the results. Nevertheless, it is imperative to caution in extrapolating our findings to other secondary or tertiary care centers lacking similar BF support structures.

CONCLUSION

The success rate of BF in VLBW infants was 55%, which is lower than the broader average. The main maternal factor for unsuccessful BF was identified as inadequate milk supply. Several factors were linked to lower BF success rates, including being male, birth via cesarean section, and extended hospital stays. Additionally, mothers with education below a bachelor's degree were found to have a higher risk of unsuccessful BF. Factors linked to unsuccessful BF were related to infants' demographic characteristics and hospital-related outcomes rather than social factors.

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Conflict of interest

All authors declare no conflicts of interest relating to any aspects of this study.

Author Contributions

The authors confirm contribution to the paper as follows: study conception and design: RK and PT; data collection: PT and VC; analysis and interpretation of results: RK, NL, and PS; draft manuscript preparation and critical revision: RK, NL, and PS. All authors reviewed the results and approved the final version of the manuscript.

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