ORIGINAL ARTICLE

# Factors Associated With the Successful Establishment of Breastmilk Feeding Among Very Low Birth Weight Infants

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## ABSTRACT

**Introduction:** Despite the widely recognised benefits of breastfeeding, preterm newborns globally exhibit lower breastfeeding rates compared to term infants. This study aims to ascertain the prevalence of breast milk feeding among VLBW infants and to evaluate the factors associated with successful breast milk feeding in this specific population. **Materials and methods:** A cross-sectional study was conducted involving 111 mothers who gave birth to premature infants with birth weights less than 1500 g between March and December 2020. This investigation took place in two tertiary Neonatal Intensive Care Units. Data encompassing maternal, perinatal, and neonatal characteristics were extracted from medical records and subjected to analysis using SPSS version 25. **Results:** Among the 111 participating mothers, only 44 (39.6%) successfully provided expressed breast milk (EBM) for their infants' initial feeds, and a mere 31 (28.0%) sustained adequate EBM provision until their infants attained full enteral feeding. The achievement of a successful breast milk feeding establishment demonstrated substantial correlations with higher maternal income ($p = 0.023$) and the timing of initiating enteral feeds ($p = 0.037$). **Conclusion:** The prevalence of breast milk feeding initiation and establishment among VLBW infants was found to be remarkably low. The potential influence of the demanding Covid-19 pandemic context during the study period cannot be ignored. It is imperative to intensify efforts to investigate the underlying causes to facilitate the swift and effective implementation of quality improvement interventions. Future research initiatives are essential to uncovering additional confounding factors that might influence the successful rate of breast milk feeding among VLBW infants.
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**Keywords:** Breast milk feeding, Breastfeeding, Expressed breast milk, Very low birth weight, Premature infant

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## INTRODUCTION

Early nutrition has been identified not only as the most crucial factor in infant survival, growth, and brain development but also as a pivotal determinant of long-term health (1, 2). Human milk has long been recognised and advocated as the optimal source of nourishment for newborn children (3). The early administration of human milk during the first week of life has been linked to improved neurodevelopmental outcomes (4,5).

The World Health Organization (WHO) recommends that all newborns, including premature infants, be provided with mother's milk from the first day of life until they are at least six months old, unless there are medical contraindications (6). In contrast to the human milk produced by women who reach full term gestation, mothers who give birth prematurely produce human milk with higher levels of overall protein content and bioactive components, as well as distinct types of fat that are more readily digestible and absorbable by the infants (7).

Despite the numerous advantages that breastfeeding offers to both mothers and premature infants, the prevalence of breastfeeding among VLBW infants remains low, particularly in Asian countries (8–10). This challenge stems from the fact that premature babies often struggle to begin direct breastfeeding due to their limited feeding skills (immature suckling) and underdeveloped gastrointestinal systems. This difficulty has been further compounded by the COVID-19 pandemic, which has introduced additional layers of complexity to the care provided to these vulnerable newborns. The pandemic has intensified the obstacles faced by mothers of premature infants, impacting their ability to engage in direct breastfeeding. Concerns regarding maternal health, limited access to hospitals, and uncertainties surrounding the transmission of

infections have necessitated significant changes in neonatal care practises. Consequently, mothers often need to rely on expressing breast milk to facilitate early breastfeeding for VLBW infants. Research indicates that combining early enteral feeds with total parenteral nutrition (TPN) can effectively decrease gut atrophy and intestinal permeability, leading to improved postnatal development and reducing the risk of sepsis (11). Therefore, the primary focus of this study was to determine the prevalence of breast milk feeding among VLBW infants and to identify the factors within the mother-infant dyads that may contribute to the successful establishment of breast milk feeding.

## MATERIALS AND METHODS

A cross-sectional study involving mother-infant pairs who were hospitalised in two neonatal intensive care units (NICU) was carried out during the period of movement control order between May and December 2020. This study received approval from the Medical Research and Ethics Committee of the National Institute of Health Malaysia (NMRR-19-2771-49280), the Ethics Committee for Research Involving Human Subjects at University Putra Malaysia (JKEUPM), and the Clinical Research Centre of both hospitals.

The feeding protocols were consistent across both centres. All VLBW infants began early parenteral nutrition shortly after admission, and trophic enteral feeding commenced using either expressed breast milk or preterm formula once the attending neonatologist determined the infant's stability. As the infants tolerated these feeds, they were gradually increased by 20–30 ml/kg/day until they reached a total of 120 ml/kg/day, at which point parenteral nutrition was discontinued, typically between days 7 and 14 of life. Following this, feeding advancement continued until the infants could tolerate a total of 160–180 ml/kg/day before being discharged from the hospital.

All mothers were informed about the advantages of breast milk for their VLBW infants. They received education regarding the process of breast milk collection, its storage, and how to transport it to the NICU. These mothers were encouraged to initiate breast milk expression shortly after delivery, aiming for sessions lasting around 20 to 30 minutes and repeating this process six to eight times daily. Mothers who desired to express breast milk in the hospital during their visits were provided with an electric breast milk pump. Alternatively, they had the option to continue expressing breast milk at home. Kangaroo care, involving skin-to-skin contact, was routinely initiated once the infant achieved stability and no longer required invasive ventilation. For mothers, whose infants were mature enough for direct breastfeeding or those facing financial or transportation constraints for daily visits, rooming-in facilities within the NICU were made available.

Once the infants reached a stage of full enteral feeding (120 ml/kg/day), the mothers were approached and briefed about the study. Written consent was obtained from those mothers who expressed their willingness to participate. Sociodemographic and clinical characteristics of both the mothers and infants were extracted from the medical records for analysis. Mothers who were medically unable to commence breastfeeding due to severe, life-threatening medical conditions (such as being on anti-failure drugs for heart failure, undergoing dialysis for end-stage renal failure, or having cancer) were excluded from the study, as were infants diagnosed with lethal congenital anomalies.

In this study, the successful establishment of breast milk feeding was defined as infants who exclusively received their mother's expressed breast milk (EBM) from their initial feeding until they attained full enteral feeding. Infants who were provided with a combination of both their mother's EBM and formula milk, referred to as mixed feeding, or those who solely received formula milk during the same period were categorised as non-successful establishment of breast milk feeding.

All data were analysed using IBM Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive data on sociodemographic characteristics and the prevalence of successful establishment of breast milk feeding were presented as frequency and percentage. The distribution of the continuous data was assessed using the Kolmogorov-Smirnov normality test. Normally distributed data were expressed as mean and standard deviation (SD), whereas median and interquartile range (IQR) were used to report data with a non-normal distribution. The relationship between two categorical variables was examined using the Chi-Square test, and in cases where the population sample was of a limited size and did not meet the prerequisites for the Chi-Squared test, the Fisher exact test was implemented. The analysis of non-normally distributed data employed the Mann-Whitney U test, whereas the comparison of means for two independent groups was accomplished using the independent t-test. A p-value of less than 0.05 denote statistical significance.

## RESULTS

A total of 213 women gave birth to 240 VLBW infants in both hospitals during the study period, including 25 sets of twins and one set of triplets. Ninety-three mothers were excluded, such as mothers with chronic medical illnesses like heart failure, chronic renal disease, and psychiatric disorders, as well as mothers whose infants had lethal congenital anomalies or dysmorphic features, were transferred to other hospitals, or passed away within the first two weeks of life (Figure 1). A total of 120

eligible mothers were approached, but nine declined participations without apparent reasons.

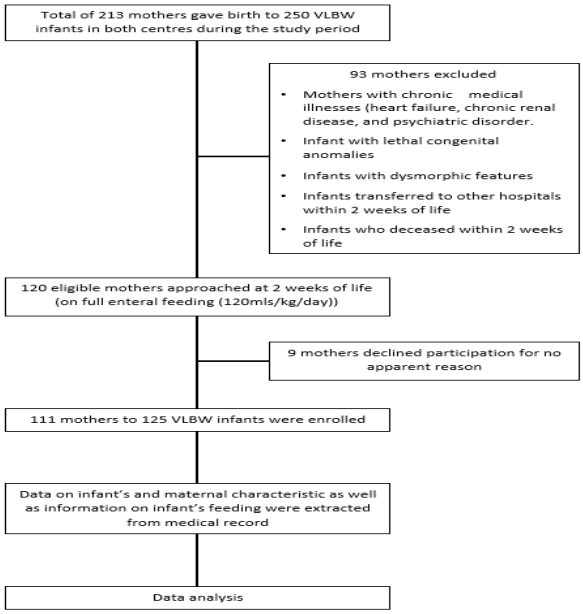


**Figure 1: Flow chart of inclusions and exclusions.**

The final analysis comprised 111 mothers and 125 VLBW infants, which included 12 sets of twins and one set of triplets. Among the mothers, 44 (39.6%) provided EBM for their infants' first feeds. However, only 31 mothers consistently supplied sufficient EBM until the infants reached full enteral feeding (120 ml/kg/day), giving rise to a prevalence rate of successful establishment of breast milk feeding among VLBW infants of 28.0%. Merely 11 mothers (9.9%) managed to successfully breastfeed their infants up until hospital discharge.

As outlined in Table I, there is a significant association between household income and the successful establishment of breast milk feeding. The data illustrates a clear pattern: higher household income is significantly associated with an elevated probability of achieving successful breast milk feeding (p = 0.023). However, the study did not find any substantial associations between successful breast milk feeding and other demographic characteristics, such as age, ethnicity, marital status, parity, types of pregnancy, mode of delivery, education level, the presence of pregnancy-related complications, or the presence of underlying chronic medical illnesses.

**Table I: Association between maternal baseline characteristics with the successful establishment of breast milk feeding (N=111)**

| Characteristics | Successful establishment of breast milk feeding | | Statistical value | p-value |
|---|---|---|---|---|
| | Yes (n=31) n (%) | No (n=80) n (%) | | |
| Age (years)<br>< 25<br>≥ 25 | <br>6 (25.0%)<br>25 (28.7%) | <br>18 (75%)<br>62 (71.3%) | <br>0.130 | <br>0.718[a] |
| Age Mean (SD) | 30.2 (4.76) | 30.11 (5.57) | 0.060 | 0.952[b] |

CONTINUE

**Table I: Association between maternal baseline characteristics with the successful establishment of breast milk feeding (N=111). (CONT.)**

| Characteristics | | Successful establishment of breast milk feeding | | Statistical value | p-value |
|---|---|---|---|---|---|
| | | Yes (n=31) n (%) | No (n=80) n (%) | | |
| Ethnicity | Malay<br>Chinese<br>Indian<br>Others | 18 (27.3%)<br>6 (35.3%)<br>5 (31.3%)<br>2 (16.7%) | 48 (72.7%)<br>11 (64.7%)<br>11 (68.8%)<br>10 (83.3%) | 1.316 | 0.725[a] |
| Marital status | Married<br>Single | 31 (29.0%)<br>0 (0%) | 76 (71.0%)<br>4 (100%) | - | 0.575[c] |
| Parity | Primigravida<br>Multipara | 18 (30%)<br>13 (25.5%) | 42 (70%)<br>38 (74.5%) | 0.279 | 0.598[a] |
| Type of Pregnancy | Singleton<br>Multiple | 25 (25.5%)<br>6 (46.2%) | 73 (74.5%)<br>7 (53.8%) | - | 0.184[c] |
| Mode of delivery | SVD<br>LSCS | 14 (28.0%)<br>17 (27.9%) | 36 (72.0%)<br>44 (42.1%) | 0.000 | 0.988[a] |
| Education level | Primary & Secondary<br>Tertiary | 24 (27.3%)<br>7 (30.4%) | 64 (72.7%)<br>16 (69.6%) | - | 0.797[c] |
| Husband's education level | Primary & Secondary<br>Tertiary | 25 (27.2%)<br>6 (31.6%) | 67 (72.7%)<br>13 (68.4%) | - | 0.780[c] |
| Household income (RM) | < 3000<br>3000-6000<br>> 6000 | 2 (8.0%)<br>25 (32.1%)<br>4 (50.0%) | 23 (92.0%)<br>53 (67.9%)<br>4 (50.0%) | 7.528 | 0.023[a] |
| Pregnancy-related complication | Yes<br>No | 14 (25.5%)<br>17 (30.4%) | 41 (74.5%)<br>39 (69.6%) | 0.331 | 0.565[a] |
| Underlying medical illness | Yes<br>No | 5 (18.5%)<br>26 (31.0%) | 22 (81.5%)<br>58 (69.0%) | - | 0.324[c] |

[a]Pearson Chi-Square [b] Independent t-test [c] Fisher exact test

Table II presents the results of bivariate analysis, demonstrating no statistically significant disparities regarding gender, gestational age, cause of prematurity, or the need for respiratory or inotropic support at birth between VLBW infants with successful and non-successful breast milk feeding. However, a significant association was observed between the Apgar score recorded at five minutes of life and the achievement of successful breast milk feeding (p = 0.022). Interestingly, 80% of infants with Apgar scores below 7 at five minutes of life faced difficulties in achieving successful breast milk feeding. However, it's important to note that this observation didn't show a strong statistical association in the later analysis (aOR 0.44; 95% CI 0.18–1.09; p = 0.08), as displayed in Table III. In our group, one notable factor linked to successful breast milk feeding was the age at which feeding was started. Infants who achieved successful breast milk feeding commenced feeding a day later in comparison to infants subject to mixed breast milk or formula feeding (aOR 1.43; 95% CI 1.036–1.98; p = 0.03).

**Table II: Association between clinical characteristics of VLBW infants and successful establishment of breast milk feeding (N = 125)**

| | Successful establishment of breast milk feeding | | Statistical value | p-value |
|---|---|---|---|---|
| | Yes (n = 33) n (%) | No (n = 92) n (%) | | |
| Gender | | | | |
| Male | 13 (23.2%) | 43 (76.8%) | 0.530 | 0.467[a] |
| Female | 20 (29.0%) | 49 (71.0%) | | |
| Birth weight (gm) Median (IQR) | 1230 (436.5) | 1275 (372.5) | -1.436 | 0.787[b] |
| Gestation (weeks) Median (IQR) | 30 (3.00) | 29 (4.00) | -0.271 | 0.153[b] |
| Causes of prematurity | | | | |
| Induced | 4 (14.8%) | 23 (85.2%) | - | 0.145[d] |
| Spontaneous | 29 (29.6%) | 69 (70.4%) | | |
| APGAR score at 5 minutes | | | | |
| ≥ 7 | 14 (41.2%) | 20 (58.8%) | 5.248 | 0.022[a] |
| < 7 | 19 (20.9%) | 72 (79.1%) | | |
| Respiratory support at birth | | | | |
| Invasive | 8 (25.8%) | 23 (74.2%) | 0.375 | 0.829[a] |
| Non-invasive | 25 (26.9%) | 68 (73.1%) | | |
| No | 0 (0%) | 1 (100%) | | |
| Duration of respiratory support | | | | |
| ≤ 3 days | 22 (25.0%) | 66 (75.0%) | 0.300 | 0.584[a] |
| > 3 days | 11 (29.7%) | 26 (70.3%) | | |
| Inotropic support | | | | |
| Yes | 2 (40.0%) | 3 (60.0%) | - | 0.607[d] |
| No | 31 (25.8%) | 89 (74.2%) | | |
| Age feeding started (days) | | | | |
| Mean (SD) | 3.42 (2.21) | 2.57 (0.95) | 2.163 | 0.037[c] |
| Age achieved full feeding (days) | | | | |
| Mean (SD) | 13.73 (5.46) | 14.27 (8.70) | -0.336 | 0.737[c] |
| Complications of prematurity | | | | |
| Yes | 25 (26.9%) | 68 (73.1%) | 0.043 | 0.835[a] |
| No | 8 (25.0%) | 24 (75.0%) | | |
| IVH | 4(14.8%) | 23 (85.2%) | 2.379 | 0.123[a] |
| NEC | 7 (29.2%) | 17 (70.8%) | 0.117 | 0.732[a] |
| PDA | 10 (24.4%) | 31 (75.6%) | 0.127 | 0.722[a] |
| RDS | 21 (27.3%) | 56 (72.7%) | 0.079 | 0.779[a] |
| Sepsis | 0 (0%) | 12 (100%) | 4.761 | 0.029[#] |
| Nosocomial Pneumonia | 3 (16.7%) | 15 (83.3%) | 1.025 | 0.311[#] |

[#]Pearson Chi-Square; [b] Mann Whitney U test; [c] Independent t-test [d] Fisher exact test

**Table III: Multiple logistic regression analysis for predictors of successful breast milk feeding in VLBW infants**

| Factors | B | SE | Adjusted OR (95% CI) | p-value |
|---|---|---|---|---|
| Household income <RM 3000 | 1.551 | 0.992 | 4.716 (0.675, 32.935) | 0.118 |
| APGAR score at 5 minutes ≥ 7 | -0.814 | 0.460 | 0.443 (0.180, 1.093) | 0.077 |
| Age feeding started (days) | 0.360 | 0.165 | 1.433 (1.036,1.982) | 0.030 |

In our study population, no significant differences were detected in the occurrence of prematurity-related complications between the two groups. However, it's important to highlight those complications such as sepsis exhibited a considerably higher prevalence among VLBW infants who received a combination of mixed breast milk and formula feeding as compared to infants who exclusively received successful breast milk feeding (100% versus 0%, p = 0.02). Similarly, though not reaching statistical significance, intraventricular haemorrhage (IVH) was also more frequently observed in VLBW infants with mixed breast milk and formula milk feeding (85.2% versus 14.8%, p = 0.12). A higher incidence of necrotizing enterocolitis (NEC) was also observed among infants with mixed feeding compared to those with successful breast milk feeding (70.8% versus 29.2%). However, the bivariate analysis revealed no statistically significant distinctions between these two groups (p > 0.05).

## DISCUSSION

In this study, we discovered that despite extensive efforts by the government and healthcare professionals to promote breastfeeding and the consensus that breast milk is the optimal choice for infant nutrition, the lactation initiation rate among mothers of VLBW infants within our cohort was only 39.5%. Our findings also revealed a prevalence of successful establishment of breast milk feeding among VLBW infants at 28.0%, with only 9.9% of these mothers successfully maintaining their breast milk supply until hospital discharge. While the observed prevalence aligns with figures in Asian countries like Japan (22.6%) and China (15.1%) (9, 10), it notably falls short of the rates reported in Western regions (60.0% to 71.9%) (12–14). This raises a significant concern, as the failure to provide sufficient breast milk to ill preterm infants exposes them to increased risks of complications and unfavourable short- and long-term outcomes (15–17). Indeed, our findings highlight this, as we observed a noticeably higher rate of sepsis among infants who received mixed feeding in contrast to those within the successful breast milk feeding group.

Prior research has previously demonstrated the absence of a significant correlation between maternal sociodemographic factors and the successful breastfeeding of preterm infants (18, 19). Our investigation corroborates these finding. This lack of correlation observed in our study may potentially be attributed to the equitable access to education and share societal values that prevail among Malaysians, transcending racial and cultural distinctions.

In this study, we observed that mothers from the higher household income group were more inclined to consistently provide constant breast milk to their VLBW infants until they reached full feeding. This finding is in accordance with the studies carried out by Patel et al.

(2019) (13). We speculated that financial stability affords these mothers a sense of comfort and security, enabling them to prioritise their own well-being and that of their infants without the burden of financial concerns such as hospital expenses or the urgency to return to work. Moreover, they are better positioned to afford essential equipment for breastmilk expression (e.g., a breast pump), storage (a breast milk storage bag, a freezer), and transportation (an ice box) of the breast milk to the NICU.

No significant connection was identified between pregnancy-related complications or underlying medical illness and the successful establishment of breast milk feeding. This contrasts with the findings of Leeners et al., who reported that women with hypertensive disorders during pregnancy exhibited significantly lower rates of breastfeeding initiation in comparison to the control group (20). Additionally, Leeners et al. revealed lower breastfeeding rates among women who experienced HELLP syndrome, delivered infants prior to 32 weeks of gestation, or had babies weighing less than 1500 g. The authors attributed this trend to the heightened need for specialised care for the mother or her protracted recovery from conditions like pre-eclampsia or HELLP syndrome, which could potentially hinder breastfeeding. Furthermore, emotions of guilt and frustration, especially in cases of premature delivery, emerged as additional barriers impeding mothers from initiating breastfeeding. It is evident that this study was conducted during the peak of the global epidemic—the COVID-19 pandemic. This circumstance might have played a role in the lower success rate of establishing breast milk feeding within our study cohort. Throughout the series of lockdowns and the implementation of social distancing measures, one of our study centres intentionally discouraged mothers from rooming in with their infants. This precaution may have reduced access to both professional and emotional support, subsequently elevating stress and anxiety levels among the mothers. Although the COVID-19 pandemic has been linked to positive breastfeeding outcomes due to extended maternity leaves and increased time for mother-infant bonding (21), the curtailed social and professional assistance could potentially impact maternal mental health and psychological well-being negatively. Additionally, the separation might have intensified mothers' distress and subsequently disrupted lactation (22).

Our study has revealed that the age at which feeding is initiated serves as a crucial predictor of successful breastfeeding. In situations where a milk bank or donor milk is unavailable, a one-day delay allows the mother additional time to establish a consistent and sufficient supply of expressed breast milk. Despite the one-day delay in feeding initiation, infants who exclusively received breast milk achieved full feeding one day earlier compared to those who were fed a mixed diet. However, this difference did not reach statistical significance. Many previous studies have also highlighted the advantages of breast milk for preterm infants. These benefits include its ease of digestion, promotion of psychomotor development, and reduction in the risks of NEC, atopy, and other infections (23). Our findings are consistent with these studies. Moreover, our results align with research demonstrating a significant association between Apgar scores and successful breast milk feeding (24). We postulate that infants with higher Apgar scores are less compromised and better prepared for feeding initiation. This enhanced readiness may also translate to mothers being less anxious about the overall health of their newborns, thereby facilitating positive lactation outcomes.

Similar to the findings of Patel et al. (2010) and Furman et al. (2002), our study identified no significant correlation between the degree of prematurity, birth weight, gender, being small for gestational age, duration of hospitalisation, or multiple births and the successful establishment of breast milk feeding rates among VLBW infants (13, 18). This observation contradicts the results of the MOSAIC study, a population-based study involving 3006 very preterm births (22–31 weeks of gestation) from eight neonatal units across European regions (25). Contrary to our results, the authors of the MOSAIC study revealed that more premature infants, those with smaller sizes, twins, and those affected by bronchopulmonary dysplasia exhibited lower rates of breastfeeding compared to infants with a higher gestational age, a larger size, a singleton, and those without prematurity-related complications.

To the best of our knowledge, this study represents the inaugural exploration into the prevalence and associated factors concerning the successful establishment of breast milk feeding among VLBW infants in Malaysia. Prior investigations predominantly concentrated on breastfeeding practises among term infants. Thus, the findings presented here offer a foundational reference point that lays the groundwork for forthcoming research endeavours focused on breastfeeding within the context of extremely premature and VLBW infants within our nation.

A notable strength of our study lies in its distinct population delineation and precise definition of breast milk feeding. Importantly, the classification of breast milk feeding status was grounded not on maternal self-reports but on concrete data extracted from medical records, thereby mitigating the risk of reporting bias. By adopting this approach, our study also permits an assessment of neonatal medicine management efficacy, particularly with regard to the optimal provision of nutritional support for VLBW infants. Despite the accreditation of both participating centres as baby-friendly hospitals, our study reveals a low rate of successful initiation and establishment of breastfeeding among VLBW infants, indicating the presence of potential enhancement.

This investigation furnishes critical insights into the determinants that may exert influence over the successful initiation and establishment of breast milk feeding among VLBW infants in the Malaysian context. The comprehension of these determinants is of paramount significance in the pursuit of ameliorating both breast milk feeding rates and the overall quality of nutritional care within our healthcare facilities.

Despite its strength, this study was constrained by a limited sample size that potentially contributed to increased variability, thus impacting the robustness of our findings. Consequently, ascertaining the authenticity of specific outcomes becomes challenging, and the potential for encountering a type II error, including the incorrect acceptance of research hypotheses and a false impression of no disparity between study groups, cannot be overlooked. Moreover, this study was bereft of data pertaining to additional confounding variables that might exert influence over the rate of successful breast milk feeding within the target population. These variables encompass aspects such as individual breast milk expression volume, length of hospitalisation, implementation of kangaroo care/skin-to-skin contact, rooming-in practises, maternal breastfeeding intentions, maternal psychological stress levels, and the extent of support provided. The omission of these variables from our analysis underscores a potential limitation of our study. Furthermore, an additional dimension of our study's limitations lies in the absence of exploration into other contributory factors, including logistics, cultural norms, and the NICU environment, all of which could conceivably impact breastfeeding practises. The absence of these facets in our analysis potentially narrows the comprehensiveness of our study's scope and its ability to capture the full spectrum of factors influencing breastfeeding outcomes.

## CONCLUSION

In conclusion, our investigation has revealed a low rate of successful establishment of breast milk feeding, with fewer than one-third of mothers achieving this outcome (28.0%). Importantly, the timing of our study during the COVID-19 pandemic may have contributed to this low prevalence. Our study emphasises the significance of higher maternal household income, better Apgar scores at five minutes of life, and a one-day delay in the timing of feeding initiation as factors significantly associated with higher rates of successful establishment of breast milk feeding. Recognising the influence of these variables highlights potential avenues for interventions aimed at enhancing the promotion of successful initiation and establishment of breast milk feeding among mothers.

To further improve the precision of our research, we must expand our sample size by including a more diverse range of participants, particularly those from tertiary centres specialising in VLBW infants. Additionally, it is crucial to investigate various factors that influence successful breastfeeding in VLBW infants, such as maternal intentions, mental well-being, and cultural norms. By gaining insight into these elements, healthcare professionals can develop more effective programmes to promote breastfeeding among VLBW infants.

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