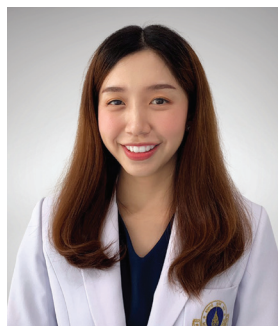


Frequency of Breastfeeding, Bilirubin Levels, and Re-admission for Jaundice in Neonates

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Abstract

OBJECTIVES: This study aimed to explore and compare bilirubin levels and re-admission for jaundice in neonates who have different frequency of breastfeeding (BFF) during the first two weeks of life.

MATERIAL AND METHODS: One-hundred mothers and full-term neonates recruited from a University Hospital, Bangkok, Thailand. The transcutaneous bilirubin (TcB) levels of neonates were recorded at 24, 48, and 72 hours after birth. The breastfeeding frequency (BFF) was recorded every day for a total of 14 consecutive days. The re-admission rates for jaundice were obtained by telephone call enquiry on day 6, 9, 12, and 14 after birth. For analysis, the samples were assigned to two groups according to their mean BFF during the first two weeks of life. The low-BFF group was breastfed < 8 times/day, and the high-BFF group was breastfed ≥ 8 times/day.

RESULT: The average bilirubin levels of neonates in the low-BFF group and the high-BFF group were 6.74 ± 1.76 mg/dl and 5.31 ± 1.76 mg/dl at 24 hours, 10.95 ± 2.44 mg/dl and 8.19 ± 2.40 mg/dl at 48 hours, and 13.34 ± 2.03 mg/dl and 10.60 ± 2.48 mg/dl at 72 hours, respectively. The bilirubin levels and re-admission rates for jaundice of neonates in the low-BFF group were higher than the high-BFF group with statistical significance ($p < 0.001$ and $p < 0.01$, respectively).

CONCLUSION: High-BFF at least eight times/day may help prevent inadequate breastfeeding jaundice in neonates.

Keywords: frequency of breastfeeding, BFF, bilirubin levels, re-admission, jaundice in neonates

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Neonatal jaundice is an important problem occurring in neonates. Approximately 80% of premature and 60% of full-term infants present with clinical jaundice during the first few weeks of life.¹ Inadequate breastfeeding is considered the major cause of jaundice.^{2,3} More than 50% of newborns who have jaundice have this condition due to inadequate breastfeeding.^{3,4} Low intake of breast milk reduces gastrointestinal motility, which decreases the excretion of bilirubin by stool output and increases the intestinal re-absorption of bilirubin into the blood. Thus, the unconjugated bilirubin levels are high and these high levels play an important role in aggravating neonatal jaundice.^{5,6}

Generally, bilirubin levels in breastfed neonates have peak values occurring between the third and fifth days of life and elevating to the second level that usually peaks between the tenth and fifteenth days of life. Prolonged neonatal jaundice over this period would suggest an etiology other than breastfeeding jaundice.⁷⁻⁹ Thus, the mechanism of breastfeeding and jaundice is not clearly understood. However, some research has consistently identified that failure to establish adequate breastfeeding is a leading factor contributing to high levels of bilirubin in breastfed neonates⁹ and 8-11% of these infants can develop severe neonatal jaundice that can cause long-term damage and an increase in neonatal death.¹⁰

Additionally, increasing numbers of neonatal re-admissions for jaundice are associated with inadequate breastfeeding.¹¹ During the first two weeks of life, 85% of breastfed infants are re-admitted to the hospital due to

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inadequate breastfeeding jaundice. Furthermore, the incidence is reported to be on the rise.¹² Re-admission for jaundice causes many negative effects on both neonates and their families. These effects include emotional stress, delayed growth and development, interruption of routine family activities and higher medical costs.^{13,14} Therefore, the prevention of neonatal jaundice due to inadequate breastfeeding, particularly during the first two weeks of life, requires health care professionals' urgent attention. Providing appropriate support with an emphasis on higher BFF each day may ameliorate the problem.^{10,15}

Several previous studies have reported that the optimal BFF is at least eight times/day. Optimal BFF is associated with decreased serum bilirubin levels, increased breast milk intake, weight gain, and frequency of defecation in neonates.¹⁶⁻¹⁸ According to the recommendations from the American Academy of Pediatrics (AAP) and the American College of Obstetricians and Gynecologists (ACOG),¹⁵ the frequency of breastfeeding during the first few weeks after birth should be at least eight times/day. Since breastfeeding at least eight times/day leads to successful establishment of breast milk volume, this feeding schedule would be helpful in the management of inadequate breastfeeding jaundice.

Despite the numerous studies conducted on the relationship between breastfeeding and neonatal jaundice, investigation of BFF and re-admission for jaundice during the first two weeks of life has not been previously studied. Most previous studies have focused on describing the link between BFF and bilirubin levels during the first week of life.^{19,20} However, the incidence of re-admission for inadequate breastfeeding jaundice in the first two weeks of life is reported to continue to rise.¹² Thus, studying these variables might offer a solution to this problem. In this study, the researcher was interested in exploring and comparing bilirubin levels and re-admission rates for jaundice in neonates with different frequencies of breastfeeding during the first two weeks of life. The results from this study could be useful for health care providers as preliminary information for prevention of inadequate breastfeeding jaundice in neonates.

Materials and Methods

Descriptive research design was used to explore and compare bilirubin levels and re-admission rates for jaundice during the first two weeks of life between neonates who received low and high-BFF. The study was conducted in the general and private postpartum units at a University Hospital, Bangkok, Thailand, from February to April 2018. Consecutive sampling was used to enroll the samples who met the inclusion criteria. The sample consisted of 100 mothers and their term neonates.

The inclusion criteria for the mothers:

1. Intended to provide breastfeeding for their neonates and no breast problems such as short, inverted and/or cracked nipples, breast engorgement or mastitis.

2. No antenatal or postpartum complications consisting of pregnancy-induced hypertension (PIH), hemorrhage or postpartum infection.
3. Ability to communicate by telephone follow-up.
4. Willingness to participate in the study.

The inclusion criteria for the neonates:

1. Gestational ages of 37-42 weeks.
2. No perinatal problems such as birth asphyxia, respiratory distress, neonatal infection and/or birth trauma.
3. No tongue-tie or cleft lip-palate problems. Neonates who had been diagnosed with pathologic jaundice, separated from mother > 24 hours, or were not able to receive breastfeeding, and mothers who could not complete the 14 days record of breastfeeding frequency, were excluded from this study.

Instruments

The following four instruments were used to collect data in this study:

1. **Bilirubinometer, Dräger Jaundice Meter JM-105:** Used to measure bilirubin levels at the foreheads of neonates at the first 24, 48 and 72 hours of neonate life. The bilirubinometer is a non-invasive measurement of bilirubin levels by gentle pressing of a probe to the neonate's skin. The validity of this device is calibrated every 6 months by The University Hospital Facilities Service and every morning by staff nurses before the device is used.
2. **A demographic data form:** To obtain personal information from the mothers on age, parity, induction delivery, telephone number, level of education, occupation and neonates' information on gender, gestational age, date of birth, method of delivery, birth weight and Apgar scores at one and 5-minutes.
3. **A BFF record form:** For gathering data on BFF, frequency of defecation and amount of formula milk given per day. The above information is recorded for 14 consecutive days after birth by neonates' mothers.
4. **The transcutaneous bilirubin (TcB) level and re-admission record form:** To collect data regarding TcB levels at 24, 48 and 72 hours of neonate life, neonate weight on Days 1, 2 and 3, date of hospital discharge, date of readmission for jaundice, age at readmission for jaundice and TcB at readmission for jaundice.

Data collection

After the consent form process, the researcher collected the demographic data and measured TcB at the foreheads of the neonates using a bilirubinometer at 24, 48 and 72 hours after birth. All postpartum mothers were requested to record BFF, frequency of defecation and amount of formula milk given per day and to record these data from Day 1 until Day 14 of neonate life in the BFF record form.

When the mothers and full-term neonates were discharged from the hospital, the researcher phoned to ask the data of BFF and re-admission for jaundice in neonates on day 6, 9, 12 and 14 of neonate life. The total time required for the telephone follow-ups was estimated at 5-minutes for each call.

Data analysis

The samples were assigned to two groups due to their mean of BFF during the first two weeks of life. The low-BFF group had a mean BFF score of < 8 times/day during the 14-day period, and the high-BFF group had a mean BFF of ≥ 8 times/day during the 14-day period.

Descriptive statistics, namely, frequency, percentage, mean, and standard deviation (SD) were used to describe the demographic characteristics of the study. The Chi-square was used to compare demographic characteristic of the subject including parity, induction of labor, level of education, occupation, neonatal gender, method of delivery, whereas independent t-test was used for maternal age, GA, BW, Apgar score, BFF,

and amount of formula milk. Comparing personal data, weight loss, frequency of defecation, bilirubin levels and re-admissions for jaundice in neonates in the low and high-BFF groups were also computed by independent *t*-test and Chi-square. An alpha level of 0.05 was set as the level of significance. All of the data obtained by this study were analyzed with the Statistical Package of the Social Sciences (SPSS).

Results

One-hundred mothers and full-term neonates were included in this study. Of these, 48 of them were assigned to the low-BFF group and 52 were assigned to the high-BFF group. The demographic data (parity, induction of labor, level of education, occupation, neonatal gender, method of delivery, maternal age, gestational age, birth weight, Apgar scores at 1 and 5 minutes and amount of formula) of both groups did not differ with statistical significance ($p > 0.05$). However, BFF between the neonates in the low and high-BFF groups were different with statistical significance ($p < 0.001$) (Table 1).

Table 1: The demographic characteristics of the sample (n = 100).

| Demographic Data | Low-BFF Group (n = 48) | High-BFF Group (n = 52) | Test-value | p |
|--|---------------------------|----------------------------|---------------------|-------|
| Parity n (%) | | | 0.65 ^a | 0.42 |
| Primipara | 27 (56.2) | 24 (46.2) | | |
| Multipara | 21 (43.8) | 28 (53.8) | | |
| Induction of Labor n (%) | | | 1.30 ^a | 0.25 |
| Yes | 22 (45.8) | 17 (32.7) | | |
| No | 26 (54.2) | 35 (67.3) | | |
| Level of education n (%) | | | 0.08 ^a | 0.78 |
| Below Bachelor's Degree | 8 (37.5) | 22 (42.3) | | |
| Bachelor's Degree & up | 30 (62.5) | 30 (57.7) | | |
| Occupation n (%) | | | 0.00 ^a | 1.00 |
| Work outside house | 23 (47.9) | 25 (48.1) | | |
| Work inside house | 25 (52.1) | 27 (51.9) | | |
| Neonatal Gender n (%) | | | 0.15 ^a | 0.70 |
| Male | 23 (47.9) | 28 (53.8) | | |
| Female | 25 (52.1) | 24 (46.2) | | |
| Method of Delivery n (%) | | | 0.58 ^a | 0.45 |
| Normal labor | 24 (50) | 31 (59.6) | | |
| Caesarian section | 24 (50) | 21 (40.4) | | |
| Maternal Age (years) m (SD) | 31.21 (5.63) | 30.35 (5.27) | 0.79 ^b | 0.43 |
| Gestational age (weeks) m (SD) | 38.31 (1.09) | 38.48 (1.15) | -0.75 ^b | 0.46 |
| Birth Weight (grams) m (SD) | 3,109.17 (388.17) | 3043.08 (304.30) | 0.95 ^b | 0.34 |
| Apgar Score m (SD) | | | | |
| 1 minutes | 8.69 (0.55) | 8.64 (0.63) | 0.45 ^b | 0.66 |
| 5 minutes | 9.67 (0.48) | 9.62 (0.63) | 0.46 ^b | 0.65 |
| Amount of formula milk (ml/day) m (SD) | 106.89 (39.84) | 99.93 (30.18) | -10.80 ^b | 0.16 |
| BFF (time/day) m (SD) | 6.09 (0.92) | 10.12 (1.55) | -15.97 ^b | 0.00* |

Note. ^a = Chi-square, ^b = Independent t-test * $p < 0.001$
m = mean, SD = standard deviation

The bilirubin levels of neonates were significantly higher in the low-BFF group when compared with the high-BFF group at all 3 times of measurement. At 24 hours, TcB levels in the low-BFF group (6.74 ± 1.76 mg/dl) was significantly higher than the high-BFF group (5.31 ± 1.76 mg/dl, $p < 0.001$). At 48 hours, TcB levels in the low-BFF group (10.95 ± 2.44 mg/dl) was significantly higher than the high-BFF group (8.19 ± 2.40 mg/dl, $p < 0.001$) and at 72 hours, TcB levels in the low-BFF group (13.34 ± 2.03 mg/dl) was significantly higher when compared with the high-BFF group (10.60 ± 2.48 mg/dl, $p < 0.001$) (Table 2).

With regards to re-admission rates for jaundice, 24% of the neonates were admitted to the hospital for jaundice during

the first 2 weeks of life. The readmission rate for jaundice during the first 2 weeks of life in the low-BFF group (39.6%) was higher than the high-BFF group with statistical significance (9.6%, $p < 0.01$) (Table 2).

Additionally, weight loss in the low-BFF group (178.54 ± 47.26 g) was significantly higher than the high-BFF group (108.42 ± 41.12 g, $p < 0.001$). The frequency of defecation of the low-BFF group (3.82 ± 0.82 times/day) was significantly lower when compared with the high-BFF group (5.48 ± 0.83 times/day, $p < 0.001$) (Table 2).

Table 2: Comparison of weight loss, frequency of defecation, bilirubin levels and re-admission rates for jaundice during the first two weeks of life between neonates in low-BFF group and high BFF group (n = 100)

| Variable | Low-BFF Group (n=48) | High-BFF Group (n=52) | Test-value | p |
|--|-------------------------|--------------------------|---------------------|--------|
| Weight Loss (grams) m (SD) | 178.54 (47.26) | 108.42 (41.12) | 7.93 ^a | 0.00** |
| Frequency of Defecation (times/day) m (SD) | 3.82 (0.82) | 5.48 (0.83) | -10.80 ^a | 0.00** |
| Bilirubin Level (mg/dl) m (SD) | | | | |
| 24 hours | 6.74 (1.76) | 5.31 (1.76) | 4.07 ^a | 0.00** |
| 48 hours | 10.95 (2.44) | 8.19 (2.40) | 5.69 ^a | 0.00** |
| 72 hours | 13.34 (2.03) | 10.60 (2.48) | 6.04 ^a | 0.00** |
| Re-admission for Jaundice n (%) | | | 10.70 ^b | 0.001* |
| No | 29 (60.4) | 47 (90.4) | | |
| Yes | 19 (39.6) | 5 (9.6) | | |

Note. ^a = Independent t-test, ^b = Chi-square * $p < 0.01$, ** $p < 0.001$
m = mean, SD = standard deviation

Discussion

The demographic data between the low and the high-BFF group had no statistical significance difference except BFF. According to recommendations from the American Academic of Pediatrics (AAP) and the American College of Obstetricians and Gynecologists (ACOG)¹⁵ BFF should be at least eight times per day, as high BFF is associated with successful breastfeeding. The researcher used the lower limit of eight time per day as the cut-off point. In the present study, the bilirubin levels and re-admission rates for jaundice were higher in relation to decreasing BFF per day. The literature review showed that lower frequency of breastfeeding during the first 24 hours of life results in decreasing intestinal movement, thereby reducing the excretion of bilirubin outside the body as stool output and increasing the intestinal bilirubin reabsorption into the blood. As a result, the unconjugated bilirubin levels are high.^{2,5-6} In addition, breast milk contains substances helping neonates to defecate. Lower frequency of breastfeeding during the first 24 hours of life diminishes stimulation from this substance.²¹ Thus, neonates in the low frequency of breastfeeding group also had significantly lower frequency of defecation per day. According to the study of

Chen YJ, et al.,¹⁶ BFF during the early postpartum period has an impact on the level of bilirubin and frequency of defecation. Thus, the bilirubin level and frequency of defecation per day are significantly higher and lower, respectively, among neonates who breastfeed less than eight times/ day. Yamauchi Y, et al.,¹⁹ found that infants who fed less than seven times during the first 24 hours had significantly decreased frequency of meconium passage and increased incidence of severe neonatal jaundice (TcB ≥ 23.5) when compared to those who fed more frequently (22.8% vs. 7.7%). Another study by Okechukwu and Okolo²⁰ reported that lower frequency of breastfeeding per day was significantly correlated with higher serum bilirubin levels and lower passage of meconium during the first 24 hours of life.

Additionally, it has reported that frequency of breastfeeding during the first 24 hours of life is related to lactogenesis.²² Since the suckling of neonates sends a signal to the anterior pituitary gland to release prolactin and oxytocin, and these are the major hormones producing breast milk in the mammary glands, this helps breast milk ejection from the mammary glands.²³ Lower BFF per day can reduce breast milk volume and increase body weight loss. The decreased intake of breast milk and greater weight loss plays an important role in impairing

bilirubin clearance by the liver.¹⁰ For this reason, the neonates in the low frequency of breastfeeding group had significantly higher levels of bilirubin and greater body weight loss than the neonates in the high frequency of breastfeeding group. The American Academic of Pediatrics and ACOG has also stated that the frequency of breastfeeding during the first few weeks after birth should be at least eight times per day. As appropriate frequency of breastfeeding, at least eight times per day, helps produce sufficient breast milk and prevents high levels of bilirubin from inadequate breastfeeding.¹⁵

Although the association of BFF and re-admission rates for jaundice during the first two weeks of life has not been studied previously, there is evidence that lower BFF is correlated with neonatal jaundice in the first few days of life. Ketsuwan, et al.,²⁴ studied the relationship between BFF and neonatal jaundice during the first 48 hours after birth. Data were collected on 116 neonates who either had or did not have jaundice at 48 hours after birth. The finding showed that the number of infants who breastfed < 8 times/day in the jaundice group was higher than that the number of neonates who fed < 8 times/day in the no jaundice group. The present study confirms these observations. The results also showed that the neonates in the low-BFF group had significantly higher re-admission rates for neonatal jaundice during the first two weeks of life when compared to the neonates in the high-BFF group ($p < 0.01$).

However, this study is a descriptive research in which the researcher exerted no effort to control extraneous variables. Therefore, the researcher could not conclude definitively that lower BFF alone leads to increased bilirubin levels and re-admission rates for neonatal jaundice since higher bilirubin levels may involve other factors beyond lower BFF. Exploring other factors with potential impact on bilirubin levels and using an experimental design to test the effects of BFF on inadequate breastfeeding jaundice needs to be considered in future studies.

Conclusion

This study demonstrated that lower BFF < 8 times/day increases bilirubin levels and re-admission rates for jaundice during the first 14 days of life. These findings may help health care professionals in breastfeeding support as it provides a knowledge base for prevention of inadequate breastfeeding jaundice in neonates.

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