Does Jaundice in Newborn Infants Affect Exclusivity and Duration of Breastfeeding in Taiwan?

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ABSTRACT
Background: Cases of breastfeeding- and breast-milk-related jaundice tend to increase with increased rates of breastfeeding. Diagnoses of jaundice often lead mothers to discontinue breastfeeding because of assumptions that breastfeeding may exacerbate neonatal jaundice and lengthen the duration of phototherapy treatment.

Purpose: This study was designed to explore the effect of neonatal jaundice on breastfeeding duration and exclusivity during the first 4 months postpartum.

Methods: This study applied a two-group comparative and follow-up design. The two groups comprised 135 and 160 mothers of infants, respectively, with and without neonatal jaundice. All of the participants were recruited from three certified baby-friendly hospitals in northern Taiwan. Follow-up was conducted by telephone at 1 and 4 months postpartum.

Results: Mean breastfeeding duration was longer in the group of participants whose infants had neonatal jaundice (group with neonatal jaundice) than in the group whose infants did not have this condition (group without neonatal jaundice; 102.00 vs. 89.85 days, p = .007). The degree of breastfeeding was higher in the group with neonatal jaundice, although the difference was significant only at 1 month postpartum and not during hospitalization or at 4 months postpartum. The results of a Cox regression model showed that the group without neonatal jaundice was more likely to discontinue breastfeeding (adjusted hazard ratio = 1.68, 95% CI [1.08, 2.62]). A generalized estimating equation model suggests that infants with neonatal jaundice had a higher likelihood of being breastfed for at least half of their feedings (adjusted OR = 1.53, 95% CI [1.04, 2.25]).

Conclusions: On the basis of the results of this study, neonatal jaundice is not an obstacle to breastfeeding in pro-breastfeeding hospital environments. Participants whose infants developed neonatal jaundice were found in this study to breastfeed more often, which promotes breastfeeding success.

Key Words: neonatal jaundice, breastfeeding, breastfeeding duration, baby-friendly hospital initiative.

Introduction
On the basis of guidelines published by the World Health Organization (WHO) in 1989 (WHO/UNICEF, 1989), Taiwan began to publicly encourage women to breastfeed in 1992. Hospitals in Taiwan are recognized as “baby-friendly” if they meet the lactation promotion criteria adapted from the WHO/UNICEF’s 10 steps to successful breastfeeding standards (Chien & Tai, 2007; Chien et al., 2007; Chou et al., 2014; Chu et al., 2005). The breastfeeding rate at 6 months postpartum has increased from 49.9% in 2011 to 57.7% in 2018 (Health Promotion Administration, Ministry of Health and Welfare, Taiwan, ROC, 2018; Waits et al., 2018). However, a rising prevalence of infants with jaundice has been identified alongside this rising breastfeeding rate. According to one study, while the breastfeeding rate in one hospital rose from 92.2% to 97.2% since the implementation of a baby-friendly policy, the prevalence of neonatal jaundice in that hospital also rose, from 10.9% to 23.8% (Lin et al., 2008).

Breastfeeding jaundice and breast milk jaundice are two types of breastfeeding-related jaundice in newborns (Leung & Sauve, 1989). The first is frequently found among newborns who do not receive sufficient breast milk and later appear to lose weight and be dehydrated between 4 and 7 days postpartum (Preer & Philipp, 2011). Breast milk jaundice typically occurs 1 week after birth. Although this condition
may last up to 12 weeks, it rarely causes complications in healthy, breast-fed infants (Prameela, 2019). More than 65% of newborns who are fed breast milk develop neonatal jaundice. Hyperbilirubinemia may be diagnosed and became severe in infants at 10–14 days postpartum, with symptoms potentially continuing for 2–3 months (Preer & Philipp, 2011). Watson (2009) posited that having neonatal jaundice is a natural process that poses no real harm to newborns, although it requires evaluation and attention to prevent large amounts of bilirubin from circulating to tissues in the brain, which may cause seizures or brain damage. Mothers and families are generally instructed to monitor for jaundice by observing the skin color of their infants and the whites of their eyes (Chuang et al., 2015).

Previous studies have shown that breastfeeding and higher levels of bilirubin at hospital discharge are two predictors of hospital readmission (Jones et al., 2018). Other similar studies have confirmed that breastfeeding may cause severe weight loss because of dehydration (Fonseca et al., 2014). Exclusively breastfed infants have been found to exhibit more-severe clinical symptoms of neonatal jaundice (Chen et al., 2012).

Phototherapy is recommended to resolve high levels of bilirubin (> 15 mg/dl) in infants (Alizadeh Taheri et al., 2014). Women in Taiwan tend to perform a customary practice, “doing-the-month,” at home after giving birth (Chien et al., 2006). According to doing-the-month practices, women should be confined at home, rest as much as possible, and follow specific behavioral rules for at least 1 month after childbirth (Chien et al., 2006; Ding et al., 2020). This restrictive situation typically requires discontinuing breastfeeding and may lead to inadequate milk supply and lactation, especially when infants are required to receive phototherapy in hospital settings (Muchowski, 2014). Any postpartum separation between mother and child has been found to harm breastfeeding rates (Chang et al., 2019) because of the interruption of baby–mother attachment and breastfeeding activities during separation (Sivanandan et al., 2009).

In addition to phototherapy, a common treatment for neonatal jaundice is to prevent fluid or water deprivation by increasing liquid intake (Becker et al., 2011; Goyal et al., 2018). Mothers are advised to increase breastfeeding times and amounts (Saedti et al., 2009). If the condition still does not improve, health professionals may suggest using formula or liquid supplementation or even stopping breastfeeding temporarily to improve liquid intake (Zhang et al., 2015). In these cases, mothers may consider discontinuing breastfeeding altogether because of worries that breastfeeding may exacerbate neonatal jaundice and lengthen the duration of phototherapy (Muchowski, 2014).

Attempts have been made in previous studies to further elucidate the impact of hospital breastfeeding policies on the breastfeeding rate. Breastfeeding while treating neonatal jaundice may worsen this condition. Few studies have focused on the impact of neonatal jaundice on exclusive breastfeeding and breastfeeding discontinuation. This study was designed to explore the effect of neonatal jaundice on breastfeeding duration and exclusivity in the first 4 months after giving birth.

Methods

Design

A two-group comparative and follow-up design was used in this study. The setting was three certified baby-friendly hospitals in Taipei City, Taiwan. The data were collected from September 2013 through September 2014. The study protocol was approved by the Taiwan Taipei Tzu Chi Hospital Institutional Review Board (No. 02-M03-018) on June 27, 2013.

Sample

The inclusion criteria were no severe health problems (mothers and neonates) and mothers having initiated breastfeeding during hospitalization. The mothers of infants with blood total bilirubin levels ≥ 5 mg/dl at 2–3 days postpartum were assigned to the group with neonatal jaundice, whereas all other mothers were assigned to the comparison group.

We estimated the required sample size at 177 participants (Schoenfeld, 1983) based on α = .05, power = 0.80, hazard ratio (HR) = 1.5, a rate of breastfeeding of 22.8%, and an event rate of 85%. Presuming a 10% rate of attrition, a sample size of at least 195 participants was recruited.

We approached 141 and 210 mothers of infants with and without neonatal jaundice, respectively, to participate in this study. Ultimately, the group with neonatal jaundice included 135 participants, and the group without neonatal jaundice included 160 participants. All participating mothers of infants with neonatal jaundice were experiencing physiological neonatal jaundice.

Measurements

Structured questionnaires were used to collect the data. Information, including sociodemographic variables (maternal age, educational level, work status, and marital status), obstetrics variables (parity, delivery mode, and infant birth weight), health problems among mothers and infants, and prior breastfeeding experience, were gathered during the first few days postpartum in the hospital. Furthermore, information on breastfeeding degree, breastfeeding duration, and management of neonatal jaundice (phototherapy, formula supplementation, liquid supplementation, interruption of breastfeeding, and increase in breastfeeding amount and times, if applicable) was gathered at all three time points (during hospitalization, 1 month, and 4 months postpartum).

Degree of breastfeeding was categorized into seven levels, as follows: 100% human milk, ≥ 80% human milk and < 20% formula (2 of 10 times not fed with human milk), 51%–79% human milk (2–4 of 10 times not fed with human milk), 50% human milk (5 of 10 times not fed with human milk), 20%–49% human milk (6–7 of 10 times not fed with human milk).
human milk), ≤ 19% human milk (8–9 of 10 times not fed with human milk), and 100% formula (no breastfeeding). Women were asked regarding their current infant feeding practices. Duration of breastfeeding was defined as from the time of birth to the complete cessation of breastfeeding.

Data Collection
Participants in the study provided their written consent and contact information. The participants were interviewed face-to-face during hospitalization and later by telephone at 1 and 4 months after giving birth. One hundred thirty (96.3%) participants whose infants developed neonatal jaundice and 146 (91.3%) participants whose infants did not develop neonatal jaundice completed the 1-month postpartum interview; 126 (93.3%) and 144 (90.0%) participants, respectively, completed the 4-month postpartum interview.

Data Analysis
This study used IBM SPSS Statistics Version 22.0 (IBM Inc., Armonk, NY, USA) for data analysis. Frequencies, percentages, means, and standard deviations were included. Crude comparisons between the two groups were examined using the Chi-squared test, Pearson’s correlation coefficients, t tests, or one-way analysis of variance. To examine the bivariable association between degree of breastfeeding and neonatal jaundice, the degree of breastfeeding was consolidated from seven to three categories (100%, > 50%, ≤ 50%), as some cell sizes were too small to yield valid statistical results. Multivariate analyses were conducted using a Cox regression model and generalized estimating equations (GEEs) for duration of breastfeeding and degree of breastfeeding, respectively. In the GEE model, the degree of breastfeeding (dependent variable) was recategorized as a binomial variable (> 50% breastfeeding and ≤ 50% breastfeeding). In the Cox regression model, time from birth to discontinuance of breastfeeding was used as the dependent variable. Only variables with two-sided p values ≤ .05 were retained in the final multivariate model.

Results
As shown in Table 1, no significant difference was found between the two groups in terms of demographics, obstetrics variables, and maternal and child health. In the group with neonatal jaundice, the bilirubin level ranged from 9.93 to 13.60 mg/dl at 2–7 days postpartum and 45 (33.3%) were prescribed phototherapy. In terms of jaundice management, in the group with neonatal jaundice, 43 infants (37.7%) received formula supplementation, two (1.8%) received liquid supplementation, 10 (8.8%) received interruption of breastfeeding, and 83 (72.8%) received an increase in breastfeeding amounts and times. Breastfeeding duration and degree of breastfeeding by group are presented in Table 2. The mean duration of breastfeeding was 102 (SD = 32.8) and 89.9 (SD = 40.9) days for the groups with and without neonatal jaundice, respectively (p = .007). At hospitalization and at 1 and 4 months postpartum, the group with neonatal jaundice had higher rates of exclusive breastfeeding and lower rates of exclusive formula feeding than the group without neonatal jaundice. However, these differences were only statistically significant at 1 month postpartum.

The GEE model showed neonatal jaundice, delivery mode, and time as significant predictors of degree of breastfeeding (Table 3). Participants who gave birth via cesarean section were significantly less likely to breastfeed for more than half of their feedings (OR = 0.33, 95% CI [0.22, 0.50]), whereas participants in the group with neonatal jaundice were significantly more likely to breastfeed for more than half of their feedings (adjusted OR = 1.53, 95% CI [1.04, 2.25]). The participants were more likely to breastfeed for more than half of their feedings during hospitalization and 1 month postpartum than at 4 months postpartum (adjusted OR = 2.20, 95% CI [1.62, 2.99], and 1.64, 95% CI [1.33, 2.02] for hospitalization and at 1 month postpartum, respectively).

The results of the Cox regression model showed that maternal age, maternal educational level, prior breastfeeding experience, and neonatal jaundice were significant predictors of breastfeeding duration (Table 4). Participants whose infants did not develop neonatal jaundice tended to stop breastfeeding (HR = 1.68, 95% CI [1.08, 2.62]). Younger participants (≤ 29 years old) were more likely than older participants (≥ 35 years old) to discontinue breastfeeding (HR = 2.39, 95% CI [1.37, 4.18]), whereas no significant difference in discontinuance was found between participants in the 30–34 years of age range and those 35 years old or older. An educational level of high school or lower was associated with a greater risk of discontinuing breastfeeding (HR = 2.14, 95% CI [1.01, 4.53]), whereas no significant difference was found among participants with higher levels of education. Likelihood of discontinuance was higher among multipara participants with no prior breastfeeding experience than among participants who gave birth for the first time (HR = 4.18, 95% CI [1.82, 9.65]), whereas no significant difference was found between primipara and multipara participants with prior breastfeeding experience. The survival curve, which illustrates the duration of breastfeeding by neonatal jaundice status, is presented in Figure 1. As shown, the survival curve for participants whose infants developed neonatal jaundice is less steep.

Discussion
This study found that participants whose infants developed breastfeeding or breast milk jaundice had a significantly longer mean duration of breastfeeding and a higher degree of breastfeeding than participants whose infants did not develop jaundice. This finding differs from a previous study that found that infants exposed to phototherapy were less likely to continue to be breastfed and be exclusively breastfed.
than infants who were not exposed to phototherapy during the first 4 months of life (Waite & Taylor, 2016). This finding also disagrees with another study showing that postdischarge breastfeeding rates for infants diagnosed with jaundice were not significantly different than the general infant population (Pound & Gaboury, 2009). The findings of this study should be viewed in the context of the ongoing Baby-Friendly Hospital Initiative in Taiwan (Health Promotion Administration, Ministry of Health and Welfare, Taiwan, ROC, 2019). In certified baby-friendly hospitals, women whose infants are diagnosed with neonatal jaundice may be encouraged to increase the amount and frequency of breastfeeding as a way to promote bilirubin metabolism. The results of past studies indicate that breastfeeding more than 8 times a day reduces the risk of high bilirubin (Chen et al., 2015). In addition, staff at baby-friendly hospitals may provide more assistance when breastfeeding-related problems such as latching or sucking occur. Ineffective sucking behaviors may suppress lactation (Mizuno et al., 2004) and have been identified as important predictors of breastfeeding jaundice and early discontinuance of breastfeeding (Almqvist-Tangen et al., 2012). The findings of this study suggest that, with the assistance of health professionals, mothers should be able to breastfeed successfully even if their infants have breastfeeding-related jaundice. Healthcare workers should encourage mothers of infants with neonatal jaundice to breastfeed and provide appropriate care and guidance.

The findings of previous studies indicate that mothers know little about neonatal jaundice and do not expect breastfeeding problems until their infant requires bilirubin-level monitoring and treatment (Chu et al., 2019; Zhang et al., 2015). In this study, the participants adopted strategies such as increased

| Variable                              | With Neonatal Jaundice (n = 135) | Without Neonatal Jaundice (n = 160) | p     |
|---------------------------------------|----------------------------------|--------------------------------------|-------|
|                                       | n %                              |                                      |       |
| Maternal age (years; M and SD)        | 32.9 3.9                         | 33.4 4.1                             | .28   |
| Maternal educational level            |                                 |                                      |       |
| Senior high school or lower           | 24 17.8                         | 33 20.6                              | .70   |
| University                            | 94 69.6                         | 104 65.0                             |       |
| Postgraduate                          | 17 12.6                         | 23 14.4                              |       |
| Maternal occupational status          |                                 |                                      | .30   |
| Full-time                             | 88 65.2                         | 109 68.1                             |       |
| Part-time                             | 3 2.2                           | 8 5.0                                |       |
| None                                  | 44 32.6                         | 43 26.9                              |       |
| Currently married                     |                                 |                                      | .15   |
| Yes                                   | 134 99.3                        | 155 96.9                             |       |
| No                                    | 1 0.7                           | 5 3.1                                |       |
| Parity                                |                                 |                                      | .08   |
| 1                                     | 82 60.7                         | 81 50.6                              |       |
| ≥ 2                                   | 53 39.3                         | 79 49.4                              |       |
| Delivery mode                         |                                 |                                      | .31   |
| Vaginal                               | 96 71.1                         | 105 65.6                             |       |
| Cesarean                              | 39 28.9                         | 55 34.4                              |       |
| Maternal health problemsa             |                                 |                                      | .32   |
| Yes                                   | 29 21.5                         | 30 18.8                              |       |
| No                                    | 106 78.5                        | 130 81.2                             |       |
| Infant birth weight (g; M and SD)     | 3116.2 384.1                    | 3098.0 352.9                        | .67   |
| Infant health problems besides jaundice|                                 |                                      |       |
| Yesb                                  | 5 3.7                           | 12 7.5                               | .16   |
| No                                    | 130 96.3                        | 148 92.5                             |       |
| Prior experience with breastfeeding    |                                 |                                      | .50   |
| (n = 132)                             |                                 |                                      |       |
| Yes                                   | 50 94.3                         | 72 91.1                              |       |
| No                                    | 3 5.7                           | 7 8.9                                |       |

aMaternal health problems include vaginal bleeding (n = 9), preeclampsia (n = 8), pregnancy-induced hypertension (n = 5), gestational diabetes (n = 30), hydramnios (n = 1), virus infection (n = 2), and other (Group B streptococci or placenta previa, etc.; n = 8).
bInfant health problems include infection (n = 3), heart problem (n = 10), ear problem (n = 1), perineum problem (n = 2), and dermatitis (n = 1).
breastfeeding duration and frequencies (72.8%), formula feeding (37.7%), and temporary stoppage of breastfeeding (8.8%) in response to a diagnosis of neonatal jaundice. Previous studies have reported that temporary cessation of breastfeeding to treat neonatal jaundice increased the risk of breastfeeding discontinuation (Alizadeh Taheri et al., 2014; Muchowski, 2014). However, the results of this study

| Variable                      | With Neonatal Jaundice | Without Neonatal Jaundice | p   |
|-------------------------------|------------------------|---------------------------|-----|
|                               | n     | %    | n     | %    |     |
| Breastfeeding during hospitalization | 135   | 45.8 | 160   | 54.2 | .30 |
| 100%                          | 56    | 41.5 | 58    | 36.3 |     |
| > 50%                         | 40    | 29.6 | 42    | 26.3 |     |
| ≤ 50%                         | 39    | 28.9 | 60    | 37.4 |     |
| Breastfeeding at 1 month (n = 276) | 130   | 47.1 | 146   | 52.9 | .03 |
| 100%                          | 59    | 45.4 | 54    | 37.0 |     |
| > 50%                         | 32    | 24.6 | 24    | 16.4 |     |
| ≤ 50%                         | 27    | 20.8 | 40    | 27.4 |     |
| None                          | 12    | 9.2  | 28    | 19.2 |     |
| Breastfeeding at 4 months (n = 270) | 126   | 46.7 | 144   | 53.3 | .10 |
| 100%                          | 57    | 45.2 | 49    | 34.0 |     |
| > 50%                         | 12    | 9.5  | 16    | 11.1 |     |
| ≤ 50%                         | 22    | 17.5 | 20    | 13.9 |     |
| None                          | 35    | 27.8 | 59    | 41.0 |     |
| Breastfeeding duration (n = 270) | 126   | 46.7 | 144   | 53.3 | .03 |
| ≤ 30 days                     | 11    | 8.7  | 31    | 21.5 |     |
| 31–60 days                    | 15    | 11.9 | 17    | 11.8 |     |
| 61–90 days                    | 6     | 4.8  | 8     | 5.6  |     |
| ≥ 91 days                     | 94    | 74.6 | 88    | 61.1 |     |
| Duration of breastfeeding (M and SD) | 102.0 | 32.8 | 9.9  | 40.9 | .01 |

Note. Different value for n is because of loss of follow-up.

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Table 3

| Variable                      | Odds Ratio | 95% CI          | p   |
|-------------------------------|------------|-----------------|-----|
| Delivery mode                 |            |                 |     |
| Caesarean                     | 0.33       | [0.22, 0.50]    | < .01|
| Vaginal                       | 1.00       |                 |     |
| Neonatal jaundice             |            |                 |     |
| No                            | 1.00       |                 |     |
| Yes                           | 1.53       | [1.04, 2.25]    | .03 |
| Time                          |            |                 |     |
| During hospitalization        | 2.20       | [1.62, 2.99]    | < .01|
| 1 month postpartum            | 1.64       | [1.33, 2.02]    | < .01|
| 4 months postpartum           | 1.00       |                 |     |

Note. Working correlation matrix is unstructured.

Table 4

| Variable                      | Hazard Ratio | 95% CI          | p   |
|-------------------------------|--------------|-----------------|-----|
| Neonatal jaundice             | 1.68         | [1.08, 2.62]    | .020|
| Maternal age (years)          |              |                 |     |
| ≤ 29                          | 2.39         | [1.37, 4.18]    | .002|
| 30–34                         | 0.94         | [0.56, 1.54]    | .810|
| ≥ 35                          | 1.00         |                 |     |
| Maternal educational level    |              |                 |     |
| High school or lower          | 2.14         | [1.01, 4.53]    | .047|
| Vocational school             | 1.07         | [0.38, 2.98]    | .910|
| University                    | 0.98         | [0.51, 1.89]    | .950|
| Postgraduate                  | 1.00         |                 |     |
| Breastfeeding experience      |              |                 |     |
| Multipara without breastfeeding experience | 4.18 | [1.82, 9.65] | .001|
| Multipara with breastfeeding experience | 1.05 | [0.67, 1.66] | .830|
| Primipara                     | 1.00         |                 |     |

Note. Working correlation matrix is unstructured.
suggest that these practices did not result in negative breastfeeding outcomes during the first 4 months postpartum. In addition, intention to increase breastfeeding duration and frequencies may be an underlying reason why the mothers in the group with neonatal jaundice obtained better breastfeeding outcomes. Therefore, healthcare workers should encourage mothers to increase breastfeeding times, recommend appropriate precautions, and suggest appropriate responses to potential problems, for example, recommending formula milk supplementation when infant weight loss exceeds 7%, when human milk expression is insufficient, and when newborn infants experience decreased stool frequencies. These actions may help ensure that infants are discharged as scheduled and avoid separation, which may cause maternal anxiety and failure in breastfeeding (O’Brien et al., 2008).

To avoid the negative impact of neonatal jaundice on breastfeeding, healthcare workers must allay the doubts of new mothers regarding breastfeeding and neonatal jaundice and assure them that jaundice is a temporary condition. For example, healthcare workers may provide information about neonatal jaundice, teach women how to express human milk when breastfeeding stops temporarily during phototherapy or when supplementary formula is given, and help extend the duration of breastfeeding sessions. In addition, healthcare workers may provide dietary suggestions to help women improve lactation. Furthermore, they may teach new mothers to express milk and save their milk while their infants receive phototherapy.

In addition to neonatal jaundice, the study found associations between cesarean delivery and reduced levels of breastfeeding during the first 4 months postpartum. In addition, young maternal age, low educational level, and no prior experience of breastfeeding were associated with a shorter breastfeeding duration. These findings are similar to those of previous studies (Colombo et al., 2018; Holowko et al., 2016; Kitano et al., 2015). Breastfeeding promotion programs should especially target younger mothers (< 30 years old), plan breastfeeding with pregnant women who are going to have a cesarean delivery, provide more assistance to mothers who undergo cesarean delivery, and improve breastfeeding-friendly environments to help prepare working mothers to continue breastfeeding after returning to work.

**Limitations**

Newborn babies with high levels of bilirubin during the first 2 or 3 days of life based on skin probing results were assigned to the group with jaundice. Infants who experienced jaundice after discharge were not included in the study. All of the infants in the group with neonatal jaundice were diagnosed with physiological jaundice, as pathological jaundice fell beyond the scope of this study. Information on breastfeeding outcomes and jaundice management were obtained using self-administered questionnaires. Thus, data may be misleading or erroneous if participants did not answer questions honestly or did not accurately recall information. More than 80% of the participants in this study held a college degree or higher, which suggests that the average breastfeeding duration may be longer among study participants than in the general population.

**Conclusions**

In this study, conducted in certified baby-friendly hospitals, participants whose infants developed neonatal jaundice reported a longer duration and a higher degree (> 50%) of breastfeeding. Neonatal jaundice was not found to be an obstacle to breastfeeding in the pro-breastfeeding environment that prevailed in the study settings. The infants with neonatal jaundice were breastfed more often, which resulted in a greater rate of breastfeeding success for this group. Future research may explore whether different approaches to managing neonatal jaundice such as hospitalization, length of phototherapy, and liquid/formula supplementation influence breastfeeding outcomes differently. In addition, studies that track changes in bilirubin level longitudinally over a longer follow-up period are warranted.

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References

Alizadeh Taheri, P., Sadeghi, M., & Sajjadi, N. (2014). Severe neonatal hyperbilirubinemia leading to exchange transfusion. Medical Journal of the Islamic Republic of Iran, 28, Article 64.

Almqvist-Tangen, G., Bergman, S., Dahlgren, J., Roswall, J., & Alm, B. (2012). Factors associated with discontinuation of breastfeeding before 1 month of age. Acta Paediatrica, 101(1), 55–60. https://doi.org/10.1111/j.1651-2227.2011.02405.x

Becker, G. E., Remmington, S., & Remmington, T. (2011). Early additional food and fluids for healthy breastfed full-term infants. Cochrane Database of Systematic Reviews, 2011(12), CD006462. https://doi.org/10.1002/14651858.CD006462.pub2

Chang, P.-C., Li, S.-F., Yang, H.-Y., Wang, L.-C., Weng, C.-Y., Chen, K.-F., Chen, W., & Fan, S.-Y. (2019). Factors associated with cessation of exclusive breastfeeding at 1 and 2 months postpartum in Taiwan. International Breastfeeding Journal, 7(14), Article 18. https://doi.org/10.1186/s13006-019-0213-1

Chen, Y.-J., Chen, W.-C., & Chen, C.-M. (2012). Risk factors for hyperbilirubinemia in breastfed term neonates. European Journal of Pediatrics, 171(1), 167–171. https://doi.org/10.1007/s00431-011-1512-8

Chen, Y.-J., Yeh, T.-F., & Chen, C.-M. (2015). Effect of breastfeeding frequency on hyperbilirubinemia in breast-fed term neonate. Pediatrics International, 57(6), 1121–1125. https://doi.org/10.1111/ped.12667

Chien, L.-Y., & Tai, C.-J. (2007). Effect of delivery method and timing of breastfeeding initiation on breastfeeding outcomes in Taiwan. Birth, 34(2), 123–130. https://doi.org/10.1111/j.1523-5366.2007.00158.x

Chien, L.-Y., Tai, C.-J., Chu, K.-H., Ko, Y.-L., & Chiu, Y.-C. (2007). The number of baby friendly hospital practices experienced by mothers is positively associated with breastfeeding: A questionnaire survey. International Journal of Nursing Studies, 44(7), 1138–1146. https://doi.org/10.1016/j.ijnurstu.2006.05.015

Chien, L.-Y., Tai, C.-J., Ko, Y.-L., Huang, C.-H., & Sheu, S.-J. (2006). Adherence to “doing-the-month” practices is associated with fewer physical and depressive symptoms among postpartum women in Taiwan. Research in Nursing & Health, 29(5), 374–383. https://doi.org/10.1002/nur.20154

Chiou, S.-T., Chen, L.-C., Yeh, H., Wu, S.-R., & Chien, L.-Y. (2014). Early skin-to-skin contact, rooming-in, and breastfeeding: A comparison of the 2004 and 2011 National Surveys in Taiwan. Birth, 41(1), 33–38. https://doi.org/10.1111/birt.12090

Chu, K.-H., Sheu, S.-J., Hsu, M.-H., Liao, J., & Chien, L.-Y. (2019). Breastfeeding experiences of Taiwanese mothers of infants with breastfeeding or breast milk jaundice in certified baby-friendly hospitals. Asian Nursing Research, 13(2), 154–160. https://doi.org/10.1016/j.anr.2019.04.003

Chu, K.-H., Tai, C.-J., & Chien, L.-Y. (2005). The relationship between in-hospital breastfeeding rates and hospital type. Hu Li Za Zhi, 52(6), 40–48. https://doi.org/10.6224/JN.52.6.40 (Original work published in Chinese)

Chuang, S.-W., Luo, P.-J., Huang, C.-L., Li, Y.-H., Peng, H.-F., & Sheng, C.-C. (2015). Knowledge promotion and identification of skin color change in neonatal jaundice for primary caregiver by using skin color chart. VGH Nursing, 32(4), 343–350. https://doi.org/10.6142/VGHN.32.4.343 (Original work published in Chinese)

Colombo, L., Crippa, B. L., Consonni, D., Bettinelli, M. E., Agosti, V., Mangino, G., Bezze, E. N., Mauri, P. A., Zanotta, L., Roggero, P., Plevani, L., Bertoli, D., Gianni, M. L., & Mosca, F. (2018). Breastfeeding determinants in healthy term newborns. Nutrients, 10(1), Article 48. https://doi.org/10.3390/nu10010048

Ding, G., Niu, L., Vinturache, A., Zhang, J., Lu, M., Gao, Y., Pan, S., & Tian, Y., Shanghai Birth Cohort Study. (2020). “Doing the month” and postpartum depression among Chinese women: A Shanghai prospective cohort study. Women Birth, 33(2), e151–e158. https://doi.org/10.1016/j.wombi.2019.04.004

Fonseca, M.-J., Severo, M., Barros, H., & Santos, A.-C. (2014). Determinants of weight changes during the first 96 hours of life in full-term newborns. Birth, 41(2), 160–168. https://doi.org/10.1111/birt.12087

Goyal, P., Mehta, A., Kaur, J., Jain, S., Guglani, V., & Chawda, D. (2018). Fluid supplementation in management of neonatal hyperbilirubinemia: A randomized controlled trial. Journal of Maternal-Fetal & Neonatal Medicine, 31(20), 2678–2684. https://doi.org/10.1080/14767058.2017.1351535

Health Promotion Administration, Ministry of Health and Welfare, Taiwan, ROC. (2018). Survey plan for breastfeeding rate in counties and cities in 2018. https://www.grb.gov.tw/search/planDetail?id=12691859

Health Promotion Administration, Ministry of Health and Welfare, Taiwan, ROC. (2019). Current status of breastfeeding in Taiwan. https://www.hpa.gov.tw/Pages/Detail.aspx?nodeid=506&pjid=463

Holowko, N., Jones, M., Koupil, I., Tooth, L., & Mishra, G. (2016). High education and increased parity are associated with breast-feeding initiation and duration among Australian women. Public Health Nutrition, 19(14), 2551–2561. https://doi.org/10.1017/S1368980016000367

Jones, E., Taylor, B., Rudge, G., MacArthur, R. C., Jyothish, D., Simkiss, D., & Cummins, C. (2018). Hospitalisation after birth of infants: cross sectional analysis of potentially avoidable admissions across England using hospital episode statistics. BMC Pediatrics, 18(1), Article 390. https://doi.org/10.1186/s12887-018-1360-z

Kitano, N., Nomura, K., Kido, M., Murakami, K., Ohkubo, T., Ueno, M., & Sugimoto, M. (2015). Combined effects of maternal age and parity on successful initiation of exclusive breastfeeding. Preventive Medicine Reports, 3, 121–126. https://doi.org/10.1016/j.pmedr.2015.12.010

Leung, A. K. C., & Sauve, R. S. (1989). Breastfeeding and breast milk jaundice. Journal of the Royal Society of Health, 109(6), 213–217. https://doi.org/10.1177/146642408910900615

Lin, Y.-Y., Tsao, P.-N., Hsieh, W.-S., Chen, C.-Y., & Chou, H.-C. (2008). The impact of breastfeeding on early neonatal jaundice. Clinical Neonatology, 15(1), 31–35. https://doi.org/10.7098/CN.200806.0031
Mizuno, K., Fujimaki, K., & Sawada, M. (2004). Sucking behavior at breast during the early newborn period affects later breast-feeding rate and duration of breast-feeding. *Pediatrics International, 46*(1), 15–20. https://doi.org/10.1111/j.1442-200X.2004.01834.x

Muchowski, K. E. (2014). Evaluation and treatment of neonatal hyperbilirubinemia. *American Family Physician, 89*(11), 873–878.

O’Brien, M., Buikstra, E., & Hegney, D. (2008). The influence of psychological factors on breastfeeding duration. *Journal of Advanced Nursing, 63*(4), 397–408. https://doi.org/10.1111/j.1365-2648.2008.04722.x

Pound, C. M., & Gaboury, I. (2009). The impact of jaundice in newborn infants on the length of breastfeeding. *Paediatrics & Child Health, 14*(7), 445–449.

Prameela, K. K. (2019). Breastfeeding during breast milk jaundice—A pathophysiological perspective. *Medical Journal of Malaysia, 74*(6), 527–533. http://www.e-mjm.org/2019/v74n6/breast-milk-jaundice.pdf

Preer, G. L., & Philipp, B. L. (2011). Understanding and managing breast milk jaundice. *Archives of Disease in Childhood. Fetal and Neonatal Edition, 96*(6), F461–F466. https://doi.org/10.1136/adc.2010.184416

Saeidi, R., Heydarian, F., & Fakehi, V. (2009). Role of intravenous extra fluid therapy in icteric neonates receiving phototherapy. *Saudi Medical Journal, 30*(9), 1176–1179. https://doi.org/10.1088/2058-7058/21/06/20

Schoenfeld, D. A. (1983). Sample-size formula for the proportional-hazards regression model. *Biometrics, 39*, 549–563. https://doi.org/10.2307/2531021

Sivanandan, S., Chawla, D., Misra, S., Agarwal, R., & Deorari, A. K. (2009). Effect of sling application on efficacy of phototherapy in healthy term neonates with nonhemolytic jaundice: A randomized controlled trial. *Indian Pediatrics, 46*(1), 23–28. https://www.indianpediatrics.net/jan2009/23.pdf

Waite, W. M., & Taylor, J. A. (2016). Phototherapy for the treatment of neonatal jaundice and breastfeeding duration and exclusivity. *Breastfeeding Medicine, 11*(4), 180–185. https://doi.org/10.1089/bfm.2015.0170

Waits, A., Guo, C. Y., & Chien, L. Y. (2018). Evaluation of factors contributing to the decline in exclusive breastfeeding at 6 months postpartum: The 2011–2016 National Surveys in Taiwan. *Birth, 45*(2), 184–192. https://doi.org/10.1111/birt.12340

Watson, R. L. (2009). Hyperbilirubinemia. *Critical Care Nursing Clinics of North America, 21*(1), 97–120. https://doi.org/10.1016/j.cccn.2008.11.001

World Health Organization/UNICEF. (1989). Archived: Protecting, promoting and supporting breast-feeding. https://www.who.int/nutrition/publications/infantfeeding/9241561300/en/

Zhang, L., Hu, P., Wang, J., Zhang, M., Zhang, Q. L., & Hu, B. (2015). Prenatal training improves new mothers’ understanding of jaundice. *Medical Science Monitor, 21*, 1668–1673. https://doi.org/10.12659/MSM.893520