# Effects of Mothers' Infant Massage on Bilirubin Levels and Re-hospitalization for Hyperbilirubinemia: A Quasi-experimental Study

*Nuthcharin Intanai, Tipawan Daramas,* Autchareeya Patoomwan*

**Abstract:** Hyperbilirubinemia is a physiological health problem of newborn infants, mostly occurring in the first week of life, which can delay development or cause disabilities or death. Massaging newborn infants early after delivery can promote bilirubin excretion and reduce hyperbilirubinemia. This quasi-experimental study aimed to determine the effect of infant massage performed by mothers on bilirubin levels and re-hospitalization for hyperbilirubinemia. The study was conducted at an obstetrics and gynecology ward of a secondary hospital in Bangkok, Thailand. The participants were 30 paired full-term infants and mothers who met the inclusion criteria. The experimental group (n = 15) received body massage performed by their mother for 15 minutes twice a day for four consecutive days, while the control group (n = 15) received only usual care. The transcutaneous bilirubin levels were recorded at 6, 48, and 96 hours after birth. Data on re-hospitalization with hyperbilirubinemia were recorded on Day 7 after birth and analyzed using Fisher's exact test, independent t-test, and repeated measures ANOVA.

The results revealed that the infants who received the massage had significantly lower mean bilirubin levels than those in the control group. However, there was no difference in the re-hospitalization with hyperbilirubinemia between the groups. In addition, the frequency of defecation on the first and fourth days in the experimental group was significantly greater than in the control group. The present study's result indicated that mothers' infant massage can help reduce bilirubin levels in full-term infants. The findings hold promise for nurses to integrate infant massage in training mothers at an early stage after birth for the prevention of hyperbilirubinemia in newborn infants. However, further testing with a larger sample size and randomized controlled trials are needed.

**Keywords:** Bilirubin level, Full-term infant, Hyperbilirubinemia, Infant massage, Nursing, Re-hospitalization

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## Introduction

Hyperbilirubinemia is a problem that affects many newborn infants worldwide.[1] Approximately 60% of full-term infants and 80% of premature infants encounter a high bilirubin level during the first week of life.[1] Although hyperbilirubinemia is screened in all infants in many countries, it is still a major health problem.[2] It was found that 85% of all infants' re-hospitalizations were due to hyperbilirubinemia during the first week of life.[3] This can lead to mothers'



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and family's anxiety, increase the medical cost, and extend the length of hospital stay.[2] The clinical signs of physiological hyperbilirubinemia frequently appear 24 to 72 hours after birth, and total serum bilirubin levels peak at days 4 to 5.[4] The high level of bilirubin can affect the infants' brain, causing delayed development, disabilities, or death.[5] Moreover, an infant with hyperbilirubinemia requires immediate treatment and close monitoring in the hospital.

Infant massage is a non-invasive treatment that can be used safely in newborn infants, especially at an early stage after birth, and could reduce infants' bilirubin levels.[6] Massage stimulates the stomach and intestinal movements, and increases lymph flow and blood circulation, which can cause bilirubin to be excreted more rapidly into the feces.[7] In addition, infant massage increases physiological development, reduces hospitalization, and increases sleep duration.[6] Previous studies of infant massage conducted in hospitalized infants with hyperbilirubinemia, in which health professionals such as nurses performed massage for 15-25 minutes twice a day for 3-5 days, found that it improved bilirubin levels and experienced a greater number of defecations.[6,8-9] In Thailand, few studies have been conducted on this topic, and most applied massage by nurses and various outcomes were determined, such as maternal-infant bonding, body weight, growth and development, infants' behavioral cues, and bilirubin levels.[10-12] One study was on the effects of infant massage performed by mothers for bilirubin levels.[13] However, the infants were massaged only three days after admission to the hospital and there were no differences in bilirubin levels and defecation frequency on the first and second days after birth between both groups. This study performed massage longer, for four days to prevent high bilirubin levels in the full-term infants which mostly rise on days 4 to 5 after birth. This study aimed to investigate whether infant massage by mothers can help reduce bilirubin levels in healthy full-term infants.

## Review of Literature and Conceptual Framework

This study used a physiological framework for neonatal jaundice and the massage mechanism. Hyperbilirubinemia or jaundice is defined as a condition in which serum bilirubin levels are greater than 5 mg/dL.[14] Bilirubin is considered a waste product from the breakdown of heme, a component of hemoglobin, with further breakdown to form unconjugated bilirubin (UCB), which is less soluble in water (hydrophobic).[15] During the process of bilirubin uptake by the hepatocyte transport proteins, the UCB will be banded to albumin, which will then enter the conjugate process in the hepatocyte. The bilirubin will be conjugated with glucuronic acid using the enzyme UGT1A1, which is water-soluble conjugate bilirubin, and then excreted into the bile and intestine. The most common area is in the colon, where intestinal bacteria convert bilirubin to urobilinogen, urobilin, and stercobilin by hydrogenation and excreted through feces, while some are turned into UCB bilirubin by deconjugation and reabsorbed through enterohepatic circulation.[16] Neonatal meconium contains high bilirubin, therefore, infants who delay the passage of meconium develop hyperbilirubinemia due to increased bilirubin reabsorption in enterohepatic circulation.[16] The most common causes of hyperbilirubinemia in full-term newborns are physiological jaundice and breastfeeding jaundice, which has more bilirubin reabsorption in the enterohepatic circulation but less bilirubin excretion.[17] The most common treatment for neonatal hyperbilirubinemia is phototherapy, which is performed when the bilirubin level is 12 mg/dL or higher.[18]

Infant massage can prevent hyperbilirubinemia by stimulating the vagus nerve through the skin increasing vagal tone and regulating the functions of the gastrointestinal tract from the esophagus, stomach, and intestines, resulting in increased gastric and intestinal motility.[6] As a result, the infant defecates

more, allowing the meconium stools to pass faster, with bilirubin excreted with feces, reducing bilirubin reabsorption in the enterohepatic circulation.[4] In addition, vagus nerve stimulation increases enzyme and hormone release, which promote digestion and absorption, such as gastrin, cholecystokinin, and insulin, leading to improved digestion and absorption of milk.[19] This increases the body's metabolism, promoting the infant's sucking and excreting. Moreover, massage can improve blood and lymph circulation and subcutaneous tissue fluid, resulting in increased excretion of waste and toxins, including bilirubin, from the body through the circulatory system.[20] Previous studies found that infants who received massages had lower bilirubin levels than infants who were not massaged.[4,21-22] Therefore, massaging infants reduces hyperbilirubinemia in infants, and re-hospitalization for hyperbilirubinemia also decreases. Most infant massages use the Vimala and Tiffany Field massage methods,[21] which are full-body massages applied by professionals such as nurses. In Thailand, Johnson's® is a well-known infant massage program,[23] and there are institutes for training for this. The massage technique is similar to Vimala and Tiffany Field massage and includes several abdominal massage positions to stimulate the infant's bowel movements. Massaging different body parts, such as the head, arms, legs, and back, helps to stimulate the blood circulation system. It causes good circulation and filters various waste products, including bilirubin, from the body. Massaging the chest and stomach stimulates the vagus nerve,[24] causing more intestinal movements. This helps bilirubin to be excreted in the stool, thus reducing the reabsorption of bilirubin into enterohepatic circulation. Moreover, mouth massage can stimulate the infant's sucking, making breastfeeding better.[25] When the infant is sucking well, it causes more bowel movements and more stools excreted, resulting in reducing the bilirubin levels. In this study, we test the effectiveness of the Infant Massage Program by Johnson's® [23] a full-body massage (head and face, chest, arm, abdomen, leg, and back) of full-term healthy infants performed by their mothers.

## Study Aim and Hypothesis

This study aimed to compare bilirubin levels and re-hospitalization for hyperbilirubinemia between full-term infants who received massage by mothers and those who received usual care. We hypothesized that the mean bilirubin levels and re-hospitalizations for hyperbilirubinemia of infants in the experimental group would be lower than those of the control group who received usual care.

## Methods

**Design:** This was a quasi-experimental study with a comparison group. This report followed the checklist for Transparent Reporting of Evaluations with Non-randomized Designs (TREND).[26]

**Sample and Setting:** The setting was an obstetrics and gynecology ward of a secondary hospital in Bangkok, Thailand. The sample size was calculated using the G* Power program with the power of the test $(1 - \beta) = .80$, level of significance $(\alpha) = .05$, and the effect size calculated based on the results of two previous studies[9,27] was equal to 0.98. The required sample size was 28, and 10% of the estimated sample was added to overcome possible attrition.[28] Therefore, the final sample required was 30, 15 per group.

The samples consisted of newborn infants and mothers. The inclusion criteria for mothers were: 1) normal delivery without postpartum complications, 2) no anemia, 3) no history of diabetes, 4) no labor induction medications administered, 5) able to breastfeed, 6) no history of jaundice in a previous child, and 7) proficient in speaking, listening, reading, and writing in Thai. Infant inclusion criteria were: 1) gestational age between 37 and 42 weeks, 2) birth weight greater than or equal to 2,500 grams, 3) no complications or congenital abnormalities, 4) no injury during delivery, 5) Apgar scores at one and five minutes greater than 7, 6) able to be breastfed, 7) no contraindications for massage such as swollen skin, redness, rash, infection,

or bone injury, and 8) bilirubin level < 5 mg/dl on the first day after birth. Exclusion criteria for mothers included: 1) the mothers who experienced a postpartum complication during the study period, such as postpartum hemorrhage or hypertension, 2) mothers unable to adhere to the massage pattern for four days, and 3) mothers unable to remain in contact for 7 days after birth. Exclusion criteria for infants included: 1) developed jaundice during the study, and 2) occurrence of other complications during the study that precluded infant massage, such as unstable body temperature, dyspnea, or sepsis.

Participants who met the inclusion criteria were recruited by convenience sampling by the primary investigator (PI): 30 pairs of mothers and full-term healthy infants. To avoid intervention contamination and the exchange of information (diffusion) between the control and experimental groups, the data collection was completed first with the control group and then with the experimental group.

**Ethical Considerations:** This study was approved by the Human Research Ethics Committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University (COA. MURA2021/655) and the Human Research Ethics Committee Bangkok (U018h/64). The rights of the participants were protected by informing the participant of the research objectives, data collection procedures, research duration, and rights in refusing to participate in the research without repercussions to nursing care and treatment. The participants were assured that the data collected from them would be kept confidential and would be reported only as group data. They were also assured that they were able to withdraw from the study at any time without justification.

**Data Collection:** This study was conducted from June to August 2022. After receiving approval from the IRB and study site, the PI met with the head nurse and staff to clarify the purpose of data collection and asked for support and cooperation during the data collection process. The PI conducted the experiment, who also recruited the infants and mothers, and collected the data. All samples received usual nursing care and had their bilirubin levels measured at 6, 48, and 96 hours, respectively, while the experimental group received an infant massage program. In addition, the mothers were taught to massage the infant individually in line with the program. The PI tracked the data in a log form in the LINE smartphone application and the mother was asked to bring the recorded form to the PI on the appointed day (at 96 hours). After that, the PI followed up on re-hospitalization with hyperbilirubinemia by LINE app when the infants reached seven days old.

**Research Instruments:** Four instruments were used for data collection and the intervention was the infant massage program.

The PI developed a demographic data questionnaire to collect personal data on mothers and infants. The mothers' data included age, education level, occupation, family income, obstetric history, and gestational age. The infants' data included sex, body weight, Apgar score, and time of birth.

A *Bilirubinometer* was used to measure the infant's bilirubin level. It was a noninvasive measurement done by gently clipping the device at the top of the ear for 3 seconds each time. The bilirubin result is displayed in mg/dL. The company services calibrated the device monthly to ensure its validity.

*The Infant Massage, Feeding, and Excretion Record Form* was designed by the PI to record the massage time and frequency of feeding, urination, and defecation. The PI requested and coached the mothers to record these data for four consecutive days after birth (two days each in the hospital and at home). LINE app was used to follow up when the mothers and infants were discharged, to remind and gather information from mothers.

*The Bilirubin Levels and Re-hospitalization for Hyperbilirubinemia Record Form* was created by the PI to collect data on bilirubin levels at 6, 48, and 96 hours after birth. The data of re-hospitalization were followed up using the LINE application on Day 7 after birth. These data were recorded by the PI.

**The Infant Massage Program**

This full-body massage (head and face, chest, arm, abdomen, leg, and back) uses the Johnson's® method,[23] with 14 massage positions, given five times each, taking 15 minutes in total. The massage is performed twice a day, morning and afternoon, at least one hour after feeding. The massage interval is at least six hours apart to allow the infant to rest. The PI was trained and received a Johnson's® baby massage certificate before the study commenced. The massage program was as follows: On the first day, 6 hours after birth, the mothers were educated about neonatal jaundice and infant massage. The PI demonstrated infant massage using a doll, with the mother demonstrating back by massaging the infant, and this was considered a real practice on the first day. The PI assessed the validity of maternal massage through observation. When the mother did not properly massage the infant, the PI helped to review the massage process and advised until the mother could perform it correctly. Mothers were also provided a record form for recording the massage, feeding, and excretion every day for four days.

On Day 2 postpartum, the mother massaged the infant twice a day, morning and afternoon, according to the massage program, with each massage lasting 15 minutes. The PI assisted mothers while massaging the infant so they could be confident and accurate on discharge from the hospital. The bilirubin level was measured three times, the first being the baseline measured at the infant age six hours before the massage was performed in the experimental group. The second measurement was taken at 48 hours of infant age and screens for neonatal jaundice, performed before discharge. The third measurement was performed when the infants were 96 hours old, the time when the infants were discharged, and an appointment was made with the hospital for jaundice assessment. This was the time when the bilirubin level reached its peak, according to the physiology of the newborn, jaundice symptoms appear at 24 to 72 hours of age, with the peak of total serum bilirubin levels at 4 to 5 days,[4] and also recorded re-hospitalization for hyperbilirubinemia on Day 7 after birth.

**Usual Care**: Mothers were taught about breastfeeding, postpartum practice, and newborn care. The infant would be weighed every day, received BCG and the hepatitis B vaccine (HBV), and screened for jaundice. If the infants and mothers had no complications, they would be discharged from the hospital after the infant was 48 hours old, and follow-up appointments were made at the doctor's discretion, generally scheduled two days after discharge from the hospital. The control group received the usual care, but the infants were not massaged. Bilirubin levels were measured, and re-hospitalization was also recorded in the control group.

**Data Analysis**: The data were analyzed using SPSS program version 22.0. Descriptive statistics were used to analyze demographic data of mothers and infants. Comparison of participant demographic data between the experiment and control groups was analyzed using an independent t-test, chi-square test, and Fisher's exact test. The differences in bilirubin levels between the two groups were assessed using repeated measures ANOVA. Before analysis, statistical assumptions were examined. The Shapiro-Wilk statistical test showed normality distribution. Homogeneity of variances was checked using Levene's test and showed no difference between the two groups. Also, compound symmetry was tested using Mauchly's test of sphericity. In addition, the differences in re-hospitalization for hyperbilirubinemia between the groups were compared using Fisher's exact test.

## Results

**Characteristics of mothers and infants**

All participants remained in the study until the end. The mothers in both groups were aged 18-37 years. Most of the mothers worked outside the house, and more than half had an education level below a bachelor's degree and had only one child. For infant data, both groups had almost the same number of males and

females. The mean birth weights of the experimental group and control group were 2,915.67 and 3,127 grams, respectively. The mean weight on discharge day was 2,740.67 and 2,954 grams, respectively. The two groups had no significant differences in the demographic characteristics of the mothers and infants (**Table 1**).

**Table 1.** Comparison of demographic characteristics between the experimental group and control group

| Demographic data | Experimental group (n = 15) | Control group (n = 15) | t | p-value |
|---|---|---|---|---|
| **Mothers' characteristics** | | | | |
| Occupation, n (%) | | | - | 1.000[b] |
| Work outside house | 12 (80) | 13 (86.7) | | |
| Work inside house | 3 (20) | 2 (13.3) | | |
| Education level, n (%) | | | - | 1.000[b] |
| Below bachelor's degree | 13 (86.7) | 13 (86.7) | | |
| Bachelor's degree | 2 (13.3) | 2 (13.3) | | |
| Number of children, n (%) | | | - | .384[b] |
| 1 | 11 (73.3) | 8 (53.3) | | |
| 2 | 1 (6.7) | 4 (26.7) | | |
| 3 | 3 (20) | 3 (20) | | |
| Maternal age (year) | | | | |
| Min-Max | 18-36 | 18-37 | .504 | .618[a] |
| Mean (SD) | 24.60 (4.22) | 25.53 (5.79) | | |
| **Infant characteristics** | | | - | .715[c] |
| Gender, n (%) | | | | |
| Male | 8 (53.3) | 7 (46.7) | | |
| Female | 7 (46.7) | 8 (53.3) | | |
| Gestational age (week) | | | .209 | .836[a] |
| Mean (SD) | 38.40 (.99) | 38.47 (.74) | | |
| Birth weight (gram) | | | 1.755 | .090[a] |
| Mean (SD) | 2,915.67 (321) | 3,127 (338.33) | | |
| Body weight at discharge (gram) | | | .076 | .076[a] |
| Mean (SD) | 2,740.67 (303.09) | 2,954 (331.06) | | |
| Weight loss (gram) | | | .096 | .924[a] |
| %, Mean (SD) | 6,175 (54.90) | 5.53, 173 (58.58) | | |

Note. [a] = Independent t-test, [b] = Fisher's exact test, [c] = Pearson chi-square

When comparing the differences in the frequency of defecation and urination, the Mann-Whitney U test was used as the distribution of data was non-normal. It was found that the defecation frequencies on days 1 and 4 in the experimental group were significantly higher than those in the control group. However, there were no significant differences in defecation frequencies on Day 2 and Day 3 between the two groups. For urinary frequency, it was found that the infants in the experimental group had significantly higher urinary frequency on day 4 than the control group. However, on Days 1, 2, and 3, the frequency of urination was not statistically different between the two groups (**Table 2**).

**Table 2.** Comparison of daily defecation and urination frequency between the experimental and control groups

| Excretion (times/day) | Experimental group (n = 15) | | Control group (n = 15) | | Z | p-value | Criteria normal |
|---|---|---|---|---|---|---|---|
| | Min-Max | Median | Min-Max | Median | | | |
| Defecation | | | | | | | |
| Day 1 | 1-3 | 2 | 0-4 | 1 | -2.353 | .019 | 1-2 |
| Day 2 | 2-4 | 3 | 2-5 | 2 | -1.037 | .300 | 1-2 |
| Day 3 | 2-5 | 4 | 2-6 | 3 | -1.687 | .092 | 3 |
| Day 4 | 3-6 | 4 | 2-4 | 3 | -3.568 | < .001 | 3 |
| Urination | | | | | | | |
| Day 1 | 1-6 | 3 | 0-4 | 2 | -1.503 | .133 | 1 |
| Day 2 | 3-7 | 4 | 2-6 | 4 | -.153 | .878 | 1-2 |
| Day 3 | 3-10 | 4 | 2-6 | 4 | -1.424 | .154 | 3 |
| Day 4 | 3-11 | 5 | 2-6 | 4 | -2.771 | .006 | 4 |

**Effects of infant massage on bilirubin levels**

The data analysis revealed that the mean bilirubin levels of infants in the experimental and control groups were significantly different. The bilirubin levels in each period differed significantly. In addition, the interaction between group and time was also found to have a statistical effect on the bilirubin levels of infants, as shown in **Table 3.**

**Table 3.** Repeated measures of ANOVA comparisons of the mean bilirubin levels between the experimental and control groups

| Source of variance | SS | df | MS | F | p-value |
|---|---|---|---|---|---|
| Between-group | | | | | |
| Group | 28.787 | 1 | 28.787 | 6.682 | .015 |
| Error 1 | 120.623 | 28 | 4.308 | | |
| Within group | | | | | |
| Time | 1,318.828 | 1 | 1,318.828 | 626.111 | < .001 |
| Group*Time | 16.748 | 1 | 16.748 | 7.951 | .009 |
| Error 2 | 58.979 | 28 | 2.106 | | |

A comparison of the mean bilirubin levels between the experimental and control groups showed that, at 6 hours (before receiving the message), the mean bilirubin levels of the two groups were not different. However, at 48 and 96 hours after the massage, the bilirubin levels of the infants in the experimental group were lower than those of the control group by 1.34 mg/dl and 2.08 mg/dl, respectively, as shown in **Table 4** and **Figure 1.**

Since the interval of repeated measurements had a statistically significant influence on the infants' bilirubin levels, a pairwise difference in mean bilirubin was tested using the Bonferroni test. It was found that the mean differences of bilirubin at 6 and 48 hours for both groups were significantly different. Moreover, in the experimental group, the mean differences of bilirubin at 48 and 6 hours and 96 and 6 hours were significantly different. However, there was no difference in bilirubin at 96 and 48 hours. For the control group, the mean differences of bilirubin at 48 and 6 hours, 96 and 6 hours, and 96 and 48 hours were significantly different, as shown in **Table 4.**

**Table 4.** Comparison of the mean difference bilirubin levels between the experimental and control groups and the mean difference bilirubin levels within each group

| Time (hours) | Experimental group (n = 15) Mean (SD) | Control group (n = 15) Mean (SD) | MD | Mean difference | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Experimental group (hours) | | | Control group (hours) | | |
| | | | | 6 | 48 | 96 | 6 | 48 | 96 |
| 6 | 1.62 (.52) | 1.59 (.54) | 0.033 | 0 | – | – | 0 | – | – |
| 48 | 9.25 (1.34) | 10.59 (2.05) | 1.34* | 7.63** | 0 | – | 9.01** | 0 | – |
| 96 | 9.94 (1.76) | 12.02 (2.42) | 2.08* | 8.32** | 0.67 | 0 | 10.43** | 1.43* | 0 |

Note. * p < .05, ** p < .001, MD = Mean difference

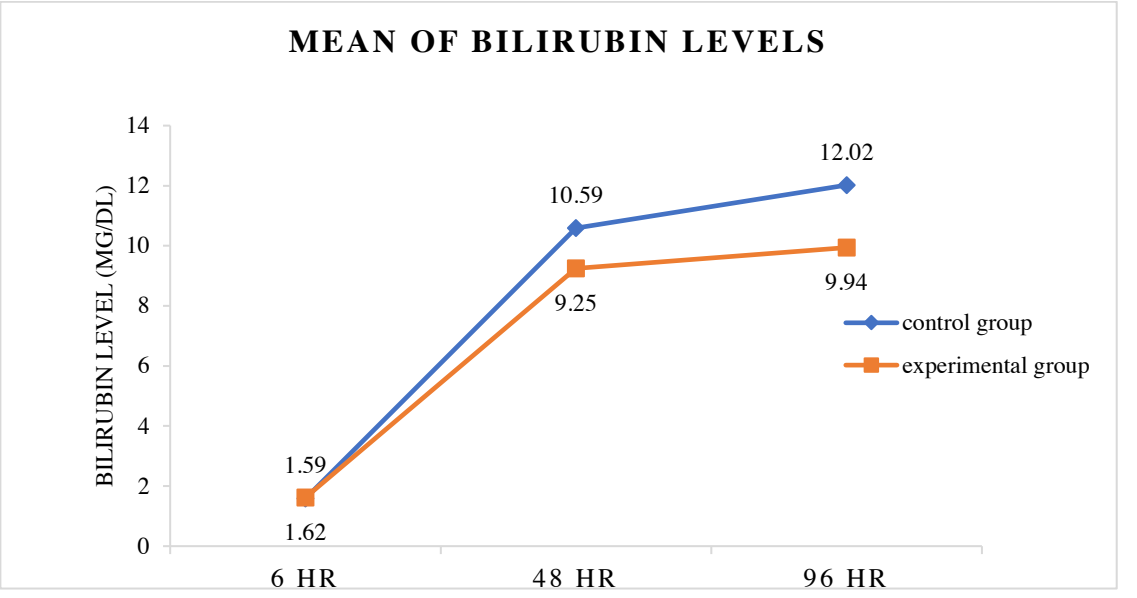


**Figure 1.** Comparison of the mean bilirubin levels between the experimental and control groups

Comparing re-hospitalization between infants in the experimental and control groups using Fisher's exact test showed that infants in the experimental group did not need re-hospitalization, while one infant in the control group needed re-hospitalization. It was found that the experimental and control groups had no statistical difference in re-hospitalization.

## Discussion

This study examined the bilirubin levels of healthy full-term infants after receiving a massage from their mothers for 15 minutes twice a day for four consecutive days. The findings showed a significant decrease in bilirubin levels between the experimental and control groups. The bilirubin levels at 48 and 96 hours of the experimental group were lower than those of the control group. This indicated the effectiveness of infant massage in decreasing bilirubin levels. As a result of massage, the stomach and intestines increased motility, resulting in more defecation and allowing meconium to be excreted faster, thus causing bilirubin to be excreted with feces and reducing the reabsorption of bilirubin into the blood circulation. Notably, the

meconium contains high bilirubin levels.[29] Therefore, meconium excretion affects reducing bilirubin levels. In addition, infant massage increases blood circulation, lymph, and tissue fluid circulation. It also increases the excretion of bilirubin from the body through the circulatory system.[21] This result is consistent with the findings of previous studies and meta-analyses,[30] which found that bilirubin levels of infants who received massage were lower than those of infants who received usual care. Other similar studies conducted in hospitalized jaundiced infants and using Field's massage or Vimala's massage, also found that those who received massage had lower bilirubin levels than those of infants who did not receive massage.[9,31] It can be seen that infant massage helps reduce the bilirubin levels in both healthy full-term infants and infants who have physiological jaundice. This is similar to another study that was conducted in infants with jaundice who received phototherapy and using the massage methods of the World Health Organization and the International Baby Massage Association with the researcher performed massaging. It was found that infants who received massage had significantly lower bilirubin levels than infants who did not receive massage.[32]

As for the defecation frequency, the experimental group had a more frequent defecation daily than the control group. However, there were statistical differences between the two groups on the first and fourth days, while there were no differences on the second and third days. Generally, infants aged one to two days should defecate at least once or twice a day, and on Days 3 and 4, they should defecate three times per day.[33] In this study, the infants in the experimental group defecated two or three times per day on Days 1 and 2 and four times per day on Days 3 and 4, which were higher than in the control group. Similar to previous studies, it was found that on Days 2-5, the infants who received massage had a significantly higher frequency of defecation than infants who did not receive massage, and on Days 3-5, the bilirubin level was lower than the control group.[9,34] Another study conducted in full-term infants who had physiological jaundice and received phototherapy using Vimala's massage technique for 15-20 minutes twice a day for five days, also reported positive outcomes of the infant massage. It was found that full-term infants who received massage had more defecation than full-term infants who did not receive massage.[31] The studied findings confirmed that infant massage increases daily defecation and contributes to bilirubin elimination.

Moreover, the findings showed that the infants in the massage group and the control group had no difference in re-hospitalization, which was inconsistent with the hypothesis. There were no infants in the experimental group who were hospitalized, and only one infant in the control group was hospitalized. The plausible explanation for this finding is that the infants in this study were healthy term infants, and the mean bilirubin level before discharge in the experimental group was 9.25 mg/dl and the control group was 10.59 mg/dl. They were in the low-intermediate risk zone of severe jaundice. Therefore, the likelihood of re-hospitalization due to jaundice is less than the infants whose pre-discharge bilirubin levels were in the high-risk zone and the high intermediate-risk zone. This was consistent with a study,[35] which found that infants who were re-admitted to the hospital for phototherapy had pre-discharge bilirubin levels in the high-risk zone and high intermediate-risk zone. Additionally, according to the assessment of the infants' weights in both groups before discharge (at 48 hours), it was found that the experimental group had an average weight loss of 6% and the control group had an average weight loss of 5.53% of their birth weight. The decrease in infant weight was associated with the incidence of jaundice from inadequate breastfeeding, causing re-hospitalization after discharge. This was consistent with a study of infants' weight loss, which discovered that infants who lost more than 7% of their weight during 72 hours after birth can be a predictor

of hyperbilirubinemia. Pulmamidi and Yendamuri[36] found that infants in both groups were less than 7% underweight at the time of discharge, implying that the risk of re-hospitalization was low. In addition, if the infant is not getting enough breast milk, jaundice can occur.[37] In this study, infants in both groups received enough breast milk, which was assessed by the frequency of defecation and urination. Therefore, the re-hospitalization of infants in both groups was not different.

## Limitations

The study was unable to record the amount of milk received by the infants at each feeding due to breastfeeding, and when the infants were discharged, they could not be weighed at home. The PI, therefore, assessed the adequacy of milk intake based on frequency of defecation and urination. Another limitation is that, in this study, bilirubin levels were induced by newborn physiology, and the findings cannot be utilized as a guideline for newborns with pathological jaundice. Additionally, the participants were purposively selected based on eligibility criteria and investigated at only one secondary hospital in Bangkok. Therefore, the results may limit generalizability to other populations and settings.

## Conclusions and Implications for Nursing Practice and Research

Infant massage at an early stage after birth should begin six hours after birth and be performed twice a day for 15 minutes each for four days. This also could be used as a routine for newborn nursing care to prevent jaundice in healthy term infants and continue care at home by the mother to promote infant health and reduce neonatal jaundice.

However, the effect of massaging infants should be studied by using different massage patterns from this research, such as different massage techniques, massage durations, and massage therapists to increase the efficiency of reducing bilirubin levels. To prevent experimental bias and increase experiment reliability, samples should be randomized and studied at the same time for both groups. There should be a comparative study on other variables resulting from infant massages, such as the amount of breast milk consumed and the infant's first pass of meconium.

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## Conflict of Interest Statement

The authors declare that they have no competing or prospective conflicts of interest.

## References

1. Satrom KM, Farouk ZL, Slusher TM. Management challenges in the treatment of severe hyperbilirubinemia in low- and middle-income countries: encouraging advancements, remaining gaps, and future opportunities. Front Pediatr. 2023;11:1001141. doi:10.3389/fped.2023.1001141.
2. Sukkar S, Lorusso G, Jananeh S, Harrison R, Martin MA, Grabois E, et al. Decreasing bilirubin serum tests in healthy newborns during birth hospitalization. Pediatrics. 2023; 151(6):e2022059474. doi:10.1542/peds.2022-059474.
3. Kumar V, Shrangi G, Jangid S, Yadav M, Verma MK. Association of cord serum albumin with neonatal hyperbilirubinemia among term-neonates. Int J Res Med Sci. 2020;8(6):2099-104. doi: 10.18203/2320-6012.ijrms20202250.
4. Rahayu KD, Hernawati Y, Agustiani I. Intervention to reduce bilirubin levels in newborn babies: a systematic review. Asian Comm Health Nurs Res. 2020;2(1):41-6. doi: 10.29253/achnr.2020.24141.
5. Hegyi T, Kleinfeld A. Neonatal hyperbilirubinemia and the role of unbound bilirubin. J Matern Fetal Neonatal Med. 2022;35(25):9201-7. doi:10.1080/14767058.2021.2021177.

6. Mrljak R, Arnsteg Danielsson A, Hedov G, Garmy P. Effects of infant massage: a systematic review. Int J Environ Res Public Health. 2022;19(11):6378. doi:10.3390/ijerph19116378.
7. Narale P, Shinde A, Mhaske SN, Waydande S. The beneficial effects of infant's massage on jaundiced neonates receiving phototherapy. VIMS Health Sci J. 2023;10(1):1-6. Available from: https://doi.org/10.46858/vimshsj.10101
8. MohammedHamad NI, Helaly NM, Mohammed AA. Effect of Vimala massage on hyperbilirubinemia among full term neonates: a randomized controlled trial. IOSR-JNHS. 2021;10(5 Ser II):50-8. doi:10.9790/1959-1005025058.
9. Babaei H, Vakiliamini M. Effect of massage therapy on transcutaneous bilirubin level in healthy term neonates: randomized controlled clinical trial. Iran J Neonatol. 2018;9(4):41-6. doi: 10.22038/ijn.2018.28906.1386.
10. Charatvisitkul K, Chusak T. The effect of infant massage on the growth of infants and maternal-infant attachment of neonatal patient Sawanpracharak Hospital, Nakhon Sawan province. VRU Res Dev J Sci Tech. 2018;13(1):76-86. Available from: https://so06.tci-thaijo.org/index.php/vrurdistjournal/article/view/121186 (in Thai).
11. Niyomkar S, Sansiriphun N, Deeleua J, Wannachaiyakul S, Kunaviktikul W, Klunklin A. The effects of a regular infant massage program on infant growth. TRC Nurs J. 2021;14(2): 193-206. Available from: https://he02.tci-thaijo.org/index.php/ trcnj/ article/view/256636 (in Thai).
12. Songklin S, Teerarungsikul N. Effects of infant massage on behavioral pain responses, heart rate and oxygen saturation in newborn undergoing vein puncture. JFONUBUU. 2020;28(2):96-105. Available from: https://ojs.lib.buu.ac.th/index. php/nursing/ article/view/6956 (in Thai).
13. Numanit R, Kamonthree K, Horaban J. Effectiveness of infant massage program on infant's behavioral cues and maternal infant bornding attachment in early post-partum period. MJSBH. 2019;34(3):413-26. Available from: https://he02.tci-thaijo.org/index.php/MJSSBH/article/view/231591 (in Thai).
14. Boskabadi H, Rakhshanizadeh F, Zakerihamidi M. Evaluation of maternal risk factors in neonatal hyperbilirubinemia. Arch Iran Med. 2020;23(2):128-40. PMID: 32061076.
15. Creeden JF, Gordon DM, Stec DE, Hinds TD Jr. Bilirubin as a metabolic hormone: the physiological relevance of low levels. Am J Physiol Endocrinol Metab. 2021;320(2): e191-207. doi: 10.1152/ajpendo.00405.2020.
16. Kalakonda A, Jenkins BA, John S. Physiology bilirubin. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470290
17. Al Gameel AK, El-Sary AY, Mahmoud RA, Abd El-Hmid R. Prevalence and associated factors of neonatal hyperbilirubinemia among NICU cases in Abshway Central Hospital. Fayoum Univ Med J. 2023;11(1):19-27. doi: 10.21608/fumj.2023.278459.
18. Han HS, Park CM, Lee DS, Sinn DH, Gil E. Evaluating mortality and recovery of extreme hyperbilirubinemia in critically ill patients by phasing the peak bilirubin level: a retrospective cohort study. PLoS One. 2021;16(8):e0255230. doi: 10.1371/journal.pone.0255230.
19. Ercelik ZE, Dogan P, Bal Yılmaz H. The effect of massage on growth in premature babies: a systematic review and meta-analysis. J Educ Res Nurs. 2022;19(2):191-7. doi:10.5152/jern.2022.13285.
20. Rashwan ZI, Abohadida RM, Khonji LM, Saleh SES. Bundling gentle body massage along with regular position change under phototherapy among full-term neonates with hyperbilirubinemia: is it effective? J Neonatal Nurs. 2023; 29(3):464-70. doi: 10.1016/j.jnn.2022.08.002.
21. Natashia D, Rahmania S, Yulianti DA, Laily D, Istinganah I, Humairah F. Effectiveness of massage therapy to reduce bilirubin levels in neonates with hyperbilirubinemia a systematic review and meta analysis. J Midwifery Nurs. 2024;6(1):345-55. doi:10.35335/jmn.v6i1.4800.
22. Korkmaz G, Esenay FI. Effects of massage therapy on indirect hyperbilirubinemia in newborns who receive phototherapy. J Obstet Gynecol Neonatal Nurs. 2020;49(1):91-100. doi: 10.1016/j.jogn.2019.11.004.
23. Johnson's.® Johnsons-baby-learn-to-massage-baby [Internet]. 2021 [cited 2024 Mar 1]. Available from: https://www.johnsonsbaby.co.th/sites/jbaby_th/files/johnsons-baby-learn-to-massage-baby.pdf. (in Thai)
24. Prescott SL, Liberles SD. Internal senses of the vagus nerve. Neuron. 2022;110(4):579-99. doi:10.1016/j.neuron.2021.12.020.
25. Yurita N, Jumari J, Solihat A. Giving oral massage is effective in increasing the suction reflex stimulus of LBW babies. J Complement Nurs. 2022;1(3):78-83. doi:10. 53801/jcn.v 1i3.45.

26. Des Jarlais DC, Lyles C, Crepaz N; the TREND Group. Improving the reporting quality of nonrandomized evaluations of behavioral and public health interventions: the TREND statement. Am J Public Health. 2004;94(3):361-6. doi: 10.2105/ajph.94.3.361.
27. Chen J, Sadakata M, Ishida M, Sekizuka N, Sayama M. Baby massage ameliorates neonatal jaundice in full-term newborn infants. Tohoku J Exp Med. 2011;223(2):97-102. doi: 10.1620/tjem.223.97.
28. Gupta KK, Attri J, Singh A, Kaur H, Kaur G. Basic concepts for sample size calculation: critical step for any clinical trials! Saudi J Anaesth. 2016;10(3):328-31. doi:10.4103/1658-354X.174918.
29. Lee B, Piersante T, Calkins KL. Neonatal hyperbilirubinemia. Pediatr Ann. 2022;51(6):e219-27.doi:10.3928/19382359-20220407-02.
30. Abdellatif M, Vuong NL, Tawfik GM, Elfaituri MK, Mansour MIM, Zaki MMM, et al. Massage therapy for the treatment of neonatal jaundice: a systematic review and network meta-analysis. J Neonatal Nurs. 2020;26(1):17-24. doi: 10.1016/j.jnn.2019.09.002.
31. Elkandoz NA, Younis AA, Ads SE, Ads SE. Effects of applying Vimala massage on neonates with exaggerated physiological jaundice on their clinical outcomes. Tanta Sci Nurs J. 2024;32(1):13-30. doi: 10.21608/TSNJ.2024.348101.
32. Doğan E, Kaya HD, Günaydin S. The effect of massage on the bilirubin level in term infants receiving phototherapy. Explore (NY). 2023;19(2):209-13. doi: 10.1016/j.explore.2022.05.001.
33. Gallagher S, Petrou T. Breastfeeding protocol: signs of effective breastfeeding [Internet]. 2019 Apr [cited 2024 Mar 1]. Available from: https://breastfeedingresourcesontario .ca/sites/default/files/pdf/BFI_Signs_ of_Effective_BF_web_final.pdf
34. Dehghani K, Nouroozi E, Mandegari Z, Salmani N, Shakiba M. Comparison of the effectiveness of bath and massage in bilirubin levels in neonates. Iran J Neonatol. 2019;10(3):45-50. doi:10.22038/ijn.2019.33607.1484.
35. Prachukthum S, Tanprasertkul C, Intarakhao S. Does weight loss predict hyperbilirubinemia requiring readmission for phototherapy in term infants? Sci Tech Asia. 2020;25(3):11-8. doi:10.14456/scitechasia.2020.30.
36. Pulmamidi RK, Yendamuri RM. Prospective study to determine weight loss as predictor for neonatal hyperbilirubinemia in term neonates. Panacea J Med Sci. 2021;11(1):120-4. doi: 10.18231/j.pjms.2021.026.
37. Rakhecha G, Parihar RR, Dhania B. Breastmilk jaundice: a nurse perspective. Int J Contemp Pediatr. 2022;9(11):1127-31. doi:10.18203/2349-3291.ijcp20222780.

# ผลของการนวดตัวทารกโดยมารดาต่อระดับบิลิรูบินและการนอนโรงพยาบาลซ้ำด้วยภาวะตัวเหลือง : การวิจัยกึ่งทดลอง

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**บทคัดย่อ:** ภาวะตัวเหลืองเป็นปัญหาสุขภาพที่สำคัญในทารกแรกเกิดซึ่งมักเกิดในช่วงสัปดาห์แรกหลังเกิด และส่งผลให้เกิดพัฒนาการล่าช้า ความพิการและเสียชีวิตได้ การนวดตัวทารกแรกเกิดสามารถช่วยขับบิลิรูบินและลดภาวะบิลิรูบินสูงในเลือดได้ การวิจัยครั้งนี้เป็นการวิจัยกึ่งทดลองเพื่อศึกษาผลของการนวดตัวทารกโดยมารดาต่อระดับบิลิรูบินและการนอนโรงพยาบาลซ้ำด้วยภาวะตัวเหลือง ทำการศึกษาในหอผู้ป่วยสูตินรีเวช โรงพยาบาลระดับทุติยภูมิแห่งหนึ่ง ในกรุงเทพมหานคร ประเทศไทย กลุ่มตัวอย่างคือทารกแรกเกิดครบกำหนดและมารดาจำนวน 30 คน คัดเลือกกลุ่มตัวอย่างแบบเฉพาะเจาะจงตามเกณฑ์การคัดเข้า กลุ่มทดลอง (15 คน) ได้รับการนวดตัวโดยมารดานาน 15 นาที วันละ 2 ครั้ง เป็นเวลา 4 วัน ส่วนกลุ่มควบคุม (15 คน) ได้รับการพยาบาลตามปกติ วัดระดับบิลิรูบินเมื่อทารกอายุ 6, 48 และ 96 ชั่วโมงหลังเกิด และติดตามการนอนโรงพยาบาลซ้ำด้วยภาวะตัวเหลืองเมื่อทารกอายุ 7 วัน วิเคราะห์ข้อมูลใช้สถิติ Fisher's exact test, independent t-test และ repeated measures ANOVA

ผลการวิจัยพบว่า ทารกที่ได้รับการนวดตัวโดยมารดามีค่าเฉลี่ยระดับบิลิรูบินน้อยกว่าทารกกลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ แต่พบว่าการนอนโรงพยาบาลซ้ำด้วยภาวะตัวเหลืองไม่แตกต่างกัน นอกจากนี้ ยังพบว่าจำนวนการขับถ่ายในวันที่ 1 และวันที่ 4 ของทารกกลุ่มทดลองมากกว่าทารกในกลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ ผลการวิจัยครั้งนี้แสดงให้เห็นว่าการนวดตัวโดยมารดาสามารถช่วยลดระดับบิลิรูบินในทารกแรกเกิดได้ ผู้วิจัยเสนอแนะให้พยาบาลสอนวิธีการนวดตัวทารกแก่มารดาหลังคลอดโดยเร็ว เพื่อป้องกันการเกิดภาวะตัวเหลือง อย่างไรก็ตาม ควรมีการศึกษาในกลุ่มตัวอย่างที่มีขนาดใหญ่และมีการสุ่มตัวอย่างในการศึกษาครั้งต่อไป

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**คำสำคัญ:** ระดับบิลิรูบิน ทารกแรกเกิดครบกำหนด ภาวะตัวเหลือง การนวดตัวทารก การพยาบาล การนอนโรงพยาบาลซ้ำ

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