The Effect of Abdominal Massage on Bilirubin Levels in Term Infants Receiving Phototherapy

A Randomized Controlled Trial

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ABSTRACT

Background: The incidence of neonatal hyperbilirubinemia in Europe and the United States is estimated to be 3.2 and 4.4 per 10,000 live births, respectively. Abdominal massage for hyperbilirubinemia is considered a safe complementary treatment for infants that may increase number of defecations and decrease bilirubin levels.

Purpose: This study was designed as a randomized controlled trial to determine the effect of abdominal massage on bilirubin levels in term infants receiving phototherapy.

Methods: The sample consisted of 43 term newborns (intervention group: 23; control group: 20) who received phototherapy in a university hospital between June 2019 and February 2021. Information and observation forms were used for data collection. The intervention group received 6 abdominal massages over 2 days, performed 3 times a day, 6 hours apart, and lasting 5 minutes each.

Results: Transcutaneous bilirubin levels and heart rate were significantly lower in the intervention group than in the control group at 48 hours ($P = .015$ and $P = .033$, respectively). Number of defecations was higher in the intervention group at 24 hours ($P = .007$) but there was no significant difference at 48 hours. The decrease in serum bilirubin between 24 and 48 hours was significantly greater in the intervention group ($P = .005$).

Implication for Practice and Research: Abdominal massage was effective in reducing bilirubin levels and may increase the number of defecations. Providing massage training to the parents of infants who are discharged early could be a protective approach to prevent the rise in bilirubin levels.

Key Words: abdominal massage, hyperbilirubinemia, nursing, phototherapy, term infants

Hyperbilirubinemia is a condition in which excess bilirubin accumulates in the blood in the neonatal period, causing yellowing of the skin, sclera, and other organs.[1] As bilirubin levels increase, there is a risk of neurological toxicity or bilirubin encephalopathy.[1,2] Hyperbilirubinemia may cause complications such as intellectual deficits, neuromotor problems, hearing loss, and speech disorders.[3] Therefore, the early diagnosis and treatment of hyperbilirubinemia is essential for infant health. However, early discharge may prevent timely diagnosis and treatment, and hyperbilirubinemia remains an important cause of neonatal readmission.[1,4] Phototherapy is frequently used to decrease bilirubin levels in infants.[5] Bilirubin levels in the body are usually determined using total serum bilirubin (TSB) or transcutaneous bilirubin (TCB) measurement. Recent studies have reported close agreement between these 2 methods.[6-8] Therefore, TCB measurement is often preferred to minimize the invasive interventions performed on infants.[9]

Massage is regarded as a beneficial alternative care method for infants.[1] In the literature, different types and durations of neonatal massage therapy have been recommended to improve infant health.[7,10-12] Abdominal massage has been reported to aid peristalsis, increase the number of defecations, and reduce bilirubin levels.[9,12,13] Abdominal massage is said to stimulate the vagus nerve and increase the production of hormones associated with food digestion and absorption (gastrin and insulin), thereby increasing meconium excretion.[7,12]

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Institutional permission and ethics committee approval were obtained from the Clinical Research Ethics Committee of Medipol University Hospital (IRB: 10840098/604.01.01-E.29907). Written informed consent was obtained from the patients.

This study was prospectively registered at ISRCTN trial registration number: 27769096.

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What This Study Adds

- Abdominal massage is effective in increasing defecation frequency, thus reducing infants' bilirubin levels.
- Abdominal massage applied to infants may be used as a complementary therapy to lower bilirubin levels.
- Abdominal massage may relax infants and have a favorable impact on physiological parameters.

METHODS

Design

This study was designed as a randomized controlled trial to determine the effect of abdominal massage on bilirubin levels in term infants receiving phototherapy.

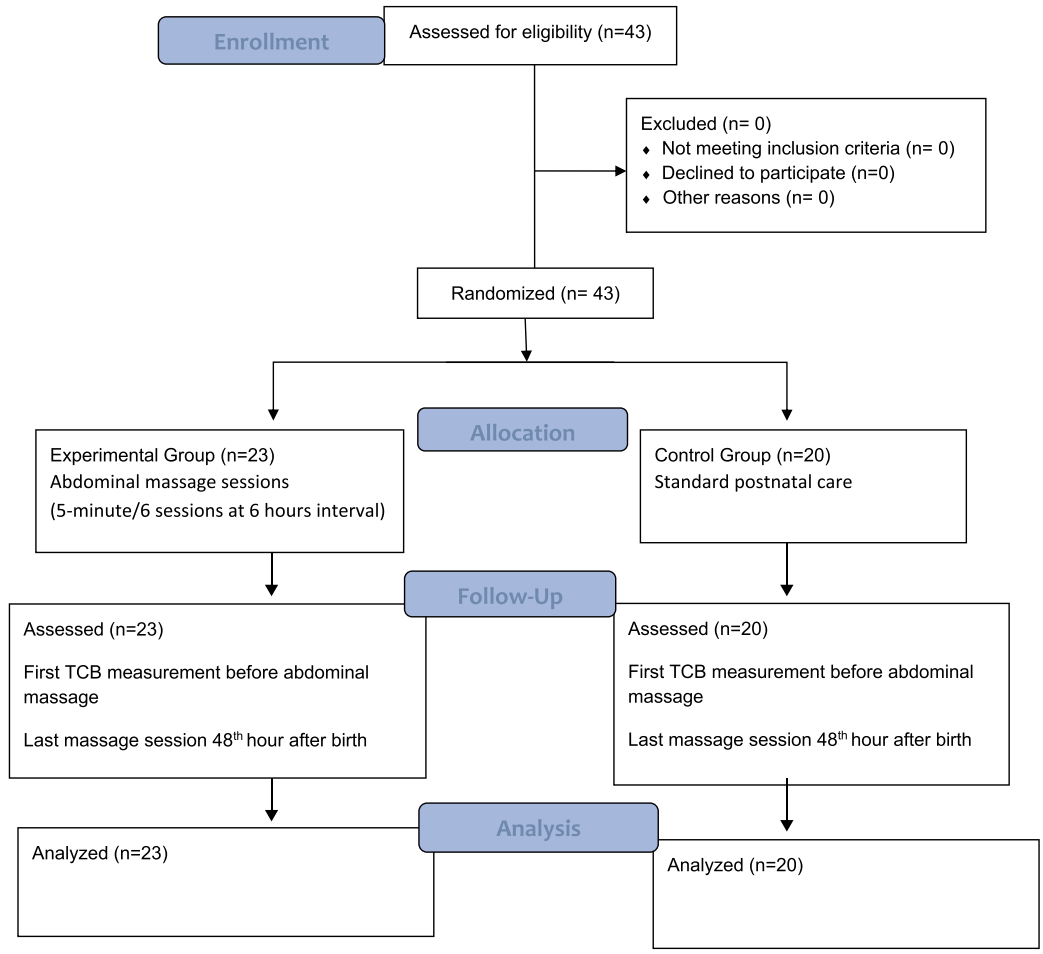
Sample

The sample of the study comprised term infants who received phototherapy in the neonatal intensive care unit of a university hospital between June 2019 and February 2021. Power analysis was performed using the G*Power (3.1.9.2) program to determine the sample size. Based on the sample of a similar study,[1] with a Δ of 0.863, a minimum of 21 infants in each group was needed to determine differences in TCB levels. A total of 43 infants were recruited for the study and allocated using the urn randomization method. As a result of randomized group assignment, there were 23 infants in the intervention group and 20 infants in the control group (Figure 1).

Inclusion criteria were

- gestational age at birth between 37 and 41 weeks;
- birth weight between 2500 and 4000 g;
- 1- and 5-min Apgar scores greater than 7;
- prescribed phototherapy by the physician;

FIGURE 1



CONSORT flow diagram.[14] TCB indicates transcutaneous bilirubin.

- receiving phototherapy for the first time;
- no abnormalities (other than jaundice) detected on physical examination performed by the physician; and
- informed consent to participate in study provided by parent.

Instruments

Information Form

This form was prepared by the researchers and included multiple-choice and open-ended questions about the infants' birth date, gestational age, birth weight and height, head circumference, sex, 1- and 5-minute Apgar scores, feeding type, mode of birth, and parental ages and educational levels.

Observation Form

This form was used to record the infants' TCB levels, number of defecations, body weight, heart rate (HR), and oxygen saturation (Spo_2) before and after phototherapy. It also included a checklist for the massage intervention applied to the intervention group.

Dräger Jaundice Meter JM-105

This TCB device enables bilirubin measurement in neonates without heel blood sampling. The probe of the device is reusable and was cleaned after each use with ready-to-use, alcohol-free disinfection wipes (Cleanisept, Draeger Medical Systems Inc, USA [REF: MU20105]).

Water-Based Neonatal Lotion

A water-based moisturizing lotion appropriate for infant skin (alcohol-, paraben-, and colorant-free) was applied to infants in both groups. In the control group, it was applied only in the morning at 10:00 am. without massaging, in accordance with clinical routine to prevent dry skin. In the intervention group, it was used to provide lubrication during massage.

Intervention

The abdominal massage applied in the study was based on Miami University Touch Therapy.[15] The nurse first massaged the right side of the infant's abdomen and moved toward the left side while applying gentle pressure. The nurse moved her hands clockwise across the abdomen to the inguen. The nurse then lifted the infant's legs by holding the ankles with her left hand and bent the knees to apply gentle pressure to the abdomen and help relax the abdominal muscles. The nurse continued to make circular strokes moving clockwise from the right inguen toward the left inguen.[16] The nurse maintained eye contact with the infant throughout the massage. Massages were performed at least 1 hour after feeding. All abdominal massage was performed by the same nurse, who has a master's degree and completed the 8-hour infant massage course from the Ege University Faculty of Nursing. During the study process, massage intervention and collecting data were made by same nurse who is the one of the researchers.

Procedures

The parents of the infants who met the sampling criteria were informed about the study and their written informed consent was obtained. Descriptive data pertaining to all infants and their parents were recorded in the descriptive information form before the intervention.

All infants in the sample group were kept in same brand of incubator and received LED phototherapy using the same brand of device (GE Healthcare) at the same distance from the body (40-45 cm), with the eyes and genitals covered appropriately.

Before starting phototherapy, the TCB levels of all infants were measured from the forehead using the Dräger Jaundice Meter JM-105 and TSB levels were measured from a blood sample, and the results were recorded in the observation form. The first abdominal massage for the intervention group was started immediately after the first TCB measurement before the phototherapy. The infants in the intervention group underwent a total of 6 abdominal massages over 2 days, performed 3 times a day, 6 hours apart, and lasting 5 minutes each. Each infant was removed from phototherapy and allowed to rest for 5 minutes before their TCB level, number of defecations, Spo_2, and HR were evaluated and recorded in the observation form. This was followed by abdominal massage. The measurements were performed before phototherapy, followed measurements; first, second, third, fourth, fifth, and sixth (6 hours apart), and last measurement was 48th hours.

Each infant in the control group was also removed from phototherapy and allowed to rest for 5 minutes before their TCB, number of defecations, Spo_2, and HR were evaluated and recorded in the observation form.

Phototherapy was continued after applying massage to infants in the intervention group and after TCB measurement in the control group. TCB measurements were repeated at 48 hours of phototherapy for all of the infants, ensuring an interval of at least 6 hours since the last massage session for those in the intervention group. In the unit where the study was conducted, TSB levels are routinely evaluated every 24 hours.

Statistical Analysis

SPSS Statistics (version 22.0) was used for statistical analyses. The Shapiro-Wilks test was used to determine whether the variables were normally distributed. In addition to descriptive statistical methods (mean, standard deviation, frequency), Student

t test was used for between-group comparisons of normally distributed quantitative data and Mann-Whitney *U* test was used for the evaluation of non-normally distributed quantitative data. Significance was accepted at the $P < .05$ level.

RESULTS

There were no statistically significant differences in the descriptive characteristics between the experimental and control groups ($P > .05$). Comparisons of descriptive characteristics between the intervention and control groups are reported in Table 1.

Comparisons of TCB levels, Spo_2, and HR between and within the groups at all 8 measurement times are reported in Table 2, and comparisons of number of defecations, TCB and TSB levels, and body weight between and within groups at 24 and 48 hours are reported in Table 3. HR was significantly lower in the intervention group before phototherapy and at 48 hours ($P < .05$), but the mean HR was within normal range in both groups at all time points. At 24 hours, the number of defecations was significantly higher in the intervention group ($Z = -2.713$, $P = 0.007$) than in the control group. In both groups, TSB and TCB levels decreased significantly between 24 and 48 hours ($P < .01$). In the between-group comparison, TCB at 48 hours was significantly lower in the intervention group than in the control group ($Z = -2.436$; $P = 0.015$). TSB measurements at 24 hours and 48 hours did not differ significantly between the groups, but the intervention group showed a significantly greater decrease in TSB between 24 and 48 hours ($P = .005$).

DISCUSSION

Massage is a beneficial method for infants to reduce bilirubin level of newborn infants.[1] Abdominal massage can be helpful in promoting peristalsis, increasing defecation frequency, and reducing bilirubin levels.[7,12,13] This has been demonstrated in the current study as well as in 3 systematic reviews and 1 meta-analysis. Abdellatif et al[17] concluded in their systematic review that the combination of massage and phototherapy was more effective in reducing bilirubin than phototherapy alone. This systematic review reports that massage is effective starting from the third day of newborn life.[17] In contrast with this finding, our study found that massage in the first 2 days after birth was effective in bilirubin reduction levels. The results of another systematic review indicated that infant massage can reduce the TSB levels without giving any specific information about duration, frequency, and type of the massage.[18] Santoso et al[18] reported in their very recent systematic review that 15-minute field massages 2 to 8 times a day for

TABLE 1. Distribution and Comparison of Descriptive Characteristics of Infants

	Intervention Group (n = 23)	Control Group (n = 20)		
Characteristics of Infants	**Mean ± SD**	**Mean ± SD**	**Test Value**	***P***
Gestational age, wk	38.03 ± 1.36	37.44 ± 1.28	*Z*: −1.960[a]	.050
Apgar score				
1 min	8.26 ± 0.68	8.05 ± 0.60	*Z*: −1.119[a]	.263
5 min	9.60 ± 0.49	9.15 ± 0.74	*Z*: −2.0101[a]	.208
Birth weight, g	3355.86 ± 382.96	3184.65 ± 499.98	*t*: 1.270[b]	.211
Birth length, cm	50.7 ± 1.73	49.9 ± 2.74	*t*: 1.207[b]	.235
Head circumference, cm	36.69 ± 3.03	35.4 ± 1.85	*Z*: −1.119[a]	.189
Gender, n (%)				
Female	15 (65.2)	11 (55.0)	χ^2: 1.048[c]	.306
Male	8 (34.8)	9 (45.0)		
Mode of birth, n (%)				
Normal	5 (21.7)	7 (35.0)	χ^2: 0.392[c]	.531
Cesarean	18 (78.3)	13 (65.0)		
Feeding method, n (%)				
Breast milk	9 (39.1)	3 (15.0)	χ^2: 2.013[c]	.156
Mixed	14 (60.9)	17 (85.0)		

[a]*Mann-Whitney U test.*
[b]*Student t test.*
[c]*Yate's chi-squared test.*

TABLE 2. Comparisons of TCB Levels, Spo_2, and HR Between and Within Groups

Measurement Time Points		Intervention Group (n = 23) Mean ± SD	Control Group (n = 20) Mean ± SD	Test Value	*P*
TCB, mg/dL	Before PT	16.84 ± 1.97	16.99 ± 1.56	*Z*: –0.365[a]	.715
	Measurement 1	16.54 ± 1.54	16.96± 0.76	*Z*: –1.590[a]	.112
	Measurement 2	15.93 ± 1.57	16.14 ± 0.58	*Z*: –0.860[a]	.390
	Measurement 3	15.40 ± 1.51	15.38 ± 0.89	*Z*: –0.310[a]	.757
	Measurement 4	14.57 ± 1.36	14.30 ± 0.82	*Z*: –0.421[a]	.674
Measurement 5	13.87 ± 1.27	13.90 ± 1.00	*Z*: –0.160[a]	.873	
	Measurement 6	12.89 ± 1.26	13.06 ± 1.20	*Z*: –0.135[a]	.893
	48 h	11.31 ± 1.47	12.35 ± 1.35	*Z*: –2.436[a]	.015[b]
Spo_2, %	Before PT	98.43 ± 0.50	98.20 ± 0.41	*t*: 1.677[c]	.101
	Measurement 1	98.56 ± 0.66	98.60 ± 0.59	*t*: –0.180[c]	.858
	Measurement 2	98.56 ± 0.78	98.60 ± 0.88	*t*: –0.137[c]	.892
	Measurement 3	98.39 ± 0.78	98.55 ± 0.82	*t*: –0.646[c]	.522
	Measurement 4	98.73± 0.61	98.70 ± 0.80	*t*: 0.180[c]	.858
	Measurement 5	98.52 ± 0.59	98.65± 0.67	*t*: –0.666[c]	.509
	Measurement 6	98.82 ± 0.49	98.75 ± 0.55	*t*: 0.479[c]	.634
	48 h	98.39 ± 0.49	98.45 ± 0.51	*t*: –0.381[c]	.705
HR, min	Before PT	121.30 ± 12.81	132.30 ± 15.04	*Z*: –2.414[a]	.016[b]
	Measurement 1	131.40 ± 13.15	130.60 ± 11.44	*Z*: –0.159[a]	.873
	Measurement 2	123.75 ± 28.45	118.08 ± 34.78	*Z*: –0.651[a]	.515
Measurement 3	126.45 ± 9.32	128.95 ± 11.57	*Z*: –0.687a	.492	
	Measurement 4	127.70 ± 11.44	131.91 ± 10.04	*Z*: –1.199[a]	.230
	Measurement 5	122.50 ± 26.87	124.26 ± 25.89	*Z*: –0.357[a]	.721
	Measurement 6	126.50 ± 10.83	126.60 ± 10.20	*Z*: 0.000[a]	.999
	48 h	120.25 ± 13.02	128.17 ± 11.00	*Z*: –2.137[a]	.033[b]

Abbreviations: HR, heart rate; PT, phototherapy; Spo_2, oxygen saturation; TCB, transcutaneous bilirubin.
[a]*Mann-Whitney U test.*
[b]*P < .05.*
[c]*Student t test.*

3 days significantly reduced bilirubin levels and increased number of defecation frequency in newborn infants with hyperbilirubinemia. In our study, a massage duration time (5 minutes) and total intervention time (2 days) were lower but frequency of massage (3 times a day) was similar compared with the study by Santoso et al.[19]

In the meta-analysis including 14 randomized controlled trials with a total of 1889 patients, Lei et al[6] reported that massage reduced TCB levels at 48 and 96 hours and defecation frequency was significantly higher in the massage group than in the control group. Dalili et al[12] examined the effect of massage on healthy newborn infants' TCB levels and defecation frequencies and they reported that the massage group had lower bilirubin levels than the control group. In our previous study, we evaluated the effect of abdominal massage on TCB levels in healthy newborns and found that the massage intervention group had a significantly lower increase in TCB levels than the control group.[7] Korkmaz and Esenay[20] also reported that massage was effective in reducing bilirubin levels in full-term infants receiving phototherapy. In their study, newborns in the intervention group had significantly lower mean total bilirubin levels than infants in the control group. The authors emphasized that massage was also effective in increasing defecation frequency in the intervention group.

Zaki and Thabet[21] demonstrated that field massage in addition to phototherapy was effective in reducing neonatal TSB levels and increasing defecation frequency on day 2 of life. Lori Kenari et al[22] compared the TSB levels of newborns in 3 groups (kangaroo mother care, field massage, and control group). They emphasized that giving field massages 2 times a day led to significantly faster reduction in TSB levels. Garg et al[23] reviewed clinical trials to evaluate the role of massage therapy for the treatment of hyperbilirubinemia in neonates and concluded that the use of massage effectively lowered bilirubin levels,

TABLE 3. Comparison of Body Weight, Number of Defecations, and TCB and TSB Levels Between and Within Groups

Characteristics		Intervention Group (n = 2 Mean ± SD	Control Group (n = 20) Mean ± SD	Test Value	*P*
Body weight, g	24 h	3210.73 ± 386.75	2986.50 ± 528.1	*t*: 1.602[a]	.117
	48 h	3316.43 ± 425.64	3072.40 ± 527.71	*t*: –4.959[a]	<.001
	Difference (Δ)	105.69 ± 123.99	85.90 ± 77.47	*t*: 0.616[a]	.541
	Test value	*t*: –4.088[b]	*t*: –4.959[b]		
	P	<.001	<.001		
Defecations, n	24 h	1.27 ± 0.59	0.65 ± 0.67	*Z*: –2.713[c]	.007
	48 h	0.86 ± 0.62	0.75 ± 0.55	*Z*: –0.613[c]	.540
	Difference (Δ)	–0.10 ± 0.7	0.3 ± 0.8	*Z*: –1.817[c]	.069
	Test value	*Z*: –0.632[c]	*Z*: –1.886[c]		
	P	.527	.059		
TCB, mg/dL	24 h	15.40 ± 1.51	15.38 ± 0.89	*Z*: –0.310[c]	.757
	48 h	11.31 ± 1.47	12.35 ± 1.35	*Z*: –2.436[c]	.015
	Difference (Δ)	–4.09 ± 2.0	–3.03±1.41	*Z*: –1.913[c]	.056
	Test value	*Z*: –3.825[c]	*Z*: –4.108[c]		
	P	<.001	<.001		
TSB, mg/dL	24 h	15.03 ± 2.07	14.2 ± 1.16	*t*: –1.634[a]	.110
	48 h	11.8 ± 1.80	12.1 ± 1.36	*t*: 0.511[a]	.612
	Difference (Δ)	–3.1 ± 1.3	–2.0 ± 1.04	*t*: –2.939[a]	.005
	Test value	*t*: 10.527[a]	*t*: 9.647[a]		
	P	<.001	<.001		

Abbreviations: TCB, transcutaneous bilirubin; TSB, total serum bilirubin.
[a]*Student t test.*
[b]*Paired sample t test.*
[c]*Mann-Whitney U test.*

possibly through enhanced intestinal motility. Similar to these findings, we also observed that abdominal massage seemed to promote defecation despite being performed for a shorter duration (6 sessions of 5 minutes over 2 days). In our study, the number of defecations at 24 hours was significantly higher in the newborns in the massage group. The number of defecations was also higher in the massage group at 48 hours, although the difference was not statistically significant. The infants in our study were not followed beyond 48 hours.

The defecation frequency in our study was similar to several other studies[6,12,20,21] but was lower than that reported by Korkmaz and Esenay.[20] In our study to control for possible differences in the measurement of increased bilirubin between the intervention and control groups and avoid unnecessary invasive interventions, TSB was measured at 24 and 48 hours, in accordance with routine practice in the clinic. TCB level was significantly lower in the massage group than in the control group at the end of the 48 hours. Although TSB values did not differ significantly between the groups at either time point, the magnitude of the decrease in TSB level was significantly higher in the intervention group than in the control group. In addition to these results, HR at 48 hours was lower in the massage group than in the control group. The HR was clinically in the normal range in each group. These results were important to support the safety of abdominal massage.

CONCLUSION

The results showed that abdominal massage may be beneficial in promoting earlier weaning from phototherapy method for infants with hyperbilirubinemia. Transcutaneous bilirubin levels were statistically lower in the intervention group than in the control group at 48 hours. The decrease in serum bilirubin between 24 and 48 hours was statistically greater in the intervention group. The results of our study indicate new randomized controlled research with large study group and long-term follow-up observations.

Summary of Recommendations for Practice and Research	
What we know:	• Hyperbilirubinemia is the most reported cause of neonatal readmission. • Abdominal massage accelerates bowel movements and increases meconium excretion and may thereby reduce bilirubin levels.
What needs to be studied:	• The effects of massage applied in different ways and at different times on neonatal bilirubin levels should be investigated in future studies. • Providing massage training to the families of infants who are discharged early should be investigated as a protective approach to prevent the rise in bilirubin levels. • Routine massage by healthcare professionals on infants with hyperbilirubinemia should be investigated as an effective method to promote earlier weaning from phototherapy and reduce the need for blood transfusion.
What can we do today:	• Develop and evaluate future strategies: routine abdominal massage in nursing care may positively impact infant's bilirubin level.

In addition, it can be recommended for future studies to evaluate the impact of reducing the frequency of massages on bilirubin levels, considering the workload of the neonatal intensive care unit.

LIMITATIONS

Infants are discharged from the hospital as early as possible to promote early infant–parent attachment, avoid infection, and reduce costs. This limited the duration of the massage intervention and bilirubin monitoring to 2 days in our study. The sample size is not adequate for generalization of the study results. In addition, because the study was conducted in term infants, the results cannot be generalized to high-risk and very low birth-weight neonates. Another limitation of the study was that the phototherapy start time was not recorded.

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