Original Article

Effects of Swaddled and Sponge Bathing Methods on Signs of Stress and Pain in Premature Newborns: Implications for Evidence-Based Practice

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Keywords
individualized developmental care, newborn, nursing care, pain, prematüre, stress

ABSTRACT

Aims: To determine the effects of sponge baths and swaddled bathing on premature infants' vital signs, oxygen saturation levels, crying times, pain, and stress levels.

Methods: This study was a clinical trial with a crossover design. Data were conducted in the neonatal intensive care unit of a public hospital in Denizli, Turkey. A total of 35 premature infants, who were born at 33–37 weeks gestation with a birth weight <1,500 g, were enrolled in the study. Two bathing methods were applied at 3-day intervals. Vital signs and oxygen saturation levels were measured before and at minutes 1, 5, 15, 30 after bathing. Infants' bathing was video recorded to assess pain and stress behaviors. The pain and stress behaviors of infants were evaluated by independent observers. A significance level of .05 was used for all statistical analyses.

Results: There were statistically significant differences between bathing methods on vital signs, oxygen saturation levels, and crying times. Levels of stress and pain according to bathing type were significantly higher in the sponge bath condition ($p < .05$).

Linking Evidence to Action: Swaddled bathing has a positive effect on the infant's vital signs, oxygen saturation levels, crying time, and level of stress and pain compared to the sponge bath condition. Swaddled bathing is a harmless and safe nursing practice.

INTRODUCTION

The goals of care in the neonatal intensive care unit (NICU) are ensuring the comfort of the newborn, reducing pain and stress, monitoring development, and providing family-centered care. Nursing care in the NICU should be applied in such a way that premature infants will experience the least amount of stress. However, nursing practices and procedures that are indispensable for the NICU can cause physiological and behavioral reactions even in healthy infants. Bathing is one of the procedures causing stress in premature infants (Coughlin, 2014).

The aims of infant bathing are to prevent infections by removing fluids and dirt from the body and to protect skin integrity. However, infant bathing is not harmless (Lund & Durand, 2011). Studies show that infant bathing caused deterioration in vital signs such as: an increase or decrease in heart and respiratory rates, a temporary decrease in oxygen saturation, and hypothermia in prematüre infants (Bembich et al., 2017; Bryanton, Walsh, Baret, & Gaudet, 2004; Tapia-Rombo et al., 2012).

Hypothermia is one of the most common problems occurring during bathing in newborns. For this reason, the World Health Organization (WHO, 2014) recommends bathing 24 hr after birth to protect the vernix caseosa and prevent hypothermia. Also, the first bathing should be performed by the nurses after the infant's vital signs have been stabilized for 4–6 hr and after considering the infant's cleaning condition, family preference, and environmental conditions (Blume-Peytavi, Faegemann, Szczapa, Vanaclocha, & Gemletti, 2009).

Infants also react to the bath behaviorally. Care practices may lead to declines in the clinical status of the infant. During the bath, the infant is touched as in other procedures, which causes disorganization and stress in infants. This situation is more evident as the age of gestation decreases, causing the deterioration of physiological and behavioral parameters (Liaw, Yang, Chou, Yang, & Chao, 2010; Loring et al., 2012). It is reported that physiological changes, motor behaviors, crying, and agitation decrease due to stress as the infant is wrapped with a towel in flexion before being placed in a tub of water (Fern, Graves, & L'Hullier, 2002; Hall, 2008).

Premature infant bathing is still discussed in the literature, but there is no consensus. Therefore, this study was conducted to present data that can provide evidence for bathing practices

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for nurses to support the results of current studies. The purpose of the study was to determine the effects of sponge baths and swaddled bathing on prematüre infants' vital signs, oxygen saturation (SpO2) levels, crying times, pain, and stress level. It was hypothesized that the swaddled bathing has a positive effect on the physiological measurements of the infants and reduces crying time and pain and stress levels when compared to the sponge bath.

METHODS

Study Design

This was a clinical trial with a crossover design in which subjects randomly received a sequence of either sponge baths or swaddled baths. A randomized, crossover design was used to prevent bias related to psychological and physical properties and reduce variability, thereby increasing the power of the study (Mills et al., 2009). In the context of developmental care practices and WHO recommendations, 3 days elapsed between the two bathing methods (Blume-Peytavi et al., 2009).

Setting

This study was conducted during the period of July 2015–December 2016 in a 34-bed NICU of a Level II–III public hospital in Denizli, Turkey. Nurses care for three and sometimes four newborns at a time in the unit.

Sample

The sample size calculation was based on the crossover design (MGH, Biostatistics Center, 2014). It assumed criteria that included the expectation of minimal differences in the average pain and stress score, 1.0; a difference of 1.75 in the standard deviation between swaddled and sponge bathing; power, 0.80 and $p < .05$. The sample size was calculated to be 35 patients.

Inclusion and Exclusion Criteria

Inclusion criteria for infants were 33–37 weeks gestational age, birth weight of 1,500 g or more, stable vital signs, body temperature ranging from 36.5 to 37.5 °C and had parental consent. Exclusion criteria were signs of infection, neurological problems, congenital defects, deterioration of skin integrity, receiving analgesic, sedative, or muscle relaxant medication that may affect pain and stress.

Randomization

Which bathing method would be applied first was determined by randomization. The sequence of bathing application was randomized by computer (Predictive Analytics Software [PASW Statistics 18; SPSS Inc, Chicago, IL, USA]). Twenty of the infants started with swaddled bathing, whereas the other 15 started with sponge bath.

Instruments and Measurements

Infant descriptive characteristics form. The form was developed in light of the relevant literature (Loring et al., 2012) to collect data about birth date, gestation age, birth weight, gender, diagnosis, crying time, physiological changes (temperature, respiratory rate [RR], heart rate [HR], and SpO2) before and after bathing.

Newborn stress scale (NSS). The NSS was developed by Ceylan and Bolışık (2017a) to assess stress in premature infants. The scale includes eight items: face expression, color, respiration, activity level, consolation, muscle tone, extremities, and posture. Each item is scored on the scale 0–2. The minimum score is 0 and the maximum score is 16. As the score increases, the stress level of the infant increases.

ALPS-Neo pain and stress assessment scale. The ALPS-Neo scale was developed by Lundqvist et al. (2014) to assess pain and stress in premature and mature neonates. The ALPS-Neo is a five-item scale including facial expression, breathing pattern, tone of extremities, hand and foot activity, and level of activity. The lowest and the highest scores obtainable from the scale are 0 and 10, respectively. As the score increases, stress and pain increase. The validity and reliability of the Turkish version of the scale were determined by Ceylan and Bolışık (2017b).

Video recording. A video was recorded to evaluate the infants' reaction to bathing. A camera was placed on a tripod. Each infant was recorded for 1 min before bathing, during bathing, and 1 min after bathing.

Implementation Steps of the Study

Precautions for hypothermia and infection were taken before the bathing. The camera was fixed on a tripod and the settings are made to record the processes. The infants' vital signs and SpO2 levels were measured and recorded. The infant was placed under the radiant warmer and video recording started. Then the bath procedure was applied. The infant was dried after each bathing method, wrapped in a dry, warm towel, and placed under a radiant warmer. Video recording continued for 1 min after bathing. After the video camera was turned off, a diaper was placed on the infant. The infant was wrapped in towel and put in the incubator. Body temperature RR, HR, and SpO2 were measured at minutes 1, 5, 15, and 30 after bathing. Three days later, the other bathing method was applied and the procedures were carried out in the same order. The swaddle procedure is illustrated in Figure 1.

The mean water temperature, room temperature, and bathing time were similar for both types of bath. The mean water temperature was 37.76 ± 0.16 °C for the sponge bath and 37.58 ± 0.8 °C for the swaddled bathing. The room temperature, for both types of bath, was kept between 25.3 and 25.6 °C during the entire procedure. The mean bathing time was 247.60 ± 38.46 s for the sponge bath, and 232.57 ± 37.19 s for the swaddled bathing. All bathings were performed by the same researcher.

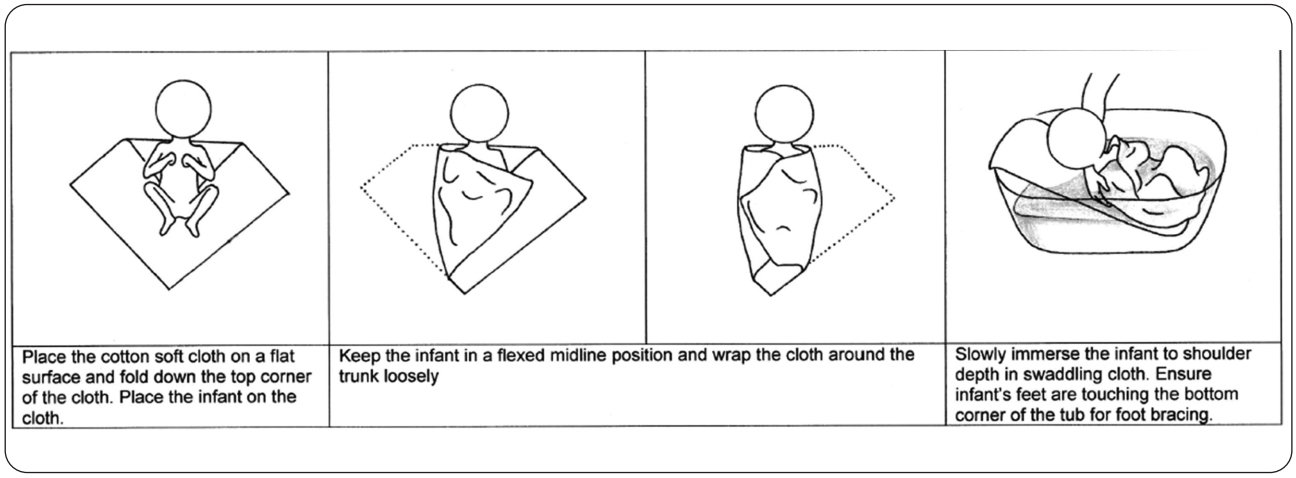

Figure 1. Swaddle procedure.

Outcome Measures

Pain and stress severity. In order to avoid bias, the evaluation of the camera recordings was carried out independently by two observers. The observers were specialists in pediatric nursing. The scores assigned by the specialists were used to determine pain and stress scores before, during, and after bathing.

Crying time. The video recordings were watched by the same researcher, and crying times during and after bathing were calculated with a chronometer for each infant.

Physiological changes. A monitor probe was attached to the foot to measure SpO2 and HR. Body temperature was measured by axillary pathway using an electronic thermometer. RR was measured by observation.

Data Analysis

Data were analyzed with PASW 18. Numbers and percentages were used to evaluate descriptive characteristics. A chi-square test was used to test homogeneity. Normal distribution suitability of the data was examined via Shapiro–Wilk test. In comparing the data, a Wilcoxon test was used for nonparametric test, and a paired sample *t*-test was used as a parametric test. The interobserver agreement was assessed by an intraclass correlation coefficient. The significance level was accepted as $p < .05$. The point-biserial correlation (r) and Cohen's d was calculated to determine the effect size of the study. The point-biserial correlation is a measurement for the effect size for the Wilcoxon test. Cohen's guidelines for r are that a large effect is .5, a medium effect is .3, and a small effect is .1 (Cohen, 1988; Fritz, Morris, & Richler, 2012). For paired sample *t*-test, Cohen's d is used to determine the effect size. Cohen (1988) suggests that d values of .8, .5, and .2 represented large, medium, and small effect sizes, respectively.

Ethical Considerations

The required permission to conduct the study was obtained from the University Medical Ethics board. Information about the study was given to the parents and their written consent was obtained.

RESULTS

The mean age of the infants was 10.34 ± 4.44 days. The mean weight of the infants was 1950 ± 303.35 g. Of the infants, 45.7% were female, and 54.3% were male. The two groups were homogenous in terms of descriptive characteristics (gender, gestation age, and diagnosis; $p > .05$).

Interobserver Agreement

The intraclass correlation coefficients were between 0.748 and 1.000 for the NSS and ALPS-Neo. The agreement between the observers was statistically significant ($p < .001$).

Physiological Measurements

There was no statistical difference between the bathing methods for average body temperature, RR, SpO2, and HR before bathing ($p > .05$). Body temperatures after swaddle bathing were significantly higher than body temperature after sponge baths and a large effect size was found ($p = .00$; $r > .5$; see Table 1). Although there was a slight decrease in body averages after swaddle bathing, body temperature increased afterwards. The mean postbath RR and HR of infants were higher in sponge baths than swaddle bathing. The SpO2 averages were lower in the sponge bath condition than the swaddle bathing condition. Postbath SpO2 levels decreased in sponge bath and increased in swaddle bathing. The point-biserial correlation (r) values were between .50 and .79, corresponding to a large effect size. For HR, Cohen's d values were .20–.43 and effect sizes were small ($p < .05$; $r > .5$; $.50 > d > .20$; see Table 2).

Crying Time

There was no significant difference between crying periods and gender or gestational ages ($p > .05$). Crying times during baths and after baths were higher in sponge baths than in swaddle

Table 1. Comparison of Mean Body Temperatures Before and After Bathing According to Bathing Method

	Swaddled bathing	Sponge bath			
Body temperature (°C)	**Mean ± *SD***	**Mean ± *SD***	***Z***	***p***	**Effect size (*r*)**
Before bathing	36.65 ± 0.17	36.68 ± 0.19	−.520	.603	.09
1st minute after bathing	36.64 ± 0.18	36.13 ± 0.23	−5.144	.000	.87
5th minute after bathing	36.69 ± 0.17	36.21 ± 0.18	−5.101	.000	.86
15th minute after bathing	36.71 ± 0.16	36.32 ± 0.19	−5.176	.000	.87
30th minute after bathing	36.73 ± 0.15	36.39 ± 0.17	−5.176	.000	.87

Note. Significant at the $p < .05$ level. Z = Wilcoxon test; r = point-biserial correlation.

bathing. This difference was statistically significant and effect sizes were large ($p = .00$; $r > .5$; see Table 3).

Stress Levels

Figure 2 shows the distribution of the mean NSS scores in the groups over time. There was no significant difference between the prebath stress scores of infants according to the bathing type. Stress scores, during and after sponge bath, were higher and this difference was statistically significant and effect sizes were large ($p = .00$; $r = .86$–$.88$; $r > .5$; see Figure 2).

Pain Severity

There was not a significant difference in the mean pain scores before the bathing or between the bathing method ($p > .05$). The pain scores of infants during and after sponge baths were higher than swaddled bathing ($p = .00$; see Figure 3). The effect sizes of difference in the pain scores were large ($r = .88$; $r > .5$).

There was not a significant difference between gender, age, and weight and the distribution of the mean pain and stress scores over time ($p > .05$).

DISCUSSION

In studies in which data are collected by observation and there is more than one observer, independent interobserver agreement is important. The closer the results of the independent observations are, the more reliable the results are (Balcı, 2015). In order to be able to say that there is agreement between the observers, the intraclass correlation coefficient should be at least 0.70 (Müller & Büttner, 1994). The results of this study indicated that there was agreement between the observers.

Several methods of infant bathing are practiced in hospital settings. These practices include sponge bathing, small tub bathing, immersion tub bathing, and swaddled tub bathing (Kuller, 2014). In Brazil, it is reported that the cleansing technique most commonly adopted in NICU is immersion baths, followed by sponge bath (Freitas, Marques, Alves, Takahashi, & Kimura, 2014). Sponge baths were not recommended in the European round-table meeting (Blume-Peytavi et al., 2016). The neonatal skin care guidelines from the Association of Women's Health, Obstetric and Neonatal Nurses and the National Association of Neonatal Nurses (2013) recommends swaddle bathing for preterm and newborn infants once their umbilical lines are discontinued, because swaddle bathing promotes both a secure feeling and a quiet calm newborn state. Routine sponge bathing is not recommended for ill premature infants due to the physiologic and behavioral disruptions during sponge bathing. Lund (2016) states that tub or immersion bathing is beneficial for full-term and late preterm infants and recommends the adoption of a protocol for swaddle bathing for the patients. In Turkey, Republic of Turkey Ministry of Health (2015) recommends sponge baths in the incubators for infants who are less than 2,500 g.

When the literature was examined, there was no similar study comparing the effects of the swaddled bathing and sponge bath. The current study revealed that body temperatures after sponge baths were significantly lower than after swaddle bathing. These findings are supported by the literature (Tapia-Rombo et al., 2012). The bathing affects the pulmonary and gastrointestinal tract, increases evaporation, and enlarges the peripheral vessels in the skin. The likelihood of hypothermia increases in infants whose thermoregulation is insufficient (Uçar & Çınar, 2015). During the sponge bath, there is heat loss due to the evaporation of the moisture. In swaddle bathing, the infant is covered with warm water during bathing, thus reducing heat changes and ensuring heat protection (Hall, 2008). It has been reported that the heat loss in swaddle bathing is less than conventional bathing (Da Fonseca Filho et al., 2017; Edraki, Paran, Montaseri, Nejad, & Montaseri, 2014).

In the study, it was determined that the swaddle bathing affects RR, HR, and SpO2 levels positively. This is supported by similar studies in the literature (Da Fonseca Filho et al., 2017). In addition, stress and pain lead to increased HR and RR in premature infants and decreased SpO2 (Als, 1982; Peng et al., 2009). Consistent with the literature, the pain and stress scores of the infants in this study were higher in the sponge bath condition.

Table 2. Comparison of Mean Cardiorespiratory Rates Before and After Bathing According to Bathing Method

	Swaddled bathing	Sponge bath		Effect size
Cardiorespiratory rates	**Mean ± *SD***	**Mean ± *SD***	***p***	**(*r*)**
Respiratory rate				
Before bathing	55.26 ± 4.73	55.43 ± 5.03	.536[a]	.06
1st minute after bathing	57.83 ± 4.71	62.97 ± 3.86	.000[a]	.79
5th minute after bathing	55.71 ± 4.61	60.54 ± 4.05	.000[a]	.73
15th minute after bathing	54.57 ± 4.24	58.37 ± 4.68	.001[a]	.62
30th minute after bathing	53.94 ± 4.12	56.51 ± 5.02	.003[a]	50
Oxygen saturation level				***r***
Before bathing	98.22 ± 1.78	98.31 ± 1.41	.844[a]	.03
1st minute after bathing	99.26 ± 0.95	97.43 ± 2.42	.000[a]	.67
5th minute after bathing	99.17 ± 0.95	98.03 ± 2.05	.001[a]	.54
15th minute after bathing	99.31 ± 0.96	98.23 ± 1.46	.000[a]	.61
30th minute after bathing	99.14 ± 1.12	98.28 ± 1.77	.032[a]	.36
Heart rate				***d***
Before bathing	146.14 ± 14.02	143.43 ± 16.59	.310[b]	.18
1st minute after bathing	154.06 ± 15.64	160.97 ± 16.36	.029[b]	.43
5th minute after bathing	143.31 ± 13.54	149.43 ± 14.99	.043[b]	.43
15th minute after bathing	140.23 ± 13.59	145.14 ± 15.58	.107[b]	.34
30th minute after bathing	137.49 ± 12.28	140.17 ± 13.83	.304[b]	.20

Notes. Significant at the $p < .05$ level. r = point-biserial correlation; d = Cohen's d.
[a]Wilcoxon test. [b]Paired sample t-test.

Table 3. Comparison of Mean Crying Time According to Bathing Method

Time	Swaddled bathing Mean ± *SD*	Sponge bath Mean ± *SD*	*Z*	*p*	Effect size (*r*)
During the bath[a]	0.28 ± 1.17	51.14 ± 67.50	−4.38	.000	.74
After the bath[b]	0.8 ± 0.37	8.80 ± 10.78	−4.32	.000	.73

Notes. Significant at the $p < .05$ level. Z = Wilcoxon test; r = point-biserial correlation.
[a]Time unit in seconds. [b]Time unit in minutes.

The intrauterine environment is hot and fluid-filled without being subject to gravity. For premature infants separated from this environment before full gestation, adapting to the external environment is harder and more stressful. The infant may feel every touch as pain and may give behavioral responses. Swaddling the baby lightly using blankets, soft toys, or the mother's hand helps the infant to feel as safe as in the uterus (Alparslan, 2013). Swaddled bathing provides a calm and stress-free bathing experience for newborns by simulating the familiar and safe uterine environment during immersion. In this method, as the infant's body is surrounded by water, the pull of gravity is reduced, and there is an opportunity to regulate motor behavior in order to rediscover the movements of fetal life. In addition, swaddled bathing allows the infant to rest without motor discomfort (Fern et al., 2002; Hall, 2008; Quraishy, Bowles, & Moore, 2013).

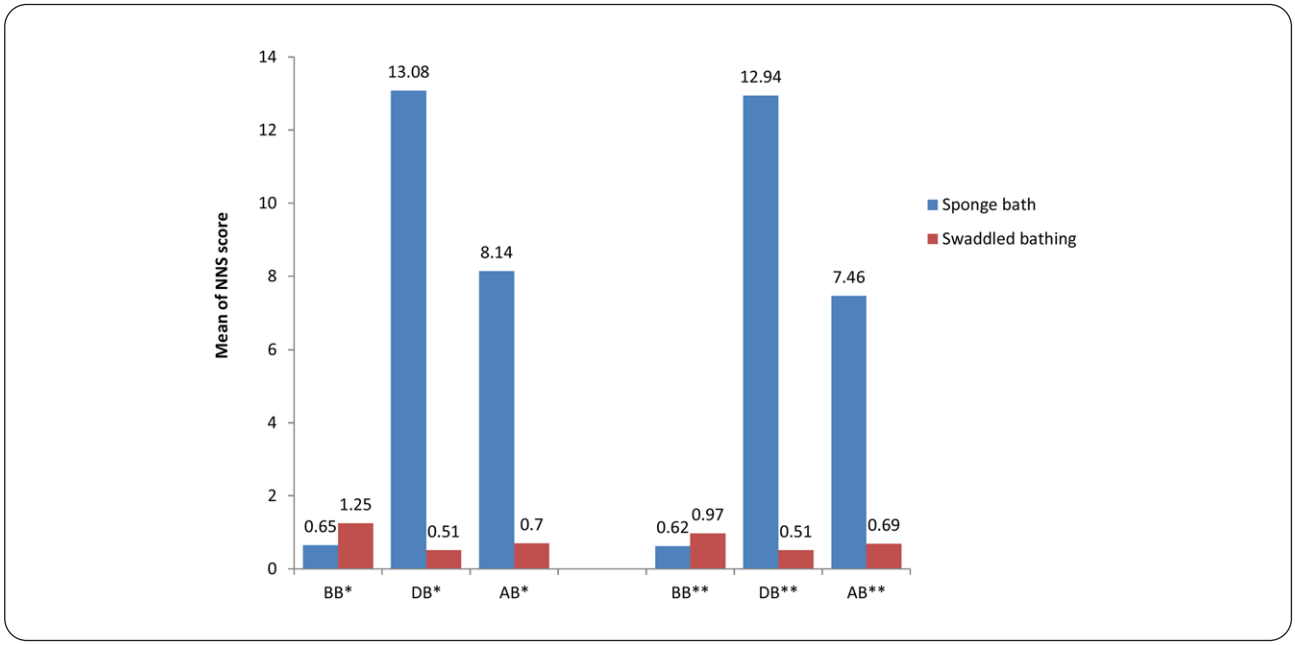

Figure 2. Comparison of mean NSS scores according to bathing method. AB = after bathing; BB = before bathing; DB = during the bath. *Mean of NSS score according to first observer evaluation. **Mean of NSS score according to second observer evaluation. Significant at the $p < .05$ level; $p = .000$; r = point-biserial correlation; $r > .5$.

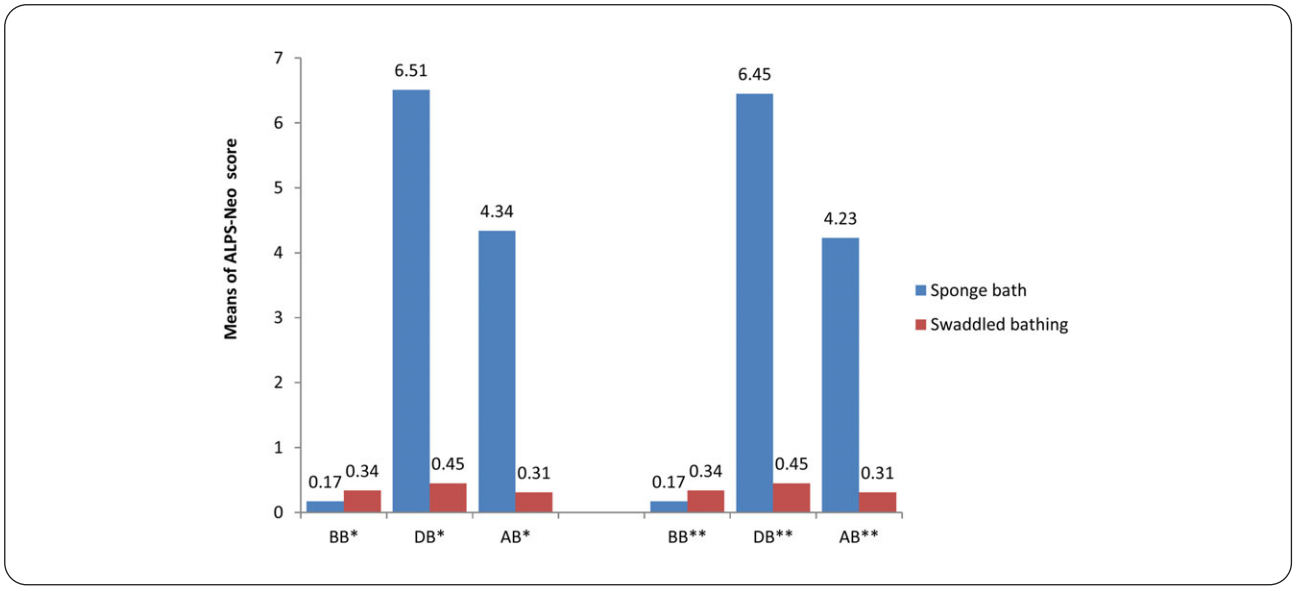

Figure 3. Comparison of mean ALPS-Neo scores according to bathing method. AB = after bathing; BB = before bathing; DB = during the bath. *Mean of ALPS-Neo score according to first observer evaluation. **Mean of ALPS-Neo score according to second observer evaluation. Significant at the $p < .05$ level; $p = .000$; r = point-biserial correlation; $r > .5$.

It has been reported in the literature that premature infants show behavioral stress symptoms during sponge baths (Bembich et al., 2017; Bryanton et al., 2004). Paran, Edraki, Montaseri, and Razavi Nejad (2016) have reported that swaddled bathing leads to fewer symptoms of stress. These findings are similar to the results of this study. Passos, Gomes, De Almeida, Filho, and Monteiro (2017) found that the pain and stress score increased during and after the in-shower bathing, whereas the pain and stress score did not change in swaddled bathing. It has also been reported in the literature

that swaddling reduces pain (Ho, Ho, Leung, So, & Chan, 2016).

Crying is the babies' most obvious response to pain and stress. The crying times of the infants were lower in swaddled bathing. Swaddling is defined as the first step in calming and relieving the infant. In studies, it has been reported that swaddling is effective in reducing the crying time of infants (Van Sleuwen et al., 2006). In the literature, swaddled bathing is recommended because it reduces crying in babies (Edraki et al., 2014; Passos et al., 2017).

The current study showed that swaddled bathing had a positive effent on the physiological measurement of the premature infants and reduces crying times, pain levels and stress scores, and is more harmless as compared to the sponge bath.

LIMITATIONS

The limitations of the study was that the sample was taken from a sample group hospitalized in the NICU of one hospital. However, this study had an advantage. This advantage was the use of a crossover design to prevent bias related to the psychological and physical properties of the patients. **WVN**

LINKING EVIDENCE TO ACTION

- Swaddled bathing helps to protect the premature infant's body heat. It also affects cardiopulmonary readings positively. Sponge bathing disrupts the comfort of premature infants, causing pain and stress. Therefore, for premature babies, swaddled bathing is recommended instead of sponge bath.
- Future studies about infant bathing methods are needed. In different populations and samples, comparative studies of different bathing methods may be conducted.
- Nurses play an active role in reducing stress and pain in infants. Evidence-based guidelines and protocols should be created for infant bathing methods.

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