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The effect of tub bathing and sponge bathing on neonatal comfort and physiological parameters in late preterm infants: A randomized controlled trial

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ABSTRACT

Background: Increasing comfort and physiological stabilization in preterm infants during neonatal care improves their neurophysiological development. Bathing procedures that support this development and will not expose the newborn to stress should be preferred.
Objectives: Our study aimed to examine the effectiveness of tub bathing and sponge bathing methods on the physiological parameters (i.e., heart rate, respiration rate, oxygen saturation, body temperature) and comfort of late preterm infants.
Design: Randomized controlled trial. Study is registered at ClinicalTrials.gov NCT03796312.
Settings: The trial was conducted in a neonatal intensive care unit of a university hospital in Antalya, Turkey.
Methods: Late preterm infants (gestational age between 34 0/7 weeks and 36 6/7 weeks) were randomly assigned by a computer program to either intervention (tub bath) or control group (sponge bath). The physiological parameters and comfort of preterm infants in both groups were evaluated at 10 min before the bath. Infant comfort was reevaluated 10 min after the procedure, while physiological parameters were reevaluated after 15 and 30 min. Preterm infant heart rate, oxygen saturation, respiratory rate, body temperature and comfort behaviors were assessed by two independent evaluators who were blinded to the purpose of the study at different phases across the two bathing protocols. Written consent was obtained from the university and hospital ethics committee where the research was performed, and from the families of the infants participating in the study. SPSS 20.0 and SAS 9.3 were used for data analysis. Data was analyzed by percentage distribution, mean, repeated analysis, variance analysis, Bonferroni analysis as a further analysis and *t*-test in dependent groups.
Results: Approximately 120 preterm infants completed the protocol (60 in each group). The two groups did not differ in gestational age, sex, weight or other demographic variables ($p > 0.05$). Tub bathing was more effective in reducing preterm infants' comfort scores (9.47 ± 2.55 vs. 14.85 ± 4.77, $p < 0.001$) and heart rate than sponge bathing (132.88 ± 12.00 vs. 144.00 ± 17.74, $p < 0.05$). Preterm infants in the tub bathing group maintained their body temperature better than those in the sponge bathing group (36.75 ± 0.26 vs. 36.59 ± 0.25, $p < 0.05$). There was no difference in oxygen saturation (98.35 ± 0.88 vs. 97.85 ± 1.36, $p = 0.291$) or respiratory rate (45.57 ± 5.39 vs. 47.20 ± 5.41, $p = 0.472$) between the tub and sponge bathing groups.
Conclusions: Tub bathing is a safer, more pleasurable/comfortable bathing option and is the recommended method for bathing healthy, late preterm infants.

What is already known about the topic?

- Preterm infants are exposed to various stressors during the period of neonatal intensive care; the immaturity of their central nervous system makes them especially vulnerable to the negative effects of these events.
- Late preterm infants are especially vulnerable to temperature instability, which can often result in clinical complications.

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Therefore, thermoregulation in the late preterm infant should be considered of vital importance to nurses caring for this vulnerable patient group.
- Bathing procedures used in neonatal intensive care units have positive implications for the skin care of infants.

What this paper adds

- Tub bathing reduces stress on late preterm infants and provides comfort.
- The tub bathing is more effective in maintaining the body temperature of late preterm infants and provides prophylaxis against the risk of hypothermia.
- Although tub bathing is effective in regulating the heart rate of late preterm infants, it has similar effects to sponge bathing with respect to respiratory rate and oxygen saturation.

1. Introduction

Preterm birth is a significant global health problem. Prematurity is the most important reason for hospitalization in the neonatal intensive care unit (NICU) (Askin and Wilson, 2007). Each year, 15 million babies are born preterm and this number is rising. Preterm delivery complications are the leading cause of death in children under 5 years of age. In 2015, preterm delivery complications were responsible for approximately one million infant deaths. Three-quarters of these deaths could have been prevented using currently available, cost-effective interventions (Liu et al., 2016).

The lower the birth weight and gestational age of preterm infants, the greater their susceptibility to maturation and prematurity complications (Yıldız, 2002). Infants in NICUs are exposed to numerous stressors, such as excessive noise and light levels, frequent medical or nursing interventions, and problems related to separation from the mother (Montirosso et al., 2012). Useful and necessary interventions, indispensable in NICUs, can lead to physiological and behavioral reactions even in healthy preterm infants (Blume-Peytavi et al., 2016; Lee, 2002; Liaw et al., 2006). Nursing care should be provided in such a way as to cause minimal distress to preterm infants because stress affects their health and growth, and slows healing (Liaw et al., 2006). In infants, especially preterm infants, stress has been shown to have potentially long-lasting effects on brain organization and neuroendocrine stress responses. In addition, epigenetic changes have been reported in preterm infants exposed to high-levels of stress in the neonatal period (Montirosso et al., 2016; Vinall and Grunau, 2014). Therefore, pharmacological and non-pharmacological strategies are recommended to prevent and control the stress of infants (Gao et al., 2018; Hall and Anand, 2014).

Comfort is a critical issue in current neonatal practice for preterm infants. Comfort measures include any intervention that maximizes preterm infants' potential neurodevelopment and provides comfort. Neonatal intensive care nurses should aim to provide solutions to the physiological distress of infants and increase their comfort to reduce their sense of stress. Therefore, it is necessary to improve the infant's environment (Aydın and Çiftci, 2015; Liu et al., 2007). The evaluation of comfort using appropriate scales, and the use of various approaches are important for increasing the patient's level of comfort, and support the important role of the neonatal nurse (Kolcaba and Dimarco, 2005; Sorrentinoa et al., 2017; Titler and Rakel, 2001).

The integumentary system protects the underlying body from the external environment, such as shocks, temperature, ultraviolet radiation, chemicals, and other threats (Yagi and Yonei, 2018). Given the dramatic transition from the aqueous womb to the dry terrestrial environment at birth, studies describing adaptations made by the skin barrier within the first month of life assume greater importance. The skin of the infant is morphologically and functionally different from the skin of adults. Neonatal skin is thinner, more fragile, and drier than adult skin; it is difficult to maintain fluid-electrolyte balance and temperature regulation (Afsar, 2010). Special care procedures are nonetheless necessary to ensure healthy development, to protect the skin from irritation and reddening, and to help the infant feel well (Ness et al., 2012; Sarkar et al., 2010).

One of the most common skin care giving practice in NICU is the bath. Although bathing has a major impact on maintaining infant health, it is stressful experimentation, especially for preterm infants. The most common bathing methods in NICUs are tub bathing, sponge bathing, swaddled bathing, under running water bathing for infants. In Turkey, the infant bathing method most commonly adopted in NICUs are sponge baths and tub baths. Infants also react to the bathing behaviorally. Some care applications may cause declines in the clinical condition of infants. In the bath application, the infant is touched as in other procedures, which causes irregularity and stress in infants. This status is more evident as the age of gestation reduces, causing a change for the worse of physiological and behavioral situations (Liaw et al., 2006; Loring et al., 2012). Numerous studies have shown that bathing can be performed without harm to the infant (Ar and Gözen, 2018; Blume-Peytavi et al., 2016; Bryanton et al., 2004; Çaka and Gözen, 2018; Darmstadt and Dinulos, 2000; Edraki et al., 2014; Garcia Bartels et al., 2009; Loring et al., 2012; Medves and O'Brien, 2004). When performed in a right method or way, it seeks to minimize the detrimental effects on the infant's physiological and behavioral systems (Passos et al., 2017). Researches show that bathing caused deterioration in physiological parameters such as an increase or decrease in heart and respiratory rates, a temporary decrease in oxygen saturation, and hypothermia in premature infants (Bembich et al., 2017; Bryanton et al., 2004; Tapia-Rombo et al., 2003). Factors affecting physiological parameters are not only associated with changes in physiological functions, but also with effects such as relief or relaxation of the individual. Considering the physiological and psychological effects of bath applications on the body, changes that may occur in the infant bath will affect the values of life findings directly, positively or negatively (Potter and Perry, 2009). While the promotion of hygiene is the most obvious benefit to bathing, studies have elucidated a number of other benefits associated with bathing. Preterm infant bathing is still discussed in the studies, but there is still no consensus. Notwithstanding, after a review of the literature, many of these studies lack blinding, fail to use control groups, have small sample sizes, lack follow-up, or have discrepancies in bathing time. Therefore, this study, taking the form of a randomized controlled trial, aims to examine the effectiveness of tub bathing and sponge bathing on the physiological parameters (heart rate, respiration rate, oxygen saturation, body temperature) and comfort of late preterm infants. The research hypotheses were:

1 Tub bathing will increase infant comfort with statistically significant differences compared to sponge bathing.
2 Tub bathing will result in better regulation of the heart rate of late preterm infants with statistically significant differences when compared with sponge bathing.
3 Tub bathing will provide more benefits to the respiratory rate and oxygen saturation of late preterm infants with statistically significant differences when compared with sponge bathing.
4 Tub bathing will better protect the body temperature of late preterm infants with statistically significant differences when compared with sponge bathing.

2. Methods

2.1. Study design

A randomized controlled two-group pre-test and repeated post-test study design was adopted. Preterm infants were randomly allocated before bathing by the researcher using a random computer-generated table to one of two groups: sponge bathing (routine care) or tub bathing. The bathing procedures were performed by the researcher. Nurses and a second researcher were blinded to the study hypotheses.

The study was conducted in the NICU of a university hospital in Turkey, between November 2015 and November 2016. The unit employs 29 nurses and treats approximately 180 preterm infants each year. Skin care is routinely performed between 08.00 and 09.00 in the form of sponge bathing. This research study sampled 120 stable, late preterm infants being cared for in the NICU. This sample was deemed adequate based on a sample size calculation conducted in PS Power and Sample Size Calculations (Version 3.0). In terms of study design, was considered a study of independent cases and controls, with one control per case. Therefore, supposing 50% of cases in the control group (sponge bathing) have low ComfortNeo scores, and that 25% of cases in the experimental group (tub bathing) have low ComfortNeo scores, we would require 58 experimental subjects and 58 control subjects to be able to reject the null hypothesis that the failure rates for experimental and control to achieve a probability (power) of 0,8. The probability for Type I error associated with this type of test of the null hypothesis is 0,05. Therefore, we use an uncorrected chi-squared statistic to evaluate this null hypothesis. We also performed a post-study power analysis using ComfortNeo scores obtained in the study. Mean and standard deviation for the control group were reported as 15.33 ± 4.92, with a Cohen's d value of 1; power for the comparison of post-bathing scores is 0.99.

2.2. Inclusion criteria

All infants with a gestational age of 34 weeks and 0 days to 36 weeks and 6 days (late preterm) were eligible to participate in this study.

2.3. Exclusion criteria

Participants were excluded from the study if they were connected to a mechanical ventilator, if they had bathed in the last 12 h before the intervention, if the infant has open incision after surgery, had a central catheter, had received either a sedative and/or muscle relaxant, or if they did not fulfill the inclusion criteria.

2.4. Randomization and allocation

Computer-generated randomization (www.randomizer.org) was used to assign infants to one of the two groups. Information concerning allocation was available only to the principal investigator. Infants were assigned a sequential number that was placed in an opaque, sealed envelope by the researcher who received the signed parental informed consent. When the infant was scheduled to be bathing, the envelope was opened by the researcher who then performed the bath. The nurses could not be blinded to the allocation because of the nature of the intervention. However, the outcome assessment of the preterm infants was blinded.

2.5. Interventions

Study protocols were developed for tub bathing and sponge bathing using the Association of Women's Health, Obstetric and Neonatal Nurses (Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN), 2018) neonatal skin care guidelines and the protocols developed by Bryanton et al. (2004) and Loring et al. (2012). The study protocol was reviewed and approved by on Clinical Trials.gov (NCT 03796312). All bathing procedures were performed in accordance with the study intervention. The researcher screened the NICU admission log each day to identify eligible infants for enrollment, and informed the preterm infant's parent of the purpose of the study before obtaining their consent. Participating preterm infants were randomly assigned to either sponge bathing or tub bathing groups. Bathing was performed anywhere from 6 to 48 h post-birth, based on individual infant needs. The umbilical cord of 24 infants was still in place. Infants were required to be fed at least 30 min after bathing as this could otherwise cause vomiting and aspiration immediately after feeding. In addition, after the bath, the infants were not touched until the assessment has been completed. This included the delaying of nutrition, treatment, medical and nursing interventions that might potentially trigger physiological and behavioral changes in the infant. Such deviations should potentially undermine the accuracy of the assessment; as such, it was difficult to set a specific time for bathing. Nonetheless, it was decided that the most suitable time for bathing would be between 08:00 and 11:00, with minimal nutritional and other interventions provided to infant during this time. Bathing was performed at room temperature without radiant warmers at a room temperature measured at 25–26 °C and 40% humidity. During bathing, infants were spoken to softly, and their bodies were cleaned in a slow, rhythmical motion. Following bathing, infants were dried with large towels. Tub bathing took approximately 3.74 ± 0.77 min and sponge bathing 3.64 ± 0.77 min. The exact time was based on infant cues and needs. Infants were subsequently placed in a preheated incubator, which varied according to the infant's weight and age. In order to compensate for such differences, the heads of all infants were placed at a height of 30 degrees in a right lateral position after bathing and they were monitored. The infants were not dressed during the observation period. After bathing, infants were left without intervention or contact for approximately 10 min or until settled before being assessed.

2.5.1. Tub bathing

The infant's face was washed and dried while still wrapped before being immersed. The water level in the tub was set at approximately 9–12 cm or deep enough to cover the infant's shoulders. A folded cloth towel was placed into the tub before bathing. The temperature of the bath water was controlled using a special water thermometer and adjusted to 37–38 °C. First, the lower part of the body was immersed in a tub before immersion up to the neck. The infant was held securely; the head and neck were supported on the researcher's forearm, and the shoulder was grasped using the researcher's thumb and finger. Cleaning was performed using a soft cloth and infant skin cleaner. The front and back areas were cleaned without turning the infant. The infant was safely removed from the water and wrapped in a clean towel. The body was quickly dried with gentle movements before moistening the infant's body with baby oil and dressing in diapers. Tubs were disinfected between infants.

2.5.2. Sponge bathing

Separate cotton cloths were prepared for each body area in the sponge bath. The room temperature was set to 26–27 °C to prevent hypothermia. The temperature of the water used for sponge bathing was set to 37–38 °C. Alongside the bath, the infant was placed on a flat, protected surface and washed from a bowl of water, using the same mild cleanser. The eyes, face, and head were wiped and dried while the infant was wrapped in a blanket. The wrap was opened so that body parts could be washed, dried, and then immediately rewrapped, after which infants were diapered.

2.6. Outcome measures

The data collection instrument, the Preterm Infant Bathing Study Record, was designed specifically for this study. The instrument incorporates a number of scales for the measurement of outcome variables, physiological parameters, and demographic information (age, gender, type of delivery, gestational age, birth weight, body weight at study time, etc.). Outcome measures include neonatal comfort behavior and physiological parameters (body temperature, heart rate, oxygen saturation, respiratory rate). Physiological data was collected by nurses trained by the lead researcher. Data on neonatal comfort behavior was collected by a second researcher and by research nurses who had been trained by the lead researcher. Those responsible for data collection were blinded as to the allocation of infants they were assessing.

The ComfortNeo scale was used to measure newborns' comfort and pain intensity. The comfort scale was created by Ambuel et al. (1992) to evaluate distress in pediatric intensive care unit patients receiving mechanical ventilator support. Van Dijk et al. (2009) revised the scale in order to measure behavior in infants. Validity and reliability for the Turkish translation of the ComfortNeo was assessed by Kahraman et al. (2014). The ComfortNeo is a Likert-type scale consisting of six parameters: alertness, calmness/agitation, crying, body movement, facial tension, and (body) muscle tone. The lowest score that can be obtained using this scale is 6, and the highest score is 30. Scores in the range of 6–13 indicate that the newborn is comfortable, while scores 14–30 are indicative of pain or distress in the newborn, thus necessitating comforting.

Infant heart rate and oxygen saturation were obtained using a pulse oximetry device. A separate pulse oximetry probe was applied into each of the infants and the respiratory rate was counted for one minute. Temperature was measured using the axillary route in degrees Celsius.

2.7. Data collection procedure

Comfort was inferred based on infant behavior, which was evaluated on two separate occasions, 10 min before bathing and 10 min after bathing, in accordance with the literature (Ambuel

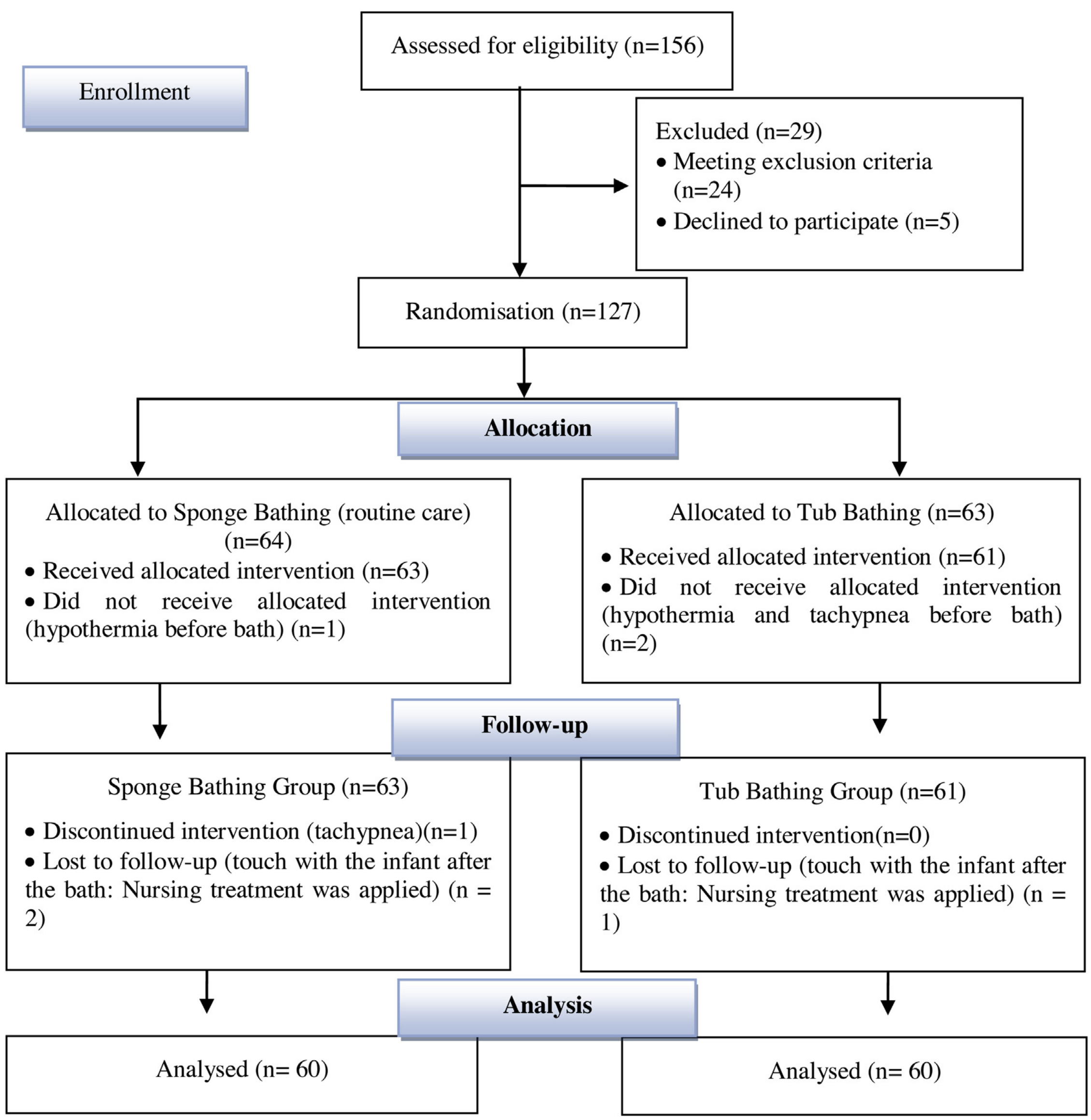

Fig. 1. Consort diagram of participants through trial.

et al., 1992; Kahraman et al., 2014; van Dijk et al., 2009). In data collection, observers are a nurse and researcher who does not see which bath method is applied to the infant. Observers were positioned to see the infant's face and body while measuring the newborn's comfort behavior. Measurement took approximately 1–2 min.

Inter-observer reliability: "Observation" is a qualitative measurement technique and inter-observer reliability, also called inter-rater reliability, is a measure of consistency between two or more independent raters (observers) of the same construct. Internal consistency was measured by way of Cronbach's alpha coefficient, which was 0.94 before bathing, 0.93 after bathing for the second researcher, and 0.92 after bathing for the nurse. Kappa coefficients were approximately 0.84 for each sub-item. Thus, there was harmony between the two observers.

Infant physiological parameters (heart rate, respiratory rate, oxygen saturation, and body temperature) were evaluated on three separate occasions (10 min before bathing, 15 min and 30 min after bathing), in accordance with the literature (Bryanton et al., 2004; Edraki et al., 2014; Loring et al., 2012).

2.8. Ethical considerations

Prior to conducting the study, ethical approval was obtained from the local state university Clinical Research Ethics Committee on October 21, 2015 (Document ID: 70904504/251). Permission for the study was also received from the hospital. All parents whose infants were included in the study were informed about the purpose of the study and the research process, and gave their informed consent for the participation of their infants in the study. The anonymity of the infants, their parents, and study data was also ensured.

2.9. Data analysis

Statistical analysis was performed using SPSS 20.0 and SAS (ver.9.3), with statistical significance set at $p < 0.05$. Data was presented as means and standard deviations for continuous variables, and frequencies for categorical variables. For preterm infant characteristics, such as the type of delivery and sex, a Chi-square test was applied to determine whether there were significant between-group differences. Late preterm infant characteristics, such as birth weight and body weight at the time of the study, were evaluated for significant between-group differences using a one way ANOVA test. For a comparison of the different phases, measurement parameters (comfort score, heart rate, oxygen saturation, respiratory rate, body temperature) through the baths were averaged separately. Repeated measurement analysis of variance was performed to analyze both between and within-group differences, followed by the Bonferroni post-hoc test.

3. Results

Of the 156 preterm infants screened for participation in this study, 24 were found not to have met the inclusion criteria (NCPAP, MV etc.). Subsequently, 132 infants were eligible for participation and were approached. Five parents whose infants met inclusion criteria declined to approve the participation of their infant in the study. Consequently, the remaining 127 preterm infants who met inclusion criteria and whose parents consented to their participation were included in the study and randomized to either experimental or control conditions. Three infants, however, did not receive the intervention strategy because their health status deteriorated before the intervention could be started (Fig. 1). Sponge bathing was performed on 63 infants, although the intervention was discontinued with one infant because of worsening tachypnea. Tub bathing was performed on 61 infants. Three infants were excluded because of contact with infants before the end of the data collection process. The characteristics of preterm infants did not vary significantly between those whose parents declined to participate or dropped out of the study ($n = 12$), and those who completed the study protocol ($n = 120$).

3.1. Comparison of sociodemographic and clinical variables of the infants as well as baseline outcomes among the groups

The demographic data of preterm infants participating in the study are shown in Table 1. The tub bathing group consisted of 60 (female = 30, male = 30) preterm infants, while the sponge bathing group included 60 (female = 26, male = 34) similarly preterm infants. In both groups, 85% of the infants were delivered by cesarean section. The mean birth weight of infants was 2527.27 ± 452.48. No statistically significant differences were found between preterm infants in either the control (sponge bath) or experimental (tub bath) groups in terms of gender, gestational age, birth weight, body weight or postnatal age at the time of study, or other sociodemographic or clinical variables

Table 1
Demographic and Clinical Characteristics of the Participants in the Both Groups (n = 120).

Variable	Tub Bathing Group (n = 60) Mean ± SD		Sponge Bathing Group (n = 60) Mean ± SD		p value
Postnatal age (hours)	64,35 ± 12,09		62,87 ± 10,33		0.297
Gestational age (weeks)	35.28 ± 1.83		35.31 ± 1.01		0.987
Maternal Age (years)	30.37 ± 5.83		30.52 ± 5.95		0.889
Weight at inclusion (g)	2572.30 ± 461.74		2663.53 ± 490.27		0.296
Birth weight (g)	2510.47 ± 417.12		2544.07 ± 488.12		0.686
	n	**%**	**n**	**%**	**p value**
Gender					
Male	30	50	34	56.7	0.464
Female	30	50	26	43.3	
Type of delivery					
Cesarean birth	51	85.0	51	85.0	
Vaginal	9	15.0	9	15.0	1.000

($p > 0.05$; Table 1). These results indicate that the intervention and control groups were similar in terms of variables.

3.2. Comparison of infant comfort behaviors

Table 2 shows the distribution of means scores for neonatal comfort behaviors for the groups according to measurement time. After tub bathing, the two observers found better subscale scores (alertness, calmness/agitation, crying, body movement, facial tension, (body) muscle tone) (Fig. 2). The difference between the total comfort score for the two groups was statistically significant (9.15 ± 2.56 vs. 15.33 ± 4.92, $p < 0.001$). Hypothesis 1 was also supported. Tub-bathed infants were significantly more comfortable than those who were sponged-bathed. Comfort ratings averaged 5–6 points lower for tub-bathed infants (i.e., the lower the score, the more comfortable/peaceful the infant).

3.3. Physiological parameters

Table 2 shows the results of the physiological measurements (heart rate, respiration rate, oxygen saturation, body temperature) for the tub bath and sponge bath groups at 10 min before bathing, and at 15 min, and 30 min after bathing. Infant heart rates in the tub bathing group showed a statistically significant improvement post-bathing, thus supporting Hypothesis 2. The heart rate was reduced by an average of 26 beats per minute in the experimental group however in the control group an average decrease of 6 beats per minute was achieved. Significant between-group differences were found in terms of heart rates after the bathing procedure (130.33 ± 11.23 vs. 139.37 ± 18.95, $p = 0.014$). Hypothesis 3 was partially supported. The repeated measures showed that there were significant time effects for the outcomes of respiratory rate and oxygen saturation at all points significant group-time interaction effect. However, no significant effect for all outcomes over time. No significant differences were found between the respiratory rates and oxygen saturation of infants in the experimental versus control groups before and after the bath ($p > 0.05$; Table 2).

The results support the fourth study hypothesis. Within-group and between-group comparisons showed that infants who were tub bathed experienced significantly less variability in their body temperatures at 15 and 30 min following the bath, and were actually warmer as compared to infants who had been sponge bathed. The mean temperature loss for tub-bathed infants was 0.08 °C (SD = 0.18). For sponge-bathed infants, the mean temperature loss for was 0.24 °C (SD = 0.15). Tub-bathed infants had significantly higher post-bath temperatures compared to those who were sponge bathed, averaging 0.2 °C (SD = 0.2) higher. The temperature measurements for all three time periods in both bathing groups are shown in Table 2.

4. Discussion

The late preterm infant is physiologically vulnerable, and thus warrants specialized nursing care for routine practices, such as bathing. During the bath, the late preterm infant is at an especially high risk for temperature instability, stress, and impairments in physiological parameters, which can have an important influence on their infantile health outcomes. By ensuring adequate thermoregulation and comfort, nurses facilitate a state of positive late preterm infant health by increasing the likelihood of a healthy environment, thus preventing complications, including neurological damage, dehydration, hyperbilirubinemia, failure to thrive, and ultimately, the possibility of hospital readmission.

In our study, late preterm infant comfort and physiological stability were significantly associated with the method of bathing used (Fig. 3). All but two study hypotheses were supported, the exceptions being those related to oxygen saturation and respiratory rate. In addition, the results were clinically significant.

Table 2
Comparison of late preterm infants' COMFORTneo scale score and physiological parameters in the **Tub Bathing** and **Sponge Bathing** Groups (n = 120).

Variable	Tub Bathing Group (n = 60) Mean ± SD	Sponge Bathing Group (n = 60) Mean ± SD	Between-groups p value
COMFORTneo scale total score			
10 min before bathing	19.13 ± 5.56	18.38 ± 4.74	*<0.001*
10 min after bathing (sec. researcher)	9.15 ± 2.56	15.33 ± 4.92	
10 min after bathing (nurse)	9.47 ± 2.55	14.85 ± 4.77	
Within-group p value	$p < 0.001$	$p < 0.001$	
Body Temperature (°C)			
Before bathing	36.83 ± 0.36	36.84 ± 0.28	*0.011*
15 min after bathing	36.75. ± 0.26	36.59 ± 0.25	
30 min after bathing	36,77 ± 0.22	36.72 ± 0.20	
Within-group p value	$p = 0.279$	$p < 0.001$	
Oxygen Saturation (%)			
10 min before bathing	97.00 ± 1.48	96.95 ± 1.47	*0.291*
15 min after bathing	97.70 ± 1.48	97.83 ± 1.15	
30 min after bathing	98.35 ± 0.88	97.85 ± 1.36	
Within-group p value	$p < 0.001$	$p < 0.001$	
Heart Rate (per minute)			
10 min before bathing	158.37 ± 16.79	150.53 ± 17.09	*0.014*
15 min after bathing	132.88 ± 12.00	144.00 ± 17.74	
30 min after bathing	130.33 ± 11.23	139.37 ± 18.95	
Within-group p value	$p < 0.001$	$p = 0.003$	
Respiratory Rate (per minute)			
10 min before bathing	53.15 ± 5.79	51.20 ± 6.00	*0.472*
15 min after bathing	47.20 ± 5.27	48.77 ± 5.12	
30 min after bathing	45.57 ± 5.39	47.20 ± 5.41	
Within-group p value	$p < 0.001$	$p = 0.001$	

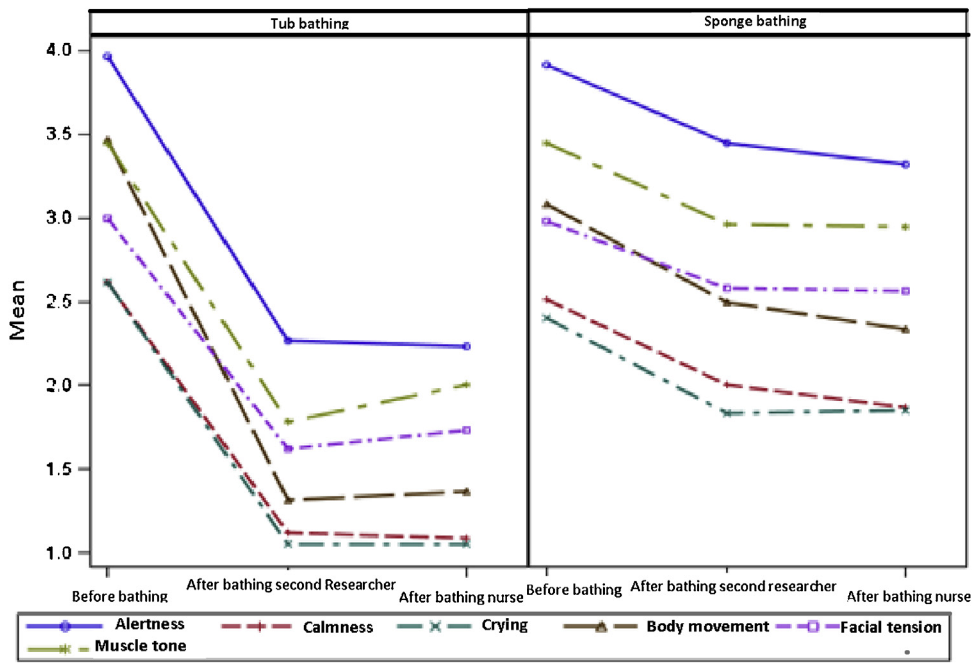

Fig. 2. Comparison of late preterm infants' ComfortNEO Scale in the tub and sponge bathing groups.

Bathing is a highly stressful agent for the preterm infants, which can be caused in some related behaviors such as fussing, crying, yawning and hiccoughing (Edraki et al., 2014). In this study, the comfort scores of preterm infants who had tub bathing reached the optimum level. When compared to sponge bathing, tub bathing was found to significantly increase infant comfort ($p < 0.001$). Tub-bathed infants were statistically and clinically more comfortable than those who was sponge bathed. Preterm infants comfort after tub bathing were higher than after the sponge bath. These findings are congruent with those of Bryanton et al. (2004); Cole et al. (1999), and Passos et al. (2017). Compared with sponge bathing, tub bathing was superior in many ways. Being immersed in warm

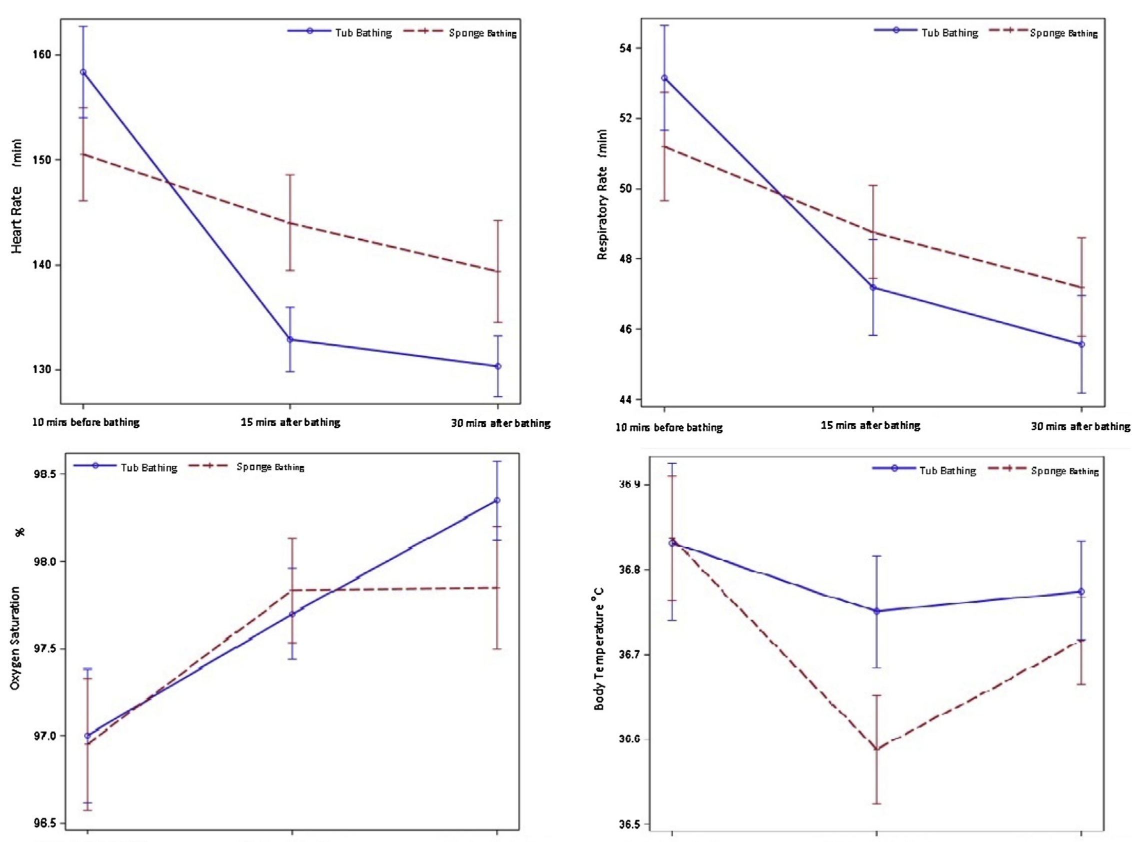

Fig. 3. Comparison of late preterm infants' physiological parameters in the tub and sponge bathing groups.

water was found to be very comforting for infants. Studies have shown that tub-bathed infants are generally quieter and peaceful (Anderson et al., 1995; Bryanton et al., 2004; Darmstadt and Dinulos, 2000; Passos et al., 2017). Using the Brazelton Behavioral Assessment Scale, Bryanton et al. (2004) showed that tub bathing was more calming in infants as compared to sponge bath ($p < 0.01$). Cole et al. (1999) found that while 90% of sponge-bathed infants were disturbed and crying, 70% of tub-bathed infants were either awake or quiet.

One common reaction among preterm infants to stressful interventions is an increase in heart rate. In this study, the mean heart rate of infants decreased in both groups at 15 and 30 min post-bathing; however, the two groups were statistically different ($p < 0.001$). The average heart rate in the tub bathed group decreased by 26 beats per minute after the procedure in the 15th minute; however, the sponge bathed group average hear rate decreased by only 6 beats per minute. After 30 min, the heart rate of the tub-bathed group decreased by 28 beats, while the heart rate in the sponge-bathed group decreased by 11 beats. Çaka and Gözen (2018) found that the heart rate of 40 infants increased during tub bathing. Some increase or deviation in the infant heart rate is to be expected during tactile interventions. Therefore, the change in during the bath was not important for us. Three studies analyzed the HR before, during and after the sponge bath (Lee, 2002; Montes-Bueno et al., 2005; Tapia-Rombo et al., 2012). Lee (2002) reported a significant heart rate increase (mean 10 beats per minute) during the wiping baths ($p < 0.001$). Tapia-Rombo et al. (2012) found statistical differences when studying heart rate before and during the bath, and during bath and after the bath (Tapia-Rombo et al., 2012). In a study of preterm infants, Peters (1998) found a significant heart rate increase during sponge bathing, and a corresponding decrease in heart rate after the bath had been completed. Therefore, the decrease in the heart rate of preterm infants in our study is consistent with the literature. These results, therefore, suggest that tub bathing preterm infants has a more significant stress reduction effect than sponge bathing.

Moreover, we found that the respiratory rate of both sponge- and tub-bathed infants decreased at 15 and 30 min post-bathing, with this decrease falling below pre-bathing values. The change in respiratory rate was similar in both groups. There were no statistically significant between-group differences ($p = 0.473$). Therefore, we conclude that bathing, irrespective of the form of bathing, had a positive effect on the respiration of preterm infants. The increased oxygen saturation after 15 min post-bathing was similar for both groups ($p = 0.335$). There were no significant between-group differences in oxygen saturation at 30 min post-bathing ($p = 0.291$). In his study, Lee (2002) found that sponge bathing did not significantly alter the oxygen saturation of infants. Tapia-Rombo et al. (2003), however, reported that wiping bath affected blood oxygen saturation of preterm infants, going on to recommend that sponge bathing should be completed very quickly.

The late preterm population is especially vulnerable to temperature loss, so bathing can produce a state of hypothermia due to the low maturity of thermoregulatory systems (Edraki et al., 2014; Kuller, 2014). Tub bathing appears to be more effective than sponge bathing in terms of maintaining body temperature and preventing temperature losses in preterm infants. Our study found that the body temperature of preterm infants in the sponge bathing group was 0.1 °C lower. This finding supports the work of Bryanton et al. (2004); Cole et al. (1999), and Loring et al. (2012). Three of the researches examined the temperature alterations caused by sponge bathings. Three researches also found significant differences between before bath and after bath temperature (Loring et al., 2012; Montes-Bueno et al., 2005; Tapia-Rombo et al., 2012). Covering the infant's entire body area with water helps support an even temperature through the distribution of water, and decreases heat loss through evaporation (Anderson et al., 1995; Bryanton et al., 2004). Montes-Bueno et al. found that in 45.5% of infants the heat reduced below 36 °C and 87.4% below 36.5 °C (Montes-Bueno et al., 2005). During our study, the sponge bathing method also showed it was not a cause of hypothermia. We think this was as a result of the combined factors of wiping (drying) and the method of immediately wrapping the infant preventing any subsequent loss of heat through evaporation.

These observations support the need to include neonatal nurses among those who care for preterm infants in order to improve the quality of health care and to enhance patient comfort. The results of this study indicate that tub bathing helps to prevent temperature loss, stress, and impairments in physiological parameters; as such, this important bathing method should be promoted. Moreover, and based on the results of this study, tub bathing is a safe and pleasurable bathing method for late preterm infants. Tub bathing may be considered method of cleaning and comforting infants in the NICU.

5. Strengths and limitations of the study

Despite its strengths, this study has some limitations: The study sample was limited based on the exclusion criteria. The primary strengths of our investigation are the sample size and the characteristics of the infants sampled. Notwithstanding, there may have been differences between those who refused to take part or those excluded from the study. However, because these numbers are so few, this is unlikely. This study was designed to survey only infants with a gestational age between 34 and 36 6/7 weeks (late preterm infants), thereby excluding very preterm infants. Therefore, the findings of this study cannot be generalized to those who are unstable or who are extremely preterm infants.

Bathing immediately after feeding the infant could have led to vomiting and aspiration, therefore, the bath was performed half an hour after feeding. Treatment or contact with the infant immediately after bathing can affect the comfort of the infant. This has a negative effect on comfort assessment. It was difficult to provide all these conditions in the intensive care environment. Three preterm infants were excluded from the study during follow-up due to these conditions. The control condition for this study was routine care (sponge bathing), which might have led to unnecessary stress for those preterm infants who had been assigned to this condition, although this limitation was minimized by offering preterm infants in this condition attentive and appropriate care. The observers were blinded in this study. They should not know which bath method was applied to the preterm infant. Therefore, it was impossible for them to evaluate the comfort during the procedure. In addition, the evaluation of physiological parameters in the shortest time immediately after the procedure would risk blinding.

6. Recommendations for future studies

The wide selection of age ranges was limited because we thought it might affect thermoregulation and comfort. It is recommended to examine the effects of tub bathing on term and other preterm groups in future studies.

7. Conclusions

Tub bathing positively affects the comfort of late preterm infants and keeps the heart rate at normal values as compared with sponge bathing. Tub bathing also helps the infant to maintain their temperature by supporting thermoregulation. Tub bathing reduces infant crying and helps them to sleep. Therefore, tub bathing is an effective stress reduction strategy for preterm infants in the NICU and can contribute to their development.

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Declaration of Competing Interest

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