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The effect of bath applied in two different sequences on stress level and physiological parameters in term babies

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ABSTRACT

Background: The sequence of neonatal bathing may significantly influence an infant's ability to maintain homeostasis. Traditional methods begin with the head, but deferring head washing to the final stage may reduce thermal loss and procedural distress.

Purpose: This study compared the effects of two swaddle bathing sequences head-first versus body-first on the stress levels and physiological parameters of term newborns.

Design and methods: This randomized controlled trial (RCT) included 104 term infants born in a Training and Research Hospital in Istanbul between July 18 and September 20, 2023. Infants were randomly assigned to Group 1 (head washed first, then body; $n = 52$) or Group 2 (body washed first, then head; $n = 52$). Stress levels, calming durations, and physiological parameters (body temperature, oxygen saturation, heart rate) were systematically analyzed.

Findings: Baseline measurements were similar between groups ($p > 0.05$). During and after the procedure, Group 1 exhibited significantly higher stress levels ($p < 0.001$) and longer calming times ($p < 0.001$) than Group 2. Post-procedure body temperature and O_2 saturation were significantly lower ($p < 0.001$), while heart rate was significantly higher ($p = 0.001$) in Group 1.

Conclusion: Washing the body before the head minimizes neonatal stress, accelerates recovery, and preserves physiological stability. Deferring head washing is recommended to enhance neonatal care (RCT ID: NCT06166485).

Implications for practice: These findings provide evidence-based guidance for neonatal nurses. Implementing a body-first sequence optimizes thermoregulation and minimizes procedural stress in term infants.

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Introduction

Adaptation problems most commonly occur during the neonatal period. Postpartum care practices play a pivotal role in the newborn's adaptation to the extrauterine environment (Mohamed et al., 2018). In recent years, research has increasingly focused on identifying ideal care practices to support neonatal skin function and development, with bathing being a primary method (Johnson & Hunt, 2019). Beyond cleansing and moisturizing, bathing is essential for enhancing skin development, preventing infections, and supporting the epidermal barrier function (Burdall et al., 2019). Furthermore, bathing has been reported to improve overall comfort and support the development of the immune and nervous systems (Huang et al., 2022). Newborn bathing practices vary depending on hospital protocols and cultural contexts, which influence the techniques, cleaning products, and frequency of baths (Mohamed et al., 2018; Ness et al., 2013).

Recent studies have aimed to identify the optimal bathing method for infants (Çaka & Gözen, 2018; Rudhiati & Murtiningsih, 2022), focusing on the physiological and stress-related effects of sponge bathing, showering, tub bathing, and swaddle bathing (de Freitas et al., 2018; Edraki et al., 2014; Huang et al., 2022; Kim & Park, 2012), as well as the ideal timing of the first bath (Çınar et al., 2020; Karakul & Doğan, 2020; Kelly et al., 2018; Priyadarshi et al., 2022). While evidence suggests that delaying the first bath and utilizing the swaddle tub method reduces stress (Nitzachon, 2022; Warren, 2018) and promotes physiological stability (Suchy et al., 2018), there is limited research investigating the specific effects of the head-washing sequence. Studies by So et al. (2014) and Mohamed et al. (2018) found that washing the head last had a positive effect; however, these studies involved variations in both technique and duration, making it difficult to isolate the impact of the washing sequence alone (Mohamed et al., 2018; So et al., 2014).

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In traditional Turkish bathing practices, washing the head first is generally preferred. However, clinical observations suggest that infants remain calmer and demonstrate higher tolerance when the head is washed last. Consequently, there is a need for evidence-based research to evaluate the effect of head-washing order on stress and physiological parameters. This study aims to determine the effect of two different head-washing sequences within the swaddle tub bathing method on the stress levels and physiological parameters of term infants. To ensure a direct comparison, the bathing procedure was identical for both groups, differing only in the timing of head washing (Mohamed et al., 2018; So et al., 2014).

Study hypotheses

The stress levels and physiological parameters of infants are similar in bathing methods in which the head is washed first and those when it is washed afterwards (H_0). Infants whose heads are washed afterwards have lower stress levels than infants whose heads are washed first (H_1). Infants whose heads are washed afterwards become calmer more quickly than infants whose heads are washed first (H_2). The physiological parameters of infants whose heads are washed afterwards are less affected than those of infants whose heads are washed first (H_3).

Methods

Study design and sample

The population of the study consisted of infants born between July 18, 2023, and September 20, 2023, in a training and research hospital in Istanbul. The sample comprised 104 healthy term infants born at this hospital within the specified dates who met the inclusion criteria and whose mothers provided informed consent. The sample size was determined using power analysis based on a study by Mohamed et al. (2018). For the calculated effect size ($f = 0.128$), the minimum sample size was determined as 86, with a statistical power level of 80.4 % and a significance level of 5 %. Considering a potential attrition rate of 20 %, the final sample size was set at 104 infants (52 per group). The infants were randomly assigned into two groups via computer-aided randomization (https://www.random.org/lists/): Group 1, infants whose heads were washed first, followed by their bodies; and Group 2, infants whose bodies were washed first, followed by their heads. The study flowchart was prepared in accordance with the CONSORT-SPI 2018 guidelines, and the study adhered to the EQUATOR Network guidelines, specifically utilizing the Child-Centered Research Checklist (CCRC) to enhance the design and reporting (Foster et al., 2024).(See Fig. 1.).

Inclusion criteria

The inclusion criteria were as follows: a gestational age between 37 and 42 weeks, a birth weight between 2.5 and 4 kg, stable skin condition, a minimum interval of 1 h since the last breastfeeding, 1st and 5th minute APGAR scores >7, the absence of any health complications, and stable vital signs. During the initial period of the study, 169 infants were screened for eligibility. Sixty-two infants were excluded for not meeting the inclusion criteria: 23 weighed over 4000 g, 19 weighed less than 2500 g, 11 had a 1st minute APGAR score below 7, and 9 were preterm. Additionally, the parents of three infants declined to participate. Consequently, the study was completed with 104 infants, with 52 assigned to the experimental group and 52 to the control group.

Exclusion criteria

Infants who were bathed immediately after delivery due to meconium-stained skin, who had various health problems (neonatal jaundice, respiratory stress syndrome, bacterial, fungal, or viral infections, congenital anomalies, etc.), premature infants, infants with a low birth weight, and infants whose parents refused to participate in the study were excluded.

Data collection tools

Data collection form

The data collection form was developed by the researcher and the advisor based on the literature and consisted of a total of 40 items (37 open-ended and three closed-ended), reflecting maternal and infant characteristics (Bedwell et al., 2009; Gathara et al., 2018; Huang et al., 2022). The form was designed to record the demographic, obstetric, and medical information of the mothers who agreed to participate in the study, the demographic and medical information of the newborn included in the study, their physiological parameters, and their calming down time.

Newborn Stress Scale (NSS)

The Newborn Stress Scale (NSS) was developed by Ceylan and Bolışık, 2017b to assess stress levels in neonates. The scale evaluates eight parameters: facial expression, body color, respiratory rate, activity level, comfort, muscle tone, extremities, and posture. Assessments are conducted via observation using a three-point Likert-type scale, comprising 24 items across eight sub-dimensions. Each sub-dimension is scored from 0 to 2, with total scores ranging from 0 to 16; higher scores indicate increased stress levels. The content validity index of the scale ranged between 0.90 and 1.00, and the Cronbach's alpha coefficient was between 0.65 and 0.81. Interobserver reliability analysis yielded kappa values between 0.83 and 1.00 before care, 0.89 and 1.00 during care, and 1.00 after care (Ceylan and Bolışık, 2017a; Ceylan & Bolışık, 2017b).

Data collection method

The researchers obtained information about the mother from medical records and information about the infant from the infant file and recorded it on the data collection form. The infants were bathed by the same practitioner (the researcher) to ensure consistency. The NSS scores were independently determined by two different observers before, during, and after bathing. The heart rate and oxygen saturation of the newborns were recorded on the data collection form by the observer at baseline and post-intervention. Pulse rate and oxygen saturation were measured with a pulse oximetry monitor using a probe attached to the wrist of the right hand. Body temperatures were measured and recorded by the observer before, immediately after, 1 min, 5 min, 15 min, and 30 min after the application. Body temperature was measured transcutaneously with a non-contact infrared thermometer. A digital stopwatch was used to measure the duration of the bathing and the time it took for the infant to achieve a calm state. To measure the bath time, the first stopwatch was started as soon as the bath began. As soon as the bath was over, the first stopwatch was stopped and the second stopwatch was started. When the infant had achieved a calm state, the second stopwatch was stopped, and the time it took the infant to become calm was recorded.

Bathing procedure

In both bathing methods, the room temperature was maintained at 26–27 °C, in accordance with the literature, to prevent hypothermia; additionally, all doors and windows were closed to eliminate airflow (Bedwell et al., 2009; Gathara et al., 2018; Huang et al., 2022). The bath water temperature was regulated at 37–38 °C, as supported by previous studies (Ceylan & Bolışık, 2022; Karakul & Doğan, 2020; Priyadarshi et al., 2022; So et al., 2014). Prior to the procedure, all necessary equipment was prepared, and the practitioner performed hand hygiene. Facial and hair hygiene for all infants in the experimental and

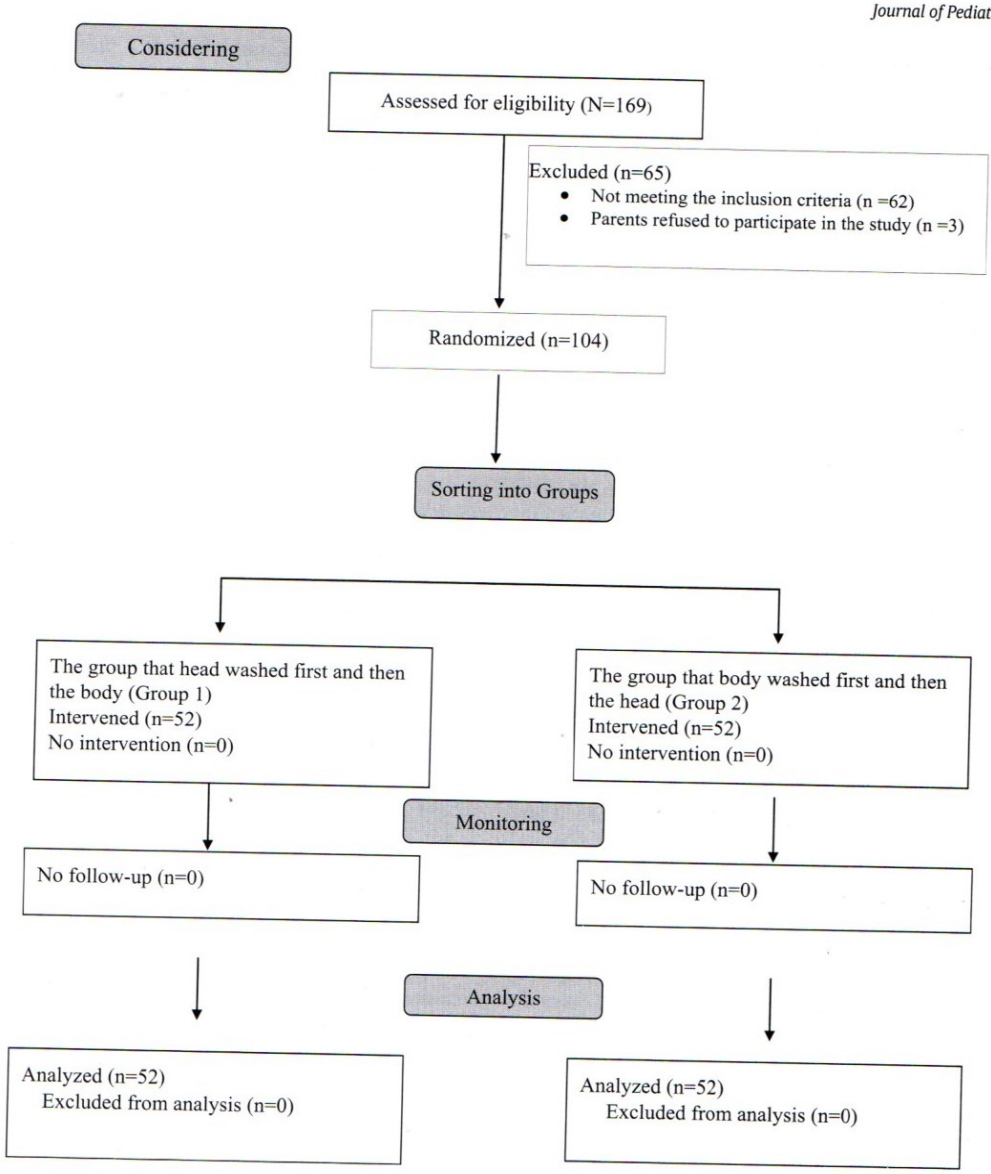

Fig. 1. Flow Diagram of the Study (CONSORT 2018).

control groups was maintained using a pH-neutral baby shampoo free from SLS, parabens, alcohol, or perfume. Following clinical recommendations, only infants who had completed their first 24 hours of life were included in the study (Association of Women's Health, Obstetric and Neonatal Nurses, 2018; Çaka & Gözen, 2018; Karakul & Doğan, 2020; Taşdemir & Efe, 2019). Before the bath, the infants' body temperatures were recorded via a non-contact infrared forehead thermometer, while heart rate and oxygen saturation were monitored using a pulse oximeter on the right wrist. Baseline stress levels were independently evaluated by two observers using the NSS. If necessary, perineal cleaning was performed before the procedure. The infants were then disconnected from the monitors, the water temperature was verified, and a stopwatch was started at the exact onset of the bath.

The researchers ensured that the total bath duration did not exceed 5 min for either group (Çaka & Gözen, 2018). Upon completion of the bath, the first stopwatch was stopped and the duration was recorded. Simultaneously, a second stopwatch was started to measure the time to calm, and the immediate post-bath body temperature was recorded. As described in the literature, infants in both groups were gently dried from head to toe with a clean towel without friction, fitted with a hat, and kept wrapped in a dry towel for 10 min before being dressed (Ar & Gözen, 2018; Ceylan & Bolışık, 2022). Body temperatures were recorded at immediate post-bath, and at the 1st, 5th, 15th, and 30th minutes. Once the infant achieved a calm state, the second stopwatch was stopped. At this stage, heart rate and oxygen saturation were remeasured by reconnecting the preductal probe to the right wrist. All equipment (bathtub, bucket, bowl) was disinfected before and after each application.

Implementation steps for both groups

Infants were placed in the bathtub in a flexion position and wrapped in a thin sheet, with their extremities maintained at the midline. The entire body was slowly immersed up to the shoulders in water 7–8 cm deep at the pre-regulated temperature. The practitioner supported the infant's head by placing one arm underneath, maintaining a secure hold at the axilla, while the infant's nape rested on the practitioner's forearm. The other hand was used to support the infant's lower extremities or buttocks as the body was fully immersed. The study groups were distinguished by the procedural sequence: In Group 2, infants were

washed using the swaddle tub bathing method where the body was washed first, followed by the head. Conversely, in Group 1, the head was washed and dried first, after which the infants were placed in the water-filled tub to have their bodies washed using the same swaddle tub bathing technique.

Data analysis

The study data were analyzed using the IBM SPSS Statistics Standard Concurrent User V 26 (IBM Corp., Armonk, New York, USA) software. Descriptive statistics are given as number of units (n), percentage (%), mean (X), standard deviation (SD), median (M), minimum (min), and maximum (max) values. The distribution normality of the numerical variables was evaluated by the Shapiro-Wilk normality test. Since the numerical descriptive characteristics and variables were normally distributed, parametric tests were employed. Independent Sample *t*-tests were used in the comparison of numerical descriptive characteristics of the patients between groups, while chi-square tests (Pearson chi-square/Fisher exact test) were employed in the comparison of categorical descriptive features between groups. Inter-rater agreement (reliability) was examined with the Intra-Class Correlation Coefficient (ICC). A mixed ANOVA was used to compare stress level, calming time, and physiological parameters by follow-up times in the groups. In the analyses, Bonferroni correction was used for the comparison of main effects, and $p < 0.05$ was considered statistically significant.

Ethical issues

Institutional and Ethics Committee approvals were obtained for the study (Date/Number: 02.05.2023/E-74555795-050.01.04-686,412). The research was conducted in accordance with the ethical framework of the Convention on the Rights of the Child and the Declaration of Helsinki. Research data were collected in accordance with the principle of confidentiality. Mothers of the infants who met the inclusion criteria were informed about the study, and their written consent was obtained through an Informed Voluntary Consent Form. The researchers obtained permission from the corresponding author to use the NSS in the present study. The study was registered on clinicaltrials.gov, and an ID number was obtained to ensure transparency (ClinicalTrials.gov ID: NCT06166485).

Results

Comparison of the groups according to demographic and descriptive characteristics

The infants in Group 1 and Group 2 were similar in terms of descriptive characteristics (maternal age, education, mode of delivery, sex of the infant, gestational age, birth weight, 1st and 5th minute APGAR score) and the physical conditions of the environment where they were bathed (room temperature, bath water temperature, bath duration), which may affect stress levels and physiological parameters ($p > 0.05$) (Table 1). Comparisons related to demographic characteristics are discussed in detail in Table 1.

Comparison of the groups according to stress levels and calming times

When the groups were compared in terms of stress scores, it was observed that the stress scores were similar 1 min before the procedure ($p = 0.065$). During and 1 min after the bath, according to both observersevaluations, the stress scores of the infants in Group 1 (during the procedure: first observer (5.62 ± 1.43); second observer (6.12 ± 1.45); 1 min after the procedure: first observer (2.52 ± 1.11); second observer (2.85 ± 1.13)) were significantly higher ($p < 0.001$) than those of the infants in Group 2 (during the procedure: first observer (3.67 ± 1.31); second observer (3.27 ± 1.42); 1 min after the procedure: first observer (1.02 ± 1.23); second observer (1.10 ± 1.14)). In addition, the post-procedure stress scores of Group 1 were statistically significantly higher ($p < 0.001$) than the pre-procedure stress scores, whereas the pre- and post-procedure stress scores of the infants in Group 2 were statistically similar ($p > 0.05$). Interobserver agreement (reliability) analysis of the stress scores determined by the two observers showed a statistically high level of agreement (pre-procedure: 99.7 %/during the procedure: 94.3 %/post-procedure: 83 %). When the groups were compared in terms of calming times, it was found that the time it took the babies in Group 2 to become calm (4.31 ± 1.55 min) was shorter than that for the babies in Group 1 (6.88 ± 2.92 min) ($p < 0.001$) (Table 2).

Table 1
Comparison of Descriptive Characteristics of Infants and Parents and Some Characteristics of Bathing Practice by Groups ($N = 104$).

Group	Group1 ($n = 52$)	Group2 ($n = 52$)	Test(p)
Mother's age, (*years*)	$X \pm SD$ (min-*max*)	$X \pm SD$ (*min*-max)	
	28.98 ± 4.67 (21–40)	28.15 ± 4.87 (19–37)	$t = 0.883$
Mother's education	*n* (%)	*n* (%)	
Primary school and below	7 (13.5)	4 (7.7)	$\chi^2 = 2.195$
Secondary education	31 (59.6)	38 (73.1)	$p = 0.334$
University	14 (26.9)	10 (19.2)	
Method of delivery	*n* (%)	*n* (%)	
Normal Birth	31 (59.6)	24 (46.2)	$\chi^2 = 1.891$
Cesarean Section Birth	21 (40.4)	28 (53.8)	$p = 0.169$
Sex of the baby	*n* (%)	*n* (%)	
Male	27 (51.9)	19 (36.5)	$\chi^2 = 2.495$
Female	25 (48.1)	33 (63.5)	$p = 0.114$
	$X \pm SD$ (*min-max*)	$X \pm SD$ (*min-max*)	
Gestational age (*weeks*)	38.79 ± 1.05 (37–41)	38.73 ± 1.12 (37–41)	$t = 0.270$ $p = 0.788$
Birth weight (*g*)	3302.44 ± 284.14 (2890–3950)	3277.79 ± 301.64 (2500–3925)	$t = 0.429$ $p = 0.669$
1st-minute Apgar score	7.13 ± 0.34 (7–8)	7.10 ± 0.30 (7–8)	$t = 0.609$ $p = 0.544$
5th-minute Apgar score	9.00 ± 0.00 (9–9)	9.00 ± 0.00 (9–9)	–
Room Temp. (°C)	26.26 ± 0.16 (26–27)	26.25 ± 0.21 (26–27)	$t = 0.258$ $p = 0.797$
Water temp. (°C)	37.25 ± 0.18 (36.5–37.6)	37.31 ± 0.25 (36.8–37.9)	$t = -1.274$ $p = 0.206$
Bath time (*min.*)	3.69 ± 0.64 (3–6.3)	3.60 ± 0.50 (3–4.2)	$t = 0.848$ $p = 0.398$

Note. Values are presented as mean ± standard deviation (SD), minimum (min)–maximum (max), or number (percentage). Independent samples t-test (t) and chi-square (χ^2) test were used for comparisons.

Comparison of the groups according to physiological parameters

It was observed that the mean body temperatures of the infants were similar before the procedure ($p > 0.05$), while the mean body temperatures of the infants in Group 2 were statistically significantly higher than those in Group 1 immediately after the procedure and at the 1st, 5th, 15th, and 30th minutes after the procedure ($p < 0.001$). While no significant difference was found between the groups in terms of mean heart rate and oxygen saturation before the bath ($p > 0.05$), it was determined that after the bath application, the mean heart rate of the infants in Group 2 was significantly lower than those in Group 1 ($p < 0.001$), and their oxygen saturation was significantly higher ($p = 0.045$) (Table 3).

Discussion

The descriptive and demographic characteristics of the mothers and children were found to be similar ($p > 0.05$). Comparing the stress

Table 2
Comparison of stress levels and calming times of infants according to groups (N = 104).

Stress score	Group1 (n = 52)	Group2 (n = 52)	Test Statistics†
1st Observer			
1 min. Before the process	1.31 ± 1.08 ^{c}	0.92 ± 1.03 ^{c}	$F = 3.479$ $p = 0.065$ $\eta^2 = 0.033$
During the process	5.62 ± 1.43^{a}	3.67 ± 1.31^{b}	**$F = 52.176$ $p < 0.001$ $\eta^2 = 0.338$**
1 min. After the process	2.52 ± 1.11^{b}	1.02 ± 1.23 ^{c}	**$F = 42.633$ $p < 0.001$ $\eta^2 = 0.295$**
Test Statistics$^{\varphi}$	**$F = 252.688$ $p < 0.001$ $\eta^2 = 0.833$**	**$F = 135.127$ $p < 0.001$ $\eta^2 = 0.728$**	
Statistical model	**Group Effect:** $F = 45.633$ $p < 0.001$ $\eta^2 = 0.309$		
	Time Effect: $F = 465.088$ $p < 0.001$ $\eta^2 = 0.820$		
	Group X Time Effect: $F = 21.258$ $p < 0.001$ $\eta^2 = 0.172$		
2nd Observer			
1 min. Before the process	1.32 ± 1.09 ^{c}	0.92 ± 1.03 ^{c}	$F = 3.479$ $p = 0.065$ $\eta^2 = 0.033$
During the process	6.12 ± 1.45^{a}	3.27 ± 1.42^{b}	**$F = 102.524$ $p < 0.001$ $\eta^2 = 0.501$**
1 min. After the process	2.85 ± 1.13^{b}	1.10 ± 1.14 ^{c}	**$F = 61.862$ $p < 0.001$ $\eta^2 = 0.378$**
Test Statistics$^{\varphi}$	**$F = 289.273$ $p < 0.001$ $\eta^2 = 0.851$**	**$F = 81.790$ $p < 0.001$ $\eta^2 = 0.618$**	
	Group Effect: $F = 92.286$ $p < 0.001$ $\eta^2 = 0.475$		
Statistical model	**Time Effect:** $F = 342.716$ $p < 0.001$ $\eta^2 = 0.771$		
	Group X Time Effect: $F = 37.352$ $p < 0.001$ $\eta^2 = 0.268$		
Calming time, (*min.*)			
X ± SD	6.88 ± 2.92	4.31 ± 1.55	**$t = 5.609$ $p < 0.001$**
M (min-max)	6.3 (2.1–15)	4.1 (1.4–8.6)	

Note. Values are presented as mean ± SD, min–max. Superscript letters (a > b > c) indicate significant differences between time points within the same group ($p < 0.05$). † Between-group comparison; φ Within-group comparison. Statistical analyses: Repeated measures ANOVA, effect size (η^2) values reported. *p* < 0.05 considered statistically significant and presented in bold.

levels and calming times of the infants, it was seen that those whose body was washed first were less stressed during the bathing and afterwards and that their calming times were shorter ($p < 0.001$). In addition, it was observed that the pre- and post-bath stress levels of the infants whose heads were washed afterwards were similar ($p > 0.05$).

Studies on infant bathing have generally focused on the effects of wiping, showering, and the bathing and swaddling methods (de Freitas et al., 2018; Edraki et al., 2014; Huang et al., 2022; Kim & Park, 2012), and have attempted to find the ideal bathing time (Greener, 2016; Kelly et al., 2018; Priyadarshi et al., 2022). However, only a limited

Table 3
Comparison of physiological parameters of infants according to groups (N = 104).

Body Temperature	(°C)		
1 min before the process	36.55 ± 0.24^{a}	36.63 ± 0.19^{a}	$F = 3.430$ $p = 0.067$ $\eta^2 = 0.033$
Immediately after the procedure	35.63 ± 0.28 ^{f}	36.01 ± 0.21^{d}	**$F = 61.485$ $p < 0.001$ $\eta^2 = 0.376$**
1 min after the procedure	35.86 ± 0.35^{e}	36.29 ± 0.27^{c}	**$F = 47.654$ $p < 0.001$ $\eta^2 = 0.318$**
5 min after the procedure	36.03 ± 0.27 ^{d}	36.36 ± 0.25^{bc}	**$F = 42.483$ $p < 0.001$ $\eta^2 = 0.294$**
15 min after the procedure	36.28 ± 0.25^{c}	36.43 ± 0.23^{b}	**$F = 10.425$ $p = 0.002$ $\eta^2 = 0.093$**
30 min after the procedure	36.36 ± 0.25 ^{b}	36.52 ± 0.21^{a}	**$F = 13.069$ $p < 0.001$ $\eta^2 = 0.114$**
Test Statistics$^{\varphi}$	**$F = 131.332$ $p < 0.001$ $\eta^2 = 0.870$**	**$F = 71.892$ $p < 0.001$ $\eta^2 = 0.786$**	
	Group Effect: $F = 50.675$ $p < 0.001$ $\eta^2 = 0.332$		
Statistical model	**Time Effect:** $F = 215.873$ $p < 0.001$ $\eta^2 = 0.679$		
	Group X Time Effect: $F = 14.054$ $p < 0.001$ $\eta^2 = 0.121$		
Heart rate/min			
1 min. Before the process	124.63 ± 2.00	124.87 ± 2.55	$F = 0.263$ $p = 0.609$ $\eta^2 = 0.003$
1 min. After the process	144.62 ± 6.51	124.10 ± 2.48	**$F = 451.181$ $p < 0.001$ $\eta^2 = 0.816$**
Test Statistics$^{\varphi}$	**$F = 860.008$ $p < 0.001$ $\eta^2 = 0.894$**	$F = 1.275$ $p = 0.262$ $\eta^2 = 0.012$	
	Group Effect: $F = 306.663$ $p < 0.001$ $\eta^2 = 0.750$		
Statistical model	**Time Effect:** $F = 397.532$ $p < 0.001$ $\eta^2 = 0.796$		
	Group X Time Effect: $F = 463.750$ $p < 0.001$ $\eta^2 = 0.820$		
Oxygen saturation			
1 min. Before the process	99.06 ± 0.98	99.37 ± 0.66	$F = 3.542$ $p = 0.063$ $\eta^2 = 0.034$
1 min. After the process	98.90 ± 1.01	99.25 ± 0.68	**$F = 4.166$ $p = 0.045$ $\eta^2 = 0.039$**
Test Statistics$^{\varphi}$	**$F = 6.253$ $p = 0.014$ $\eta^2 = 0.058$**	$F = 3.517$ $p = 0.064$ $\eta^2 = 0.033$	
	Group Effect: $F = 4.134$ $p = 0.045$ $\eta^2 = 0.039$		
Statistical model	**Time Effect:** $F = 9.575$ $p = 0.003$ $\eta^2 = 0.086$		
	Group X Time Effect: $F = 0.195$ $p = 0.659$ $\eta^2 = 0.002$		

Note. Values are presented as mean ± SD. Superscript letters (a > b > c) denote significant differences between time points within the same group ($p < 0.05$). † Between-group comparison; φ Within-group comparison. Statistical model: Mixed-design ANOVA. *p* < 0.05 considered statistically significant and presented in bold.

number of studies has looked at the effect of the order in which bathing is carried out in (washing the head before the body or washing the body before the head) on stress and physiological parameters. In Huang et al.'s (2022) randomized controlled study with premature infants, one group had a traditional bathtub bath with the head washed before the body, while the other group was subject to the swaddle tub bathing method, in which the body was washed before the head; and it was observed that the stress levels of the infants whose body and then head were washed with the swaddle tub bathing method were lower (Huang et al., 2022). The randomized controlled experimental study conducted by Edraki et al. (2014) with premature infants compared the effects of swaddle bathing, in which the head is washed last, and traditional bathtub bathing, in which the head is washed first, on the body temperature and crying times of infants. They determined that the babies whose heads were washed later had shorter calming times (Edraki et al., 2014).

Contrary to our study, these two studies were conducted with premature infants. In addition, in the present study, all the stages of bathing except the order in which the head and body were washed were implemented in exactly the same manner in both groups. In the studies of Edraki et al. and Huang et al., there were differences between the groups in terms of methods used, except for the order of head bathing. Therefore, the results of the present study provide stronger evidence for the effect of the order in which the head is bathed on infants' stress levels and calming times. The results of the present study are similar to the results of these two studies of preterm infants, and suggest that term infants better tolerate bathing when the head is washed at the end. In a randomized controlled experimental study conducted by Çınar et al. (2020) with healthy term infants, it was determined that infants bathed using the swaddling tub bath method, where the body is washed first followed by the head, had lower stress levels (Çınar et al., 2020). On the other hand, Çaka and Gözen found that the physiological parameters of infants whose bodies were washed prior to their heads using a wrap-around tub bath were more positively affected and that these infants had lower stress levels. In these two studies, swaddling and traditional tub bathing were compared, and in both groups, the infants' bodies were washed first, followed by their heads. Therefore, the results reflect the effects of the swaddling tub bathing method rather than the effects of the order in which the head was washed. In the present study, the infants in both groups were bathed with the swaddle tub bathing method as supported by the literature, and only the sequence in which the head was washed was changed. The aim of this procedure was to maximize the comfort of both groups.

In the present study, when the physiological parameters (body temperature, heart rate, O_2 saturation) of the infants in each group were compared, it was found that the body temperature of the infants whose bodies were washed first (Group 2) was significantly higher immediately after the procedure (Group 1: 35.63 ± 0.28 / Group 2: 36.01 ± 0.21) ($p < 0.001$). Although the body temperature returned to pre-bath values 30 min after the procedure in Group 2 (36.52 ± 0.21), it remained significantly lower than the initial value in Group 1 (36.36 ± 0.25, $p < 0.05$). In addition, the heart rate of the infants whose heads were washed after their bodies was significantly lower ($p < 0.001$), and oxygen saturations were significantly higher ($p = 0.044$) immediately after the procedure. Infants whose heads were bathed after their bodies had lower stress levels and calmed down more quickly, which may have contributed to better stabilization of heart rate and oxygen saturation.

So et al. (2014) compared the effects of immersion bathtub bathing, in which the head was washed last, and swaddle bathing, in which the head was washed first, on the temperatures of healthy term infants, and determined that, although the temperature decreased in both groups, the temperature of those infants whose heads were washed second returned to normal more quickly. There was no significant difference between the groups in terms of oxygen saturation and heart rate (So et al., 2014). In Mohamed et al.'s (2018) randomized controlled study with term infants, one group was bathed 1–2 h after birth (body first and then the head), while the other group were bathed 4–6 h after birth (head first and then the body). It was determined that body temperature, heart rate, and oxygen saturation levels were more positively affected in infants whose bodies were washed before their heads, compared to infants whose heads were washed first (Mohamed et al., 2018).

In a randomized controlled experimental study with premature infants, Huang et al. (2022) compared the effects of traditional bathtub bathing in which the head was washed first, and swaddle bathing in which the head was washed afterwards, on the body temperature of infants and found that although the body temperature of the infants in both groups decreased, the body temperatures of the infants whose heads were washed afterwards were higher and their heart rates were lower 10 min after the procedure compared to the infants whose heads were washed first. It was determined that the oxygen saturation of the infants whose bodies were washed first using swaddle bathing was higher than that of the infants whose heads were washed first using the traditional bathing method. In these studies, there were differences between the bathing methods of the two groups in terms of the time and method of application, as well as the order in which the head was washed. In the present study, the two bathing methods were exactly the same except for the order of washing the head. It is thus considered that the present study more accurately reflects the effects of the order in which the head was washed. The results of the study may update the knowledge of healthcare professionals, especially midwives and nurses who care for newborns, regarding bathing practices and enrich the literature on infant bathing techniques. Furthermore, the findings can contribute to evidence-based discussions for nurses and midwives to make informed decisions regarding the order of washing the head. Based on the study findings, it is suggested that washing the baby's head last to help them calm down more quickly and be less affected by the bathing process.

This study is the first randomized controlled experimental trial to reveal the effect of the order in which the head is washed on infants' stress levels, calming times, and physiological parameters. However, it is insufficient to base a decision to change the bathing practice in this direction solely on the results of a single study. Therefore, more well-designed randomized controlled trials are needed to demonstrate the full effect of this practice on variables such as stress level, calming time, and physiological parameters. Based on these study results, it may be recommended to consider washing the head last during baby bath time as the primary option. In addition, as demonstrated in other randomized controlled trials, it is recommended that the bathing practice be administered using the swaddle tub bathing method.

Strengths of the study

This study represents the first randomized controlled experimental trial conducted with healthy term infants to investigate the effect of the sequence of head washing on stress levels, calming times, and physiological parameters. A key strength is that by maintaining identical conditions across both groups, except for the washing sequence, the study provides robust evidence specifically attributable to the order of the procedure.

Limitations of the study

Several limitations warrant consideration. During the pilot study, it was observed that moisture prevented the secure attachment of pulse oximetry probes to infants' wrists during the bath. Furthermore, body temperature could not be accurately monitored during the procedure, and respiratory rate could not be determined due to the swaddling technique. Preliminary assessments indicated that measuring these

parameters during the bath would require a cessation of the procedure, thereby inadvertently prolonging the duration. Therefore, physiological parameters were not evaluated intra-procedurally. While infants were randomly assigned to groups and demographic characteristics were comparable, individual biological differences or unpredictable environmental fluctuations may have exerted a negligible effect on stress levels and physiological responses.

Implications for clinical practice

The findings of this study offer important evidence-based insights into neonatal care, suggesting that modifying the bathing sequence specifically deferring head washing until the end serves as a cost-effective, non-pharmacological intervention to preserve physiological stability and minimize procedural stress in term newborns. Integrating this sequence into standard neonatal nursing protocols can enhance the quality of neonatal care without requiring additional resources. Furthermore, these results provide a practical framework for developing clinical guidelines that prioritize neonatal comfort and neurodevelopmentally supportive care during routine hygiene practices.

Recommendations for clinical practice

Healthcare providers should prioritize washing the head last, as this study demonstrates its superior efficacy in stabilizing physiological parameters and mitigating stress levels. These findings serve to update the clinical competencies of healthcare professionals, especially midwives and nurses specializing in newborn care. It is recommended that clinicians educate and provide training to families regarding evidence-based bathing techniques, emphasizing the benefits of the "body-first" approach.

Recommendations for future research

It is recommended that further randomized controlled trials be conducted to examine the effect of the head-washing sequence on the stress levels, calming times, and physiological parameters of preterm infants. Additionally, large-scale, multicenter randomized controlled trials are warranted to validate, expand upon, or challenge the findings of this study across diverse neonatal populations.

Conclusion

In conclusion, this study demonstrates that infants achieve calming in a shorter time and experience significantly less stress when the head is washed after the body. Furthermore, the physiological parameters (body temperature, oxygen saturation, and heart rate) remain more stable and are less affected when cranial washing is deferred to the end of the procedure, compared to the traditional sequence of washing the head first.

Contributions of the corresponding author

Specialist Midwife Ayşe Dilan Koçak was responsible for the conceptualization and design of the study, data collection, statistical analyses, and manuscript drafting. Additionally, she coordinated the submission and revision process of the manuscript.

Contributions of the advisor

Prof. Dr. Sevil İnal provided academic supervision throughout the research process, contributed to the study design and methodology, and reviewed and revised the manuscript to ensure its academic integrity. The advisor also provided critical insights to enhance the scientific quality of the study.

Declaration of Submission

This work has not been previously published in the form of a preprint, abstract, published lecture, academic thesis, or registered report. The article has not been submitted for evaluation to be published elsewhere. The publication of this article has been explicitly approved by all authors and by the relevant authorities at the institution where the research was conducted. If accepted, the article will not be published elsewhere in the same form, in English or in any other language, including electronically, without the written consent of the copyright holder.

CRediT authorship contribution statement

Ayşe Dilan Koçak: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Sevil Inal:** Writing – review & editing, Validation, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Authorship

The authors have made significant contributions to the study's conception and design, data acquisition, data analysis and interpretation, and manuscript preparation and revision.

The authors must designate a corresponding author who will communicate with the journal throughout the editorial process. All authors agree to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the study are appropriately investigated and resolved.

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Declaration of competing interest

The authors declare no conflict of interest related to this manuscript.

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