Original Investigation

Timing of Post-bath Skin Moisturizer Application to Newborn Infants: A Randomized Controlled Study

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ABSTRACT

OBJECTIVE: To investigate whether the timing of postbath moisturizer application affected the skin moisture (SM) and body temperature (BT) of newborn infants.

METHODS: The researchers conducted a randomized controlled study with 80 newborns who were monitored in a university hospital between March 2017 and May 2018. In both the control and experimental groups, newborns were bathed and dried. However, in the control group, moisturizer was applied immediately to the newborn's body, whereas in the experimental group, moisturizer was applied 10 minutes after the completion of the bath. Researchers evaluated the BT and SM of all infants both before and immediately after the bath and at 10, 20, 40, and 60 minutes postbath.

RESULTS: The control and experimental groups were similar according to the descriptive characteristics of the infants ($P > .05$). In both groups, infants' SM values increased in the first 10 minutes after the bath compared with the prebath values ($P < .05$). However, the whole-body SM value of the experimental group was significantly higher than that of the control group 60 minutes postbath ($P = .027$). There was also a statistically significant change in the body temperatures of infants in both groups after bathing ($P = .004$).

CONCLUSIONS: Waiting 10 minutes postbath before applying moisturizer positively affected newborns' SM and BT. Additional research with a broader age range and a more diverse sample is needed to further clarify the effects of postbath moisturizer application timing on newborns' SM and BT.

KEYWORDS: bath, body temperature, moisturizer, newborn, skin moisture

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INTRODUCTION

Skin plays an important barrier role in maintaining internal moisture balance by preventing water loss. The development of the skin barrier function in term infants continues up to 12 months after birth.[1,2] Transepidermal water loss (TEWL) is common in newborns, especially after bathing. Most TEWL occurs through evaporation and respiration from immature skin.[3,4] Decreased skin moisture (SM) causes the epidermal barrier to weaken, thus increasing TEWL. Therefore, it is important to maintain SM to preserve skin barrier function.[5–8] In particular, the thickness of the stratum corneum (SC), the outermost layer of the epidermis, is inversely proportional to the fluid permeability of the skin. The SC layer prevents heat loss and TEWL.[2,7]

Topical moisturizers form a layer on the skin surface to prevent water loss from subcutaneous tissue and support hydration. They also maintain subcutaneous tissue integrity and help prevent hypothermia by improving barrier function.[3,6,9,10] In this study, the authors used a randomized controlled experimental design to determine whether infants' SM or body temperature (BT) varied depending on the timing of moisturizer application after bathing.

METHODS

Study Population and Sample

Study participants were infants who were cared for in the full-term nursery of Istanbul Medipol University Hospital between March 2017 and May 2018. Researchers conducted a power analysis (G*Power 3.1.9.2) using a previous similar study as the basis[11] and determined that a minimum of 36 newborns needed to be included in each group (experimental and control) for power = 0.95, $\beta = .20$, and $\alpha = .05$ when they took $\Delta = 0.784$. To account for possible case losses, the researchers included 40 newborns in each group (N = 80 newborns total; Figure). Randomization was determined using the urn method[12] to ensure that infants were distributed randomly to both groups (Figure).

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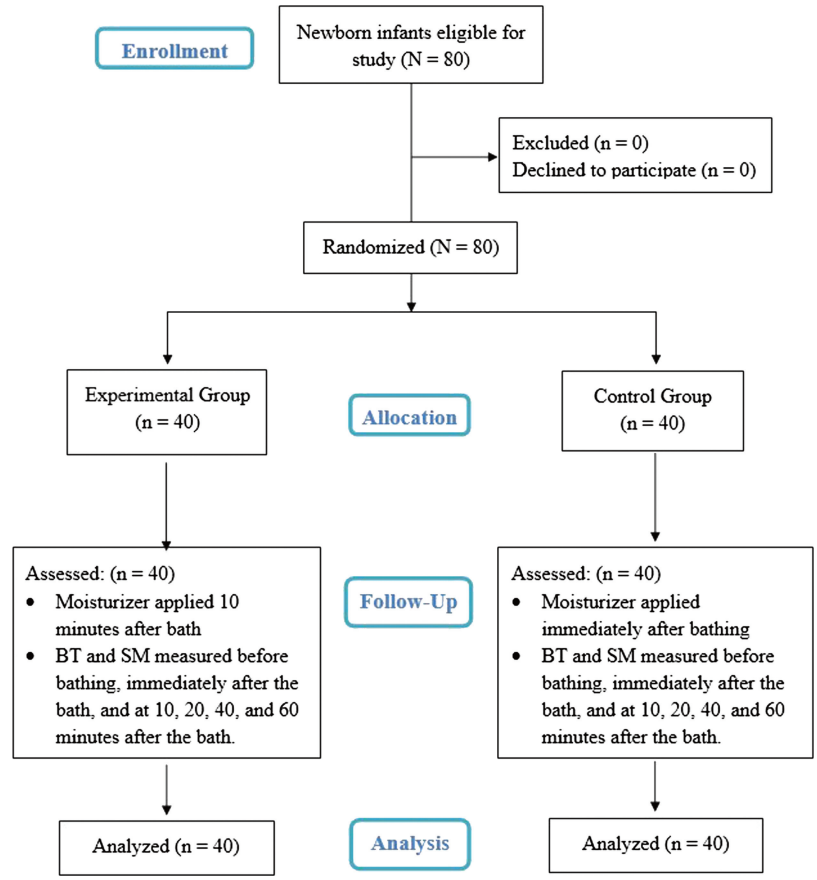
Figure. CONSORT FLOW DIAGRAM



Abbreviations: BT, body temperature; SM, skin moisture.

Inclusion Criteria

Newborns were included in this study if

- at least 24 hours had passed since their birth, and their vital signs were within normal limits;
- the attending physician determined they were healthy;
- they were born 37 weeks' gestation or longer;
- their birth weight was ≥2,500 g or higher;
- at least 1 hour had passed since their last feeding;
- their 1- and 5-minute minute Apgar scores were 7 or higher;
- they scored 3 points on the Neonatal Skin Condition Scale (NSCS) indicating healthy skin; and
- their parents provided informed consent to participate.

Data Collection Forms

Descriptive information form. This form was created by the researchers to record infants' birth data: gestational week; birth weight, length, and head circumference; sex; and APGAR scores.

Observation form. Researchers used this form to record infants' prebath and postbath SM and BT values, environmental conditions (room temperature, room moisture, air movement), and bath variables (depth and temperature of the bath water and bath time). This form also contains a checklist of the materials to be used during the bath: bathtub suitable for newborns, boiled warm water (38 °C), sponge, liquid shower gel with neutral pH, room thermometer to measure room temperature and humidity, SM meter, thermometer, cotton tampons, bath thermometer to measure water temperature, two 100% cotton blankets big enough to swaddle the infant, two towels, hat, diapers, and clean baby clothes.

Neonatal Skin Condition Scale. Neonatal skin condition was assessed with the NSCS. This scale was developed for the Association of Women's Health, Obstetric and Neonatal Nurses/National Association of Neonatal Nurses Neonatal Skin Care Research-Based Practice Project and adapted from a visual scoring system used in a previous study.[13] In a validity and reliability study by Lund and Osborne,[14] interobserver reliability was reported to be between 0.66 and 0.89. This tool was adapted into Turkish by Çalışır et al.[15] Within the scope

of Turkish validity, it was reported that total score correlations between the observers were between 0.72 and 0.88 and statistically significant. The reliability of the scale was determined with within-group correlation coefficients and Cronbach α; the total consistency coefficient between the observers was 0.94 and ranged from 0.92 to 0.94 for each item. The researchers obtained permission from Association of Women's Health, Obstetric and Neonatal Nurses and Çalışır et al to use the NSCS in this study.

Data Collection Tools and Products

Infant thermometer. The HT-812 digital, noncontact laser infrared thermometer (TFA DOSTMANN TFA 30.5002) is a calibrated, noncontact thermometer used to evaluate the temperature of newborns. It can measure temperatures ranging from −50 to 450 °C.

Room thermometer. The calibrated TFA 30.5002 room thermometer (TFA Dostmann) was used to evaluate room temperature and humidity. This device was already available in each hospital room to ensure appropriate environmental conditions (temperature and humidity) for each infant. Room temperature was 26 to 27 °C, and room humidity was 40% to 60%.

Water thermometer. Researchers used the AR857 bathroom thermometer (Arzum) to measure water temperature.

Skin moisture meter. To measure SM loss, researchers used the DMM-Digital Moisture Monitor for Skin (DMM-dmmcilt). The digital SM meter has a fast, reliable, and wide measurement range (0%–99.9%) to determine SM from several anatomical regions.

Bath gel. For bathing, researchers used the standard hospital bath gel that is used to bathe all infants—a colorless, alcohol- and paraben-free baby bath gel with a neutral pH (5.5–7.0).

Liquid petroleum jelly. As moisturizer, 1 mL liquid petroleum jelly moisturizer (Naturel) was gently applied on the infants' entire body except for their heads.

Procedure

Researchers obtained descriptive information from the newborns' file, family members, and physician and recorded it on the data collection form. Nurses washed their hands before preparing materials listed on the observation form. Researchers measured and recorded BT and SM (from regions of forehead, abdomen, back, arm, leg, palm, sole of feet) of the newborns in both groups before the bath.

During bathing, the door of the room was closed to prevent air flow and heat loss due to convection. A nonslip bathtub designed for young infants was placed on a table to prevent excessive bending while bathing the infant and filled with boiled, warm tap water (38 °C).[16] The nurse wore gloves while bathing the infant.

To prevent hypothermia and fear of water when placed into the tub, each infant was first loosely swaddled with a cotton cover and then slowly placed into the tub. The practitioner supported the infant under the shoulder to keep the head elevated. The infant's eyes and face were cleaned with cotton soaked in boiled warm water. Using the bath gel, the infant's right arm, left arm, right leg, left leg, body, back, and hair were washed. Then the cotton cover was removed, and the infant was turned to face the tub. Researchers covered the infant's ears using their index and middle fingers to prevent water from getting into the infant's ears. With the researcher's other hand, the infant's body was rinsed by pouring water from head to toe. After the bath, the newborn was immediately dried with a towel and swaddled with the other dry cotton cover.[5] In both groups, the bath time was less than 5 minutes, and all bath and measurement procedures were carried out by the same neonatal nurse.

Control Group

The standard procedure of the study hospital is to bathe infants 24 hours after birth and then apply a moisturizer immediately. After being dried following their bath, infants in the control group were dressed in a diaper and hat and gently swaddled with a cotton cover. Measurements of SM and BT were then immediately taken from the forehead, abdomen, back, arm, leg, palm, and sole of the foot. Afterward, the researcher gently applied the moisturizer to the infant's whole body. All procedures were conducted in the same room.[1] After 10 minutes had passed, SM and BT measurements were again taken from the forehead, abdomen, back, arm, leg, palm, and sole of the foot. The infant was then dressed in cotton clothes. Additional SM and BT measurements were repeated and recorded from the same parts of the body at 20, 40, and 60 minutes postbath. During these measurements, the infant's clothes were not removed; only the areas of exposed skin were measured.

Experimental Group

After being dried following their bath, infants in the experimental group were also dressed in a diaper and hat and gently swaddled with a cotton cover. Measurements of SM and BT were taken from the forehead, abdomen, back, arm, leg, palm, and soles of the feet. Then, researchers waited for 10 minutes. The baby also rested for 10 minutes. After 10 minutes, SM and BT measurements were taken from the same regions, and moisturizer was applied to the infant's body. As in the control group, the infant was then dressed in cotton clothes, and SM and BT measurements were repeated at 20, 40, and 60 minutes postbath and recorded on the data collection form.

Table 1. COMPARISON OF DESCRIPTIVE CHARACTERISTICS OF INFANTS AND BATH ENVIRONMENT (N = 80)

Features	Experimental Group (n = 40) Mean ± SD (Median)	Control Group (n = 40) Mean ± SD (Median)	*t*	*P*[a]
Gestational age, wk	38.85 ± 1.00	38.84 ± 1.08	0.054	.957
Postnatal age, wk	38.98 ± 1.02	38.95 ± 1.08	0.139	.890
Birth weight, g	3,371 ± 342.54	3,347.75 ± 352.26	0.299	.766
Birth length, cm	50.08 ± 1.54	49.70 ± 1.76	1.014	.314
Birth head circumference, cm	35.00 ± 1.26	35.05 ± 0.85	–0.208	.836
APGAR score (1st minute)	8.18 ± 0.55 (8)	8.03 ± 0.53 (8)	–1.243	.214
APGAR score (5th minute)	9.23 ± 0.48 (9)	9.08 ± 0.47 (9)	–1.376	.169
Room temperature, °C	26.88 ± 0.33	26.88 ± 0.33	0.001	1.000
Humidity level of the room, %	41.68 ± 4.97	40.33 ± 4.43	1.282	.204
Water depth in the bathtub, cm	11.65 ± 0.77	11.78 ± 0.48	–0.872	.386
Bath time, min	3.78 ± 0.42	3.95 ± 0.32	1.945	.052
	n (%)	n (%)	χ^2	*P*[b]
Sex			0.001	1.000
Female	16 (40)	17 (42.5)		
Male	24 (60)	23 (57.5)		
Delivery method			0.894	.344
Vaginal birth	16 (40)	11 (27.5)		
Cesarean birth	24 (60)	29 (72.5)		

[a]Student *t* test.
[b]Continuity (Yates) corrected χ^2 test.

The World Health Organization recommends that newborns not be washed for the first 24 hours after birth; infants can be bathed once their heart rate and temperature become stable.[17] Therefore, all of the infants in this study were bathed 24 hours after birth.

Analysis

Researchers used the SPSS Statistics program (IBM Corp) for statistical analysis. The Shapiro-Wilk test was used to evaluate the compatibility of the variables to a normal distribution. In terms of data assessment, the investigators used descriptive statistics (mean, SD, and frequency) and Student *t* tests to evaluate between-group differences in the normally distributed quantitative data. To evaluate between-group differences of nonnormally distributed quantitative data, researchers used the Mann-Whitney *U* test. The Friedman test was used to evaluate repeated measures, and the Wilcoxon signed rank test was used to determine the measurement causing the difference. Significance was evaluated at the level of $P < .05$. The continuity (Yates) corrected χ^2 test was used to evaluate quantitative data.

Ethical Considerations

Approval for the study was granted by the Clinical Trials Ethics Committee of a university hospital (10840098-604.01.01-E.22403). The parents of the newborns included in the study provided written and verbal informed consent prior to their inclusion in the study.

RESULTS

The control group and experimental group participants did not differ in terms of descriptive characteristics ($P > .05$; Table 1). In addition, the humidity level of the room ($t = 1.282$, $P = .204$), total bath period ($t = 1.945$, $P = .052$), and water depth in the bathtub ($t = -0.872$, $P = .386$) did not differ between groups (Table 1).

When the BT values of the infants in the experimental and control groups were compared, no between-group differences were seen in BT values before the bath, immediately after the bath, or at 10, 20, 40, or 60 minutes postbath ($P > .05$; Table 2). However, there was a statistically significant difference in the prebath versus immediately postbath BT among the infants both in the experimental group ($\chi^2 = 23.327$, $P = .001$) and the control group ($\chi^2 = 17.575$, $P = .001$). Both groups experienced a rise in average BT. In addition, the BT measurement 10 minutes postbath was also significantly higher than the prebath BT in both groups (*P*s < .05; Table 2). However, the average BT values measured at 20 minutes postbath and later did not differ significantly from the prebath average BT in either group (*P*s > .05; Table 2).

Researchers calculated mean SM values by averaging the values measured from the different areas of the body

Table 2. BETWEEN-GROUP COMPARISON OF BODY TEMPERATURE (BT) VALUES (N = 80)

BT Measurement	Experimental Group (n = 40) Mean ± SD (Median), °C	Control Group (n = 40) Mean ± SD (Median), °C	*Z*	*P*[a]
Before bath	36.38 ± 0.27 (36.3)	36.41 ± 0.26 (36.4)	–0.747	.455
Immediately after bath	36.60 ± 0.22 (36.6)	36.53 ± 0.26 (36.5)	–1.560	.119
10 min after bath	36.48 ± 0.23 (36.5)	36.50 ± 0.26 (36.5)	–0.282	.778
20 min after bath	36.48 ± 0.29 (36.4)	36.50 ± 0.27 (36.5)	–0.802	.423
40 min after bath	36.43 ± 0.27 (36.4)	36.46 ± 0.31 (36.4)	–0.098	.922
60 min after bath	36.44 ± 0.32 (36.4)	36.35 ± 0.27 (36.3)	–1.221	.222
χ^2	23.327	17.575		
P[b]	.001[c]	.004[c]		
Before bath—immediately after bath			–1.906	.057
Difference	0.22 ± 0.29 (0.2)	0.12 ± 0.28 (0.1)		
P[d]	.001[c]	.015[e]		
Before bath—10 min after bath			–0.229	.819
Difference	0.10 ± 0.27 (0.2)	0.09 ± 0.30 (0.15)		
P[d]	.011[e]	.045[e]		
Before bath—20 min after bath			–0.024	.981
Difference	0.10 ± 0.32 (0.1)	0.09 ± 0.34 (0.1)		
P[d]	.096	.106		
Before bath—40 min after bath			–0.024	.981
Difference	0.05 ± 0.26 (0)	0.05 ± 0.40 (0)		
P[d]	.460	.543		
Before bath—60 min after bath			–1.403	.161
Difference	0.06 ± 0.30 (0)	–0.06 ± 0.37 (–0.1)		
P[d]	.496	.213		

[a]Mann-Whitney *U* test.
[b]Friedman test.
[c]$P < .01$.
[d]Wilcoxon signed ranks test.
[e]$P < .05$.

(forehead, abdomen, back, arm, leg, palm, and sole of the foot). The average SM was then compared between groups at all measurement times: before the bath, immediately after the bath, and at 10, 20, and 40 minutes after the bath. No statistically significant differences were seen between the groups before the bath, after the bath, or at the 10-, 20-, or 40-minute measurements after the bath (*P*s > .05; Table 3). However, at the 60-minute postbath measurement, the whole-body SM values of the experimental group (34.42%) were significantly higher than those of the control group (31.71%; $Z = -2.213$; $P = .027$).

In both groups, the average SM value increased after bathing. Infants' average SM was significantly higher immediately after the bath and at 10 minutes postbath compared with the prebath SM measurement (*P*s < .05). However, the average SM values of the control group decreased significantly below prebath SM values at 40 minutes (–2.95%; $P = .003$) and 60 minutes postbath (–4.87%; $P = .001$). These decreased SM values seen in the control group were significantly different from the experimental group values at the same time points (*P*s < .05; Table 3).

DISCUSSION

BT Comparisons

In contrast to previous literature,[4,11,18–23] the BT of infants in both the experimental and control groups increased at 10 minutes postbath in comparison with the prebath BT value; there was no difference between the groups (Table 2).

Decreased BT after a bath is caused by evaporation that occurs in the first 10 minutes after bathing.[4,5] In this study, the room temperature was kept at a constant 26 to 27 °C; the bath water temperature was set at 38 °C; the infants were placed into the water swaddled with a cotton cover; and infants were reswaddled with a cotton cover after they were bathed and dried. Researchers

Table 3. BETWEEN-GROUP COMPARISONS OF SKIN MOISTURE (SM) VALUES (N = 80)

SM Measurement	Experimental Group (n = 40) Mean ± SD (Median) (%)	Control Group (n = 40) Mean ± SD (Median) (%)	*Z*	*P*[a]
Before bath	36.25 ± 6.95 (33.89)	36.58 ± 6.11 (36.38)	–0.751	.453
Immediately after bath	44.74 ± 7.52 (44.45)	47.56 ± 8.87 (47.33)	–1.439	.150
10 min after bath	39.71 ± 7.01 (39.8)	40.60 ± 7.45 (40.25)	–0.447	.655
20 min after bath	38.89 ± 12.05 (35.11)	36.16 ± 5.93 (35.04)	–0.900	.368
40 min after bath	35.29 ± 6.34 (33.76)	33.63 ± 6.12 (32.09)	–1.314	.189
60 min after bath	34.42 ± 6.54 (32.32)	31.71 ± 6.13 (29.9)	–2.213	.027[b]
X^2	74.900	104.771		
P[c]	.001[d]	.001[d]		
Before bath—immediately after bath			–1.848	.065
Difference	8.49 ± 7.25 (8.64)	10.97 ± 8.2 (13.12)		
P[e]	.001[d]	.001[d]		
Before bath—10 min after bath			–0.303	.762
Difference	3.46 ± 5.92 (2.85)	4.01 ± 6.62 (3.84)		
P[e]	.001[d]	.001[d]		
Before bath—20 min after bath			–1.160	.246
Difference	2.64 ± 13.5 (0.59)	–0.43 ± 6.86 (–0.76)		
P[e]	.340	.361		
Before bath—40 min after bath			–2.223	.026[b]
Difference	–0.95 ± 6.67 (0.3)	–2.95 ± 6.7 (–3.31)		
P[e]	.727	.003[d]		
Before bath—60 min after bath			–2.088	.037[b]
Difference	–1.83 ± 6.62 (–1.71)	–4.87 ± 7.54 (–4.15)		
P[e]	.083	.001[d]		

[a]Mann-Whitney *U* test.
[b]$P < .05$.
[c]Friedman test.
[d]$P < .01$.
[e]Wilcoxon signed ranks test.

then waited for 10 minutes before measuring BT. Because there was no decrease in infants' BT, these environmental measures appear to have protected the infants from hypothermia.

In a study by Yalnızoğlu Çaka and Gözen,[23] researchers compared two bathing methods for infants: bathing while swaddled versus traditional bathing. Term infants were bathed either while swaddled or in a traditional tub, then dressed and swaddled. When their BT was measured 10 minutes later, it had decreased by an average of 0.44 to 0.54 °C. However, the BT of infants in the swaddled bathing group decreased less in comparison with the control group.

In the present study, moisturizer was applied to the infants' skin either 10 minutes after the bath (experimental group) or immediately after the bath (control group). The use of moisturizer was believed to be effective in maintaining the BT; average BT remained elevated for a longer time in the experimental group than in the control group. Sixty minutes after the bath, the average BT of infants in the experimental group was 0.06 °C higher than the prebath BT. In contrast, the average BT of infants in the control group decreased gradually and was 0.06 °C lower than the prebath BT value after 60 minutes (Table 2). Thus, applying moisturizer 10 minutes after the bath was a more effective method for maintaining BT. The results suggest that it is useful to swaddle infants after bathing and then wait for 10 minutes before applying moisturizer in order to retain BT.

In a study involving preterm infants, Kan Öntürk and Gözen[11] found that drying infants immediately after bathing, wrapping them in a blanket, waiting for 10 minutes, and then dressing them positively affect infants' SM and BT in comparison with infants who were dressed immediately. Therefore, in this study, babies in both groups were wrapped in cotton towels immediately after bathing, waited for 10 minutes, and then were dressed in cotton clothes. During the first 10 minutes

after bathing, clothes that are put on the infant immediately after bathing may become damp and cause rapid heat and fluid loss from evaporation. Thus, the first 10 minutes after the bath are important in terms of retaining the baby's BT and SM.[11]

In a study investigating the effect of tub bathing on thermoregulation in late preterm infants, infants were dried, dressed, and swaddled with two blankets after bathing; their BT was then measured after 10 and 30 minutes. The average BT of the infants bathed with tub bathing was 37.05 °C (98.7 °F) before the bath, 36.83 °C (98.3 °F) 10 minutes after the bath, and 37.0 °C (98.6 °F) 30 minutes after the bath.[3] The study by Loring et al[3] also involved a similar procedure to the present research in that infants were dressed after 10 minutes, but in the present study, moisturizer was applied beforehand.

According to the findings in the literature, evaporation occurs if infants are dressed immediately after the bath, which causes moisture loss in their body and thus decreased BT. In the present study, swaddling the infants after bathing and waiting 10 minutes before dressing may have prevented this moisture loss and thus maintained their BT.

Timing Effects of Moisturizer Application

Although some studies[9,24–27] have examined the effects of different bath products or moisturizing products on newborns' skin hydration, none have investigated the timing of moisturizer use after bathing. In the present study, researchers compared the average SM values before and after bathing. They observed that, in both groups, the average SM value at 10 minutes postbath was higher than the prebath SM value. At 20 minutes postbath, the SM value of the experimental group remained higher than the prebath average SM, whereas the control group value did not differ significantly. In addition, the average SM of the infants in the experimental group 60 minutes postbath was significantly higher than that of the control group. When the changes in SM values before and after the bath were compared by group, the SM of infants in the control group decreased significantly more than that of the experimental group at 40 and 60 minutes postbath. Whereas SM started to decrease 30 minutes after moisturizer application in the experimental group, it began to decrease after only 20 minutes in the control group. Further, the SM of the experimental group had decreased by −1.83% (SD, 6.62%) from the prebath value at the 60-minute postbath measurement (50 minutes after the application of skin moisturizer). In contrast, in the control group the SM value decreased by −2.95% (SD, 6.7%) from the prebath value after only 40 minutes. These results demonstrate that SM was maintained for a longer time and decreased more slowly by applying moisturizer 10 minutes after the bath.

In the study conducted by Cooke et al with term infants,[7] four drops of oil (olive oil or sunflower oil) were applied to the infants' left forearm, left thigh, and abdomen twice a day for 4 weeks; the change in SC hydration from 48 hours to 4 weeks was measured using a Corneometer Model CM825 (Courage & Khazaka Electronic GmbH). The authors found no significant difference between the groups of infants receiving sunflower oil or olive oil in terms of SC hydration; however, there was significantly higher SC hydration in the infants who received the oil application versus a control group.[25] In the present study, liquid petroleum jelly was applied to the infants in the experimental and control groups as a moisturizer. The moisturizer prevented water loss from subcutaneous tissue by forming a layer on the infant's skin. Consequently, the skin hydration of the infants was supported. Moisturizing infants 10 minutes after bathing caused SM to be preserved for a longer time and to decrease more slowly.

Limitations and Recommendations for Future Study

One limitation of the current study was that the same moisturizer was applied to all infants. Future studies should further investigate the effect of moisturizer application after bathing on infants' BT and SM. It would be beneficial to include a larger sample size, different ages of participants, and longer follow-up periods, and to compare the effects of different moisturizers.

CONCLUSIONS

The results of the study demonstrated that moisturizer application 10 minutes after the bath had a positive effect on the SM and BT of infants compared with applying moisturizer immediately after the bath. These results demonstrate that moisturizing practices play an important role in maintaining newborn health. Taking environmental precautions during and after bathing, applying moisturizer after waiting for 10 minutes, and dressing the newborns helped to maintain their BT and SM. ●

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