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# Comparing the Effects of Swaddled and Conventional Bathing Methods on Body Temperature and Crying Duration in Premature Infants: A Randomized Clinical Trial

**Mitra Edraki[1*], Maryam Paran[2], Sedigheh Montaseri[3], Mostajab Razavi Nejad[4], Zohre Montaseri[3]**

[1]*Community Based Psychiatric Care Research Center, Department of Pediatric Nursing, Faculty of Nursing and Midwifery, Shiraz University of Medical Science, Shiraz, Iran*
[2]*Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran*
[3]*Department of Pediatric Nursing, Faculty of Nursing and Midwifery, Shiraz University of Medical Science, Shiraz, Iran*
[4]*Department of Pediatrics, Neonatal Research Center, Shiraz University of Medical Science, Shiraz, Iran*

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**ABSTRACT**

***Introduction:*** Maintaining body temperature and reducing stress are important challenges in bathing preterm infants. Swaddle bathing, which includes in itself the principles of developmental care, can be used as a low-stress and appropriate bathing method for premature infants. Given the limitations of the researches carried out on this bathing method, the present study was conducted with the aim of comparing the effects of swaddled and conventional bathing methods on body temperature and crying duration in premature infants.
***Methods:*** In this randomized clinical trial study, 50 premature infants hospitalized in Neonatal Intensive Care Unit (NICU) who were eligible for the study were divided by random allocation into two experimental and control groups. The infants in the experimental group were bathed using the swaddle bathing method and the infants in the control group were bathed using the conventional bathing method. Body temperature was measured 10 minutes before and 10 minutes after the bath. To record the crying, the infants' faces were filmed during the bath. The data were analyzed using chi-squared test, independent t-test, paired t-test and Mann-Whitney U test.
***Results:*** The mean temperature loss was significantly less in the swaddle-bathed newborns compared to the conventionally-bathed newborns. Furthermore, crying time was significantly less in the experimental group than in the control group.
***Conclusion:*** Given the positive effect of swaddled bathing in maintaining body temperature and reducing stress, it can be used as an appropriate bathing method in NICU.

## Introduction

Every year, 15 million preterm births occur across the world, which represents more than 1 out of every 10 births. Iran is among the countries with a high incidence of preterm births with approximately 12.9% of births identified as preterm.[1] Preterm infants are commonly admitted to NICU to receive special care. These infants are exposed to various stressors in NICU such as painful procedures, interrupted sleep, excessive noise and light levels, and separation from the mother.[2] These stressors can adversely affect maturation and organization of vision, hearing, sleeping pattern, growth and consequently neuro- development and long-term outcomes of the newborn.[3] It is important to protect this vulnerable population as much as possible from the damaging effects of the unfamiliar extra-uterine environment. Since the preterm

*** Corresponding Author:** Mitra Edraki (MSc). E-mail: mitraedraki@yahoo.com.
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infant's central nervous system is immature, it is also necessary to reduce the stress levels experienced by the newborn to enhance developmental outcomes. In this regard, incorporating the developmental care approach into care-giving practices can reduce stress levels and improve developmental consequences.[4]

A simple and common care-giving practice in NICU is bathing newborns. Although bathing has a major impact on maintaining newborn health, it is a stressful experience for newborns, especially preterm ones.[5] Studies conducted on the effects of bathing on premature infants indicate that these infants show behavioral distress during the bath.[6-8]

Such behaviors as crying, fussing, hiccoughing, yawning, tremoring, trunkal flaccidity, extremities flaccidity, facial flaccidity, arching, finger splays, grimacing and tongue extension have been described as stress-related behaviors in preterm infants.[9]

Another problem that can occur following the premature infant's bath is the risk of temperature loss. Large body surface area compared to body mass, insufficient brown fat for non-shivering thermo genesis, thinner skin, and less ability to maintain flexion of extremities are among the factors making premature infants more likely to experience heat loss and hypothermia as compared with their term counterparts.[10] Hypothermia can result in tachypnea, apnea, hypoxia, metabolic acidosis, hypoglycemia, coagulation defects, acute renal failure, necrotizing enterocolitis, and ultimately death.[11] Considering the above mentioned, one of the most important concerns in bathing premature infants is maintaining their body temperature and reducing behavioral stress cues. One of the bathing methods that incorporates developmental principles into a routine care-giving practice is swaddle bathing. In swaddle bathing, the infant is placed in a flexed, midline position, swaddled in a blanket or soft towel, and then immersed in a tub of warm water. Each limb is then individually unswaddled, washed, rinsed, and re-swaddled allowing the infant to remain in a fixed, midline position for the duration of the bath.[12]

Fern et al., have stated benefits to swaddled bathing in infants including decreased physiological and motor stress, conserved energy, improved state control. Decreased crying and agitation, facilitated social interaction by keeping the newborn in a calm, quiet alert state, increased self-regulatory behaviors, enhanced ability to participate in feeding immediately after the bath, and increased feeling of security in the infant. They have also observed benefits to parents such as increased confidence in parenting skills, facilitated parent attachment, enhanced interaction with the infant, and decreased parental stress.[13]

There is minimal research into the physiological and behavioral impact of swaddle bathing on premature infants. In addition, the conventional bathing method used in most NICUs in the country does not seem to be an evidence-based and safe method for premature infants. Therefore, in keeping with the objective of reducing the developmental consequences caused by care practices during the premature infant's hospitalization in NICU and enhancing preterm infant care, this study was conducted, based on the necessities stated and considering the limited studies on this field, in order to compare the effects of swaddled and conventional bathing methods on body temperature and crying as one of the prominent stress-related behaviors in premature infants in NICU.

This research is based on the following hypotheses:

1. Swaddle bathing lowers the infant's body temperature significantly less than conventional bathing does.
2. The crying time in newborns who are swaddle bathed is less than in those who are conventionally bathed.

## Materials and methods

This single-blind randomized clinical trial was performed on 50 premature infants hospitalized in NICU of Hafez hospital in Shiraz between July 2013 and January 2014. Hafez hospital was chosen for the study because of its convenient accessibility to subjects, as it has one of the major childbirth centers in Shiraz and has numerous cases of premature infants. Based on the study conducted out by Bryanton et al.,[14] and considering the power of 0.9 and α=0.05, a 50-subject sample size was selected for the study (25 subjects in each group). The subjects were selected through convenience sampling and then randomly assigned to an experimental group and a control group by block randomization (Figure 1).

The inclusion criteria were gestational age of 30–36 weeks, postnatal age of 7-30 days, not using sedatives or skeletal muscle relaxants, no major congenital, chromosomal or neurological abnormalities, no need for surgery, no severe growth problems from birth, no evidence of grade II or higher intraventricular hemorrhage, stability of physiological parameters in the infant, and no substance abuse or sedative drug use by the mother. The exclusion criteria were occurrence of seizures or symptoms of physiological instability in the infant, and parents' unwillingness to continue participating in the study.

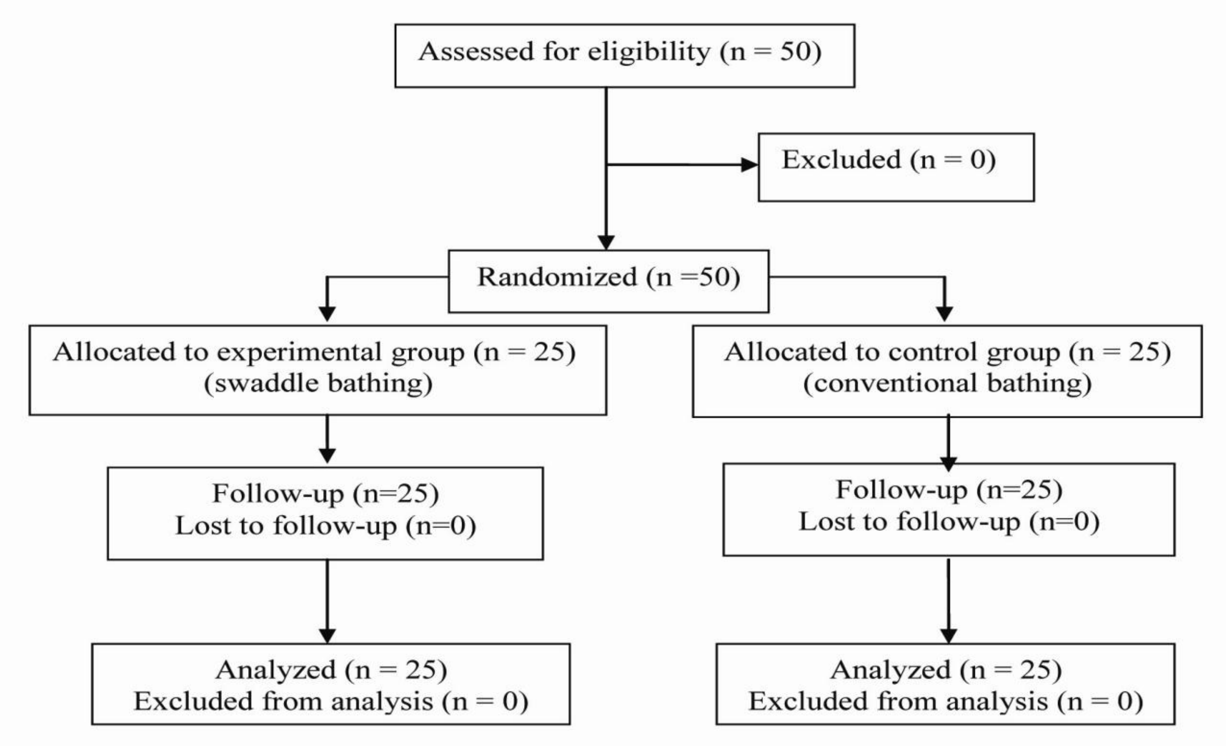


**Figure 1.** Clinical trial flowchart

After obtaining the approval of the ethics committee of Shiraz University of Medical Sciences and receiving the research permit from Hafez hospital, the researcher entered the research environment. The parents received explanations about the objectives, importance and procedures of the research and a written informed consent was signed by them before the study.

The infants in the experimental group were bathed using the swaddled bathing method and the infants in the control group were bathed using the conventional bathing method. In the experimental group, the infants were placed in a flexed, midline position, swaddled with a soft towel, and after being taken out of the incubator, they were fully immersed in a tub of warm water. Swaddle baths were given in a standardized plastic tub. To ensure that the majority of the infant's body would be immersed from the shoulders down, the water depth was maintained at 10 cm. The infant's feet were positioned at the bottom corner of the tub for foot bracing. To wash the eyes and the face, a container of warm water and cotton wool balls were used. The eyes were wiped with water, from the inner corner to the outer corner. The limbs were cleaned using cotton wool, only exposing one extremity at a time. The infant's back was washed through the cloth, as un-swaddling would disorganize the infant, and finally the hair was washed before finishing the bath to reduce cold stress. To complete the bath, the cloth was removed and the baby was quickly wrapped in a towel. The newborn was then placed under the radiant warmer and was dried. In the control group, the infant was taken out of the incubator and different parts of his/her body were washed under the tap. The infant's body was then covered and his/her head and face were washed. Then the baby was quickly placed under the radiant warmer and was dried. It is worthwhile mentioning that, in order to improve the research accuracy and equalize the stress experienced by the newborns during the bath, the swaddle bath was conducted by the researcher and the conventional bath by an experienced nurse.

The baths were given one hour after a feed, when the newborns were in a stable and calm condition. The bathing site was a quiet and draft-free environment. All cloths used during the baths were of the same material.

At the start of each bath, the room temperature was measured at 25°C. The baths took less than 5 minutes, but the exact length was based on infant cues and needs. All the baths were carried out during morning shifts. The water temperature was measured at the onset of each bath with an electronic thermometer and adjusted in both methods at 37-38°C. To achieve identical conditions, the same warmer was used for all newborns and the warmer temperature was set at 36.5°C for all newborns in both the experimental and control groups.

In both groups, body temperature was measured 10 minutes before and 10 minutes after the bath using the axillary method in which a mercury thermometer with an accuracy of 0.1°C was used. The thermometer was held in place for 3 minutes as recommended by the literature.[15] To record the crying, the infants' faces were filmed in close-up from the beginning to the end of the bath using a digital camera (Canon Power Shot A470). A computer with Media Player software was applied for viewing each recording session. The infants' faces were observed and interpreted in 10 second intervals by a trained observer blind to the purpose of the study and the type of intervention, in order to determine the crying time during the bath. To compare the crying time in the two groups, the crying percentage was calculated as follows: (crying duration/total bath time) × 100. Finally, the body temperature changes before and after the bath and the crying percentages in the two groups were compared.

The data collecting tools included a data recording form and a cry recording sheet. The data recording form contained the demographic characteristics of the subjects and their body temperatures 10 minutes before and 10 minutes after the bath. The demographic characteristics of the subjects were compiled by the researcher according to the relevant studies. These characteristics included gender, 1- minute and 5- minute apgar score, birth weight, weight at bath time, gestational age, postnatal age, mother's age and delivery type. The demographic characteristics of the subjects were obtained through the information recorded in the medical documents and through interview with the parents. Content validity was used to assess the validity of the data recording form, i.e. the form was given to 5 faculty members and after collecting the comments, the relevant comments were applied.

The cry recording sheet was compiled by the researcher according to the relevant studies. The crying time in 10 second intervals, the total bath time, and the total crying percentage were recorded in the sheet for each newborn. This method of assessing behavioral responses during the bath was utilized in studies by Liaw et al.,[6,16,17] .These studies are cited as evidence to support the validity of the infant's crying as a behavioral response in this study. To improve the reliability of the recorded crying data, Inter-rater reliability was used. After observation of the video recordings by the first observer and recording the total crying time, 20 video recordings were randomly selected and interpreted by an independent trained person blind to the study hypotheses and the intervention type. The agreement between the interpretations was then assessed using Pearson's correlation coefficient (r= 0.98).

The data collected were analyzed by SPSS software version 13 (SPSS Inc., Chicago, IL). Data were reported as mean and standard deviation (SD) for quantitative variables and frequency (percentage) for qualitative variables. The qualitative variables were compared using the chi-square test. The Kolmogorov-Smirnov test was used to confirm the normal distribution of the quantitative variables. The results of this test indicated that all the quantitative variables except crying time during the bath showed a normal distribution. To compare the mean variables between two groups, an independent t-test was used in cases of normal distribution and a Mann-Whitney U test for crying time during the bath. In addition, a paired t-test was used to compare the mean body temperature changes in the infants of each group.

## Results

The findings of the study showed no significant difference between the two groups regarding gender, birth type, mother's age, gestational age, postnatal age, birth weight, weight at bath time, and 1-minute and 5-minute Apgar scores (Table 1).

The results of the study regarding the objective of comparing the effects of swaddle bathing and conventional bathing on body temperature in premature infants showed no significant difference between the two groups in the infants' mean body temperature 10 minutes before the bath (P=0.40). The comparison of the infants' mean body temperature before and after the bath in each group, which was conducted using paired t-test, showed no significant statistical difference in body temperature before and after the bath in the experimental group (P=0.22). However, in the control group, the infants' body temperature before and after the bath was statically different (P<0.001). In addition, according to the independent t-test, the mean body temperature 10 minutes after the bath was significantly lower in the control group than in the experimental group (P<0.001) (Table 2). The comparison of the infants' mean body temperature changes 10 minutes after as compared to 10 minutes before the bath between the two groups according to the independent t-test showed a significantly lower mean temperature change in the experimental group than in the control group (P<0.001) and a higher temperature loss after the bath in the control group than in the experimental group (Table 2).

The results of the study regarding the objective of comparing the effects of swaddle bathing and conventional bathing on premature infant's crying time according to the Mann–Whitney U test indicated that the crying time in the experimental group was significantly lower than in the control group (P<0.001) (Table 3).

**Table 1.** Demographic characteristics of the participants in the experimental (n=25) and control (n=25) groups

| Characteristics | Experimental group Mean (SD) | Control group Mean (SD) | Statistical indicators |
|---|---|---|---|
| **Gender*** | | | $\chi^2$=3, df=1, P=0.08[a] |
| Female | 7(28) | 13(52) | |
| Male | 18(72) | 12(48) | |
| **Birth type*** | | | $\chi^2$=0.35, df=1, P=0.55[a] |
| Vaginal | 1(4) | 2(8) | |
| Cesarean section | 24(96) | 23(92) | |
| **Mother's age** (years) | 28.52 (3.35) | 28.64 (4.01) | t=0.11, df=48, P=0.90[b] |
| **Apgar score, 1 minute** | 6 (0.82) | 6.08 (1.04) | t=0.30, df=48, P=0.76[b] |
| **Apgar score, 5 minutes** | 8.84 (0.75) | 8.96 (0.93) | t=0.50, df=48, P=0.61[b] |
| **Gestational age** (weeks) | 31.64 (2.02) | 31.60 (1.85) | t=-0.07, df=48, P=0.94[b] |
| **Postnatal age** (days) | 19.32 (9) | 20.12 (7.83) | t=0.33, df=48, P=0.73[b] |
| **Birth weight** (grams) | 1524.20 (427.72) | 1509.60 (446.23) | t=-0.12, df=48, P=0.90[b] |
| **weight at bath time** (grams) | 1599 (301.44) | 1608.80 (371.47) | t=0.10, df=48, P=0.91[b] |

SD: Standard Deviation, * N(%), [a] Chi-square test; [b] Independent t-test

**Table 2.** Comparisons of the infants' mean body temperature in the experimental and control groups

| Variables | Experimental group (n=25) Mean (SD) | Control group (n=25) Mean (SD) | Mean differences 95% CI | Statistical indicators (between-group) |
|---|---|---|---|---|
| **Body temperature**(°C) (10 minutes before the bath) | 36.50 (0.14) | 36.55 (0.24) | -0.07, 0.16 | t=.85, df=48, P=0.402[b] |
| **Body temperature**(°C) (10 minutes after the bath) | 36.42 (0.35) | 35.96 (0.26) | -0.63, -0.28 | t=-5.25, df=48, P<0.001[b] |
| **Statistical indicators** (within-group) | t=1.26, df=24, P= 0.220[c] | t=11.69, df=24, P<0.001[c] | | |
| **Body temperature changes** (10 minutes after as compared to 10 minutes before the bath) | -0.09 (0.35) | -0.59 (0.25) | -0.68, -0.33 | t=-5.84, df=48, P<0.001[b] |

SD: Standard Deviation; CI: Confidence Interval; [b] Independent t-test; [c] Paired t-test

**Table 3.** Comparison of crying percentages during the bath in the experimental and control groups

| Variable | Experimental group (n=25) Mean (SD) | Control group (n=25) Mean (SD) | Statistical indicators |
|---|---|---|---|
| **Crying time** | 5.81 (11.97) | 43.41 (26.54) | U=47.50, Z=-5.23, P<0.001* |

SD: Standard Deviation; *Mann-Whitney U test

## Discussion

This study was conducted to compare the effects of swaddled and conventional bathing methods on body temperature and crying duration in premature infants. The results indicated that the body temperature after the bath in the conventionally bathed group was less than in the swaddle bathed group. Changes in the body temperature were also less in the swaddle bathed group than in the conventionally bathed group. This result supports the first hypothesis of the study. Therefore, swaddle bathing is more effective in maintaining body temperature and preventing heat loss in premature infants compared to conventional bathing. One advantage stated for this bathing method is the reduction of temperature variations in neonates.[5] However, no studies were found in the Iranian or international literature regarding the effect of swaddle bathing on the body temperature in premature newborns. The results of the present study are consistent with those of the other studies on the effect of tub bathing on infant body temperature. For instance, Bryanton et al., compared the effects of tub and sponge bathing on body temperature changes in the infant and the results suggested that the infant's heat loss in tub bathing is lower than in sponge bathing ($P<0.001$).[14] Furthermore, Loring et al., in their study on comparing premature infants' body temperature before and after tub and sponge bathing, reported that the premature infants in the tub bathing group showed significantly less temperature changes than those in the sponge bathing group ($P = 0.02$).[10] Given that the body's heat loss occurs as a result of evaporation, conduction, convection, and radiation processes,[18] it can be concluded that immersing newborns in water has probably been effective in reducing heat loss through evaporation in both tub and swaddle bathing methods. Moreover, newborns seem to be more exposed to air-flow in the conventional bathing method used in most of our NICUs and this very factor probably has a major impact on infant heat loss after the bath. In the swaddle bathing method, covering and immersing the newborn can reduce heat loss through radiation, conduction and evaporation.[12]

Another finding of this study indicated that the crying time during the bath was significantly lower in the newborns of the swaddle bathing group than in those of the conventional bathing group. This result supports the second hypothesis of this study.

An advantage of this bathing method stated by Fern et al., is improved state control, i.e. decreased crying and agitation in newborns.[13] No studies were found in the Iranian or international literature regarding the effect of swaddle bathing on crying duration in premature newborns. However, Liaw et al., in their study aimed to determine the effect of nurse's care-giving behaviors on preterm infant behavioral responses during the bath reported that infants whose nurses provided them with more supportive behaviors during the bath (especially such behaviors as position support and containment) showed less stress and more self-regulatory behaviors.[17]

Bathing techniques varies among NICUs, but as mentioned previously bathing is considered as a stressful experience for infants. A study by Peters indicated a significant increase in stress behaviors in sponge bathing.[8] Furthermore, in a study by Liaw et al., which aimed to determine the effect of tub bathing on preterm infants' distress and state behavior, it was observed that tub bathing can increase stress-related behaviors such as crying and agitation in premature infants ($P<0.001$).[6] However, the results of a study by Bryanton et al., comparing the effects of tub and sponge bathing on the contentment of healthy term newborns, showed that tub bathing is more pleasant to newborns than sponge bathing ($P<0.001$). In the tub bathing method, being immersed in warm water is comforting to newborns.[14] Studies show that swaddling can help reduce pain in newborns[19-21] and is effective in decreasing their behavioral distress.[22] Providing containment to the newborn during the bathing process, can reduce stress.[12] In the swaddle bathing method, immersion into water and containment simulates the familiar and secure uterine environment and promotes a calm and stress- free bathing experience for the newborn.[5]

The limitations of this study include the following:
Because of the numerous inclusion criteria, there were few participants included in the study and it was not feasible to access more samples within the time limit. It is therefore

suggested to conduct this research on a larger number of samples.

Although the newborns were only filmed in close-up to record the crying time during the bath and the observers were kept uninformed about the objectives and type of intervention, the nature of the study was such that the observers may have been unintentionally made aware of the method used and the purpose of the study. One suggestion to reduce this potential bias in future studies is to record infant crying time during the bath through the use of a voice recorder device.

The presence of unwanted environmental stimuli was another limitation of this study. Since environmental stimuli can influence the infant's behavior, an attempt was made during the research to have the baths performed in a calm and stimulus-free environment. However, it was not possible to fully control all the environmental stimuli in NICU environment.

Because each newborn is unique, behavioral responses caused by stress vary among infants. Therefore, this can somewhat affect the results of the study.

## Conclusion

The findings of this study indicate that swaddle bathing can help to maintain body temperature and reduce stress in preterm infants during the bath. This bathing method, which includes in itself the components of developmental care, offers an appropriate, low-stress and safe method for preterm and ill infants and can be used as a routine bathing method in NICUs. It is hoped that the results of this research will help to improve the short- and long-term developmental outcomes caused by the hospitalization of preterm infants in NICU and increase the quality of nursing care.

Further studies are suggested to be conducted on the effect of swaddle bathing on other behavioral responses causes by stress, sleep pattern, feeding pattern, sucking efficiency, and weight gain in premature infants, as well as the effect of this bathing method on mother-infant attachment, parental stress, confidence in parental skills, and parents' contentment.

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## Ethical issues

None to be declared.

## Conflict of interest

The authors declare no conflict of interest in this study.

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