Relative Effectiveness of Swaddle Bath and Conventional Bath on Level of Thermal Stability and Crying Duration among Preterm Infants at Selected Hospital in North India

1Gaddam Swapna*, 2Nandhini P, 3Ruthrani Princely J, 4Kanchana S, 5Celina D
1–PG Scholar, Omayal Achi College of Nursing, Chennai, Tamilnadu, India.
3–Associate Professor, Omayal Achi College of Nursing, Chennai, Tamilnadu, India.
4–Principal, Omayal Achi College of Nursing, Chennai, Tamilnadu, India.
5–VicePrincipal, Omayal Achi College of Nursing, Chennai, Tamilnadu, India.

Abstract
Background: Swaddle bath is one of the stress free, safe and secure bath simulating the familiar uterine environment for preterm infants but the current practice of conventional bath for preterm infants followed in various hospitals is “easy bath”, which is a simplest and time saving for nurses. Maintaining thermal stability and reducing stress especially crying are important challenges in bathing preterm infants. Objective: To assess the relative effectiveness of swaddle bath and conventional bath on level of thermal stability and crying duration among preterm infants. Methodology: Quantitative approach, True experimental comparative research design was adopted to compare the relative outcome of swaddle bath and conventional bath on level of thermal stability and crying duration among preterm infants. Methodology: Quantitative approach, True experimental comparative research design was adopted to compare the relative outcome of swaddle bath and conventional bath on level of thermal stability and crying duration among preterm infants (30 in group A and 30 in group B) who satisfied the inclusion and exclusion criteria in Neonatal Intensive Care Unit (NICU) at Anand Hospital, Surat. Simple random sampling technique – lottery method was used to select the samples. The swaddle bath was given to group A and conventional bath was given to group B. Results: The study findings revealed that there was no significant difference in the pretest level of thermal stability among preterm infants between group A and group B. The calculated unpaired ‘t’ value of thermal stability at 10th minute & at 30th minute after bath were 2.27,4.33 for temperature; -7.39,-6.80 for heart rate; -10.75,-7.21 for respiratory rate; 2.40,1.39 for oxygen saturation respectively which shows that there was high statistical significant difference between group A and group B at p<0.001 level. The crying duration among preterm infants between group A and group B revealed that swaddle bathed preterm infants cried less period than conventionally bathed preterm infants. The calculated unpaired ‘t’ value was -10.92 which shows there was high statistical significance at p<0.001. Conclusion: The results revealed that the swaddle bath was found to be relatively effective in maintaining thermal stability for prolonged period of time and reducing crying duration, where as conventional bath could not maintain thermal stability and reduce crying duration and thus swaddle bath can be practiced as a part of routine nursing care for stable preterm infants during hospitalization. Keywords: swaddle bath, conventional bath, thermal stability, thermoregulation, crying duration, behavioural distress, physiological parameters, preterm infants.

I Introduction

Preterm infants are infants born before gestational age of 37 completed weeks or 259 days of gestation. Neonates born between 34-36 weeks of gestation are known as “Near term” or “Late preterm” infants and between 26-34 weeks of gestation are called as “early preterm” infants, whereas before 26 weeks of gestation are said to be “very preterm” infants. However prematurity is a leading cause of neonatal mortality and morbidity in India. The morbidity associated with preterm birth often results in enormous physical, psychological and economic costs.

Figure 1: Major Determinants of premature mortality

Preterm infants are considered to be “Born too soon” or “Preemies”, in which they are both structurally and physiologically immature presenting very small and scrawny appearance because they have only minimal subcutaneous fat deposits and they are more vulnerable pertaining to their physical immaturity. The adaptation of a preterm infant to the extra uterine life can take weeks or even months to complete, leading to short term and long term difficulties for survival.

Table 1: Survival ability of preterm infants

<table>
<thead>
<tr>
<th>Levels of Income</th>
<th>Preterm infants born with Gestational age</th>
<th>Survival ability of preterm infant</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Born with 24 weeks</td>
<td>Likely to survive</td>
</tr>
<tr>
<td>Middle</td>
<td>Born with 28 weeks</td>
<td>Moderately survive</td>
</tr>
<tr>
<td>Low</td>
<td>Born with 32 weeks</td>
<td>Mostly Die</td>
</tr>
</tbody>
</table>

The preterm infant finds difficult to adjust with the extra uterine life because throughout the intra-uterine life the preterm infants fundamental stages of growth and development are done in an ideal environment, offering fortification and security\(^1\). However, when a neonate is born prematurely this becomes far from the veracity as constant care is provided in the Neonatal Intensive Care Unit (NICU).

Preterm infants are frequently admitted to NICU to receive exceptional care. These infants are exposed to an assortment of stressors in NICU such as painful procedures, interrupted sleep pattern, extreme noise and light levels and separation from the mother\(^2\). These stressors can unfavourably affect physiological cum psychological maturation and organization of vision, hearing, sleeping pattern consequently the growth of neuro-development, all of which have been found to cause distress in preterm infants, disrupting
their normal growth and development which have an impact on their daily life[3]. It is important to protect this vulnerable population as much as possible from the damaging effects of the unfamiliar extra-uterine environment. There are diverse measures like incubator, radiant warmer, nesting and kangaroo mother care etc., to protect the preterm infants from temperature loss but the preterm infant’s central nervous system is structurally and functionally immature commonly causing thermal instability[4]. The detrimental effects of this structural immaturity causes behavioural distress cues like crying, fussing, back arching and finger splaying which are generally experienced during the daily nursing practices like painful heel stick procedures, diaper changing, feeding, position changing and finally bathing[5]. Therefore the lower level activities of vagal nerve extends from the brain stem to the abdomen causes tension in the vocal cords and there by affects crying duration.

The preterm infant has high 'trans-epidermal' water losses due to a thin, poorly keratinised skin which universally matures by 21 days of postnatal age. Trans-epidermal water loss is a most important cause of heat loss in the preterm infant. Thus preterm infants are prone to temperature instability which needs to be highly acknowledged and understood in order to suitably manage the situation and limit the effects of either cold or heat stress[6].

Figure 2: Mechanism of heat loss, Journal of Perinatal and Neonatal Nursing, 2010[7].

Bath is an essential daily nursing practice to preserve skin integrity, to maintain the function of skin, to protect against skin breakdown caused by epidermal stripping and extravasations, to minimize trans epidermal water loss thereby rehydrates skin and promotes stratum corneum barrier maturation in order to prevent microbial colonization, promotes hygiene and improves feeding practices[8]. Thus bath acts as precursor to create an environment for physical, psychological and emotional growth of preterm infants[9]. There are various kinds of bath with their own benefits such as lap bath for bonding with mother, tub bath to prevent heat loss, sponge bath and easy bath to save time for nurses, oil bath for weight gain of preterm infants, and swaddle bath to reduce crying duration[10].

Multiple Researchers[11] stated benefits of swaddle bath among preterm and term infants comprises reduced physiological and motor stress cues, conservation of energy, improves physiological state control i.e., decreased crying and agitation. Furthermore facilitated social interaction by keeping the newborn in a calm, quiet alert state, increased self-regulatory behaviours and enhanced the preterm infant ability to participate in feeding immediately after the swaddle bath, and thus increases the feeling of warmth and security in the infant[12]. The study also observed wide variety of benefits to parents such as increased confidence in
parenting skills, facilitated parent infant attachment, enhanced interaction with the infant and decreased parental stress during bath\[13\].

Swaddle bath is one of the stress free, safe and secure bath simulating the familiar uterine environment and provides containment during entire bath for preterm infants but the current practice of conventional bath for preterm infants followed in various hospitals is “easy bath”, which is a simplest and time saving for nurses in their busy schedule of NICU\[14\]. The investigator during her clinical experience identified that preterm infant exhibit various physiological and behavioural stress cues during bath. Based on the necessities of the preterm infant and there is minimal research into the physiological and behavioural component, the investigator with her personal and professional interest wanted to compare the relative outcome of the two approaches on level of thermal stability and crying duration i.e., swaddle bath and conventional bath.

**Objectives of the study**
1. To assess the relative effectiveness of swaddle bath and conventional bath on level of thermal stability and crying duration among preterm infants.
2. To correlate the post test mean score of thermal stability with post test mean score of crying duration among preterm infants in group A and group B.
3. To associate the selected demographic variables with the mean score of thermal stability and mean score of crying duration among preterm infants in group A and group B.

**Null hypotheses**

**NH\(_1\):** There is no significant difference in relative effectiveness of swaddle bath and conventional bath on level of thermal stability and crying duration among preterm infants at p<0.05 level.

**NH\(_2\):** There is no significant correlation of post test mean score of thermal stability with post test mean score of crying duration among preterm infants in group A and group B at p< 0.05 level.

**NH\(_3\):** There is no significant association with selected demographic variables with the mean score of thermal stability and mean score of crying duration among preterm infants in Group A and Group B at p<0.05 level.

**II Methodology**

A true experimental comparative research design was adopted in order to compare the relative outcome of swaddle bath and conventional bath on level of thermal stability and crying duration. The independent variables of this study were swaddle bath for group A and conventional bath for group B. The dependent variables were thermal stability and crying duration. The study was conducted in Anand Hospital, Surat. The study population includes preterm infants between 30-36weeks of gestation admitted in Anand Hospital. The sample size consisted of 60 preterm infants who fulfills the inclusion and exclusion criteria.

**Inclusion Criteria:**
1. Preterm infants born between 30 – 36weeks of gestation.
2. Preterm infants with stable physiological parameters (Temperature >350c & <37.50c, Heart rate 120-170beats/min, Respiratory rate 40-70breaths/min and Oxygen saturation 90-94%) based on their gestational age and after the umbilical cord fall.
3. Preterm infants with weight before bath >/=1500gms.

**Exclusion criteria:** Parents of preterm infants who are not willing to participate.
**Research Design**

True experimental comparative research design

---

**Target population**

All the preterm infants born between gestational age of 30-36 weeks

**Accessible population**

Preterm infants born between 30-36 weeks of gestation, who were admitted in NICU at Anand Hospital, Surat.

---

Selection of preterm infants based on the collected demographic

Selection of participants by **Simple Random sampling technique using lottery method** – 60 preterm infants

---

Randomization (pair matching of the selected demographic variables i.e, gestational age, gender and place of preterm infant before bath)

---

Group A

n=30

- Pre test
- Intervention (Swaddle bath)
- Post test

Group B

n=30

- Pre test
- Intervention (Conventional bath)
- Post test

---

**DATA ANALYSIS AND INTERPRETATION**

Figure 3: Schematic Representation of Research Methodology
The tool consisted of two parts i.e., data collection tool and intervention tool. The data collection tool used in this study was structured interview schedule and medical record review for demographic data. WHO guidelines was used to assess the level of thermal stability and Video recording was done during bath to assess the crying duration using crying percentage formula. After preparation of articles, environment and preterm infant, the investigator wore cap and mask and performed hand hygiene and given swaddle bath once to the preterm infants for the duration of 5 minutes, in which the preterm infant was snuggly wrapped with autoclaved thick soft towel in a flexed midline position and placed in the tub filled with warm water till shoulder level with the temperature of 100-101°F Fahrenheit. Then each part of the body is individually unwrapped, washed with mild foamless soap, rinsed from lower and upper limbs, trunk to head and rewrapped in group A. The investigator given conventional bath once to the preterm infants by exposing the body and wiped with wet wipes from face to neck, trunk, limbs, genitals and back, for the duration of 5 minutes in group B. After the both swaddle and conventional bath the preterm infant was wiped with dry cloth, mummified and given to mother for feeding. The whole procedure was videotaped by research assistant and the videos were used to interpret crying duration and calculated crying percentage.

**Ethical considerations**

Ethical approval was obtained from the Institutional Ethics Review Board. Formal permission was obtained from the Director of Anand Hospital. The researcher followed the fundamental ethical principles of right to freedom from harm and discomfort to the samples and respect for human dignity and informed consent was obtained from the caregivers of preterm infants.

In order to maintain Right to fair treatment the investigator selected the study participants based on the inclusion and exclusion criteria and divided them into group A and group B. Both the groups were given equal consideration with regard to safety, privacy, and aseptic technique throughout the study period. If the preterm infants have minimal parameters, the investigator given justice by providing intervention to maintain optimum parameters. In case of Right to privacy the investigator maintained the study participant’s privacy through confidentiality pledge obtained through oral consent from the Neonatologist of hospital and ensured that the video recordings of the crying of each infant are used only to interpret the crying duration and was discarded immediately after interpretation of the crying duration. The investigator maintained confidentiality of the data provided by the study participants through individual coding for each participant.

**Statistical analysis**

Statistical analysis was performed using the Statistical Package for Social Sciences Programme (SPSS) version 23. Descriptive statistics was used to describe the demographic variables. Frequency and percentage distribution was used to analyze the demographic data of preterm infants. Mean and standard deviation was used to assess the level of thermal stability and crying duration among preterm infants undergoing swaddle bath and conventional bath procedure. Paired and Unpaired ‘t’ test was used to compare the data within and between the group A and group B. Correlation Coefficient was used to find out the relationship of post test level of thermal stability with post test crying duration in group A and group B. Chi-square test was used to test the homogeneity of demographic variables and One way ANOVA was used to associate the selected demographic variables with the mean score of thermal stability and mean score of crying duration among group A and group B.
III Results

The demographic variables of both group A and group B depicts that homogeneity of the group was maintained for three demographic variables such as gestational age, gender and place of preterm infants before bath as they were pair matched.

In group A the study findings depicts that on assessment of demographic variables the majority of preterm infants belongs to 34 weeks of gestation and were born by normal vaginal delivery and most of the preterm infants were predominantly females and had birth weight between 1500-1700gms with postnatal age of 15-21days (3weeks) and had APGAR score between 5 and 7 at 5th minute of birth. All most all were on expressed breast feeding every 2 hourly. Majority of them were from open cot and weighed between 1901-2100gms before swaddle bath and were fed 1hour prior to swaddle bath.

In group B the study findings depicts that on assessment of demographic variables the majority of preterm infants belongs to 34weeks of gestation and were born by normal vaginal delivery and most of the preterm infants were females and had birth weight between 1701-1900gms with postnatal age of 8-14days (2weeks) and had APGAR score greater than 7 at 5th minute of birth. All most all were on expressed breast feeding every 2 hourly. Majority of them were from open cot and weighed between 1901-2100gms before conventional bath and were fed 2 hours prior to conventional bath.

The above figure portrays that the mean temperature loss was less in preterm infants who underwent swaddle bath and mean temperature loss was high in conventional bath. The calculated unpaired ‘t’ value shows there was significant difference was found between group A and group B at p<0.001 level.

Table 2: Comparison of pretest and post test level of thermal stability among preterm infants between both group A and group B.
The above table shows that although there was significant difference found in both the groups, it was proved that the mean temperature loss was less among preterm infants with 0.9°C at 10th minute and 0.2°C at 30th minute after swaddle bath and mean temperature loss was high among preterm infants with 2.0°C at 10th minute and 1.3°C at 30th minute after conventional bath. The heart rate, respiratory rate and oxygen saturation were maintained at 10th minute and 30th minute after swaddle bath, whereas the heart rate and respiratory was increased to tachycardia and tachypnoea at 10th and 30th minute respectively after conventional bath. The oxygen saturation was reduced from 92% to 91% at 10th minute and maintained to 91% at 30th minute after swaddle bath, whereas the oxygen saturation was reduced from 92% to 90% at 10th minute and maintained to 91% at 30th minute.
Figure 5: Comparison of crying duration among preterm infants between Group A and Group B with Percentage

The above figure describes the mean percentage between preterm infants of swaddle bath and conventional bath, which shows that swaddle bathed preterm infants cried for very less duration as comparatively with conventionally bathed preterm infants.

Table 3: Comparison of crying duration among preterm infants between Group A and Group B with mean and standard deviation

<table>
<thead>
<tr>
<th>Crying Duration</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean</th>
<th>S.D</th>
<th>Mean difference</th>
<th>Unpaired ‘t’ value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Swaddle Bath) N=30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration (minutes)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.150</td>
<td>0.4939</td>
<td>-1.48</td>
<td>-10.92 .000***</td>
</tr>
<tr>
<td>Percentage (%)</td>
<td>10.0</td>
<td>40.0</td>
<td>23.000</td>
<td>9.878</td>
<td>-29.66</td>
<td></td>
</tr>
<tr>
<td><strong>Group B</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Conventional Bath) N=30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration (minutes)</td>
<td>2.0</td>
<td>3.5</td>
<td>2.633</td>
<td>0.5561</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage (%)</td>
<td>40.0</td>
<td>70.0</td>
<td>52.667</td>
<td>11.121</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*** - High statistical Significance at p<0.001

The above table reveals that preterm infants had a less cry, minimum of 30 seconds to maximum of 2 minutes crying time during swaddle bath in group A and minimum of 2 minutes to 3 minutes and 30 seconds crying time during conventional bath in group B. The calculated unpaired ‘t’ value was found to be statistically highly significant at p<0.001 level.

Table 4: Correlation of level of thermal stability with crying duration among preterm infants in Group A
Correlation of variables | Post test | ‘r’ value | Level of significance
--- | --- | --- | ---
Temperature & Crying duration | Post test 10 minutes | -0.35 | P = 0.053 NS
| Post test 30 minutes | -0.69 | P = 0.01, S**
Heart rate & Crying duration | Post test 10 minutes | -0.44 | P = 0.05, S*
| Post test 30 minutes | -0.21 | P = 0.01, S**
Respiratory rate & Crying duration | Post test 10 minutes | 0.15 | p = 0.412, N.S
| Post test 30 minutes | -0.19 | P = 0.01, S**
Oxygen saturation & Crying duration | Post test 10 minutes | 0.24 | p = 0.197, N.S
| Post test 30 minutes | -0.08 | P = 0.0, S**

**Correlation is significant (S) at 0.01 level (2 tailed test)
*Correlation is significant (S) at 0.05 level (2 tailed test)

The above table shows that thermal stability and crying duration are negatively correlated with temperature, heart rate and oxygen saturation and positively correlated with respiratory rate and oxygen saturation at 10 minutes and negatively correlated at 30 minutes after bath.

Table 5: Correlation of level of thermal stability with crying duration among preterm infants in Group B.

Correlation of variables | Post test | ‘r’ value | Level of significance
--- | --- | --- | ---
Temperature & Crying duration | Post test 10 minutes | -0.17 | 0.348, N.S
| Post test 30 minutes | -0.40 | 0.01 S**
Heart rate & Crying duration | Post test 10 minutes | 0.10 | 0.593, N.S
| Post test 30 minutes | -0.04 | 0.01 S**
Respiratory rate & Crying duration | Post test 10 minutes | -0.12 | 0.498, N.S
| Post test 30 minutes | -0.13 | 0.01 S**
Oxygen saturation & Crying duration | Post test 10 minutes | 0.02 | 0.906, N.S
| Post test 30 minutes | 0.06 | 0.01 S**

**Correlation is significant at 0.01 level (2 tailed test)
*Correlation is significant at 0.05 level (2 tailed test)

The above table shows that thermal stability and crying duration are negatively correlated with temperature and respiratory rate and positively correlated with heart rate at 10 minutes and negatively at 30 minutes after bath and also positively correlated with oxygen saturation.
Table 6: Association of selected demographic variables with mean score of thermal stability among preterm infants in group A (swaddle bath) with respect to temperature (One way ANOVA)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Demographic Variables</th>
<th>Pre test 10minutes</th>
<th>Post test 10minutes</th>
<th>Post test 30 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>‘F’ value</td>
<td>Sig.</td>
</tr>
<tr>
<td>1.</td>
<td>Mode of delivery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal vaginal delivery</td>
<td>36.55</td>
<td>35.46</td>
<td>0.212</td>
</tr>
<tr>
<td></td>
<td>Caesarean delivery</td>
<td>35.82</td>
<td>35.12</td>
<td>0.649</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>Post natal age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1wk(7days)</td>
<td>37.00</td>
<td>36.00</td>
<td>0.394</td>
</tr>
<tr>
<td></td>
<td>2wk(8-14days)</td>
<td>35.86</td>
<td>35.35</td>
<td>0.759</td>
</tr>
<tr>
<td></td>
<td>3wk(15-21days)</td>
<td>36.32</td>
<td>35.09</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>4wk(22-30days)</td>
<td>36.73</td>
<td>36.03</td>
<td>-</td>
</tr>
<tr>
<td>3.</td>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>36.03</td>
<td>34.67</td>
<td>4.039</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>36.60</td>
<td>35.96</td>
<td>0.054</td>
</tr>
<tr>
<td>4.</td>
<td>Birth weight in grams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1500-1700</td>
<td>36.39</td>
<td>35.09</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1701-1900</td>
<td>36.21</td>
<td>35.52</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1901-2100</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2101-2300</td>
<td>37.13</td>
<td>36.10</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2301-2500</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>&gt;2500</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>&lt;1500</td>
<td>36.01</td>
<td>35.38</td>
<td>-</td>
</tr>
<tr>
<td>5.</td>
<td>Type of feed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expressed breast feed</td>
<td>36.56</td>
<td>35.96</td>
<td>1.686</td>
</tr>
<tr>
<td></td>
<td>Formula feed</td>
<td>36.26</td>
<td>34.69</td>
<td>0.204</td>
</tr>
<tr>
<td></td>
<td>Combined</td>
<td>35.80</td>
<td>34.90</td>
<td>35.34</td>
</tr>
</tbody>
</table>

The above table shows that the calculated ‘F’ value indicated there was significant association of mode of delivery, post natal age, gender, birth weight and type of feed with the temperature among preterm infants in group A (Swaddle bath).

Table 7: Association of selected demographic variables with the mean score of thermal stability among preterm infants in group A (Swaddle bath) with respect to Respiratory rate
The above table shows that the calculated ‘F’ value indicated that there was significant association of type of feed with respiratory rate among preterm infants in group A (Swaddle bath).

The above table shows that the calculated ‘F’ value indicated that there was significant association of type of feed with respiratory rate among preterm infants in group A (Swaddle bath).

Figure 6: Association of selected demographic variables with mean score of crying duration among preterm infants in group A (Swaddle bath) (One way ANOVA)

The above figure shows that there was significant association of mode of delivery and postnatal age with crying duration among preterm infants undergone swaddle bath in group A.
Figure 7: Association of selected demographic variables with mean score of crying duration among preterm infants in Group A (Swaddle Bath) (One way ANOVA).

The above figure shows that there was significant association of gender, type of feed and time of last feed before bath with crying duration among preterm infants undergone swaddle bath in group A.
Table 8: Association of selected demographic variables with the mean score of thermal stability among preterm infants in group B (Conventional bath) with respect to temperature (One way ANOVA)  

<table>
<thead>
<tr>
<th>S. No</th>
<th>Demographic Variables</th>
<th>Pre test 10 minutes Mean</th>
<th>‘F’ Value Sig.</th>
<th>Post test 10 minutes Mean</th>
<th>‘F’ Value Sig.</th>
<th>Post test 30 minutes Mean</th>
<th>‘F’ Value Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mode of delivery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal vaginal delivery</td>
<td>36.57</td>
<td>1.048</td>
<td>0.315</td>
<td></td>
<td>34.63</td>
<td>0.704</td>
</tr>
<tr>
<td></td>
<td>Caesarean delivery</td>
<td>36.33</td>
<td></td>
<td></td>
<td></td>
<td>34.35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Time of last feed before bath</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 hour</td>
<td>36.70</td>
<td>0.825</td>
<td></td>
<td></td>
<td>35.22</td>
<td>8.402</td>
</tr>
<tr>
<td></td>
<td>2 hours</td>
<td>36.51</td>
<td>0.492</td>
<td></td>
<td></td>
<td>34.70</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 hours</td>
<td>36.25</td>
<td></td>
<td></td>
<td></td>
<td>33.57</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 hours</td>
<td>36.00</td>
<td></td>
<td></td>
<td></td>
<td>35.20</td>
<td></td>
</tr>
</tbody>
</table>

The above table shows that there was significant association of mode of delivery and time of last feed before bath with temperature among preterm infants undergone conventional bath in group B.

Table 9: Association of selected demographic variables with the mean score of thermal stability among preterm infants in group B (Conventional Bath) with respect to heart rate.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Demographic Variable</th>
<th>Pre test 10 minutes Mean</th>
<th>‘F’ Value Sig.</th>
<th>Post test 10 minutes Mean</th>
<th>‘F’ Value Sig.</th>
<th>Post test 30 minutes Mean</th>
<th>‘F’ Value Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mode of delivery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal vaginal delivery</td>
<td>141.81</td>
<td>0.345</td>
<td></td>
<td></td>
<td>167.50</td>
<td>19.144</td>
</tr>
<tr>
<td></td>
<td>Caesarean delivery</td>
<td>139.42</td>
<td></td>
<td></td>
<td></td>
<td>187.85</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above table shows that there was significant association of mode of delivery with heart rate among preterm infants in group B (Conventional bath).

Table 10: Association of selected demographic variables with the mean score of thermal stability among preterm infants in group B (Conventional bath) with respect to respiratory rate.
The above table shows that there was significant association of postnatal age and frequency of feeds in a day with respiratory rate among preterm infants in group B (conventional bath).

**Figure 8:** Association of selected demographic variables with mean score of crying duration among preterm infants in Group B (Conventional bath) (One way ANOVA).

The above figure shows that there was significant association of place of preterm infant preterm infants before bath with crying duration among preterm infants in group B (conventional bath).
IV Discussion

The findings of the study revealed that when comparing the thermal stability among preterm infants between group A and group B, there was no significant difference in the pretest level of thermal stability among preterm infants between group A and group B. The post test mean difference & calculated unpaired ‘t’ value found at 10th minute & 30th minute after bath were 0.86, 0.90 & 2.27, 4.33 for temperature; -36.23,-33.46 & -7.39, -6.80 for heart rate; -19.40,-15.00 & -10.75,-7.21 for respiratory rate ; 0.83,0.53 &2.40,1.39 for oxygen saturation respectively.

The calculated unpaired ‘t’ value shows there was statistically high significant difference in the post test level of thermal stability among preterm infants between group A and group B at p<0.001 level. Although there was significant difference found in both the groups, it was proved that the mean temperature loss was less among preterm infants with 0.90°C at 10th minute and 0.20°C at 30th minute after swaddle bath and mean temperature loss was high among preterm infants with 2.00°C at 10th minute and 1.30°C at 30th minute after conventional bath. The heart rate, respiratory rate and oxygen saturation were maintained at 10th minute and 30th minute after swaddle bath, where as the heart rate and respiratory was increased to tachycardia and tachypnoea at 10th and 30th minute respectively after conventional bath. The oxygen saturation was reduced from 92% to 91% at 10th minute and maintained to 91% at 30th minute after swaddle bath, where as the oxygen saturation was reduced from 92% to 90% at 10th minute and maintained to 91% at 30th minute.

Hence preterm infants undergone swaddle bath had maintained thermal stability at 10th and 30th minute after swaddle bath, where as preterm infants undergone conventional bath were not maintained thermal stability at 10th minute but regained at 30th minute after conventional bath.

The comparison of crying duration among preterm infants between group A and group B with the mean percentage and calculated unpaired ‘t’ value shows that swaddle bathed preterm infants cried less with 23% and conventionally bathed preterm infants cried for longer time of 52.67%.The calculated unpaired ‘t’ value was -10.92 which shows there was high statistical significant difference between group A and group B at p<0.001 level. The mean percentage between preterm infants of swaddle bath and conventional bath shows that swaddle bathed preterm infants cried for very less duration as containment was provided during the bath comparatively with conventionally bathed preterm infants, where they had more crying duration with behavioural distress cues like crying, fussing, back arching, finger splaying, trunkal flaccidity, grimacing and tongue extension which lead to expenditure of large amounts of energy. Therefore it concludes that during swaddle bath, preterm infants cried less since the bath mimics the uterine environment as they feel secure, familiar and warmth comparatively with conventional bath.

The findings were supported by Mitra edraki, et al., (2014) [13] who conducted a randomized control trial using random allocation and divided 50 preterm infants in to two groups (25 in swaddle bath and 25 in conventional bath) and assessed the thermal stability and crying duration among preterm infants. The results indicated that the mean temperature loss was significantly less in preterm infants who were given swaddle bath than the preterm infants who were given conventional bath. The study also supports the findings for crying duration as they found that crying time was significantly less among swaddle bathed preterm infants than conventionally bathed preterm infants. Bryanton (2014) [15] compares the diverse effects of tub and sponge bath on body temperature among the preterm infants and the results
found that the preterm infant's heat loss in less in tub bath method than in sponge bath method at P<0.001 level. The results contributes that during the tub bathing as the preterm or term infants being immersed in the warm water is just like being immersed in amniotic fluid in- utero environment which comforts the newborns. A research Study by Quraishy K, et al., (2013) [4] shows that swaddling technique helps to reduce pain in newborns because swaddling is an effective technique in decreasing the preterm infants behavioural distress by providing containment to the newborn during the bathing process which can reduce stress levels. In the swaddle bathing method, immersion into water which mimics the uterine environment and containment stimulates the familiar and secure feeling and promotes a calm and stress free bathing experience for the newborns (Hall K, 2010) [1]. An advantage of this bathing method stated by Fern et al., is improved state control, i.e. decreased crying and agitation in newborns [10].

The conceptual framework adopted for this study was Mefford’s theory of health promotion for preterm infants derived from Levine’s conservation model, which supported this study and was helpful for the investigator to accomplish the study in an integrated approach. The investigator identified the felt need of preterm infants by assessing the pre test level of thermal stability using WHO guidelines and promoted wholeness by using principles of conservation. In the wholeness of preterm infant the investigator assessed the post test level of thermal stability using WHO guidelines and crying duration was assessed by using video recordings and interpreted with crying percentage formula and directed the sample for reinforcement. Thus the null hypothesis NH1 stated earlier that “There is no significant difference in relative effectiveness of swaddle bath and conventional bath on level of thermal stability and crying duration among preterm infants at P< 0.05 level was rejected.”

The analysis of correlation between post test level of thermal stability and post test crying duration among preterm infants in group A revealed that calculated 'r' value -0.698 indicated that there was negative correlation between temperature and crying duration which was found to be statistically significant at p<0.01 level; The calculated ‘r’ value -0.447 indicated that there was negative correlation between heart rate and crying duration which was found to be statistically significant at 10minutes after bath at p<0.05 level and 'r' value -0.218 at 30minutes after bath statistically significant at p<0.01 level. The calculated 'r' value 0.155 indicated that there was positive correlation between respiratory rate and crying duration at 10minutes which was not statistically significant and the calculated 'r' value -0.195 indicated negative correlation at 30minutes after bath which was found statistically significant at p<0.01 level. The calculated ‘r’ value 0.243 indicated there was positive correlation between oxygen saturation and crying duration at 10minutes after bath which was not statistically significant and the calculated ‘r’ value -0.086 indicated negative correlation at 30minutes after bath which was found to be statistically significant at p<0.01 level.

The findings of correlation between post test level of thermal stability and post test crying duration among preterm infants in group B revealed that calculated ‘r’ value -0.177 indicated that there was a negative correlation between temperature and crying duration at 10minutes after bath which was not statistically significant and the calculated ‘r’ value -0.406 indicated negative correlation at 30minutes after bath which was found to be statistically significant at p<0.01 level. The calculated ‘r’ value 0.101 indicated that there was positive correlation between heart rate and crying duration at 10minutes after bath which was not statistically significant and the calculated ‘r’ value 0.101 indicated that there was positive correlation at 30minutes after bath which was found to be statistically significant at p<0.01 level. The calculated ‘r’ value -0.129 indicated there was negative correlation between respiratory rate
and crying duration at 10 minutes which was not statistically significant and the calculated ‘r’ value -0.129 indicated there was negative correlation at 30 minutes after bath which was found to be statistically significant at p<0.01 level. The calculated ‘r’ value 0.022 indicated that there was positive correlation between oxygen saturation and crying duration which was not statistically significant and the calculated ‘r’ value 0.068 indicated there was positive correlation at 30 minutes after bath which was found to be statistically high significant at p<0.01 level.

Thus it concludes that when the crying duration during the bath is high, there will be alterations in the physiological parameters. The relationship between the thermal stability and crying duration found that as crying duration increases, temperature and oxygen saturation decreases, heart rate and respiratory rate increases. Hence null hypothesis NH2 stated earlier that “There is no significant correlation on post test mean score of thermal stability with post test mean score of crying duration among preterm infants in group A and group B at P< 0.05 level was rejected.

The analysis of variance (one way ANOVA) for association of selected demographic variables with the mean score of thermal stability and mean score of crying duration shows that mode of delivery, postnatal age, gender, birth weight and type of feed associated with temperature among preterm infants undergone swaddle bath in group A at p<0.05 level. In context to mode of delivery, during caesarean section as anaesthesia is given to mother, it affects the immature central nervous system of preterm infant and slows down the thermoregulation process performed by immature hypothalamus and thus posed to significant minute temperature loss at 10 minutes after swaddle bath but still maintained temperature at 10 minutes before swaddle bath and at 30th minute after swaddle bath among preterm infants and during normal delivery the preterm infants had maintained temperature at 10 minutes before bath but minute reduction was found at 10 minutes after swaddle bath and maintained again at 30 minute after swaddle bath due to containment offered during entire swaddle bath as preterm infants were kept in flexed midline position and were swaddled with autoclaved thick soft towel which protects from heat loss by conserving energy. With regard to the postnatal age, preterm infants who belongs to 3 weeks (15-21 days) and 4 weeks (22-30 days) of postnatal age had significant influence on temperature because it was theoretically proved that as the age of the preterm infant increases the structural immaturity of central nervous system also improves. Therefore hypothalamus functions better to maintain thermoregulation and hence maintained temperature at 30th minute after swaddle bath. In context of gender, preterm infants who were females had maintained temperature at 10 minutes before swaddle bath and at 30th minute after swaddle bath as it has impact on maintaining thermoregulation. In context to birth weight, preterm infants weighed between 2101-2300 grams had maintained temperature at 10 minutes before swaddle bath which influences the thermal stability of preterm infant where the body muscle mass is high they develop their ability to maintain thermoregulation. Whereas preterm infants who were received expressed breast feed had maintained temperature at 10 minutes before swaddle bath and at 30th minute after swaddle bath because it was theoretically proved that breast feed helps to maintain thermoregulation. Type of feed associated with respiratory rate because of scientific reason that breast feed protects preterm infant and all neonates against respiratory infections. Thus protected preterm infant from tachypnoea after swaddle bath as familiar containment was offered during swaddle bath. With regard to the postnatal age, preterm infant belongs to 1 week (7 days) of postnatal age had cried very less period of time due to their immaturity levels during swaddle bath than other preterm infants in group A. There was significant association with
the demographic variables mode of delivery and time of last feed before bath with temperature among preterm infants in group B (conventional bath) at p<0.05 level. In context to Mode of delivery, preterm infants who were born by caesarean delivery were not maintained temperature at 30th minute after conventional bath because during caesarean delivery due to anaesthesia given to mother, it affects the immature central nervous system of preterm infant and slows down the thermoregulation process performed by immature hypothalamus and thus posed to significant minute temperature loss at 10minutes after conventional bath. With regard to the time of last feed before bath, preterm infants who were received feed 2hours before bath had maintained temperature at 10th minute after conventional bath because the feed taken by preterm infant helps to conserve the energy during bath. There was also significant association of demographic variables gestational age and mode of delivery with heart rate among preterm infants in group B (conventional bath) at p<0.05 level. With regard to the gestational age, preterm infants who were born between 34 to 36 weeks of gestation had maintained heart rate at 30th minute after conventional bath because of the reason with reference to many studies; it was found there was significant association was found between the heart rate and gestational age. As the gestational age reaches near to term, the heart develops its ability to maintain to its rate and rhythm. The other demographic variables had not shown statistically significant association with the mean score of thermal stability and post test mean score of crying duration among preterm infants in group A (swaddle bath) and group B (conventional bath). Hence the null hypothesis NH3 stated earlier “There is no significant association of selected demographic variables with the mean core of thermal stability and mean score of crying duration among preterm infants in group A and group B at P< 0.05 level” was rejected for the demographic variables namely mode of delivery, post natal age, gender, birth weight, type of feed for thermal stability and mode of delivery, postnatal age, gender, type of feed and time of last feed before bath for crying duration in group A. Time of last feed, mode of delivery, gestational age, post natal age and frequency of feeds in a day for thermal stability and place of preterm infant before bath for crying duration in group B. It was accepted for other demographic variables for thermal stability and crying duration in both group A and group B.

Based on these results, the investigator recommends that nurses can effectively carry out Swaddle bath to maintain thermal stability and reduce crying duration among preterm infants. Accordingly, mother and their family members will be trained in this regard. It is noteworthy that one of the main objectives of nursing care is to provide preterm infants a stress free and familiar experience during hospitalization.

V Conclusion

The findings proved that the swaddle bath was relatively effective in maintaining the thermal stability both at 10th minute and 30th minute after bath for prolonged period of time and reduced stress cues during the bath by reducing crying duration. Whereas in the conventional bath thermal stability was not maintained at 10th minute but maintained at 30th minute after bath and could not reduce the distress during the bath i.e., the crying duration. Therefore the swaddle bath was found relatively effective than conventional bath in maintaining thermal stability and reducing crying duration and hence this bathing method, which includes in itself the components of developmental care, offers an appropriate, stress free and safe method for preterm infants and can be used as a routine bathing method in NICU’s.
VI References


VII Source of support: None

VIII Conflict of interests: None declared

IX Acknowledgement
   We would like to thank The Director, Anand Hospital, Surat for granting permission to carry out this study in their hospital.

X Contributors
   SG: Conceptualization of the study, collection, analysis of the data, writing the manuscript, finalized the manuscript and will act as the guarantor of the paper; NP: Conceptualization of the study, analysis of the data, writing the manuscript, edited and critically evaluated the manuscript; RJ, KS, CD: Edited and critically evaluated the manuscript.