

Comparison of Effectiveness of Two Polyethylene Covers on Body Temperature and Oxygen Saturation of Neonates Transferring to NICUs

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ABSTRACT

Background: The sudden exposure of premature newborns to a cold and dry environment can lead to hypothermia. This study aimed at comparing the effectiveness of two polyethylene covers on the body temperature and oxygen saturation of premature neonates.

Methods: This experimental study was conducted on 72 premature newborns in the neonatal intensive care unit (NICU) of Shahid Sadoughi Hospital in Yazd, Iran. The study subjects were randomly assigned into three groups, including the neonates with polyethylene head cap, polyethylene body bag, and routine care. The data were collected using a thermometer and a pulse oximeter. The data analysis was performed through descriptive statistics, Chi-square test, analysis of variance (ANOVA), repeated measures ANOVA, and Tukey test using SPSS (version 18) software.

Results: There was a significant difference in the mean body temperature of control and intervention groups immediately after their NICU admission and 1 h later. Other significant differences were found in the mean of oxygen saturation belonging to the control group and the hat group upon admission and 1 h later. Also, the mean scores of oxygen saturation belonging to the control group were compared with those of the bag group, and the differences were significantly different 1 h after the admission.

Conclusion: In the light of these findings, the application of both polyethylene head cap and body bag can maintain the body temperature and oxygen saturation in the premature neonates transferring to the NICU. In particular, the head cap seems to better improve than oxygen saturation.

Keywords: Newborn, Oxygen saturation, Premature, Temperature, Transfer

Introduction

The quality of healthcare in every country is determined by neonatal and maternal mortality rates during or after pregnancy. According to statistical reports, around 13 million premature neonates are annually born around the world (1, 2). In Iran, a number of 1,266,500 full-term neonates and 163,900 premature newborns are born 7900 of whom die due to the complications of prematurity (3). Although new advances in medicine have led to the increased survival of premature neonates, the newborns are still exposed to numerous consequent stressors in

their neonatal period (4). The appropriate transportation of premature newborns from the delivery room to neonatal intensive care unit (NICU) appears to be the most important factor affecting their mortality rates after birth (5).

In this process, the goal is to reduce neonatal mortality rate by means of stabilization and preservation of their general health status before, during, and after transportation to NICU in the most optimal possible conditions (6). Nonetheless, the available evidence suggested that some complications may arise during the newborn's

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transfer, such as hypothermia, changes in respiratory rate, hypoxemia, and acidosis, with hypothermia and acidosis occurring more frequently (7, 8).

Accordingly, the incidence rate of hypothermia in premature neonates at birth has been reported as 42-73% (2). In this regard, the results of a study in Nigeria also revealed that 62% of studied newborns underwent hypothermia at birth 32% of whom died (6). The results of another study conducted in Sari, Iran, demonstrated that 10.1% of newborns suffered from hypothermia even after their stabilized health condition and transfer (9).

The sudden exposure of a newborn with wet body to a cold and dry environment can lead to hypothermia and consequent compensatory responses, such as increased heat production and vascular contraction, which may last for hours (10). Moreover, being neglectful of the provision of heat preservation items, wrapping or swaddling neonate, as well as bathing them immediately after birth, can increase the likelihood of hypothermia in neonates (11).

The above-mentioned situation can be even worse in premature neonates due to their insufficient adipose tissue, increased body surface area relative to their weight, and altered vasomotor system controlling body temperature (12). This matter is also of paramount importance due to the negative consequent outcomes, including (but not limited to) hypoglycemia, acidosis, chronic pulmonary disease, increased intracerebral hemorrhage, infection, and death (13-14).

Additionally, the hypoxia and respiratory distress can be other concerns in premature neonates exposed to a cold environment due to their doubled rates of oxygen demand and consequently metabolism (15). Therefore, the hypoxia is more common in premature neonates and appears to increase their oxygen demand for more than 40% (15). Since hypoxia is a widespread phenomenon, it can affect other body organs, causing hypotonia, intra-ventricular hemorrhages, seizure, coma, and even death (16).

Due to the poor quality of given care during the premature neonate's transfer, the incidence of these consequences can be high. According to the literature, the intrahospital transfer of premature newborns in Iran is far from global standards (17). Moreover, the preventive measures for the neonatal hypothermia are missing elements in the common context of care in developing countries that should be taken into account. In this regard, the World Health Organization highlighted the

importance of protective thermal measurements in premature neonates in developing countries that lack related equipment and facilities in particular (18).

Despite various approaches that have been introduced so far in order to preserve the body heat of premature neonates, such as using radiant heaters, drying their skin, and wrapping neonates in dry and warm blankets, premature neonates are still at high risk of cold stress. In its latest guideline, the American Academy of Pediatrics recommended that the neonates should be placed in polyethylene covers under a radiant heater immediately after birth (19, 20).

Few studies have been conducted in Iran so far that studied the use of polyethylene covers in preterm newborns. For instance, a study carried out by Talakoub et al. in which the effectiveness of two polyethylene covers was studied in the prevention of body heat loss in premature neonates at birth. To do so, the control group received routine care, and two intervention groups were provided with either a polyethylene body wrap and a cotton cap or a polyethylene head cap and body wrap.

The findings of the above-mentioned study revealed that the body temperature in the intervention group with the polyethylene head cap and body wrap was higher than those of the polyethylene body bag and the cotton cap group, as well as the control group (21). Another study conducted by Valizadeh et al. explored the effectiveness of a plastic cover and a blanket in the body temperature, heart rate, and oxygen saturation (O₂Sat) in preterm newborns. The findings demonstrated that the plastic cover could better maintain body temperature and O₂Sat at optimal levels (22).

No study was found that compared the effectiveness of polyethylene head cap and body wrap in body temperature and O₂Sat over the course of intrahospital transfer of premature neonates in particular. Accordingly, this study aimed to compare the effectiveness of these two polyethylene body covers on the body temperature and O₂Sat in premature neonates during the phase of transfer to NICU.

Methods

This was an experimental study conducted on preterm newborns admitted to the NICU of Shahid Sadoughi Hospital in Yazd, Iran. Considering the 95% confidence level and 80% power, the sample size was determined as 26 individuals per group using the following formula.

$$n = \frac{(z \frac{\alpha}{2} + z\beta)^2}{(x1 - x2)^2} \times 2 \delta^2$$

The inclusion criteria consisted of the premature newborns (1) with the 5-minute Apgar score equal to or higher than 7, (2) with the gestational age of 28-36 weeks at birth, and (3) born through Caesarean section (CS). The exclusion criteria comprised (1) the newborns with plain neural tube defects and/or congenital skin disorders, including, epidermolysis, abdominal wall defects, such as gastroschisis and omphalocele, and (2) the newborns with the need for advanced cares, including, resuscitation and/or mechanical ventilation. Also, the drop-out criteria included the newborn's death, parent's reluctance to continue participation in the study, and the need for resuscitation and/or mechanical ventilation after entry into the study.

After receiving the ethical approval of the institute under consideration, the parents of eligible newborns were provided with necessary explanations of the procedures and their right to withdraw from the study at any time. Then, the eligible newborns were assigned into three groups using the simple random allocation method. To do so, the sampling was performed through the lottery method by means of three identical envelopes; each one contained three papers with the labels as follows: hat group (Figure 1), bag group (Figure 2), and control group. Prior to the selection of each participant (i.e. after the birth of eligible newborn), an envelope was randomly selected by a nurse unaware of the content of each envelope in order to determine the group of each eligible newborn.

Immediately after birth and cutting the umbilical cord in the delivery room, the newborns of the first intervention group were placed under



Figure 1. Premature neonate with polyethylene head cap

a warmer. Their head was wrapped with a dry surgical drape, and their body (to neckline) was placed in a polyethylene body wrap by the researcher. To do so, the bottom of the bag was cut by a pair of scissors so that the newborn's head could easily pass through and be held out of the bag.

Afterward, the newborn's axillary temperature was measured and recorded as the temperature before the transfer. To minimize heat loss through evaporation, top of the re-sealable zipper bag was closed. In order to attach the pulse oximeter probe to the newborn's right hand, a small hole was made in the bag and their pulse oximeter oxygen saturation (O_2Sat) was measured and recorded.

In the second intervention group, the newborns were placed under the warmer, and their heads were placed in polyethylene body wraps without being dried upon birth and cutting their umbilical cord. Then, the body was dried and wrapped with a dry surgical drape, and the axillary temperature and O_2Sat were measured and recorded as explained earlier.

The newborns belonging to the control group received routine care as it follows: at birth and after cutting their umbilical cord, they were wrapped with two pieces of surgical drapes and placed under a warmer by the researcher. Afterward, the newborns were completely dried with one piece of surgical drape. The wet surgical drape was left aside, the newborns were covered with another surgical drape, and their axillary temperature and O_2Sat were measured and recorded in the same way as explained earlier. The neonates of all three groups were placed in a portable incubator and transferred to the NICU. Upon their arrival at the NICU, their body temperatures and O_2Sat were measured and recorded twice with 1 h interval.

In order to measure O_2Sat levels, a pulse



Figure 2. Premature neonate with polyethylene body wrap

oximeter (SAADAT Novin S1800) was used manufactured by a company in Iran. Also, a digital thermometer was used to measure body temperature. In order to ensure the reliability of the measurements, the utilized instruments were calibrated by a biomedical equipment technician. It should be noted that all the procedures were undertaken by the researcher and an assistant researcher.

The data were collected and documented using the check sheets, which were designed for this purpose and included the information as follows: the neonate's age, gender, as well as body temperature and oxygen saturation levels of three points in time (i.e. immediately after birth, immediately after entering into the NICU, and 1 h after entering into the NICU).

The polyethylene bags called Zip-Bag were made by the Techno-zip company in Iran for food storage with 25×40 cm size. According to Neonatal resuscitation (i.e., the name of a book), the bag was approved by the Ministry of Health (23). The data were analyzed with the 95% confidence level using descriptive statistics, Chi-square test, analysis of variance (ANOVA), repeated measures ANOVA, and Tukey test by means of SPSS (version 18) software.

Results

The results of Kolmogorov-Smirnov test demonstrated the normal distribution of the

studied variables so that the use of parametric tests was feasible. The findings of ANOVA revealed that there was no significant difference between the mean age of the three groups ($P < 0.05$). However, the mean weight of the three groups was statistically significant ($P = 0.02$) and consequently was considered as a confounding variable that its effects on the dependent variables were controlled. Also, the results of Chi-square test showed that there was no significant difference among the three groups in terms of gender as a qualitative variable ($P < 0.05$) (Table 1).

According to the results of ANOVA, there was a significant difference in the mean body temperature of control and intervention groups upon the NICU admission ($P = 0.007$), and 1 h later ($P < 0.001$). The findings of Tukey test revealed a significant difference between the mean temperature in the control and body wrap groups ($P = 0.001$), as well as the control and head cap groups ($P = 0.001$) in the NICU admission phase. In addition, significant differences were found between the mean temperature in the control and cap groups ($P < 0.001$), as well as the control and body wrap groups ($P = 0.005$) 1 h after the ICU admission.

The results of repeated measures ANOVA demonstrated that changes in the body temperature of all three groups were significant ($P < 0.001$) over the course of time (Diagram 1).

Table 1. Frequency distribution of mean and standard deviation of demographic variables

Demographic variables	Groups	Number	Mean±Standard deviation	P-value
Weight (Gram)	Control	26	565.3±1811.19	0.02
	Cap	26	531.9±1580.3	
	Body wrap	26	427.8±1350.7	
Gestational age (week)	Control	26	2.2±31.5	0.5
	Cap	26	3.1±31.9	
	Body wrap	26	3.3±30.3	

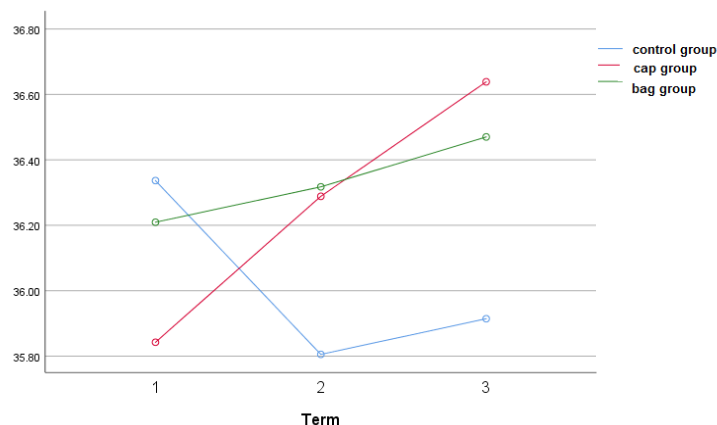
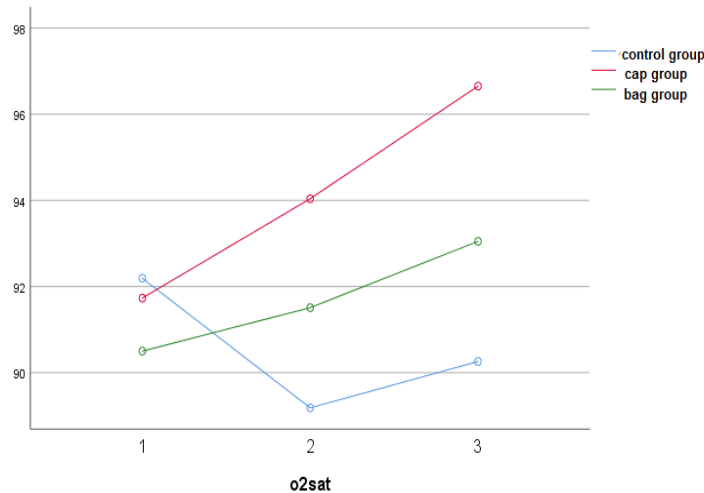


Diagram 1. Changes of temperature in three groups over three courses of time

Table 2. Comparison of mean and standard deviation of temperature prior, upon, and 1 h after neonatal intensive care unit admission in three groups

Temperature	Group			P-value
	Control	Cap	Body wrap	
	Mean±Standard deviation	Mean±Standard deviation	Mean±Standard deviation	
Prior to admission	36.3±0.43	35.8±0.7	36.16±0.5	0.07
Upon admission	35.8±0.5	36.2±0.6	36.2±0.5	0.007
1 h after admission	35.9±0.5	36.61±0.5	36.4±0.4	<0.001

**Diagram 2.** Changes of oxygen saturation in three groups over three courses of time**Table 3.** Comparison of mean and standard deviation of oxygen saturation prior, upon, and 1 h after neonatal intensive care unit admission in three groups

Temperature	Group			P-value
	Control	Cap	Body wrap	
	Mean±Standard deviation	Mean±Standard deviation	Mean±Standard deviation	
Prior to admission	92.27±3.3	91.73±4.5	90.42±2.6	0.17
Upon admission	89.23±3.7	94.03±4.2	91.46±2.7	<0.001
1 h after admission	90.19±2.5	96.65± 2.7	93.12±2.2	<0.001

However, the findings of the test showed no significant difference ($P=0.16$) between body temperature and weight as a confounding variable. Other significant differences were found among the mean scores of O_2Sat belonging to all three groups on admission to the NICU ($P<0.001$) and 1 h later ($P<0.001$) by means of ANOVA (Table 2).

In addition, the mean scores of O_2Sat 1 h after admission were compared between the control and cap groups ($P<0.001$), between the control and body wrap groups ($P<0.001$), as well as between the body wrap and cap groups ($P<0.001$), and the results were significantly different using Tukey test. Also, the results of repeated measures ANOVA demonstrated that the changes in the O_2Sat of all three groups were significant ($P<0.001$) over the course of time (Diagram 2) with no significant difference ($P=0.16$) between S_pO_2 and weight as a

confounding variable (Table 3).

Discussion

The results of the present study indicated that the application of polyethylene head cap and body wrap could influence the body temperature and O_2Sat in premature neonates transferring to the NICUs. In other words, the use of two polyethylene covers could increase the body temperature in both intervention groups, compared with that in the control group. This finding is consistent with the results of a study carried out by Ahmad et al., which assessed the influence of a plastic cover on the prevention of hypothermia in premature neonates.

The findings of the above-mentioned study revealed that the mean scores of body temperature in the intervention group on admission and 1 h later were both high in

comparison with that in the control group (20). Belsches et al. also declared that the use of a plastic body wrap had a positive effect on the body temperature of neonates in the first hour after birth (24). In addition, the results of a study conducted by Rohana et al. (Year) are in line with the above-mentioned findings. In other words, the prevalence of hypothermia episodes in the premature neonates covered with a polyethylene body wrap and those who received routine care were reported as 78% and 98%, respectively (25).

Another consistency is found in a study carried out by Trevisanuto et al. in which the premature neonates were covered with either the polyethylene head cap or the polyethylene body wrap (i.e. the intervention groups) or the dry surgical drape (i.e. the control group). According to their findings, the mean scores of body temperature in both intervention groups compared with the control group was significantly high at the NICU admission and 1 h later (10).

In fact, the findings of the present and previously-mentioned studies suggest that wrapping the premature neonates with either a polyethylene cap or a polyethylene body wrap can be effective in the prevention of hypothermia through the premises and reasoning as follows: reducing stress caused by physical contact in order to dry the neonate, saving the time spent on changing the wet drapes, keeping the vernix on the neonate's skin, reducing evaporation via the skin, and ultimately reducing the heat loss from the skin (26).

Another finding of the present study was the effect of polyethylene head cap and body wrap on O₂Sat values. The O₂Sat values of the cap and body wrap groups were higher than that of the control group, and the cap group had a higher O₂Sat value than the bag group. These findings are in line with those of a study carried out by Valizadeh et al. that demonstrated the increased body temperature and S_PO₂ in the premature neonates being wrapped with a plastic body wrap rather than a blanket (22).

Kim et al. also found out that there was a positive significant relationship between covering the neonate's head after bath and their increased body temperature and O₂Sat (27). Prasanna et al. also placed the premature newborns' bodies in a vinyl body cover, wrapped their heads with cotton caps, and measured physiologic parameters, including respiratory rate, O₂Sat, and body temperature over a course of 6 h right after birth. Their findings showed that the ratio of mean

scores of the temperature between the control group and intervention group was 1:31, and the vinyl group had a higher O₂Sat value that was in line with our findings (28).

Although none of the previously-mentioned studies explored the effect of the application of cap and body wrap on the O₂Sat of premature neonates, this can arguably be explained with the higher oxygen demands in the brain and larger surface area of the head to the surface area of total body for 20.8% that can lead to increased heat loss (10). Besides, cold stress affecting premature neonate can raise their physiologic and metabolic demands and consequently increase their respiratory rate. As a result, the increased respiratory rate might raise oxygen and energy consumption in order to produce extra heat rather than supplying vital organs, such as the brain and heart.

Among the neonates who are unable to maintain sufficient oxygen partial pressure (PAO₂), consequent vasoconstriction might lead to impaired lung perfusion, and as a result, decreased PAO₂ and blood pH (29). Thus, this might explain the findings of the current study that covering the neonate's head rather than their body can better improve the O₂Sat.

The present study had some limitations. Firstly, the study participants were only the premature neonates born through CS, and the neonates born through vaginal delivery were excluded from the study. Secondly, the temperature and O₂Sat measurements were limited to only 1 h after entering into the NICU. Regarding the fact that the physiologic stability of newly born infants can occur during the first 4 h after delivery, it is recommended to carry out further studies in order to assess these variables more frequently over the first 4 h after delivery and the premature neonates born through vaginal delivery.

Conclusion

In the light of these findings, the application of both polyethylene head cap and body wrap can maintain the body temperature and O₂Sat in premature neonates transferring to the NICU. In particular, the head cap seems to better improve the O₂Sat. Given the accessibility, cost-effectiveness, and simplicity of the application of polyethylene covers, it is recommended to consider these items for the premature neonates over their intrahospital transfer. Also, the application of these covers in neonates during the first 4 h after birth and admission to the NICU can maintain their body

temperature and O₂Sat in optimal levels and improve their physiologic state.

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Conflicts of interests

No conflict of interest was declared for this study.

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