Effect of Polyethylene Cap on Hypothermia Prevention among Low Birth Weight Neonates

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Abstract

Background: Neonatal hypothermia after birth is a worldwide issue across all climates and can prevented by using polyethylene plastic applied immediately after birth. **Aim:** The study aimed to determine the effect of polyethylene cap on hypothermia prevention among low birth weight neonates. **Subjects and method: Design:** Quasi-experimental design, pre and post-test with the control group were used to fulfill the aim of this study. **Setting**: The study was conducted at the neonatal intensive care unit (NICU) affiliated to Sohag University Hospital. **Subjects**: A purposive sampling technique was used in the study of 100 low birth weight neonates was included, randomly assigned to polyethylene cap (the experimental group included 50 low birth weight neonates who had polyethylene caps put on without drying and the control group (50 low birth weight neonates were underwent routine care and without polyethylene cap). **Tools:** Low birth weight neonates assessment sheet; it is divided into two parts: **Part (1):** characteristics of the studied low birth weight neonates **Part (2):** Hypothermia assessment sheet; and **Part (3):** Low birth weight neonates' outcomes assessment sheet. **Results:** The study result revealed that mean axillary temperatures in the experimental group were different after admission and 1 hour and 2 hours later. In low birth weight, neonates' mean temperatures were significantly higher in the experimental group after admission and 1 hour and 2 hours after birth compared to low birth weight neonates in the control group. In the experimental group mean axillary temperature was significantly higher than in the control group. **Conclusion**: Application of a polyethylene cap was an effective method to reduce hypothermia among low birth weight neonates in the experimental group compared to low birth weight neonates in the control group. **Recommendation:** The application of a polyethylene cap is recommended for low birth weight neonates to prevent hypothermia.

Keywords: Hypothermia, Low birth weight neonates, polyethylene cap

Introduction:

Low-birth-weight babies are those who weigh less than 2500 gram at delivery. Low birth weight kids have a higher risk of developing health problems later in life, such as hypothermia, birth trauma, birth asphyxia, necrotizing enterocolitis, and patent ductus arteriosus. Neonatal hypothermia is a global problem that affects people in all climates **(WHO, 2018).**

Hypothermia occurs when the core body temperature drops below 36.50 degrees Celsius. Hypothermia is usually acknowledged as a key contributory cause of substantial illness and mortality in newborns the polyethylene hat was the most effective alternative method for preventing hypothermia **(Baumgart, 2018).**

Excessive heat loss, insufficient metabolic heat generation, a lack of brown fat, CNS injury from anoxia, intracranial bleeding, and abnormalities are all causes of hypothermia. Due to the huge surface area per unit of body weight, a newborn is more likely to suffer hypothermia. Because there is less subcutaneous fat and brown fat in a low-birth-weight baby, he or she has less thermal insulation. Heat is produced by brown fat. The newborn is at risk of increased heat loss and hypothermia if exposed to the cooler extrauterine environment for an extended period without taking thermoprotective measures **(Mance, 2018).**

When the neonate's compensatory systems fail, hypothermia can cause increased oxygen and metabolic demands, acid-base disturbances, respiratory compromise, hypoglycemia, and even death. On arrival in the neonatal critical care unit, however, the rate of hypothermia in transport incubators is fairly high (NICU). As a result, a polythene cap can be utilized in the treatment of preterm newborns to prevent hypothermia during neonatal transport for those delivered in maternity homes and needing to be transported to a NICU at a different hospital **(Vohra S. (2014).**

Hypothermia is reduced in extremely low and very low birth weight infants when a polythene occlusive cap is utilized in the delivery room. Low birth weight babies are wrapped with a polyethylene hat comprised of thermoplastic polymer lined with aluminum silver swaddling, which reduces evaporative and convective heat losses **(Baumgart, 2018)**.

Polyethylene caps are efficient in preventing heat loss in women under 29 weeks of pregnancy, according to the Indian Academy Of Pediatrics. The global incidence of low birth weight newborns was estimated to be 9.6% of all births. Every year, 17 million infants in India are born with LBW, with 16 percent of LBW in underdeveloped countries. At term, about 80% of LBW babies are born in Asia **(WHO, 2018).**

Because the skin is not directly exposed to air, this cover lowers evaporation and heat loss and works as a barrier to prevent heat loss from the body of neonates. Furthermore, because the newborn is placed in the bag after drying, the vernix caseosa remains on its skin, preventing heat loss. In a Turkish study of 60 premature neonates weighing less than 1500 gram, the infants lying in polyethylene blankets attained their normal body temperature faster than the controls (**Duman et al., 2016)**.

Although the frequency of hypothermia in a group of infants covered by polyethylene bags decreased from 25% to 16% in a research conducted in England, a large number of these neonates developed overheating (12.5 percent vs 39.8 percent, respectively). A study in Italy showed that the group covered in a polyethylene bag and those with a polyethylene hat had a higher temperature, compared to controls. They concluded that polyethylene cap and bags were efficient in the prevention of heat loss from premature neonates (**Trevisanuto et al., 2016).**

A study in Iran found that those who were placed in a polyethylene plastic bag had a lower risk of hypothermia than those who were not. This group had a much shorter resuscitation time, and just one episode of hypothermia was documented (**Farhadi et al., 2016).**

It's worth noting that several recent types of research produced mixed results, concluding that the use of polyethylene plastic bags caused hypothermia in newborns and accompanying problems. The use of polyethylene bags in newborns after birth caused hypothermia in them, according to a study conducted on neonates under 30 weeks of age during their transition to the neonatal unit **(Singh et al., 2018).**

Because the head accounts for 20.8 % of total body surface area, the heat lost from its accounts for a significant fraction of overall heat loss. The head is currently dried with linen and then wrapped with a cotton cap, but cotton caps do not reduce hypothermia. Three groups of preterm children born at weeks of pregnancy: I plastic cap (head covered with a plastic cap without prior drying and body dried with linen); (ii) body wrap (body wrapped with plastic without drying and head dried); and (iii) control (body and head dried). Hypothermia was reported by 43% of the plastic cap group, 62% of the body wrap group, and 90% of the control group. They found that wearing a plastic head cover reduced hypothermia in the same way that wearing a body wrap did **(McCall et al., 2015)**.

Treatment of Hypothermia in Neonates Rewarming in an incubator or under a radiant warmer Hypothermia is treated by rewarming in an incubator or under a radiant warmer. The neonate should be monitored and treated as needed for hypoglycemia, hypoxemia, and apnea. Underlying conditions such as sepsis, drug withdrawal, or intracranial hemorrhage may require specific treatment (**Kim dong-Yeon, 2016**).

Pediatric nurses play an important role in the prevention of hypothermia in neonates as maintaining an appropriate environmental temperature is the most important step in preventing hypothermia in neonates. The World Health Organization recommends the delivery room temperature be at least and that neonates be dried immediately and placed in skin-to-skin contact with the mother and covered **(Oatley et al., 2016).**

Significance of the study:

According to a study of a large, multicenter cohort of LBW infants, each 1 C drop in body temperature raised the risk of late-onset sepsis by 11% and death by 28%. The skull, which accounts for up to 30% of total body heat loss is one area of special concern (**Laptook et al., 2017**). Hypothermia is extremely LBW neonates (those weighing less than 1500 g) can be prevented by wrapping with a plastic bag, according to the **American Academy of Pediatrics and the American Heart Association's guidelines (2015).** Hypothermia during the newborn period is widely regarded as a major contributing cause of significant morbidity and mortality in the developing world (**Darmstadt, 2015).**

Aim of the study:

The study aimed to determine the effect of polyethylene cap on hypothermia prevention among low birth weight neonates through:

- Assess the level of hypothermia among low-birth-weight neonates in the experimental and control group before polyethylene cap application.
- Apply polyethylene cap in the experimental group.
- Evaluate the level of hypothermia among low-birth-weight neonates in the experimental and control group after polyethylene cap application.

Research hypothesis:

Application of a polyethylene cap would be an effective method to reduce hypothermia among low-birth-weight neonates in the experimental group compared to low-birth-weight neonates in the control group

Subjects and Method:

Research design:

Quasi-experimental design, pre, and post-test with the control group were used to fulfill the aim of this study**.** It identified a pre-group that is as comparable to the post-group as possible. There were differences in results between the before and after groups **(Creswell, 2012).**

Setting:

The study was conducted at the neonatal intensive care unit (NICU) affiliated to Sohag University Hospital, Egypt. These settings were chosen because of the high prevalence of neonates in the selected setting, as well as the fact that it serves the most populous region of the country.

Subjects:

A purposive sampling technique was used in the study of 100 low birth weight neonates was included, randomly assigned to polyethylene cap (the experimental group included 50 low birth weight neonates who had polyethylene caps put on without drying and the control group (50 low birth weight neonates were underwent routine care and without polyethylene cap).

Sample size:

The sample size was calculated based on a power analysis of 0.95(β=1-0.95=0.5) at alpha .05 (one-sided) with a large effect size (0.5) was used as the significance, and 0.001 was used as the high significance.

Inclusion criteria:

- Both sexes
- low birth weight neonates weighing ≤ 2500 gm
- Preterm neonates < 37 weeks of gestational age.

Exclusion criteria:

- Preterm neonates with Major congenital anomalies

Tool of data collection:

Tool: Low birth weight neonates assessment sheet; this tool was developed by the researcher after reviewing related

literature ((**Kim dong-Yeon, 2016; Oatley et al., 2016; Trevisanuto et al., 2017)** to assess Low birth weight neonates characteristics and evaluate the effect of polyethylene cap on hypothermia that may occur. It is divided into three parts:

Part (1): Demographic characteristics of the studied low birth weight neonates such as gender, gestational weeks of newborn, weight, and birth order.

Part (2): The hypothermia assessment sheet, included levels of hypothermia among low birth weight neonates, it is categorized into three levels; normothermia (≥36.5°C), mild hypothermia (36–36.4°C) moderate hypothermia: (32–35.9°C), and severe hypothermia (less than 32°C)

Part (3): Low birth weight neonates' outcomes assessment sheet: It was developed by the researchers to assess the effectiveness of a polyethylene cap on hypothermia improvement among low birth weight neonates after application of the polyethylene cap.

Validity of the tools:

The validity of the tools was ascertained by a Jury of three expert professors in the pediatric nursing field who reviewed the tools for content validity. They were asked also to judge the items for completeness and clarity. No modifications were done to the tools.

Reliability of the tools

Reliability was applied by the researchers to test the internal consistency of the tools. The Reliability of the tool through Cronbach's alpha test $\alpha = 0.92$.

Methods:

- Official permission was obtained through an issued letter from the Dean of Faculty of Nursing, Sohag University, to conduct this study and the directors of the Neonatal Intensive Care Unit at Sohag University Hospital. The aim of the study was explained to obtain permission to collect the research data from the hospital.
- A pilot study was conducted on 10% of the low birth weight neonates (10 low birth weight neonates) to test the clarity and testing of the feasibility of the research process, and the time needed to complete the tool. No modifications were carried out; so, all low birth weight neonates were included in the study sample.

The procedure of data collection:

- From the beginning of February to the end of July 2019, data were collected over six months. Two days a week, from 9 a.m. to 11 a.m., researchers went to the previously specified location to collect data.
- Implementation of the study included three phases (assessment phase, implementation phase, and evaluation phase).

I- Assessment phase:

Researchers completed the data collection tool. Each tool took approximately 20-25 minutes to complete on average. Both the experimental and control groups were given the same data collection tool. From their medical records, their gestational age and birth weight were taken.

II. Implementation Phase:

The researcher started the intervention after the low birth weight neonates' parents signed the consent form and received explanations of the research goal and method. Demographic characteristics were collected by referring to low birth weight neonates' medical records.

In the experimental group:

- The neonates in the experimental group were laid in a 25–40 cm heat-resistant by the researcher, which had been already heated up under a warmer without drying, immediately after their birth and cut their umbilical cord in the labor room or operating room and their heads were covered by a polyethylene cap, already warmed-up cap with no strips, without drying.
- After checking their vital signs concerning stable respiration, pulse, and color, in a portable incubator already regulated at 35°C.

- Then, neonates' axillary temperature was measured with a pediatric digital thermometer. The length of intervention (wearing the polyethylene cap) was 1 hour.
- Neonates' body temperature was measured in all stages (at admission and 1 and 2 hours after admission) in the two groups.

In the control group:

- Low birth weight neonates were shared as a control group who did not receive a polyethylene cap and received routine care only in the study setting. The control group underwent routine care (being dried with a cloth and being placed under a warmer).

III. Evaluation phase:

In both the study and control groups, the researchers reassess low birth weight neonates' body temperature at 2 hours after admission in the two groups after polyethylene cap application using the same tool in both groups to ensure its effectiveness.

Ethical considerations:

All ethical issues were ensured. The parents were approached for written informed consent. The researchers informed parents that, the study was voluntary, they were allowed to refuse to participate and they had the right to withdraw from the study at any time, without giving any reason. Moreover, they were assured that their information would be confidential and used for research purposes only.

Statistical analysis:

The data were analyzed using SPSS version 21.0 (SPSS, Chicago, IL, USA). Chi-squared and Fisher exact tests were used to compare categorical variables. Student's t-test and Mann–Whitney U-test were used for normally distributed and skewed quantitative data, respectively. $P<0.05$ was considered significant.

Results:

Table (1) showed that (54% and 58%) of the low birth weight neonates in the polyethylene cap and control groups were males respectively. The mean± gestational age of low birth weight neonates was 31.5±1.4weeks in the Polyethylene cap group and 31.8±1.3in the control group. Regarding birth weight, 74% and 76 % of low birth weight neonates in the polyethylene cap and control groups were from 1.500 - ≤ 2.000 grams. In addition, the same table illustrated the birth order, while the majority of low birth weight neonates (46% and 48%) in the polyethylene cap and control groups were the first in birth order respectively. No statistically significant differences between polyethylene cap and control groups regarding their demographic data ($P > 0.05$).

Table (2): Demonstrated that the polyethylene cap group had significantly higher scores of temperature than the control group ($P<0.001$) and improvement in the hypothermia levels.

Table 3: Portrayed the study result revealed that mean axillary temperatures in the experimental group were different after admission and 1 hour and 2 hours later. In the control group, there was no significant difference regarding mean axillary temperature after admission and 1 hour and 2 hours later. In low birth weight, neonates' mean temperatures were significantly higher in the experimental group after admission and 1 hour and 2 hours after birth compared to low birth weight neonates in the control group. In the experimental group mean axillary temperature was significantly higher than in the control group.

Table (4): Illustrated that there were highly statistically significant improvements between pre and post-test scores of the level of hypothermia among low birth weight neonates in both the control and experimental group.

Table (1): Distribution of the studied low birth weight neonates in both groups regarding their demographic characteristics

Items	Polyethylene cap group (50)		Control group (50)		t-test	P-value
	No	%	No	%		
Gender:						
- Male	27	54.0	29	58.0	0.35	0.58
- Female	23	46.0	21	42.0		
Gestational age in weeks						
Mean± SD	31.5±1.4		31.8±1.3		1.07	0.27
Birth weight						
- 1.500 - ≤ 2.000	37	74.0	38	76.0	0.34	0.73
- ≥ 2.000	13	26.0	12	24.0		
Mean± SD	1573 ± 553					
Birth order						
1st	23	46.0	22	48.0	0.30	0.45
2nd	22	44.0	23	42.0		
3rd	5	10.0	5	10.0		

Table (2): Frequency and distribution of the studied low birth weight neonates in both studied groups regarding their level of hypothermia pre and after polyethylene cap application

Items	Pre-intervention		Post-intervention		t-test	P-value
	Polyethylene cap group .(50)	Control group (50)	Polyethylene cap group .(50)	Control group (50)		
	No (%)	No (%)	No (%)	No (%)		
Normothermia (≥36.5°C)	0	0	16	0	0.434	<0.001
Mild hypothermia(36–36.4°C)	24	26	58	28		
Moderate hypothermia (32–35.9°C),	62	60	26	62		
Severe hypothermia (less than 32°C)	14	14	0	10		

Table 3: Mean temperatures of low birth weight neonates in the two groups at various time

Group	Temperature at admission		The temperature at 1 h after admission		The temperature at 2 h after admission		F	P-value
	Mean	SD	Mean	SD	Mean	SD		
Control	35.96	0.82	36.02	1.15	35.83	1.26	0.834	>0.05
Polyethylene cap	36.42	0.73	36.46	0.75	36.59	0.63	20.43	<0.001

Table (4): Compare the effectiveness of polyethylene cap on hypothermia among control and experimental group of low birth weight neonates.

Low birth weight neonates	"t" TEST				P-value
	Paired 't-test value		Unpaired 'test value		
	Calculated value	Table value	Calculated value	Table value	
Control group	6.4	2.145	35.4	2.043	P < 0.05 significant
Experimental group	7.04	2.143			P < 0.05 significant
Control group and experimental group posttest	-	-			P < 0.05 significant

Discussion:

There are various mechanisms involved in the prevention of heat loss when a neonate is covered in a polythene cap during transport. € e chief determinant of evaporative heat loss is the water vapor pressure in the layer of air immediately adjacent to the fetal skin. It seems probable that when a neonate priorly covered with amniotic ,fluid is placed in a polythene wrap, the evaporative water loss from the skin surface that is not in contact with the bag membrane will contribute to high humidity and vapor pressure in the air between the membrane and the skin and this will cause a drop in evaporative heat loss **(Sedin, 2014).**

Results of the current study revealed that the polyethylene cap group had significantly higher scores on temperature than the control group and improvement in the hypothermia levels. From the researchers' point of view, it reflected the positive effects of applying a polythene cap on improving low birth weight neonates. This finding is similar to other studies conducted by **Knobel et al., (2015) who studied "** Heat loss prevention in the delivery room for preterm infants: a national survey of newborn intensive care units" **and Vohra, (2014)** who conducted a study about " Heat loss prevention help in the delivery room " and they reported that mean admission temperature in NICU was higher in polythene cap group as compared to control group. €

Concerning mean temperatures among low birth weight neonates at admission and one hour and two hours after admission, the study result revealed that mean axillary temperatures in low birth weight neonates were significantly higher in the experimental group after admission and 1 hour and 2 hours after birth compared to control group. From the researchers' point of view, it confirmed the effectiveness of polyethylene cap in various times of application.

This finding is supported by **Farhadi et al., (2016)** who studied "Plastic cap on prevention of hypothermia in preterm infants" and concluded that covering the neonates with polyethylene cap increased their temperature within the first hour after admission.

Similary, **Trevisanuto, et al., (2017)** conducted a study entitled "Heat loss prevention in very preterm infants in delivery rooms" and found that covering the neonates with a polyethylene cap increased their temperature within the first hour. Also, **Leaford et al., (2013)** published a randomized controlled trial that found that covering a neonate in a polythene cap helps in achieving a higher temperature 1 hour after birth.

This finding is in line with the study conducted by **Gathwala et al., (2016)** who conducted a study entitled " Safety and efficacy of vinyl bags in the prevention of hypothermia of preterm neonates at birth" and found that mean axillary temperature was slightly higher in the intervention group at 1 h after admission, From the researchers' point of view, it indicated the cause for recommended usage of polyethylene cap.

This finding is matched with **Agourram et al., (2018)** who studied "Why wrapping premature neonates to prevent hypothermia can predispose to overheating" on neonates under 30 weeks of age during their transfer to the neonatal ward and concluded that using a polyethylene cap may lead to the occurrence of hyperthermia and its complications among the neonates. A study conducted

This result is in the same line as a randomized controlled trial conducted by **Rohana et al., (2017)** about "Reducing hypothermia in preterm infants with polyethylene cap" and **Simon et al., (2015)** about " Thermal defense of extremely low gestational age newborns during resuscitation: exothermic mattresses vs polyethylene cap " and they found that application of polyethylene cap to the preterm neonate in the delivery room shows high temperature on admission compared to control group.

In addition, Talakoub et al., (2015) studied the" Effect of two polyethylene covers in the prevention of hypothermia among premature neonates "on neonates at 28–32 weeks' gestation and concluded that the use of polyethylene head cap play an important role in improvement between pre and post-test scores of the level of hypothermia among low birth weight neonates in both the control and experimental group.

Kim dong-Yeon & Park ho-ran, (2016) conducted a meta-analysis of the four studies and found that polyethylene caps were statistically significantly more effective than routine care in

reducing heat losses in infants aged < 28 weeks of gestation [weighted mean difference. **Doglioni et al., (2014**), also, studied" Total body polyethylene wraps for preventing hypothermia in preterm infants" and found that the infants wore the plastic cap for 1 h. The temperature was measured on admission to NICU, and at 1 and 2 h after admission. Mean axillary temperature on admission to NICU and at 1 and 2 h after admission was better in both intervention groups compared with the control group. Even in a study conducted in Newzealand, the subjects' heads were not covered by a plastic hat, and the researchers suggested covering the neonate's head with a plastic cover in future studies to prevent hypothermia. They argued that the big size of the head in neonates and its high proportion of the body surface was the reason for this. Concerning the complications and the importance of prevention of hypothermia in premature neonates **(Meyer MP, & Bold GT., 2017)**

Results of the current study revealed that there were highly statistically significant improvements between pre and post-test scores of the level of hypothermia among low birth weight neonates in both the control and experimental group. This result highlighted the success of the application of Polyethylene Cap in improving the level of hypothermia among low birth weight neonates. This result is supported by **Karthika and Moses (2015)** who found the same results.

Conclusion:

From the result of the present study, it can be concluded that the application of a polyethylene cap was an effective method to reduce hypothermia among low birth weight neonates in the experimental group compared to low birth weight neonates in the control group.

Recommendation:

In the light of the results of this study, the following recommendations were suggested:

- The application of a polyethylene cap is recommended for low birth weight neonates to prevent hypothermia.
- A study can be conducted with large samples to generalize the findings.
- A comparative study can be conducted to assess the effectiveness of polyethylene cap with various types of methods to prevent hypothermia like warmer, Incubator, warm room, transwarmer mattress, and polyethylene bag.
- A comparative study can be conducted to assess the effectiveness of polyethylene cap among low-birth-weight babies Versus normal birth weight babies.

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