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Original Research Article

Role of Polyethylene Bag in Prevention of Hypothermia in Preterms and Low Birth Weight Infants

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Abstract: ***Background:*** Neonatal hypothermia is a common and preventable complication in preterm and low birth weight infants, associated with increased morbidity and mortality. Effective and low-cost strategies such as polyethylene bags have been proposed to minimize heat loss immediately after birth. ***Objectives:*** To evaluate the role of polyethylene bags in preventing hypothermia among preterm and low birth weight infants compared with standard care. **Study Design & Setting:** This study was conducted at the neonatal intensive care unit of Sughra Shafi Medical Complex Narowal from 1st February 2025 to 1st August 2025. ***Methodology:*** A total of 130 preterm and low birth weight infants were enrolled and randomized equally into two groups: polyethylene bag group (n=65) and standard care group (n=65). Axillary temperature was recorded at one hour post-delivery. Hypothermia was defined as a body temperature <36.5°C. Data were stratified by gestational age, birth weight, and gender. Post-stratification, chi-square test was applied with $p \leq 0.05$ considered significant. ***Results:*** The mean temperature at one hour was significantly higher in the polyethylene bag group (36.6 ± 0.3°C) compared to the standard care group (36.2 ± 0.4°C; $p < 0.05$). Incidence of hypothermia was markedly lower in the polyethylene bag group (27.7%) than in the standard care group (70.8%). Stratified analysis demonstrated a significant reduction in hypothermia across subgroups of gestational age (<34 weeks vs. ≥34 weeks), birth weight (<2000 g vs. ≥2000 g), and gender ($p < 0.05$). ***Conclusion:*** Polyethylene bags are an effective, simple, and inexpensive intervention for preventing hypothermia in preterm and low birth weight infants. Their routine use in delivery rooms should be encouraged, especially in resource-limited settings.

Keywords: birth weight, hypothermia, neonates, polyethylene bag, preterm, prevention, randomized controlled trial

INTRODUCTION

Neonatal hypothermia is defined as a core body temperature below 36.5°C, it represents a serious thermal emergency in the immediate postnatal period.[1] The transition from intrauterine to extrauterine life poses unique thermoregulatory challenges, especially for vulnerable neonates who lack adequate physiological reserves to counter rapid heat loss.[2] Globally, hypothermia is recognized as a "silent emergency," affecting between 32% and 85% of newborns in different regions, with the highest prevalence reported in low- and middle-income countries.[3] According to the World Health Organization (WHO), neonatal hypothermia is strongly associated with increased risks of sepsis, respiratory distress, hypoglycemia, intraventricular hemorrhage, and mortality.[4] The burden is more pronounced in South Asia and Sub-Saharan Africa,

where preterm birth rates are high and access to sophisticated neonatal intensive care facilities is limited.[5] In Pakistan, where nearly 40% of neonatal deaths occur within the first 24 hours of life prevalence ranging from 25% to over 50% among hospitalized neonates, making it one of the leading preventable causes of neonatal mortality.[6]

Preterm and LBW infants are at a particular disadvantage due to a constellation of factors: large surface area-to-body mass ratio, thin epidermis with poor keratinization, deficient subcutaneous fat, and reduced brown adipose tissue stores. These factors not only predispose them to increased radiant, convective, conductive, and evaporative heat loss but also limit their capacity for non-shivering thermogenesis.[7] Furthermore, immature neurological and metabolic pathways impair effective thermoregulation, while delayed initiation of skin-to-skin contact and inadequate environmental control in delivery rooms exacerbate the risk. Hypothermia, in turn, triggers a vicious cycle by increasing oxygen consumption, inducing metabolic acidosis, impairing coagulation, and suppressing immune responses.[8]

Traditional approaches for preventing neonatal hypothermia include warm delivery rooms, radiant warmers, incubators, heated mattresses, and skin-to-skin care (kangaroo mother care). While effective, these interventions may not always be feasible or immediately available, particularly in low-resource settings or during emergency deliveries.[9] The use of polyethylene bags or plastic wraps has emerged as a simple, inexpensive, and practical strategy to reduce heat loss, especially in very low birth weight and extremely preterm infants.[10] By creating a barrier to evaporative and convective heat loss, polyethylene wrapping preserves body temperature during the critical period after birth before more advanced thermal care can be initiated.[11]

In light of the persistent challenge of neonatal hypothermia and its substantial contribution to mortality in preterm and LBW infants, evaluating low-cost interventions such as polyethylene bag use holds significant clinical and public health importance. Understanding its role in thermal regulation not only informs neonatal resuscitation protocols but also provides a feasible, scalable solution for resource-constrained environments like Pakistan, where improving neonatal survival remains a top priority.

MATERIALS AND METHODS

This study was conducted in the Neonatology Department of Sughra Shafi Medical Complex Narowal from 1st February 2025 to 1st August 2025. A total of 130 preterm and low birth weight neonates were enrolled using non-probability consecutive sampling. The sample size of 130 neonates was calculated using the WHO sample size calculator. By keeping a confidence level of 95%, a power of 80%, and an expected incidence of mild hypothermia was taken as 26.6% from previous literature, the required sample size was estimated at 130.[12] Written informed consent was obtained from parents or guardians prior to enrollment.

Neonates with gestational age less than 37 weeks or birth weight below 2500 grams were included. Babies with major congenital malformations, perinatal asphyxia requiring extensive resuscitation, or those with life-threatening conditions at birth were excluded. Eligible neonates were randomized into two groups by computer-generated random numbers. Group A (intervention group) was immediately placed in a sterile polyethylene bag up to the level of the neck after birth, while Group B (control group) received standard thermal care, which included drying with pre-warmed towels, placement under a radiant warmer, and covering with caps and blankets.

All deliveries were attended by trained neonatal staff, and ambient delivery room temperature was maintained at 25–28°C. In both groups, routine neonatal resuscitation steps were carried out as per Neonatal Resuscitation Program (NRP) guidelines. Core body temperature was measured with a digital axillary thermometer at 10 minutes, 30 minutes, and 60 minutes after birth. Hypothermia was defined as body temperature less than 36.5°C, and was further classified according to WHO criteria into mild (36.0–36.4°C), moderate (32.0–35.9°C), and severe (<32.0°C). All neonates were closely monitored for cardiorespiratory stability, hypoglycemia, and other complications during the first 24 hours of life. Data regarding gestational age, birth weight, gender, mode of delivery, Apgar scores, and temperature readings at specified intervals were recorded on a predesigned proforma. Any episodes of hypothermia, need for supplemental warming, and early neonatal outcomes were documented. The primary outcome measure was the incidence of hypothermia within the first hour of life. Secondary outcomes included mean temperature differences, severity of hypothermia, and requirement of additional thermal support.

Data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 25. Quantitative variables such as gestational age, birth weight, and body temperature were presented as mean ± standard deviation. Categorical variables such as gender, mode of delivery, and presence or absence of hypothermia were expressed as frequencies and percentages. Data were stratified with respect to gestational age, birth weight, and gender. Post-stratification, chi-square test was applied to compare categorical outcomes, while independent sample t-test was used for continuous variables. A p-value ≤ 0.05 was taken as statistically significant

RESULTS

The baseline characteristics of the study population showed that gender distribution was comparable across the two groups, with 46.2% females and 53.8% males in the polyethylene bag group, while in the standard care group 47.7% were females and 52.3% were males. The mean gestational age was 32.6 ± 1.5 weeks in the polyethylene bag group and 32.8 ± 1.6 weeks in the standard care group. A higher proportion of infants in both groups were between 34–36 weeks of gestation (56.9% in polyethylene bag vs. 55.4% in standard care). The mean birth weight was comparable between the groups, with nearly half of the neonates in both groups weighing below 2000 g (50.8% vs. 52.3%). Thus, the baseline demographics and clinical characteristics were evenly distributed across the two groups, as given in Table 1. At one hour post-delivery, the mean temperature of neonates in the polyethylene bag group was 36.6 ± 0.3°C compared to 36.2 ± 0.4°C in the standard care group, indicating a higher maintenance of normothermia in the polyethylene bag group, as shown in Table 2.

When comparing hypothermia incidence, neonates managed with polyethylene bags demonstrated a substantially lower rate of hypothermia (27.7%) compared to those receiving standard care (70.8%). Conversely, the majority of neonates in the polyethylene bag group maintained normothermia (72.3%) compared with only 29.2% in the standard care group, as shown in Table 3. Stratification analysis revealed that hypothermia was more common in neonates with gestational age below 34 weeks, occurring in 36.4% of the standard care group versus 15.6% in the polyethylene bag group ($p = 0.041$). Similarly, among infants with birth weight <2000 g, hypothermia occurred more frequently in the standard care group (37.1%) compared to the polyethylene bag group (17.6%) ($p = 0.038$). With respect to gender, male infants in the standard care group had a higher hypothermia incidence (30.4%) compared to those in the polyethylene bag group (14.9%). A similar pattern was observed in females (29.5% vs. 13.2%) ($p = 0.049$). These findings emphasize the consistent protective effect of polyethylene bags across gestational age, birth weight, and gender categories, as given in Table 4.

Table 1 – Baseline Characteristics & Demographics of Study Population (n = 130)

Parameters	Category	Polyethylene Bag (n = 65)	Standard Care (n = 65)
Gender	Female	30 (46.2%)	31 (47.7%)
	Male	35 (53.8%)	34 (52.3%)
Gestational Age weeks	Mean ± SD	32.6 ± 1.5	32.8 ± 1.6
	<34 weeks	28 (43.1%)	29 (44.6%)
	34–36 weeks	37 (56.9%)	36 (55.4%)
Birth Weight	Mean ± SD	32.6 ± 1.5	32.8 ± 1.6
	<2000 g	33 (50.8%)	34 (52.3%)
	2000–2499 g	32 (49.2%)	31 (47.7%)

Table 2 – Mean Temperature at 1 Hour Post-Delivery (n = 130)

Group	Mean Temperature (°C)	SD
Polyethylene Bag	36.6	0.3
Standard Care	36.2	0.4

Table 3 – Incidence of Hypothermia in Polyethylene Bag versus Standard Care Groups (n = 130)

Group	No Hypothermia n (%)	Hypothermia n (%)
Polyethylene Bag	47 (72.3%)	18 (27.7%)
Standard Care	19 (29.2%)	46 (70.8%)
Total	66 (50.8%)	64 (49.2%)

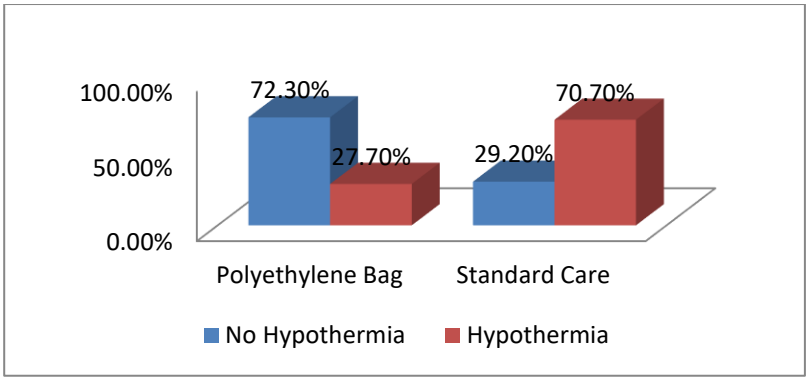

Figure-I: Incidence of Hypothermia in Polyethylene Bag versus Standard Care Groups

Table 4 – Stratification of Hypothermia by Gestational Age, Birth Weight, and Gender in Study Groups

Variable	Category	Polyethylene Bag (n=65)	Standard Care (n=65)	p-value
Gestational Age	<34 weeks	5 (15.6%)	12 (36.4%)	0.041
	≥34 weeks	7 (13.7%)	15 (30.6%)	
Birth Weight	<2000 g	6 (17.6%)	13 (37.1%)	0.038
	≥2000 g	6 (11.8%)	14 (29.8%)	
Gender	Male	7 (14.9%)	14 (30.4%)	0.049
	Female	5 (13.2%)	13 (29.5%)	

DISCUSSION

Neonatal hypothermia remains a major contributor to morbidity and mortality, particularly in preterm and low birth weight infants. Despite advances in neonatal care, heat loss immediately after birth continues to pose a significant challenge.13 Polyethylene bags offer a simple, cost-effective, and evidence-based method to reduce evaporative heat loss. Their role in preventing hypothermia is increasingly recognized as a practical intervention in both high- and low-resource settings.14

In our study, the mean temperature at one hour post-delivery was significantly higher in neonates managed with polyethylene bags (36.6 ± 0.3 °C) compared to standard care (36.2 ± 0.4 °C), and the incidence of hypothermia was substantially lower in the polyethylene bag group (27.7%) than in the standard care group (70.8%). These findings are consistent with previous studies that have demonstrated the efficacy of polyethylene bags in maintaining neonatal body temperature.

Yalestyarini et al. (2024) reported that 93% of neonates had baseline hypothermia (<36.5 °C), and after the use of polyethylene bags, 87% experienced an increase or stabilization in temperature with a highly significant Wilcoxon test result ($p = 0.000$).15 Similarly, Chantaroj et al. (2019) observed higher median body temperatures in the intervention group {36.5 °C (35.5–37.2)} compared with controls {35.9 °C (34.9–36.5)}, $p < 0.001$, and a reduced incidence of hypothermia (26% vs. 89%, $p < 0.001$) with a number needed to treat of 1.58, which is comparable to our observed 43% reduction.16 Hu et al. (2018) further supported this by showing a significantly lower rate of moderate hypothermia (3.7% vs. 27.8%, RR 0.10, 95% CI 0.02–0.46, $p < 0.001$) and higher axillary temperatures (36.4 ± 0.4 °C vs. 35.9 ± 0.9 °C, $p = 0.001$), findings that closely align with our results.17 Mansour et al. (2020) also demonstrated significantly higher mean axillary temperatures in the intervention group at admission and at subsequent time points up to two hours, corroborating our findings of sustained thermoprotection.18

Possidente et al. (2023) documented a markedly lower admission hypothermia rate in the polyethylene bag group (2.6% vs. 14.7%, OR 0.14, 95% CI 0.03–0.64, $p = 0.007$) and higher median admission temperatures (36.8 °C vs. 36.5 °C, $p = 0.001$). However, they also reported a higher incidence of hyperthermia (9.2% vs. 1.0%, $p = 0.023$), an outcome not observed in our cohort, where no infant developed hyperthermia.19 In contrast, Ali et al. (2024) found no significant difference in overall hypothermia incidence (85.9% vs. 88.9%, $p = 0.521$), although polyethylene wraps significantly reduced the need for subsequent interventions ($p = 0.001$). This partial agreement may reflect differences in study populations, as their cohort included very preterm and very low birth weight neonates at higher baseline risk.20

Leadford et al. (2023) highlighted normothermia maintenance in 64.8% of the intervention group versus 77.8% in controls, which is different from our findings where polyethylene bags outperformed standard care. Mortality outcomes, however, did not differ significantly between groups in either study.21 Khan et al. (2021) also found significantly higher

temperatures at one and two hours post-admission in the polyethylene group (<0.05), which parallels our observed one-hour temperature advantage.22 Pervaiz et al. (2023) demonstrated a higher median temperature (37.6 ± 0.7 °C vs. 36.8 ± 1.8 °C, $p < 0.05$) and a lower hypothermia incidence (6.5% vs. 32.6%, $p < 0.05$) in the intervention group, echoing our substantial reduction in hypothermia. Riaz et al. (2017) similarly reported hypothermia in 45% of the polyethylene bag group compared to 69% in controls, with a significant p value of 0.000, reinforcing the effectiveness of this intervention.23

A major strength of this study is its randomized design with an adequate sample size of 130 neonates, ensuring balanced comparison between groups. The study provides locally relevant data on hypothermia prevention, which is valuable for neonatal care guidelines in Pakistan. Use of objective temperature measurements adds reliability to the findings. However, the study was limited to a single center, which may affect generalizability. Short follow-up duration restricted assessment of long-term outcomes. Additionally, other confounding factors such as resuscitation time and ambient room temperature were not fully controlled.

CONCLUSION

Polyethylene bags were effective in reducing hypothermia among preterm and low birth weight infants compared to standard care. This low-cost, simple intervention has the potential to improve neonatal survival in resource-limited settings. Its routine adoption in delivery rooms is strongly recommended.

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