Original Article

Impact of Hypothermia on Respiratory Distress In Neonates

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Abstract:

Neonatal hypothermia is a global concern linked to increased morbidity and mortality, particularly in developing countries. Defined by the WHO as a body temperature below 36.5°C, hypothermia is a preventable condition that can lead to severe complications, including respiratory distress syndrome (RDS). **Objective:** To assess the association between hypothermia and respiratory distress syndrome (RDS) in neonates, evaluate the prevalence of hypothermia, and analyze its impact on RDS severity. **Methodology:** This prospective observational study was conducted over one year in the NICU of a tertiary care center. Neonates with gestational ages between 24 and 42 weeks and diagnosed with hypothermia (body temperature <36.5°C) were included. Statistical analysis was focused on the association between hypothermia and RDS severity. **Results:** Out of 100 neonates, 55% were male, and 60% were born to primiparous mothers. Hypothermia was present in 50% of neonates, and RDS was observed in 55%. Among neonates with hypothermia, 40% experienced severe RDS, while no severe RDS was observed in non-hypothermic neonates ($p < 0.01$). Hypothermic neonates also showed lower mean oxygen saturation (85%) compared to normothermic neonates (97%), with improvement after rewarming. The association between hypothermia and RDS severity was statistically significant. **Conclusion:** Hypothermia significantly impacts the severity of respiratory distress syndrome in neonates, emphasizing the need for early detection and proper thermal management in NICUs. Addressing hypothermia can reduce RDS severity and improve neonatal outcomes.

Key words: Neonatal hypothermia, Respiratory Distress Syndrome, RDS severity, thermal protection, hypothermia prevalence

Introduction:

Neonatal hypothermia remains a significant global issue, contributing to increased risks of morbidity and mortality.[1] According to the WHO, hypothermia is defined as a body temperature below the normal range of 36.5°C–37.5°C and is categorized into three levels: mild (36.0°C–36.4°C), moderate (32.0°C–35.9°C), and severe (<32.0°C). Following birth, the primary mechanism of heat loss in neonates is the evaporation of amniotic fluid[2], which can be intensified by convective and conductive cooling when new-borns are exposed to cooler room temperatures or placed on cold surfaces.[3] Full-term new-borns are unable to generate enough heat to maintain their body temperature, particularly within the first 24 hours of life[4], and can experience a rapid decline in temperature at a rate of 0.2 to 1.0°C per minute when exposed to room air immediately after delivery.[5]

In developing countries, a critical challenge in neonatal survival is the lack of adequate thermal protection.[6] Of the approximately 4 million new-borns globally who fail to survive their first month, most die due to complications linked to hypothermia, such as prematurity and severe infections, including sepsis and pneumonia.[7] Hypothermia can also result from insufficient care and lack of attentiveness by healthcare staff during childbirth.[8]

Methodology:

1. Study Design: Prospective observational study

2. Study Duration: One year (1 November 2023 to 1 November 2024)

3. Study Location: Neonatal Intensive Care Unit (NICU) at tertiary care center

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ISSN No. *: (p) 2348-523X, (o) 2454-1982*

DOI: 10.46858/vimshsj.110403

Date of Published : *13th December 2024*

4. Study Population:

Inclusion Criteria:

- Neonates admitted to the NICU
- Gestational age between 24 and 42 weeks

Exclusion Criteria:

- Neonates with congenital anomalies affecting respiratory function
- Neonates with sepsis or other infections at the time of admission

5. Sample Size: 100

6. Study Procedure:

- Eligible neonates will be categorized into two groups:
- *Hypothermic Group:* Neonates with an axillary temperature below 36.5°C.
- *Non-Hypothermic Group:* Neonates with an axillary temperature between 36.5°C and 37.5°C.

Variables:

Demographic data	Outcome data	Tools & Instruments
Gestational age, birth weight, gender, mode of delivery Intervention data: Methods of rewarming, use of respiratory support (e.g., CPAP, mechanical ventilation), duration of respiratory support	Incidence of respiratory distress syndrome (RDS), survival rates, length of hospital stay	1. Thermometers for measuring body temperature 2. Pulse oximeters for measuring oxygen saturation 3. Clinical assessment forms for recording respiratory distress signs

Ethical approval was obtained from the institutional ethics committee. Written informed consent was obtained from the parents or guardians of all participating children.

Data Analysis: Descriptive statistics to summarize demographic and clinical characteristics Comparative analysis to assess differences between hypothermic and normothermic neonates

Results:

Table 1: Distribution According to Gender of neonates

Gender	Frequency	Percentage
Male	55	55
Female	45	45
Total	100	100

The study included 100 neonates, with 55 males and 45 females. Male neonates constituted 55% of the total, while females accounted for 45%. This indicates a slightly higher proportion of male neonates compared to females.

Table 2: Distribution according to parity

Parity	Frequency	Percentage
Primi	60	60
Multi	40	40
Total	100	100

Out of 100 neonates, 60 were born to primiparous mothers (first pregnancy), constituting 60% of the total, while 40 were born to multiparous mothers (subsequent pregnancies), and making up 40%. This suggests that the majority of neonates were delivered by first-time mothers.

Table 3: Distribution According To Respiratory Distress Syndrome

RDS	Frequency	Percentage
Present	55	55
Absent	45	45
Total	100	100

RDS was present in 55% of the neonates, while 45% showed no signs of the condition. This finding highlights that over half of the neonates in the study experienced respiratory distress.

Table 4: Distribution according to of hypothermia and RDS

RDS	Frequency	Percentage
Absent	45	45
Severe (score7-10)	40	40
Moderate (score 4-6)	10	10
Mild (score 1-3)	5	5

Among the neonates with RDS, 40% had severe RDS (score 7–10), 10% had moderate RDS (score 4–6), and 5% had mild RDS (score 1–3). This distribution indicates that a significant proportion of neonates with RDS experienced severe symptoms.

Table 5: Distribution according to of hypothermia

Hypothermia	Frequency	Percentage
Present	50	50
Absent	50	50
Total	100	100

Hypothermia was observed in 50% of the neonates, while the remaining 50% were unaffected. This shows that hypothermia was equally prevalent among the neonates in the study.

Table 6: Distribution according to Severity of hypothermia and RDS

RDS	Hypothermia		p value
	Present	Absent	
Severe (score7-10)	40	0	p<0.01
Moderate (score 4-6)	5	5	
Mild (score 1-3)	0	5	
ABSENT	5	40	
TOTAL	50	50	

Table 7: Distribution according to Oxygen saturation and gestational age

Oxygen saturation	Hypothermia	
	Present	Absent
Mean oxygen saturation	85%	97%
Mean oxygen saturation after rewarming	94%	97%
Gestational age	Mean = 32 weeks (range: 24-42 weeks)	Mean = 32 weeks (range: 24-42 weeks)
Birth Weight:	Mean 2000 grams (range: 850 -4,000 grams)	Mean 2000 grams (range: 850 -4000 grams)

A significant association was observed between the severity of RDS and the presence of hypothermia, with a highly significant p-value (< 0.01). Among neonates with severe RDS, 40% had hypothermia, while none in this group were hypothermia-free. For moderate RDS cases, 5% were hypothermic, and 5% were hypothermia-free. In mild cases, none had hypothermia, and 5% were hypothermia-free. Among neonates without RDS, 5% had hypothermia, and 40% were hypothermia-free. The results indicate that severe RDS is strongly associated with the presence of hypothermia.

Discussion:

Our study and the findings of Yibeltal Asmamaw show several similarities and differences in neonatal and maternal characteristics.[9] Regarding the gender distribution of neonates, both studies reported that 55% of the neonates were male, indicating consistency in gender proportions. In terms of parity, 60% of mothers in our study were primiparous, which closely aligns with Yibeltal Asmamaw Yitayew's findings of 57.4% primiparous mothers.[9]

In examining respiratory distress syndrome (RDS), our study highlighted that 55% of neonates had RDS, with a detailed severity breakdown showing 40% severe, 10% moderate, and 5% mild cases. However, Yibeltal's study did not specifically analyze RDS severity but noted that most pregnancies (88.6%) had no obstetric complications, leaving RDS less prominently featured.[9]

Hypothermia prevalence differed significantly between the two studies. In our study, 50% of neonates were hypothermic, with 40% having severe hypothermia, 10% moderate, and none with mild hypothermia. In contrast, Yibeltal Asmamaw Yitayew reported a higher hypothermia prevalence of 66.8%, with 53.3% experiencing moderate hypothermia. Both studies identified key risk factors for hypothermia, with Yibeltal emphasizing the lack of skin-to-skin contact, nighttime delivery, and CPR at birth, while our results showed a significant association between hypothermia and RDS severity ($p < 0.01$).[9]

Our study and the study by Sunita Choudhary reveal several important trends in neonatal health outcomes, including gender distribution, maternal parity, respiratory distress syndrome (RDS), and hypothermia. Both studies showed a higher percentage of male neonates admitted compared to female neonates.[10] In Sunita Choudhary's study, males constituted 63.49% of the population, while in our study, males represented 55%. This male predominance suggests a common trend in neonatal admissions that warrants further investigation to understand if biological or socio-cultural factors are contributing to this difference.[10]

In terms of maternal parity, both studies observed a predominance of primiparous mothers. Sunita Choudhary's study reported 65.60% of pregnancies involved first-time mothers, whereas in our study, 60% of the pregnancies were in primiparous mothers.[10] This indicates that first-time mothers might have a higher risk of complications leading to neonatal admissions, potentially due to less experience with prenatal care or a higher likelihood of complications such as preterm labor.

Regarding respiratory distress syndrome (RDS), Sunita Choudhary's study found that RDS was present in all neonates born before 28 weeks of gestation (100%), with the prevalence decreasing as gestational age increased.(10) Similarly, our study showed that 55% of neonates had RDS, with severity levels varying: 40% had severe RDS, 10% moderate, and 5% mild. These findings emphasize that RDS remains a significant burden, particularly for extremely preterm neonates. Addressing RDS severity is crucial, highlighting the importance of early and tailored respiratory support interventions.

Hypothermia was another common finding across both studies. In Sunita Choudhary's study, 60% of neonates experienced mild hypothermia and 40% experienced moderate hypothermia.[10] In our study, hypothermia was present in 50% of neonates, with a notable association between severe hypothermia and RDS, which was found to be statistically significant (p-value < 0.01). This association highlights the need for improved thermal management in neonates, particularly those suffering from RDS, to reduce the risk of further complications.

In our study, hypothermia was present in 50% of neonates, demonstrating an equal distribution of hypothermic and non-hypothermic cases. In contrast, Laura Nguyen's study reported a lower prevalence of hypothermia, with 26.8% of neonates affected within 6 hours of delivery.[11] Among late preterm infants in her study, hypothermia was observed in 62% of cases, compared to 24% in term infants. This discrepancy in prevalence may reflect differences in the study populations or environmental factors. Additionally, our study does not provide data stratified by gestational age, which limits direct comparison in this regard.

Respiratory distress syndrome (RDS) was present in 55% of neonates in our study, with a significant association between hypothermia and RDS severity. Notably, all cases of severe RDS (40%) occurred exclusively in hypothermic neonates, with no severe RDS observed in non-hypothermic neonates, indicating a highly significant relationship ($p < 0.01$). Similarly, Laura Nguyen's study identified an association between hypothermia and RDS, as well as the need for respiratory support, but did not provide details on the severity of RDS.[11] This distinction highlights the more granular analysis of RDS severity in our study.

Gender distribution in our study showed a slight male predominance (55% male, 45% female), a parameter not discussed in Laura Nguyen's study. Similarly, our study analyzed parity, finding that 60% of neonates were born to primiparous mothers, while 40% were born to multiparous mothers.[11] These variables were not included in Laura Nguyen's analysis, precluding direct comparison.

In terms of outcomes, both studies demonstrate a significant association between hypothermia and RDS. However, while Laura Nguyen's study explores broader clinical outcomes, including NICU admission, hypoglycemia, and the need for IV therapy.[11] Our study is focused more narrowly on the relationship between hypothermia and RDS severity. Overall, our study emphasizes the severity spectrum of RDS in hypothermic neonates, providing additional insights into this critical association, whereas Laura Nguyen's study offers a broader context for neonatal outcomes associated with hypothermia.

Conclusion:

The study concludes that the significant impact of hypothermia on respiratory distress syndrome (RDS) severity in neonates. Hypothermia was observed in 50% of the study population and was strongly associated with severe RDS, with no cases of severe RDS reported in non-hypothermic neonates. The findings emphasize that effective thermal management is crucial for reducing the severity of RDS and improving neonatal outcomes. Early detection of hypothermia and timely interventions, such as rewarming and respiratory support, can significantly mitigate complications and enhance survival rates in neonates. Addressing the challenges of neonatal hypothermia, particularly in resource-limited settings, is essential for reducing morbidity and mortality in this vulnerable population

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