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# Association of Hypothermia in Newborn at Admission with Morbidity and Mortality in a Tertiary Level Hospital in Bangladesh

MOHAMMAD RASEL[1], MAHBUBUR RAHMAN[2], MOHAMMOD. SHAHIDULLAH[3], M A MANNAN[4], UMMEY TAMIMA NASRIN[5], PROHLAD KARMAKER[6], SANJOY KUMER DEY[7]

**Abstract**

***Background:*** *The neonatal mortality is still significantly high in Bangladesh. One of the major risk factors for morbidity and mortality in the first 28 days of life is neonatal hypothermia. Hypothermia is a risk factor for neonatal sepsis, intraventricular haemorrhage, necrotizing enterocolitis, respiratory distress, hypoglycemia, metabolic acidosis, hyperbilirubinemia, scleroderma, DIC and pulmonary haemorrhage.*

***Objective:*** *To find out the association between neonatal hypothermia at admission with mortality and morbidity.*

***Methodology:*** *This prospective observational study was conducted in Department of Neonatology in Bangabandhu Sheikh Mujib Medical University over a period of one year from July 2021 to June 2022. Temperature was measured in axilla using commercially available Digital Axillary Thermometer (Elite Digital Thermometer). Study population was divided into normothermic (84) and hypothermic (84) group. The babies were followed up until discharge or death, whichever came first. The primary outcome in this study was neonatal mortality and morbidity.*

***Results:*** *Among the total study population of 497 newborns, frequency of hypothermia was 18.90%. Outborn babies significantly suffered from hypothermia (p=0.021). Early Onset Neonatal Sepsis, Late Onset Neonatal sepsis, shock and hospital stay were significantly higher in hypothermic group than normothermic group (p= 0.03, <0.001,0.002 and 0.001 respectively). Death rate was significantly higher in hypothermic group (p<0.001). More respiratory support were required in hypothermic group compared to normothermic group (p=0.049). Multivariate analysis of hypothermia related mortality and morbidities showed, statistically significant higher rate of late onset neonatal sepsis, shock, prolonged hospital stay (≥7 days) and mortality among the hypothermic neonates.*

***Conclusion:*** *Frequency of admission hypothermia is 18.9%. Hypothermia is more common in outborn babies. Late onset neonatal sepsis, shock, prolonged hospital stay and mortality are significantly more common in hypothermic newborns.*

***Key words:*** *Newborn, Hypothermia at admission, Morbidity and Mortality*

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1. Assistant professor, Department, Paediatrics, Monno Medical College and Hospital, Manikganj, Bangladesh
2. Assistant Registrar, Department of Paediatrics, Shaheed M Monsur Ali Medical College & Hospital, Sirajgonj, Bangladesh.
3. Founder Chairman & Professor, Department of Neonatology, Bangabandhu Sheikh Mujib Medical University Shahbag, Dhaka, Bangladesh
4. Professor, Department of Neonatology, Bangabandhu Sheikh Mujib Medical University Shahbag, Dhaka, Bangladesh
5. Assistant Surgeon, Department of Paediatrics, Upazilla Health Complex, Chandina, Cumilla, Bangladesh.
6. Assistant Registrar, Sheikh Sayera Khatun Medical College Hospital, Gopalgonj, Bangladesh.
7. Professor & Chairman, Department of Neonatology, Bangabandhu Sheikh Mujib Medical University Shahbag, Dhaka, Bangladesh

**Correspondence**: Dr. Mohammad Rasel, Assistant professor, Department Paediatrics, Monno Medical College and Hospital, Manikganj. Mobile: 01912-192970, Email: mohammad.rasel 201384@gmail.com

## Introduction

Neonatal period is the most vulnerable time for a child's survival. Though Bangladesh has achieved the MDG4 target for reduction of under 5 mortality ahead of time, neonatal mortality is still significantly high (30/1000 live birth) which accounts for 67% of all under 5 deaths.[1] One of the major risk factors for morbidity and mortality in the first 28 days of life is neonatal hypothermia.[2]

In low re-source settings, a high incidence of hypothermia has been documented in hospitals immediately following birth. The incidence of admission hypothermia in Bangladesh is ranging from

14%-64.29% in different studies.[3] It was found that mild and moderate hypothermia were significantly more in Early Onset Neonatal Sepsis.[4] Incidence in Central India is 17%, In North India 45% and in Nepal 81%.[5] Studies conducted in Zambia and Zimbabwe in the late 1990s to 2000s identified hypothermia in 44–51% of sick newborns on admission to the neo-natal unit.[6]

Neonatal hypothermia is a common and dangerous condition, particularly in LMIC.[7] Neonatal hypothermia is associated with a five-fold higher in mortality during the first 5 days of life, previous studies had revealed that every one degree centigrade decrement of neonate's body temperature increases the mortality risk by 80%.[8]

Hypothermia can lead to severe clinical condition and is risk factors for developing neonatal sepsis, intraventricular haemorrhage and necrotizing enterocolitis.[2] Neonatal hypothermia is also a risk factors for development of respiratory distress, hypoglycemia, metabolic acidosis, hyperbilirubinemia, scleroderma, DIC and pulmonary hemorrhage.[9] Neonatal hypothermia increase the mortality irrespective of other clinical condition.[8]

Some studies done outside the country to evaluate the association of neonatal hypothermia with mortality and morbidity. However, more recent data on hypothermia in NICU in Bangladesh are lacking. Furthermore, few studies have evaluated the incidence of hypothermia in newborn at admission but no data regarding the association with mortality and morbidity.

This study aimed to address this gap by documenting association of hypothermia in newborn at admission with morbidity and mortality in a Tertiary Level Hospital in Bangladesh.

## Materials and Methods

**Study design:** Prospective observational study.

**Place of Study:** Department of Neonatology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbag, Dhaka, Bangladesh.

**Time of Study:** July 2021 to June2022.

**Study population:** All inborn and outborn neonates admitted to NICU of BSMMU, Dhaka.

**Exclusion criteria:** Neonates with major congenital malformations and those who were discharged against medical advice were excluded from this study.

**Sample size:** 168 (84 in each group).

### Study Procedure

This prospective observational study was conducted in the Department of Neonatology in BSMMU, a tertiary care hospital of Dhaka city after approval by Institutional Review Board over a period of one year from July 2021 to June 2022. All neonates admitted into NICU of BSMMU were enrolled in the study after getting informed written consent from parents. Those who had congenital malformations incompatible with life, those who were discharged against medical advice were excluded from this study.

After that admission temperature was measured by attending doctor in axilla using commercially available Digital Axillary Thermometer (Elite Digital Axillary Thermometer) keeping thermometer for 3 minutes. Then the patients were divided into Normothermic and Hypothermic group. Total sample size was 168, 84 in Normothermia group and 84 in Hypothermia group. Neonatal hypothermia is defined as a core body temperature <36.5°C and is categorized into three levels of severity: mild or cold stress (core 36.0 to 36.4°C), moderate (core 32.0 to 35.9°C) and severe (core <32°C).

At first hypothermic patient was selected according to inclusion criteria. Then a normothermic newborn was selected whose birth weight and gestation was closed to corresponding hypothermic newborn. Regarding birthweight, ± 200 gm was considered. For Gestation, ± 2 weeks was considered for selecting normothermic corresponding newborn. Newborn were selected 1:1 manner from each group. Hypothermic babies were managed according to institutional guideline.

Then babies were followed up routinely. All the data were collected from the patient's attendants in predesign Data collection form.

Neonatal sepsis was diagnosed with clinical features and laboratory evidence. Patent ductus arteriosus was diagnosed clinically by attending physician and was confirmed by Echocardiography. DIC was diagnosed clinically with or without laboratory evidence.

Shock was diagnosed clinically. Intraventricular hemorrhage was diagnosed mainly clinically as USG of brain were not done for all suspected cases. Some patients died before doing UGS.

During discharge or death, duration of hospital stay was calculated. All the admitted infants got standard

care according to NICU protocol of BSMMU. The babies were followed up until death or discharge, whichever came first. All the data were compared between hypothermic and normothermic group. The primary outcome measured in the study was neonatal morbidity and mortality.

**Statistical analysis**

After collection data were analyzed using the statistical package for social sciences (SPSS) version 20. Quantitative data were expressed as mean ± SD and categorical data were presented as frequency and percentage. All quantitative data were compared by Independent sample t test; categorical data were compared by Chi-square test. The effects of confounding factors on outcomes were adjusted by multivariate logistic regression analysis. $p<0.05$ was considered as significant.

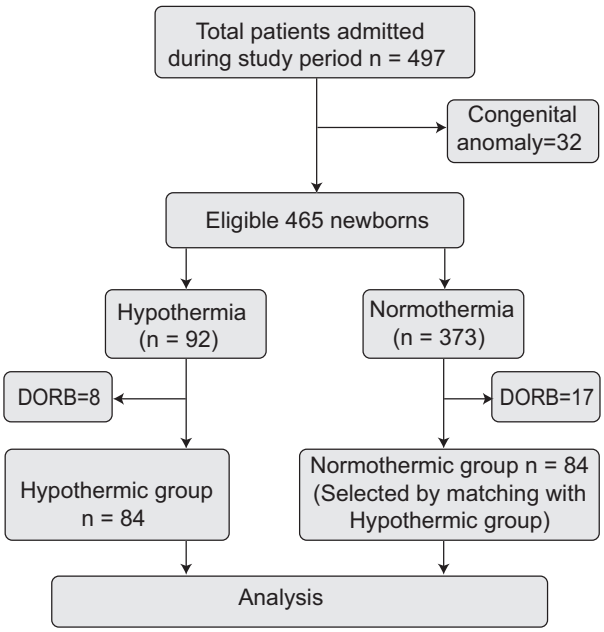


**Fig.-1:** *Flow chart of patient enrollment and their outcome*

**Table I**

*Maternal and Neonatal baseline characteristics (N=168)*

| Characteristics | Normothermia (n=84) | Hypothermia (n=84) | P value |
|---|---|---|---|
| **Maternal Characteristics** | | | |
| Maternal age, Years ( Mean ± SD) | 28.6 ± 4.6 | 28.04 ± 5.08 | 0.454$^{ns}$ |
| Type of gestation (%) | | | 0.577$^{ns}$ |
| Single | 76(90.5) | 78 (92.2) | |
| Multiple | 8(9.5) | 6 (7.1) | |
| Mode of Delivery (%) | | | 0.294$^{ns}$ |
| Vaginal Delivery | 11(13.1) | 16 (19) | |
| LUCS | 73 (86.9) | 68 (81) | |
| Delivery attendant by health care provider (%) | 83 (98.8) | 80 (95.2) | 0.173$^{ns}$ |
| Antenatal corticosteroid (%) | | | 0.504$^{ns}$ |
| Not received | 60 (71.4) | 56 (66.7) | |
| Complete | 24 (28.6) | 28 (33.3) | |
| Maternal pregnancy induced hypertension (%) | 22 (26.2) | 23 (27.4) | 0.862$^{ns}$ |
| Gestational Diabetes Mellitus (%) | 19 (22.6) | 18 (21.4) | 0.852$^{ns}$ |
| Risk factors for sepsis (%) | 15 (17.9) | 18 (21.4) | 0.560$^{ns}$ |
| **Neonatal Characteristics** | | | |
| Gestational age, weeks (Mean± SD) | 34.77± 3.29 | 34.55± 3.43 | 0.663$^{ns}$ |
| Sex, Male (%) | 41 (48.8) | 51 (60.7) | 0.121$^{ns}$ |
| Age at admission, Days (Mean± SD) | 2.70± 3.66 | 3.89± 5.52 | 0.102$^{ns}$ |
| Inborn (%) | 73 (86.9) | 61 (72.6) | 0.021$^{s}$ |
| Outborn (%) | 11 (13.1) | 23 (27.4) | |
| Birth weight, gm (Mean ±SD) | 2114.35±809.23 | 2140.75±838.43 | 0.836$^{ns}$ |
| APGAR score (Mean ±SD) | 7.17±0.83 | 6.89±1.07 | 0.067$^{ns}$ |
| Admission temperature, Celcius (Mean ±SD) | 36.66±0.14 | 35.84±0.68 | <0.001$^{s}$ |
| Capillary blood glucose,mmol/L (Mean ±SD) | 4.60±0.785 | 4.51±0.91 | 0.502$^{ns}$ |

Statistical test: Independent Sample t- test and Chi square test . s= significant, ns= not significant.

Baseline maternal and neonatal characteristics of the studied neonates were presented in (Table I). Mean gestational age and birth weight was similar in both group. Most of the babies were singleton in both the groups, 76(90.5%) and 78(92.2%). Outborn babies suffered significantly more from hypothermia (p=0.021). Mean admission temperature was 36.66±0.14°C among the normothermic group and 35.84±0.68°C among the hypothermic group (p<0.001).

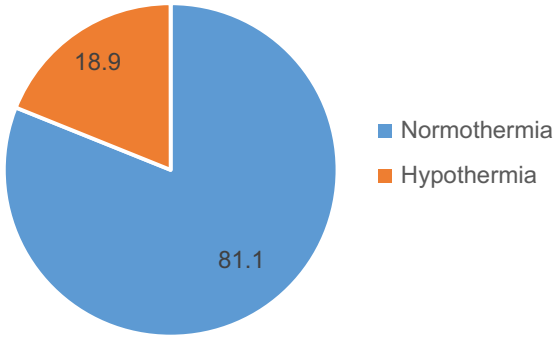


**Fig.-2:** *Frequency of hypothermia*

Among the hypothermic neonates, 64.30% had mild hypothermia, 34.50% had moderate hypothermia and 1.2% had severe hypothermia (Figure 3).

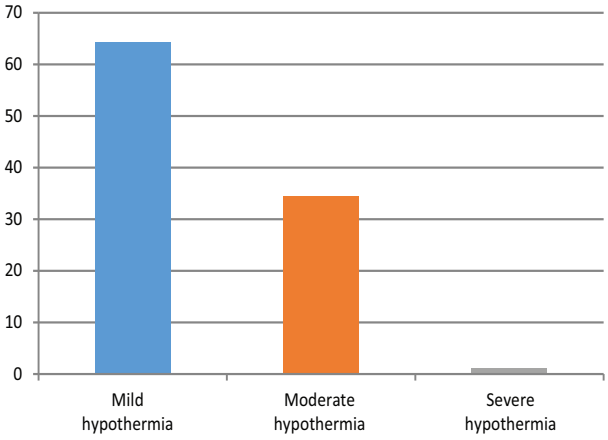


**Fig.-3:** *Grading of hypothermia among studied babies*

**Table II**

*Mortality and Morbidities among study population (N=168)*

| Outcome variables | Normothermia (n=84) | Hypothermia(n=84) | P value |
|---|---|---|---|
| Respiratory distress syndrome (%) | 19 (22.6) | 26 (31) | 0.223$^{ns}$ |
| Early Onset Neonatal Sepsis (%) | 23 (27.4) | 36 (42.9) | **0.036$^{s}$** |
| Late Onset Neonatal Sepsis (%) | 10 (11.9) | 31 (36.9) | **<0.001$^{s}$** |
| Patent Ductus Arteriosus (%) | 7 (8.3) | 5 (6) | 0.549$^{ns}$ |
| Necrotizing Enterocolitis (%) | 2 (2.4) | 3 (2.6) | 0.650$^{ns}$ |
| Perinatal Asphyxia (%) | 6 (7.1) | 11 (13.1) | 0.201$^{ns}$ |
| Shock (%) | 7 (8.3) | 22 (26.2) | **0.002$^{s}$** |
| DIC (%) | 6 (7.1) | 14 (16.7) | 0.057$^{ns}$ |
| IVH (%) | 3 (3.6) | 4 (4.8) | 0.699$^{ns}$ |
| Transient Tachypnea of Newborn (%) | 16 (19) | 18 (21.4) | 0.701$^{ns}$ |
| Acute Kidney Injury (%) | 2 (2.4) | 6 (7.1) | 0.147$^{ns}$ |
| Neonatal Jaundice (%) | 43 (51.2) | 38 (45.2) | 0.440$^{ns}$ |
| Death (%) | 6 (7.1) | 19 (22.6) | **0.005$^{s}$** |

Statistical test: Independent Sample t- test and chi square test. s= significant, ns= not significant.
DIC : disseminated intravascular coagulation, IVH = Intraventricular hemorrhage.

Regarding morbidities among the study population, Early Onset Neonatal Sepsis, Late Onset Neonatal Sepsis and shock were significantly higher in hypothermic group than normothermic group (p= 0.03, <0.001 and 0.002 respectively). Death rate was significantly higher in hypothermic group (p<0.001) (Table II).

More respiratory support were required in hypothermic group compared to normothermic group (p=0.049). Duration of hospital stay was 7.61±7.64 days and 12.44±10.88 days among normothermic and hypothermic group respectively which was statistically significant (p=0.001 (Table III).

Among the study population, inborn babies were more. Regarding morbidities among inborn and outborn neonates respiratory distress syndrome, early onset neonatal sepsis, late onset neonatal sepsis, necrotizing enterocolitis and shock were significantly more among the outborn neonates (Table IV). Hospital stay 7 days or more was also significantly high among outborn babies (p=0.011). Death rate was similar in both group (Table IV).

Hypothermia was significantly more among outborn neonates (p=0.021) (Table V).

**Table III**

*Respiratory support and duration of hospital stay among study population (N=168)*

| | Normothermia (n=84) | Hypothermia (n=84) | P value |
|---|---|---|---|
| Respiratory Support(%) | | | 0.049[s] |
| Not needed | 31 (36.9) | 19 (22.6) | |
| Only oxygen | 30 (35.7) | 27 (32.1) | |
| Heated Humidified High Flow Nasal Cannula | 1 (1.2) | 0 (0) | |
| Continuous Positive Airway Pressure | 16 (19) | 22 (26.2) | |
| Mechanical Ventilator | 6 (7.1) | 16 (19) | |
| Duration of hospital stay, days (Mean,SD) | 7.61±7.64 | 12.44±10.88 | 0.001[s] |
| Duration of hospital stay 7 or more days | 35 (41.7) | 56 (66.7) | 0.001[s] |

Statistical test: Chi square test. s= significant, ns= not significant.

**Table IV**

*Mortality and Morbidities between inborn and outborn neonates (N=168)*

| Outcome variables | Inborn (n=134) | Outborn (n=134) | P value |
|---|---|---|---|
| Respiratory distress syndrome (%) | 30 (22.4) | 15 (44.1) | 0.011[s] |
| Early Onset Neonatal Sepsis(%) | 40 (29.9) | 19 (55.9) | 0.005[s] |
| Late Onset Neonatal Sepsis(%) | 22 (16.4) | 19 (55.9) | <0.001[s] |
| Patent Ductus Arteriosus(%) | 8 (6) | 4 (11.8) | 0.241[ns] |
| Necrotizing Enterocolitis(%) | 2(1.5) | 3 (8.8) | 0.025[s] |
| Shock(%) | 19 (14.2) | 10 (29.4) | 0.036[s] |
| DIC(%) | 14 (10.4) | 6 (17.6) | 0.247[ns] |
| IVH(%) | 5 (3.7) | 2 (5.9) | 0.575[ns] |
| Hospital Stay 7 or more days (%) | 66 (49.3) | 25 (73.5) | 0.011[s] |
| Death (%) | 17 (12.7) | 8 (23.5) | 0.113[ns] |

Statistical test: Chi square test. s= significant, ns= not significant. DIC=Disseminated Intravascular Coagulation, IVH=Intraventricular hemorrhage

**Table V**

*Comparison of admission temperature between inborn and outborn neonates (N=168)*

| Temperature category | Inborn (n=134) | Outborn (n=34) | P value |
|---|---|---|---|
| Normothermia | 73 (54.5) | 11 (32.4) | 0.021[s] |
| Hypothermia | 61 (45.5) | 23 (67.6) | |

Statistical test: Chi square test. s= significant, ns= not significant.

**Table -V**

*Mortality and Morbidities among hypothermic newborns (N=84)*

| Outcome variables | Mild hypothermia (n=54) | Moderate and severe hypothermia (n=30) | P value |
|---|---|---|---|
| Respiratory distress syndrome (%) | 11 (20.4) | 15 (50) | 0.005 |
| Early onset neonatal sepsis (%) | 21 (38.9) | 15 (50) | 0.324ns |
| Late onset neonatal sepsis (%) | 20 (37) | 11 (36.7) | 0.973ns |
| Patent ductus arteriosus (%) | 3 (5.6) | 2 (6.7) | 0.837ns |
| Necrotizing enterocolitis (%) | 2(3.7) | 1 (3.3) | 0.930ns |
| Shock(%) | 10 (18.5) | 12 (40) | 0.032 |
| DIC(%) | 8 (14.8) | 6 (20) | 0.541ns |
| IVH(%) | 1 (1.9) | 3 (10) | 0.093ns |
| Hospital Stay 7 or more days (%) | 21 (38.9) | 7 (23.3) | 0.147ns |
| Death (%) | 10 (18.5) | 9 (30) | 0.285 |

Statistical test: Chi square test. s= significant, ns= not significant. DIC=Disseminated intravascular coagulation, IVH=Intraventricular hemorrhage.

**Table VI**

*Multivariate analysis of hypothermia related mortality and morbidities*

| Outcome variables | OR (95% CI) | P value |
|---|---|---|
| Early Onset Neonatal Sepsis | 1.75 (0.90-3.40) | $0.097^{ns}$ |
| Late Onset Neonatal Sepsis | 3.74 (1.62-8.63) | $0.002^{s}$ |
| Shock | 3.45 (1.40-8.94) | $0.007^{s}$ |
| Death | 3.52(1.31-9.46) | $0.012^{s}$ |
| Prolong hospital stay ( 7 or more days) | 4.23 (1.95-9.16) | $<0.001^{s}$ |

Statistical test: logistic regression analysis . s= significant, ns= not significant.

Among hypothermic neonates (84), 54 were mild hypothermic and 30 were moderate to severe hypothermic. Regarding mortality and morbidities among hypothermic newborn, respiratory distress syndrome and shock were more in moderate to severe hypothermic group compared to mild hypothermic group (p 0.005 and 0.032 respectively) (Table VI).

Multivariate analysis of hypothermia related mortality and morbidities showed, statistically significant higher rate of late onset neonatal sepsis, shock, prolonged hospital stay (≥7 days) and mortality among the hypothermic neonates (Table VII).

**Discussion**

This prospective observational study was conducted to see the association of hypothermia in newborn at admission with mortality and morbidity. Total 497 newborns were admitted in neonatal intensive care unit (NICU) of BSSMU during the study period. After exclusion 84 babies of each group were analyzed. The primary and secondary outcomes were compared between the two groups.

In this study the frequency of admission hypothermia is 18.9%, which is different from previous studies done in home and abroad where frequency of admission hypothermia ranging from 14% to 64%.[3,10,11] Possible cause of low incidence in our study is, most of the patients were inborn and all the delivery were attended by trained doctors who ensured the thermal care after birth. Percentage of severe hypothermia, moderate hypothermia and mild hypothermia were 1.2%, 34.5% and 64.3%

respectively which was comparable with previous study by Datta V. et.al. (2017) in Delhi[7].

In this study, the mean gestational age were 34.77 ± 3.29 weeks and 34.55±3.43 weeks in the normothermic and hypothermic group respectively which is different with previous study (Shirin M. et.al., 2019) where mean gestational age were 36.4±2.7 weeks[4]. Study done in India (Agrawal, J.M. et al., 2020) where mean gestational age was 34±4.54 weeks that is consistent with our study.[12] Possible explanation is, main bulk of our babies usually come from Fetomaternal medicine department, they deal with critical deliveries and complicated pregnancy which ultimately leads to more preterm delivery.

The mean age at admission was 2.7±3.66 days and 3.89±5.52 days in normothermic and hypothermic group respectively which is different from the previous study (Shirin M. et.al.2019).[4] Possible explanation is most of our patient are inborn and admitted immediately after birth. Another study done in Ethiopia (Demissie BW et al., 2018) where most of the patient were admitted within 24 hours of age (965.4%). They included the inborn newborn.[10]

Most of the gestation was singleton in this study, 90.5% and 92.2% in normothermic group and hypothermic group respectively which was consistent with the previous study (Frank Phoya et.al., 2020).[13] Most of the delivery were done by Caesarean section delivery in this study, 86.9% and 81% in normothermic and hypothermic group respectively which is different from the previous study done in Bangladesh ( Shirin M. et al., 2019).[4] Another study done in Malawi by Frank Phoya and his team (2020), where 31% delivery occurred by Caesarean section.[13] This difference can be explained by more complicated pregnancy were delivered here as it is a tertiary care hospital and patients were referred from different location of this country.

Antenatal risk factors for sepsis was found in 17.9% and 21.4% in normothermic and hypothermic group respectively, which is consistent with a study done by Yanyu lyu and his team (2015) where antenatal risk factors for sepsis was 22.7%.[14]

Main bulk of our study population is inborn (79.8%). Outborn baby suffered more from hypothermia (0.021). Possible cause of increased frequency of hypothermia among outborn newborns is poor thermal care during transport. Although there is no such type of study conducted to compare hypothermia among inborn and outborn neonates. Another study done in this institute (SK Dey et al., 2017) where, among the outborn babies 14% were hypothermic and their explanation was lack of safe transport system is responsible for hypothermia.[11] Study done in Tanzania (Kiputa M et al., 2022) regarding transport of sick newborn and they stated that Neonatal transportation in Tanzania was observed to be challenging. Pre transfer care and monitoring during transportation was inadequate and this contributed to poor clinical status on admission specially hypothermia.[15] Hypoglycaemia were not found in this study.

Mean capillary glucose level was similar in both group which was comparable with previous study done Frank Phoya (2020).[13]

In this study the mean admission temperature was 36.66±0.14$^0$Cand 35.84±0.68$^0$C in normothermic and hypothermic group respectively which is consistent with previous study where the mean admission temperature in hypothermic neonates was 35.9$^0$C (De Siqueira Caldas, J.P. et al., 2019).[16] Another study in Korea by Na Hyun Lee et al. (2019) where mean admission temperature was 36.1±0.6, although it was done for very low birth weight baby.[17]

In this study, death was statistically more in hypothermic neonates where p value was 0.012(OR 3.52, 95% CI 1.31-9.46) which was comparable with previous study done in Nepal ( Mullany, L.C et al., 2010) where OR was 3.12 (95%CI 2.40-4.05).[8] Another study done in a tertiary care hospital in Malawi which revealed the similar finding where p vale was 0.02 for hypothermia associated mortality (Frank Phoya et al., 2020).[13] Another multicenter study done in 20 Brazilian university tertiary public hospitals, revealed hypothermia associated mortality was significantly higher (OR 1.29, 95%CI 1.09-1.84) (De Siqueira Caldas, J.P. et al., 2019).[16]

In this study prolonged hospital stay was more in hypothermic group and p value was <0.001(OR 4.23, 95% CI 1.95-9.16) which is comparable with previous study done by Frank Phoya et al., (2020) in Malawi where p value was 0.03.[13] Regarding respiratory support, hypothermic patient got more ventilator and CPAP support support compared to normothermic group, normothermic patient got no or only Oxygen supplementation and p value were 0.049 and 0.049 which was closely similar to previous study where oxygen requirement and CPAP requirement were more

in hypothermic group and p value was 0.01 and 0.05 respectively. Although they did not see the need of mechanical ventilator in hypothermic patient.

Sepsis, shock and respiratory distress in hypothermic newborn leads to increased respiratory support. Another study done in Korea by Na Hyun Lee et al., (2019), where mechanical ventilator requirement was significantly higher in hypothermic very low birth weight infants, were p value was <0.001.[17] Morbidities like early onset neonatal sepsis, respiratory distress syndrome, late onset neonatal sepsis, necrotizing enterocolitis and shock were significantly more in hypothermic group. After doing multivariate logistic regression analysis, late onset neonatal sepsis and shock were more in hypothermic neonates compared to normothermic neonates and P value is 0.002 (95% CI 1.62-8.63) and 0.007 (95% CI 1.40-8.94) respectively. These results are consistent with previous study done in Korea (Na Hyun Lee et al., 2019).[17] Another study revealed that hypothermia is contributory factor in neonatal mortality and morbidity in both developed and developing countries as it may cause hypoglycaemia, respiratory distress, hypoxia, metabolic acidosis, coagulation defects, delayed readjustment from fetal to newborn circulation , acute renal failure, necrotizing enterocolitis and failure to increase in weight or weight loss (Jeffrey Pradeep Raj et al., 2015).[18]

There was a multicenter prospective study done among 15 centers of the National Institute of Child Health and Human Development Neonatal Research Network in Providence, Rhode Island by Laptook AR et al., (2007) and they examined the distribution of temperatures in low birth weight infants on admission to the NICUs and determined whether admission temperature was associated with antepartum and birth variables and selected morbidities and mortality. They found that hypothermia in preterm neonates is associated with morbidity like late onset sepsis (11% increase per 1°C decrease) and mortality. Admission temperature was inversely related to mortality (28% increase per 1°C decrease). Increased rate of infection is due to, hypothermia leads to lymphopenia and decreased immune response which ultimately leads to sepsis.[19]

The common morbidities were compared between inborn and outborn baby where Respiratory distress syndrome (p value 0.011), Early onset neonatal sepsis (p value 0.005), Late onset neonatal sepsis (p value <0.001), Necrotizing enterocolitis (p value 0.025), Shock (p value 0.036) and prolonged hospital stay 7 or more days (p value 0.011) were significantly higher in outborn baby compared with inborn baby. This was comparable with previous study which was done in Japan for extremely preterm baby, where they compared the morbidities between inborn and outborn neonates. They found that the frequency of severe intraventricular hemorrhage, necrotizing enterocolitis or focal intestinal perforation and cognitive impairment was significantly higher in outborn infants (Yoshihito Sasaki et.al., 2019).[20] Although they did not compare between hypothermic and normothermic group. Possible explanation of increased morbidities among outborn babies is they were already diagnosed with morbidities that required treatment and referral to tertiary center like our hospital.

**Limitation**

Most of the participants were inborn which have not reflected the whole newborn population. In all suspected cases of intraventricular hemorrhage, USG of brain were not done due to unavailability of sonography. In all suspected cases of DIC, coagulation profile were not done due to unavailability of laboratory procedure specially at night and some babies died before the investigation. In our study USG confirmation were not done for all suspected patients. Only symptomatic patient were evaluated by sonography and some baby died before doing USG of brain which may missed some patients.

**Conclusion**

Frequency of admission hypothermia in this study is 18.9%. Among the admitted newborns hypothermia is more common in outborn babies. Late onset neonatal sepsis, shock and prolonged hospital stay are significantly more in hypothermic newborns. Among the studied newborn, deaths are significantly more common in hypothermic newborns compared to normothermic newborns.

**Recommendation**

A multicenter longitudinal study may be done to reveal hypothermia prevalence and effects on mortality, morbidity severity and long term outcomes.

**Author Contribution**

All authors contributed to the study conception and design. Material preparation, data collection and statistical analysis was performed by first author. The first draft of the manuscript was written by first author and respected other authors further reviewed and commented on the first and the following drafts, until the final version of the article. All authors commented on previous versions of the manuscript. All authors read the final manuscript.

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The authors declare that they have no conflict of interest.

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