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ADMISSION HYPOTHERMIA AND ASSOCIATED FACTORS AMONG NEONATES ADMITTED TO NEONATAL INTENSIVE CARE UNIT IN PUBLIC HOSPITALS, ADDIS ABABA, ETHIOPIA, 2024

PRINCIPAL INVESTIGATOR;

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STATEMENT OF DECLARATION

I, the undersigned, declare and affirm that this thesis is my original work. I have followed all ethical principles of scholarship in the preparation, data collection, data analysis, and completion of this thesis. All scholarly matters that are included in the thesis have been given recognition through proper citation. Every effort has been made to avoid plagiarism in the preparation of this thesis.

I solemnly declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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LIST OF ABBREVIATIONS/ACRONYMS

AABR - Automated Auditory Brainstem Response

AAHB - Addis Ababa Health Beuaro

AH - Admission Hypothermia

ANC - Antenatal Care

BPD - Broncho Pulmonary Dysplasia

CPR - Cardiopulmonary Resuscitation

GMH - Gandhi Memorial Hospital

GA - Gestational Age

IVH - Intraventicular Hemorrhage

LBW - Low Birth Weight

MOE - Ministry Of Education

NEC - Necrotizing Entrocolitis

NICU - Neonatal Intensive Care Unit

PIVH - PeriIntra Ventricular Hemorrhage

PTNB - Preterm Newborns

PVL - Peri Ventricular Leukomalacia

RDS - Respiratory Distress Syndrome

ROP - Retinopathy of Prematurity

SPHMMC - Saint Paul Hospital Millennium Medical College

TASH - Tikur Anbessa Specialized Hospital

USG - Ultrasonography

VON - Vermont Oxford Network

VLBW - Very Low Birth Weight

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ABSTRACT

Background: - Neonatal hypothermia is a worldwide problem and an important contributing factor for neonatal morbidity and mortality, especially in developing countries. The risk is higher for infants who are smaller birth weight and more premature. In Ethiopia specifically, admission hypothermia is estimated to be present in a staggering 69.4% of all neonatal deaths.

Objective: To assess prevalence of admission hypothermia and associated factors among neonates admitted in public hospitals NICU, Addis Ababa.

Method: - An institution-based cross-sectional retrospective study design was Conducted From 1st January 2021 to 30 December 2023 with total sample size of 414, the data was collected during 25 February to 25 March 2024. A single population formula used for sampling and Simple random sampling technique was used to collect the samples from neonates admitted with hypothermia in selected hospitals in addis ababa. Check list was used for data collection and SPSS 27 Version was used for analysis. Descriptive and bivariate analysis was utilized 95% confidence intervals and P- value < 0.05 was considered statistically significant.

Result: - A total sample size was 414 in these 402 samples were collected with 98% of response rate. 241 (60%) were male neonates. The prevalence of neonatal hypothermia among new born babies admitted to Neonatal Intensive Care Unit of Public Hospitals in Addis Ababa were 232 (57.7%). From 402 responses 30(7.5%) had extremely low birth weight, 51 (14.7%) had received resuscitation during birth, 250(62.2) were born in cold season. Neonates with low Apgar score at five minute, received resuscitation at birth, neonates didn't received KMC, night time delivery and cold season delivery were significantly associated with admission hypothermia.

Conclusion and Recommendation: - In this study extremely low birth weight, low Apgar scores, Neonates with low Apgar score, received resuscitation at birth, neonates didn't received KMC, delivery during the night time, and cold season were identified as risk factors for neonatal admission hypothermia. Enhanced monitoring of high-risk newborns: Infants with low birth weight, low Apgar scores, and those born during colder seasons or at night should receive enhanced monitoring for signs of hypothermia.

Keywords: Admission hypothermia, NICU

1. INTRODUCTION

1.1 Background

A baby has neonatal hypothermia when their body temperature falls below 36.5 ºC (97.7ºF). This condition is categorized as mild when it occurs between 36.5 and 35.9ºC (96.8 – 97.5ºF), moderate between 32.0 and 35.9ºC (89.6 – 96.6ºF), and severe when it occurs below 32ºC. The typical range for body temperature is 36.5 to 37.5 ºC (1). When the body is unable to maintain a healthy core temperature through physiological processes such vasoconstriction, shivering, contraction of the muscles, and non-shivering thermogenesis, hypothermia sets in. The body cannot maintain its core temperature when shivering stops; the syndrome of hypothermia sets in when the body temperature drops below 35°C(2).

Hypothermia has the greatest impact on neonates during the first 24 hours and early days of life Reports from different Asian and African developing countries show that neonatal hypothermia is common and has been regarded as a major contributor cause of significant morbidity. Neonatal hypothermia upon admission to the NICU is a common cause of morbidity in developing, tropical, and subtropical countries. The temperature on admission to NICU reflects the efficacy and level of newborn care from the time of birth, the stay in labor ward or home, and the transfer to NICU(3).

Neonates with hypothermia are more susceptible to infections, respiratory distress, and metabolic problems, all of which can contribute to fatal complications. Even if neonates survive hypothermia, they may experience various adverse health outcomes in the short and long term. These include:

Infectious diseases: Hypothermia weakens the immune system, making newborns more vulnerable to bacterial and viral infections that can damage organs and developmental trajectories(4).

Neurological problems: Studies suggest a potential link between hypothermia and long-term neurological issues like cognitive deficits, learning difficulties, and cerebral palsy(5).

Growth and development delays: Hypothermia can disrupt crucial metabolic processes and hinder growth, leading to slower weight gain and developmental delays.

Public Health Burden: The widespread prevalence of admission hypothermia places a significant strain on healthcare systems, increasing the need for intensive care resources and specialized interventions. In developing countries, this adds to the existing challenges of limited healthcare access and infrastructure.

The following morbidities were evaluated regarding to Admission Hypothermia: early neonatal death (< 7 days) and in-hospital death (up to discharge from the hospital), Broncho pulmonary Dysplasia (BPD); use of any inspired oxygen fraction above 0.21 at the corrected gestational age of 36 weeks), Peri-intraventricular Hemorrhage (PIVH) Retinopathy of Prematurity any grade, stage ≥ II Necrotizing Enter colitis, cystic or diffuse periventricular Leukomalacia diagnosed by ultrasound and/or magnetic resonance image, and a combined outcome of death or BPD or PIVH or NEC(6).

Premature infants are prone to hypothermia due to their inability to prevent heat loss and low ability to produce heat. To prevent hypothermia, the World Health Organization recommends maintaining a delivery room temperature of 25°C, as the warmer the ambient temperature, the lower the incidence of hypothermia. The higher-risk groups were infants born too early and those who were too small for their gestational age. The identification of inborn VLBW infants as the high risk group underlines an urgent need to improve measures for preventing hypothermia in these hospitals(7).

1.2 Statement of the problems

Neonatal hypothermia is a worldwide problem and an important contributing factor for neonatal morbidity and mortality, especially in developing countries. High prevalence of hypothermia has been reported from countries with the highest burden of Neonatal mortality(8). Additionally, hypothermia can prolong recovery times and increase the risk of mortality in critically ill patients. In Bangladesh, 85% of women deliver babies at home, with minimal attention being given to thermal protection (9).

Neonates cannot regulate body temperature as efficiently as adults, and thus hypothermia occurs easily. The risk is higher for infants who are smaller and more premature. There is an association with 28% higher mortality and 11% higher late-onset sepsis for each 1◦C lower admission temperature below 36◦C(10). The problem of admission hypothermia is a significant concern in healthcare settings, particularly in emergency departments and intensive care units.

Neonatal mortality and morbidity are closely linked to admission hypothermia. In America mortality rate is 5.44/1000 neonates, but in Ethiopia 35/1000 neonates are dyed, admission hypothermia is major cause for neonatal mortality in Ethiopia. Newborns are particularly vulnerable to hypothermia due to their high surface area-to-body mass ratio, limited ability to regulate body temperature, and immature thermoregulatory mechanisms. Hypothermia can also impact organ function and increase the likelihood of complications such as intraventricular hemorrhage and necrotizing enter colitis.

Admission hypothermia in newborns can indeed contribute to psychological suffering for parents. When a newborn is admitted with hypothermia, it can be distressing and anxiety-inducing for parents who may feel a sense of helplessness and concern for their child's well-being.

The emotional impact of seeing a newborn suffering from hypothermia can lead to feelings of guilt, fear, and worry for the parents. They may also experience a sense of powerlessness and concern about the potential long-term effects on their child's health. This may include separation from their newborn if the infant requires treatment in a neonatal intensive care

unit (NICU) or specialized medical interventions. Healthcare providers should be aware of the psychological impact of admission hypothermia on parents and provide support, empathy, and clear communication to help alleviate their concerns. Involving parents in the care of their newborn and providing opportunities for them to participate in their child's treatment can also help reduce anxiety and distress.

The economical aspect of neonates with admission hypothermia can be significant, as it involves costs associated with medical care, hospitalization, and potential long-term health implications. The economic impact can be felt by families, healthcare systems, and society as a whole.

Hospitalization Costs: Neonates with admission hypothermia often require specialized medical care, including treatment in a neonatal intensive care unit (NICU). The cost of NICU care, which includes monitoring, medical interventions, and specialized equipment, can be substantial. Additionally, the length of hospitalization for neonates with hypothermia may be longer due to the need for careful monitoring and treatment to address potential complications. Long-Term Health Implications: Admission hypothermia in newborns can lead to long-term health consequences, such as increased risk of infections, developmental delays, and neurological issues. Addressing these potential long-term effects may involve ongoing medical care, therapies, and support services, all of which contribute to the overall economic burden.

Impact on Families: The economic impact of admission hypothermia extends to families, who may face financial strain due to medical expenses, time off work to care for their newborn, and potential long-term healthcare needs. This can lead to increased stress and financial hardship for families.

Healthcare System Costs: Neonatal hypothermia contributes to the overall healthcare costs within a system. It requires resources for specialized care, medical staff, equipment, and ongoing monitoring and follow-up care.

Therefore, in this study will show or identify the prevalence of admission hypothermia and associated factors in Addis Ababa selected public hospitals.

1.3 Significance of the study

In Ethiopia specifically, admission hypothermia is estimated to be present in a staggering 69.4% of all neonatal deaths(11). Addressing this issue is critical for achieving Ethiopia's goals for reducing neonatal mortality and ensuring child health and well-being, neonatal morbidity and mortality is still high like in other sub-Saharan African countries and its prevalence and impact are particularly worrisome in developing countries like Ethiopia, where it contributes to a substantial percentage of neonatal deaths. Every 1°C drop in temperature can raise the mortality rate by up to 80%.

In Ethiopia, there are significant gaps associated with neonatal admission hypothermia, particularly in the areas of healthcare infrastructure, resources, and access to care. Some of the key gaps include:

Healthcare Infrastructure: Many regions in Ethiopia lack adequate healthcare infrastructure, including neonatal intensive care units (NICUs) and facilities with the capacity to provide specialized care for hypothermic newborns.

Training and Resources: There is a shortage of healthcare professionals with specialized training in neonatal care, including the management of hypothermia. Additionally, there may be a lack of essential resources such as radiant warmers, incubators, and temperature monitoring devices needed to prevent and treat admission hypothermia in newborns.

Access to Prenatal and Postnatal Care: Many mothers in Ethiopia may not have access to adequate prenatal and postnatal care, which can contribute to a higher incidence of neonatal admission hypothermia.

Financial Barriers: Economic challenges often prevent families from seeking timely medical care for their newborns, leading to delays in treatment for hypothermia. The cost of transportation to healthcare facilities and the expenses associated with NICU care can be significant barriers for families.

The finding of this study will support the existing knowledge on the of neonatal admission hypothermia and provide evidence-based information about the admission hypothermia and will help NICU team to focus and provide appropriate health services to prevent hypothermia by which the health of the neonates will be improved and morbidity &

mortality due to neonatal hypothermia will be minimized. The results of this study will also helpful for the further research.

2. LITRATURE REVIEW

2.1 Burden of Admission Hypothermia

Attributing neonatal hypothermia to direct or indirect causes of newborn mortality is a complex and challenging task for several reasons. In regions with inadequate vital registration systems or unreliable data sources, neonatal deaths are particularly prevalent. In countries where neonatal mortality rates are highest, the data on deaths are often based on national sample death registrations at best, and primarily rely on verbal autopsy data-based models with limited accuracy in identifying causes of death. Only 2.5% of global neonatal death data comes from reliable vital registration systems, while 97% is estimated through systematic estimations or household surveys. Globally, severe infections are responsible for an estimated 36% of all neonatal deaths, complications related to prematurity account for another 29%, and birth asphyxia contributes to 23% of neonatal deaths (with congenital malformations and various other causes accounting for 19% of neonatal deaths)(12).

The occurrence of hypothermia in newborns admitted to the neonatal intensive care unit (NICU) is a frequent yet avoidable factor leading to illness and death. In community settings, the prevalence of hypothermia ranges from 11% to 92%, while in hospital settings in developing countries, it ranges from 8% to 85%. A recent study conducted in India found that 37% of newborns admitted to the NICU experienced moderate hypothermia(13).

2.2 Magnitude of Admission Hypothermia

The study conducted in Jima revealed that approximately 75.1% of the newborns admitted to the neonatal unit were hypothermic upon admission. Among those, 21.8% had mild hypothermia, while the remaining 78.2% had moderate hypothermia; no cases of severe hypothermia were reported. However, within the first hour after admission, around 53.1% of the newborns were still experiencing hypothermia, with 43.1% having mild hypothermia and 10.1% having moderate hypothermia. There were no cases of severe hypothermia at this time. After 6 hours of admission, only 16.8% of the newborns were found to be hypothermic, with 16.1% experiencing mild hypothermia and 0.7% experiencing moderate

hypothermia. A study conducted in Wollo revealed that the most common reasons for neonatal admission to the NICU were neonatal sepsis (53.8%), LBW (36.9%), hypothermia (32.3%), respiratory distress (26.9%), prematurity (24.2%), asphyxia (20.1%), congenital malformation (12.9%), anemia (12.4%), hypoglycemia (9.7%), jaundice (9.5%), meconium aspiration syndrome (9.2%), and hypoxic–ischemic encephalopathy/encephalopathy (3.2%)(14).

2.3 Prevalence of Admission Hypothermia

The research carried out in Brazil revealed that 68.2% of preterm newborns admitted to the neonatal intensive care unit were found to have hypothermia. An analysis of the characteristics of these preterm newborns, both with and without hypothermia, showed that lower gestational age, birth weight, Apgar score in the 1st minute of life, and transfer to the NICU from the Operating Room were associated with higher rates of hypothermia. Furthermore, an association was found between hypothermia in preterm newborns at the NICU and healthcare-related factors, with those who received surfactant, ventilator support, peripherally inserted catheter, umbilical catheter, orotracheal intubation, and peripheral venous access having lower temperatures(15).

A study in Paris indicated that 53.5% of patients admitted to the recovery room (RR) were hypothermic, with 26% having a temperature of 35.5˚C. In comparison, 20.3% of patients had a temperature of 36.5˚C when admitted to the RR. The incidence of hypothermia was 44.1% when anesthesia lasted 31 to 60 minutes, 58.3% between 1 and 2 hours, 54.1% between 2 and 3 hours, and 49.6% for more than 3 hours ($p = 0.07$). 57.2% of patients saw a temperature drop of more than 0.5˚C between anesthetic induction and admission to the RR, with 28.3% having a temperature of 36˚C at admission. Hypothermia upon admission to the recovery room was a risk for active warming in the recovery room (OR = 3.53 [CI95%: 2.28–5.47]; $p<0.001$) and hypothermia upon leaving the recovery room (OR = 5.85 [CI95%: 3.93–8.7]; $p<0.001$))(16).

A study conducted in western Nigeria found that preterm newborns' entrance temperatures varied from 34.0 to 39.4℃. None of the preterm newborns experienced severe

hypothermia. It was discovered that 35.6% of preterm infants had hypothermia at admission, which was much higher than 15.2% of term babies. The variations between the occurrence of hypothermia in preterm and term babies was statistically significant (p=0.0003)(17).

According to a study done in Kenya, just 7.8% of the neonates received the proper thermal care during the first hour after admission, and 73.7% of the babies were hypothermic. Furthermore, on the day of arrival, 68% of the neonates had multiple episodes of hypothermia. Of the neonates who were enrolled, one-tenth had severe hypothermia and the plurality (46%) had moderate hypothermia(18).

About 50.3% of neonates admitted to NICUs in Southwest Ethiopia were found to be hypothermic, according to studies. At Jinka General Hospital, where 58.6% of newborns were affected, hypothermia was more common than at Arba Minch General Hospital, where 36.6% of neonates were affected. Neonatal hypothermia was remarkably common upon entrance to these two Ethiopian NICUs. Neonatal hypothermia was much more common in NICUs when certain factors were present, including low birth weight (less than 2500 gm), delayed breastfeeding initiation, bathing within 24 hours of delivery, obstetric problems during pregnancy and/or labor, and admissions during the cold season(19).

Additionally, the risk of hypothermia was approximately seven times greater for those born at night than for those born during the day (AOR=6.63; 95% CI: 2.23 to 19.77)(20). With a high frequency, neonatal hypothermia is a serious problem in Eastern Africa. Preterm birth, low birth weight, delayed breastfeeding initiation, neonatal health concerns, and midnight delivery have all been found to be major risk factors for neonatal hypothermia. Neonatal hypothermia was shown to be prevalent in East Africa in 57.2% of cases (95%CI: 39.5–75.0)(21).

The data base from the Vermont Oxford Network (VON) collated from across 28 countries of high- or upper-middle-income status also reported that the highest rates of hypothermia occurred amongst the smallest (22.1% of 501 to 750 g) and amongst the most immature infants (26.2% at <24 weeks' gestation) Prematurity and decreasing birth weight are thus

identified risk factors for hypothermia however, literature and data from Nigeria on this subject are sparse(17).

2.4 Factors Associated with Admission Hypothermia

Risk factors for admission to hypothermia include low gestational age, asphyxia, improper control of the thermal environment, inadequate breastfeeding, mode of delivery, and place of birth. Management of admission hypothermia is considered a cornerstone for neonatal resuscitation as it reduces rates of neonatal mortality and morbidity(22).

2.4.1 Neonatal factors

The research, carried out in Oromia, found that the odds of hypothermia was 3.43 times greater than in babies weight less than 2500 g compared to those weight more than 2500g (adjusted OR (AOR)=3.43; 95% CI: 1.18 to 9.97). Additionally, birth resuscitation was identified as a significant risk factor for neonatal hypothermia. Also the study in Addis Ababa, Ethiopia revealed that over half (56.7%) of the preterm babies who died from hypothermia were very low-birth-weight babies. The odds of hypothermia were 3.42 times higher among those who received birth resuscitation (cardiopulmonary resuscitation) compared to those who did not (AOR=3.42; 95% CI: 1.16 to 10.08). Another significant factor contributing to neonatal hypothermia was the lack of skin-to-skin contact with mothers after delivery. Infants who did not have skin-to-skin contact with their mother after birth were 4.54 times more likely to develop hypothermia compared to their counterparts (AOR=4.54; 95% CI: 1.75 to 11.81)(11) (20).

The odds of hypothermia was greater in preterm neonates compared to term neonates, possibly due to the immature and thin skin of preterm neonates, which increases heat loss through radiation. Additionally, the odds of hypothermia were higher in neonates with delayed initiation of breastfeeding compared to those who began breastfeeding within 1 hour after birth(20).

2.4.2 Socio-demographic factors

A neonate decreased body temperature is also linked to having a mother who is young and lacks experience, being from a family with limited financial resources, or being born to a mother who has already given birth multiple times(21).

The research, carried out in Jima, found that a majority of the mothers (77.7%) were from rural areas, and 71.7% were housewives. Regarding obstetric characteristics, 97.1% of the mothers had received antenatal care (ANC) at health facilities during their recent pregnancy at least once. Additionally, 13.6% of the mothers experienced obstetric issues during their most recent pregnancy, with premature rupture of membranes being the most frequently reported problem. Another study in Addis Ababa, Ethiopia, revealed that over half (56.1%) of the deceased hypothermic preterm babies were male(11, 19).

2.4.3 Maternal factors

The research, carried out in the United States, found significant differences between hypothermic and normothermic infants with regard to maternal race, birth weight, gestational age, antenatal steroids, chorioamnionitis, mode of delivery, and Apgar score. After accounting for gestational age, infants whose mothers received antenatal steroids had a higher risk of being admitted to the NICU with hypothermia compared to those whose mothers did not receive steroids (OR=1.7 [95% CI; 1.1-2.6])(20).

2.4.4 Environmental Factors

Environmental influences: Infants born at night had a higher likelihood of developing hypothermia compared to those born during the day. 61.1% of the newborns were admitted to Jinka General Hospital, while the remainder were admitted to Arba Minch General Hospital. Over half of the newborns were born during the day, with 59.0% being admitted during daytime hours and 45.0% admitted during colder seasons of the year(19).

Furthermore, a majority of the infants, 79.9%, exhibited normal body temperatures six hours after being admitted. Factors such as age at admission, gender, gestational age, birth weight, number of towels used, and maternal temperature were found to be associated with hypothermia. Specifically, being female, younger age at admission, low birth weight, and

using only one towel continued to show statistically significant associations with hypothermia (AOR= 3.85, 2.25, 2.58, .36, & 2.33; with 95% CI: 1.59, 9.32; 1.23, 4.13; 1.25, 5.34; .129, .99; 1.11, 4.89) respectively(23).

2.5 Consequences of Admission Hypothermia

Babies with an Apgar score of 7–10 at 5 minutes (OR=0.6 [0.4-0.9]) and newborns whose mothers experienced chorioamnionitis (OR=0.4 [0.3-0.6]) were less likely to be affected. Infants with Respiratory Distress Syndrome (RDS) exhibited an adjusted odds ratio of 1.4 [1.0-2.1] for hypothermia; the Null is included in the confidence interval. When gestational age was taken into account, the odds ratios of admission hypothermia for Retinopathy of Prematurity (OR=2.2 [0.8-6.0]), Broncho pulmonary Dysplasia (BPD, as determined by oxygen administered at 36 weeks) (OR=1.1 [0.7-2.0]), and Intraventricular Hemorrhage (OR=1.4 [0.8-2.3]) did not change significantly(24).

A study in Germany found that admission hypothermia (AH) is associated with in-hospital death and early neonatal death. The study revealed that in Group 1, AH was associated with a 29% increased risk of in-hospital death and a 41% increased risk of early neonatal death. However, the significance disappeared after controlling for selected variables. In Group 2, AH was found to be significantly associated with a 34% increased risk of early neonatal death and tended to be associated with hospital death, although the trend was not statistically significant. Additionally, the occurrence of necrotizing enter colitis (NEC) was statistically significant and less frequent in the hypothermic group even after adjustment (6).

According to a meta-analysis conducted in Sudan, there are three main risks associated with hypothermic VLBW infants: (1) a higher risk of mortality (with a pooled OR of 1.89 (95% CI, 1.72–2.09); (2) a higher risk of intraventricular hemorrhage (IVH) (with a pooled OR of 1.86 (95% CI, 1.09–3.14); and (3) a higher risk of bronchopulmonary dysplasia (BPD) among hypothermic VLBW infants. The risk of newborn sepsis is higher in hypothermic VLBW infants, with a pooled OR of 1.28 (95% CI, 1.16–1.40) indicating a higher risk of BPD VLBW infants The hypothermic VLBW infants have a higher risk of

sepsis with a pooled OR of 1.47 (95% CI, 1.09– 2.49), Risk of retinopathy of prematurity (ROP) among hypothermic VLBW infants The hypothermic VLBW infants have a higher risk of ROP with a pooled OR of 1.45 (95% CI, 1.28–1.72) but Studies regarding NEC were controversial, and we did not detect an association between neonatal hypothermia and NEC(22).

The study in the Inha University College of Medicine, Korea, the multivariate analysis revealed that, admission hypothermia was associated with pulmonary hemorrhage, air-leak, BPD at 36 weeks, pulmonary hypertension, proven sepsis, seizure, high-grade IVH, and advanced ROP requiring laser therapy. Compared with infants who were norm thermic (36.5°C–37.5°C), the adjusted OR of BPD and pulmonary hypertension increased to 1.26 (95% CI, 1.01–1.57) and 1.66 (95% CI, 1.12–2.45) for infants with admission temperatures of 35.0°C–35.9°C and 1.81 (95% CI, 1.20–2.86) and 1.75 (95% CI, 1.06– 2.87) for infants with admission temperatures <35.0°C. The adjusted ORs of sepsis increased to 1.27 (95% CI, 1.05–1.54), 1.39 (95% CI, 1.07–1.78), and 1.74 (95% CI, 1.51–2.08) for infants with admission temperatures of 36.0°C–36.4°C, 35.0°C–35.9°C, and <35.0°C, respectively. For pulmonary hemorrhage, air-leak, seizure, IVH grade3 or 4 and advanced ROP requiring laser, significantly higher ORs were observed in infants with admission temperatures <35°C than in norm thermic infants. NEC stage ≥2, PVL and abnormal AABR test results were not significantly correlated with admission temperature in the multivariate analysis(25).

The study in conducted in India shows that RDS was present in all the neonates 100% who were <28 weeks followed by neonates who were within 28 to 32 weeks gestation 87.75% and was lost in neonates of 37 to 42 weeks gestation 73%. A 75% neonates were in moderate hypothermia whose gestational age was <28 weeks. Most of the neonates with RDS whose gestational age was more than 28 weeks had mild hypothermia and 22% of neonates suffered from sepsis. In the present study sepsis was second most common short-term outcome among the neonates admitted with admission hypothermia. 2.6% neonates were detected with IVH using cranial USG all neonates with IVH were in the moderate category of hypothermia. Eleven hypothermic neonates with ROP Grade II all neonates

with gestational age <28 weeks had ROP. No neonates were detected with ROP above 32-week gestation(26).

The study conducted in Malawi has shown that, two most common comorbidities were respiratory distress syndrome RDS, 38% and transient tachypnea of the newborn 23%. Over half of the subjects 57% required oxygen support during their hospital stay. 14% Neonates died and this number was higher among lower birth weight neonates with hypothermia. Among the neonates, 38% of the neonates were hypothermic on their last temperature reading before discharge or death(27).

According to the Addis Ababa study, the average admission temperature was 35.2°C (1.3°C). Of the hypothermic preterm babies admitted to the NICU, 52.56% recovered and were allowed to go. Preterm newborns with thrombocytopenic conditions had 3.4 times higher death odds than non-thrombocytopenic neonates [AOR = 3:36: 95% CI (1.49-7.58)]. Compared to newborns who did not get kangaroo mother care, those who did had a 62% lower chance of dying [AOR = 0:38 : 95% CI (0.16-0.88)(11).

2.5 Conceptual framework

The conceptual framework discloses the relationship between independent variables (maternal factors, neonatal factors, socio demographic factors, and environmental factors) with dependent variable (admission hypothermia).

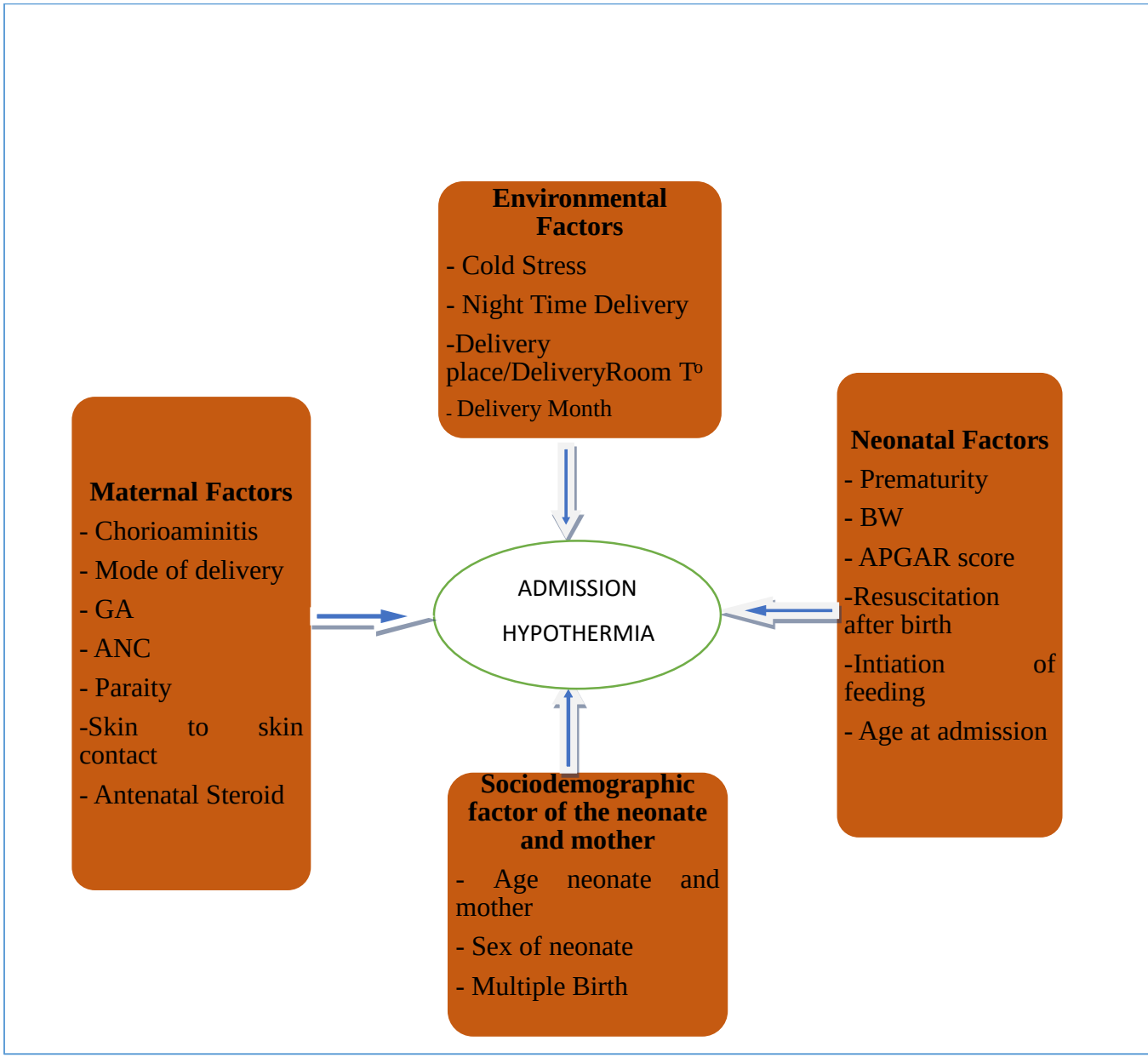

Figure 1 Conceptual framework Admission hypothermia and related outcomes among neonates admitted to NICU in Addis Ababa selected public hospitals 2023/24(11, 25, 26)

3. OBJECTIVES

3.1 General objective

To assess admission hypothermia and its associated factors admitted in public hospitals NICU, Addis Ababa.

3.2 Specific Objectives

1. To identify the prevalence of admission hypothermia in Neonates admitted with hypothermia in public hospitals NICU, Addis Ababa.
2. To identify factors associated with admission hypothermia among neonates admitted in public hospitals NICU, Addis Ababa.

4. METHOD AND MATERIAL

4.1 Study Area and Period

The study was conducted in Addis Ababa selected public hospital. There are twelve government hospitals in the town. Five operate under the Addis Ababa Health Authority; four operate under the Federal Ministry of Health, one of the Ministry of Education (AAU), and two to the Ethiopian Defense Force. Eleven of them have a neonatal unit. The study will be conducted in selected four hospitals by lottery method; At St. Paul Hospital Millennium Medical College, the unit has 60 beds and is staffed by 50 nurses, two of them are neonatal nurse specialists and in addition to 3 senior neonatologists. The yearly admission rate was 3000 on average. Zewuditu Memorial Hospital has 36 beds, 5 pediatricians on staff, 30 nurses, and an average yearly admission rate of 2,500 patients. A lottery system was used to select the three pediatricians, 35 nurses, and 28 beds at St. Peter Specialized Hospital and the two pediatricians, 42 nurses, and 38 beds at Gandhi Memorial Hospital, which have an average yearly admission rate of 2300. The study will assess neonates diagnosed and treated with admission hypothermia in selected public hospitals NICU, Addis Ababa from 1st January 2021 to 30th December 2023. The data collection period was from 25th February, 2024 to 25th March 1, 2024.

4.2 Study Design

An institution-based cross-sectional retrospective study design was used to assess neonates treated in public hospitals NICU, Addis Ababa from 1st January 2021 to 30th December 2023.

4.3 Population

4.3.1 Source population

All neonates treated in public hospitals NICU, Addis Ababa from 1st January 2021 to 30th December 2023, Addis Ababa, Ethiopia.

4.3.2 Study populations

Neonates treated in public hospitals NICU, Addis Ababa, from 1st January 2021 to 30th December 2023, Addis Ababa, Ethiopia.

4.4 Eligibility criteria

4.4.1 Inclusion criteria

Neonates treated in NICU from 1st January 2021 to 30th December 2023 Addis Ababa, Ethiopia

4.4.2 Exclusion criteria

Neonates with incomplete medical records (unrecorded admission temperature and outcome).

4.5 Sample size determination and sampling technique

The sample size was calculated based on the single population proportion formula by taking into account the following statistical assumptions P = proportion of hypothermia pooled prevalence Þ =57:2%(21),

$$\text{sample size}(n) = z\frac{\alpha^2}{2} \times \frac{p(1-p)}{d^2}$$

n = sample size,

Z α/2= the standard normal variable at 1− α % confidence levels (5% = 1.96)

P= estimated proportion of admission hypothermia=57.2(21)

d = margin of sampling error tolerated (5%),

Therefore, based on the above single population proportion formula the sample size can be Calculated as

$\frac{(1.96)^2\ 0.572(0.428)}{(0.05)^2} = 376$

=376+10% nonresponsive rate**, =376+38=414**

So, the total sample size was 414

Table 1. Proportional allocation of total sample size from selected hospitals based on the previous 3 years used to identify to assess the admission hypothermia and related outcomes among neonates admitted to NICU in Addis Ababa selected public hospitals, Addis Ababa Ethiopia.

Name of selected hospitals	Previous 3 years admission report and proportional allocation						
	Year 1		Year2		Year3		Total
	No admission	Allocation	No admission	Allocation	No admission	Allocation	
SPHMMC	2860	44	2750	43	3000	46	8610
ZMH	2310	35	2520	38	2500	37	7330
St. Peter	1520	22	1620	23	1700	24	4840
GMH	2030	31	2250	35	2300	36	6580

NB.

Year 1 1st January 2021 to 30th December 2021

Year 2 1st January 2022 to 30th December 2022

Year 3 1st January 2023 to 30th December 2023

4.5.1. Sampling Procedure

By simple random sampling technique 402 neonates were included in the study as the study participant from four selected hospitals. To proportionate the number of study subject for each hospitals, the formula $= \frac{(n)x\ (nf)}{N}$ Will used. Where n=number of admissions in each hospital, nf =total sample size and N=the total number of admissions in the four hospitals.

SPHMMC the first selected study area by simple random sampling technique average annual admission is 3000 so the sampling distribution for St. Paul is $= \frac{3000x\ 414}{9350}$ = 133

Gahandi Memorial hospital the second selected study area by simple random sampling technique average annual admission is 2300 so the sampling distribution for Gahandi is $= \frac{2300x\ 414}{9350}$ = 102

St. Peter hospital the second selected study area by simple random sampling technique average annual admission is 1500 so the sampling distribution for St. Peter is $= \frac{1500x\ 414}{9350}$ = 69

Zewuditu Memorial Hospital the second selected study area by simple random sampling technique average annual admission is 2500 so the sampling distribution for TASH is $= \frac{2500x\ 414}{9350}$ = 110

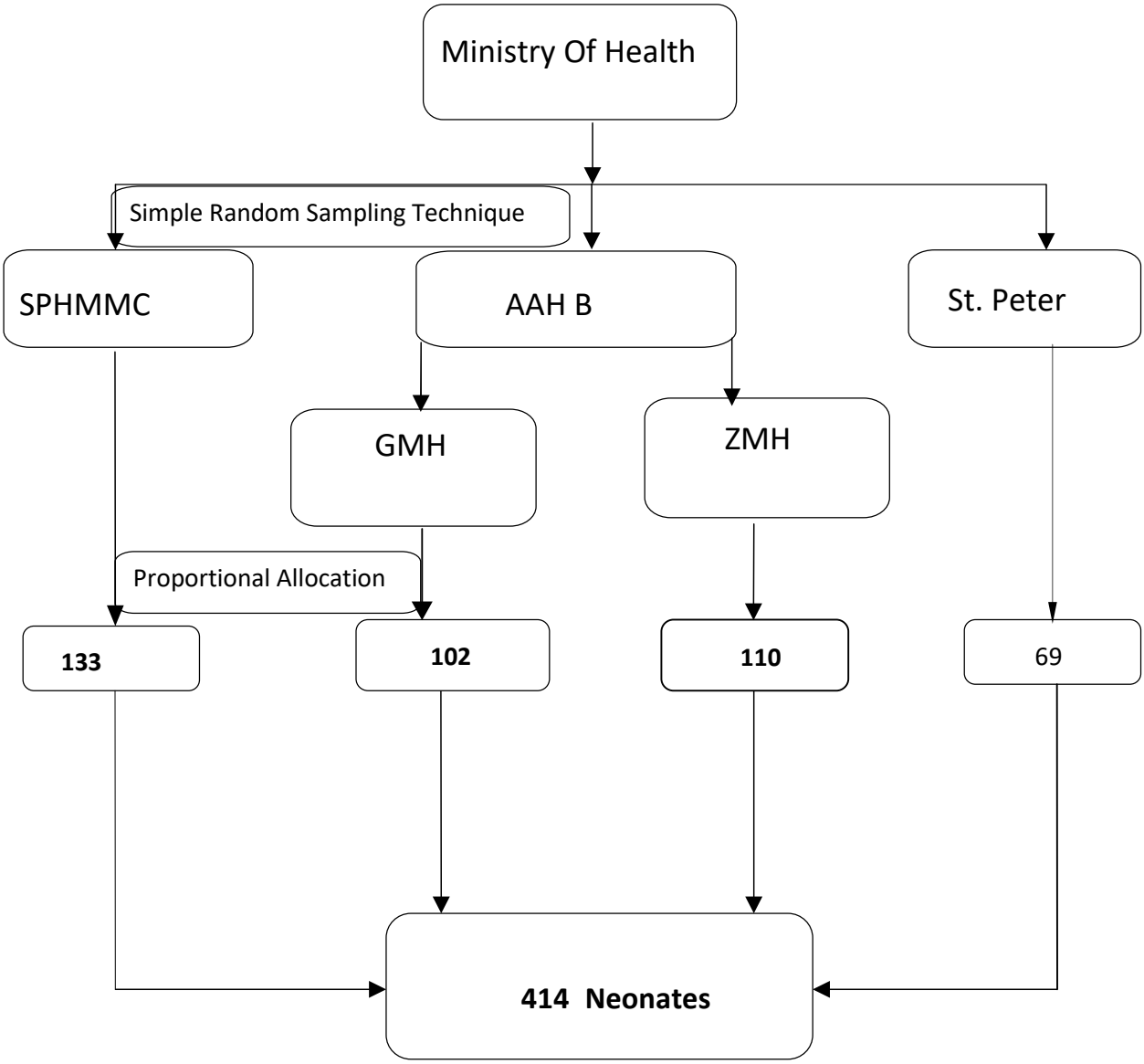

Figure 1 Schematic representation of sampling technique from the four Hospitals, 2024.

4.6 Study variable

4.6.1 Dependent variable

- Admission hypothermia

4.6.2 Independent variable

- Socio-demographic factors:
  Age of the neonate and mother, Sex of neonate, Multiple Birth.
- Neonatal Factors:
  Age at admission, Birth weight, Apgar score, Prematurity, Resuscitation after birth, Initiation of feeding with 1hr.
- Maternal Factors:
  Chorioaminitis, Antenatal steroid, ANC, Parity, Gestational Age, Mode of delivery, and Skin to skin contact.
- Environmental Factors
  Cold stress, Night time delivery, Delivery season.

4.7 Operational / Term definitions

Admission normothermia: If admission temperature is ≥ 36.5and < 37:5 degree centigrade by axillary thermometer during the initial assessment of admission to the NICU(1).

Admission hypothermia: If the body temperature of the neonate below 36.5 degree centigrade by axillary thermometer during the initial assessment of admission to the NICU(1).

Mild hypothermia- If the body temperature of the neonate between 36.0^0C and 36.5 degree centigrade at admission(1).

Moderate hypothermia- If the body temperature of the neonate between 32^0C and 36.0 degree centigrade at admission(1).

Severe hypothermia- If the body temperature of the neonate is below 32 degree centigrade at admission(1).

4.8 Data Collection Tool and Procedure

The Data was collected with prepared checklist and chart review, the checklist are adapted (modify) from previous similar literatures on admission hypothermia.(11, 25, 26, 28). The checklist were in English, and four parts a total of 27 questions; four questions in socio-demographic factors, seven questions in Neonatal factors, also Maternal factors consists seven questions and three questions in Environmental factors finally six questions in treatment and complication category to assess Admission hypothermia and associated factors.

Three BSc nurses collected data using the online Kobo collecting tool. Supervisors reviewed the data every day to ensure it was accurate. A one-day training covered the objectives of the study, its applicability, protocols for gathering data, safeguarding client confidentiality, qualifying requirements, informed consent, and methods of collecting data was given to the supervisor and data collectors.

4.9 Data Quality Assurance

The checklist was prepared in English, and translated to Amharic, and back-translated to English by two language experts to check for consistency of the checklist. The content validity of the tool was checked by senior expert's (four Neonatologists) three neonatologists from St. paul Hospital Mellinium Medical College and one neonatologist from Black Lion Specialized Hospital, finally the tool was valid to assess admission hypothermia. Both supervisors and data collectors was closely follow in the data collection process. Before the actual data collection pretest was conducted 21(5%) of the study population out of selected study hospitals in Black lion specialized hospital, two weeks before the actual data collection to evaluate the clarity of the questions and validity of the instrument and reaction of the respondents to the questions. Maintenance of the privacy and confidentiality of the patient charts as well as good communication skills between the record office and data collector that was gained through a training session of both data

collectors &supervisor was contribute to the quality of the study. Every day all checklist was reviewed and checked at the end of the data collection period and any errors was corrected accordingly with supervisor and data collectors.

4.10 Data Analysis and Processing

The Data was cleaned manually, coded, entered and analyzed by SPSS version 27 statistical software. Binary logistic regression and multi variable logistic regression analyses was employed to identify admission hypothermia associated factors. After bivariate logistic regression analysis, P-value < 0.25 was taken as a cutoff point to select variable eligible for multiple logistic regression models. Which used to control possible confounders variables. Then 95%Confidence interval will be used to see the precision of the study variable. Finally, P value less than 0.05 the statistical association were considered as a significant variable. Then the result was interpreted and presented using statements, tables, figures, texts, and pie charts as a whole.

4.11 Ethical Approval

Ethical clearance for the study was received from the Department of Nursing, School of Nursing and Midwifery, College of Health Science Addis Ababa university a formal letter was written to St. Paul hospital millennium medical college, St. Peter specialized hospital and Addis Ababa Health buearu, finally permission was secured at all levels and also ethical clearance was obtained from Addis Ababa Public Health and Emergency Management Directorate. Information related to those neonates was confidential in any ways.

4.12 Presentation and Dissemination of the Data

The final result (report) will be presented and discussed in Addis Ababa University, School of Nursing and Midwifery and copy of the research will be sent to school of Nursing, College of Health Science main library, for each Hospitals and to Minister of Health for

utilization and use of the result as a base line data that help to suggest interventions to be designed in order to improve quality of neonatal care specifically thermal protection. And finally I will prepare manuscript and try to publish the research in internationally recognized journals.

5. RESULT

5.1 Socio-demographic characteristics

A total sample size was 414 in these 402 samples were collected with 98% of response rate. In this study 241 (60%) neonates were males and 161(40%) were females. 71.1% of the mothers were in the age group "between" 20-30 and 29(7.2%) were below the age of 20. 227(56.7%) of neonates were under the age of 24 hour and 313 (57.9) neonates were singleton, 78(19.4%) were twins and 11(2.7%) triplets.

Table 2 Socio-demographic characteristics of mothers and neonates admitted to Neonatal Intensive Care Unit of Governmental Hospitals in Addis Ababa, Ethiopia, 2024. [n=402]

Variables	Categories	Frequency	Percentage
Age of Mothers(years)	<20 years	29	7.2
	20-30 years	286	71.1
	>30 years	87	21.6
Age of Neonates(hour)	<24 hours	227	56.7
	>24 hours	175	43.3
Sex	Male	241	60
	Female	161	40
Multiple Birth	Singleton	313	57.9
	Twins	78	19.4
	Triplets	11	2.7

5.2. Neonatal Characteristics

Medical diagnoses during admission were reviewed from medical record of the Neonates and 272(67.7%) were admitted for the reason of Respiratory distress, 232 (57.7%) diagnosed as suspected sepsis and 185(46%) were diagnosed as preterm, and 35 (8.7%) diagnose as perinatal asphyxia. The mean birth weight was 1850 gram (SD 936 gram). About 292(72.6%) of the neonates had birth weight ≤ 2500 gram. And 110(27.3%) of the neonates had birth weight > 2500 grams. Most of the neonates 251(62.4%) were with Apgar score >7. Only 342(85.1%) of neonates had cried after birth immediately. Fifty nine (14.7%) had received resuscitation (CPR) during birth. Only one hundred sixty eight (41.8%) of neonates had early initiation of breast feeding within one hour after birth.

Table 3 Neonatal characteristics of respondents among New Born admitted to Neonatal Intensive Care Unit of Governmental Hospitals in Addis Ababa, Ethiopia, 2024.[n=402]

Variables	Categories	Frequency	Percentage (%)
Reason for Admission	Prematurity	185	46
	Suspected sepsis	232	57.7
	Respiratory Distress	272	67.7
	PNA	35	8.7
	Congenital malformation	12	3
	MAS	41	10.2
	IUGR	29	7.2
Birth weight(grams)	<1000	30	7.5
	1000-1499	115	28.6
	1500-2499	147	36.6
	2500-4000	105	26.1
	>4000	5	1.2
APGAR Score	>7	251	62.4
	<7	128	31.8
	Unknown	23	5.7
Baby cried immediately	Yes	342	13.4
	No	54	85.1
	Unknown	6	1.5
Received resuscitation/CPR during birth	Yes	59	14.7
	No	337	83.8
	Unknown	6	1.5
Started breast feeding within one hour after birth	Yes	168	41.5
	No	224	56
	Unknown	10	2.5

5.3. Maternal Characteristics

Most of the pregnancies 313(77.9%) were single and majority of neonates 255(63.4%) were delivered through SVD. Two hundred ninty two 292(72.6%) were delivered below gestational age of 37and 9(2.2%) were delivered with unknown gestational age. Three hundred thirty nine (84.3%) mothers had regular antenatal care. Two hundred six (51.2%) were primipara mothers and Two hundred nine (52%) mothers had received antenatal steroid. 60 (14.9%) had maternal chorioaminitis. More than half of neonates 299(74.4%) had no skin to skin contacts. Three hundred ninety neonates were born in health facility and of them 12(3%) delivered at home.

Table 4 Maternal characteristics of respondents among neonates admitted to Neonatal Intensive Care Unit in Public Hospitals in Addis Ababa, Ethiopia, 2024.[n=402]

Gestational Age	<37 weeks	292	72.6
	>37weeks	101	25.1
ANC	Yes	339	84.3
	No	63	15.7
Mode of delivery	SVD	255	63.4
	Assisted vaginal Delivery	12	3
	C/S	135	33.6
Treated by KMC	Yes	103	25.6
	No	299	74.4
Parity	Primipara	206	51.2
	Multipara	196	48.8
Chorioaminitis	Yes	336	83.6
	No	60	14.9
	Unknown	6	1.5
Did the mother received antenatal steroid	Yes	209	52
	No	152	40.3
	Unknown	31	7.7

5.4 Environmental Characteristics

Out of 402 responses three hundred ninety (97%) were born in health facility and twelve (3%) were home delivery. One hundred thirty one (32.6%) were delivered during day time and 271 were delivered at night time. Most of the neonates 250(62.2) were born in cold season and 152(37.8) were born on hot season.

Table 5; Environmental characteristics respondents among neonates admitted to Neonatal Intensive Care Unit of Governmental Hospitals in Addis Ababa, Ethiopia, 2024.[n=402]

Place of Delivery	Health facility	390	97
	Home delivery	12	3
Time of Delivery	Day time delivery	131	32.6
	Night time delivery	271	67.4
Month of Delivery	Cold season	250	62.2
	Hot season	152	37.8

5.5. Treatments of neonates admitted with admission hypothermia

Two hundred twenty two (55.2%) neonates had treated with radiant warmer, two hundred sixty nine (66.9%) treated with CPAP, two hundred thirty four (58.2%) treated with maintenance fluid, three hundred eight (76.6%) treated with antibiotics.

Table 6 Treatments received by respondents among neonates admitted to Neonatal Intensive Care Unit in public Hospitals in Addis Ababa, Ethiopia, 2024.[n=402]

Variables	Categories		Frequency	Percentage (%)
Treatments of neonates had received	Radiant warmer	Yes	222	55.2
		No	173	43
		Unknown	7	1.7
	Oxygen	Yes	258	64.2
		No	144	35.8
	CPAP	Yes	269	66.9
		No	133	31.1
	Maintenance fluid	Yes	234	58.2
		No	168	41.8
	Antibiotics	Yes	308	76.6
		No	94	23.4

5.6. Complications and outcomes of neonates admitted with admission hypothermia

Ninety four (23.4%) neonates after admitted with admission hypothermia developed worsening of respiratory distress, one hundred fifty two (37.8%) had developed sepsis, forty five (11.2%) had hypoglycemia, nineteen (4.7%) had pulmonary hemorrhage, seventeen (4.2) had necrotizing enter colitis, ten (2.5%) had Broncho pulmonary dysplasia, six (2.2%) had intra ventricular hemorrhage, finally three hundred thirteen (77.9%) neonates had discharged and eighty eight (21.9%) neonates had died.

Table 7 Complications and outcomes of respondents among neonates admitted to Neonatal Intensive Care Unit of Governmental Hospitals in Addis Ababa, Ethiopia, 2024.[n=402]

Variables	Categories		Frequency	Percentage (%)
Complications and outcomes of neonates	Sepsis	Yes	152	37.8
		No	250	62.2
	Worsening of RD	Yes	94	23.4
		No	308	76.6
	Pulmonary hemorrhage	Yes	19	4.7
		No	383	95.3
	Necrotizing enter colitis	Yes	17	4.2
		No	385	95.8
	Broncho pulmonary dysplasia	Yes	10	2.5
		No	392	97.5
	Intra ventricular hemorrhage	Yes	9	2.2
		No	293	97.8
	Outcomes	Discharged	314	78.1
		Death	88	21.8

5.7. Classification of admission hypothermia among neonates

Among 402 twenty one (5.2%) neonates had sever hypothermia, One hundered eighty six 186(46.3%) Neonates had moderate hypothermia, twenty five (6.2%) had mild hypothermia and one hundered seventy (42.3%) had normothermia.

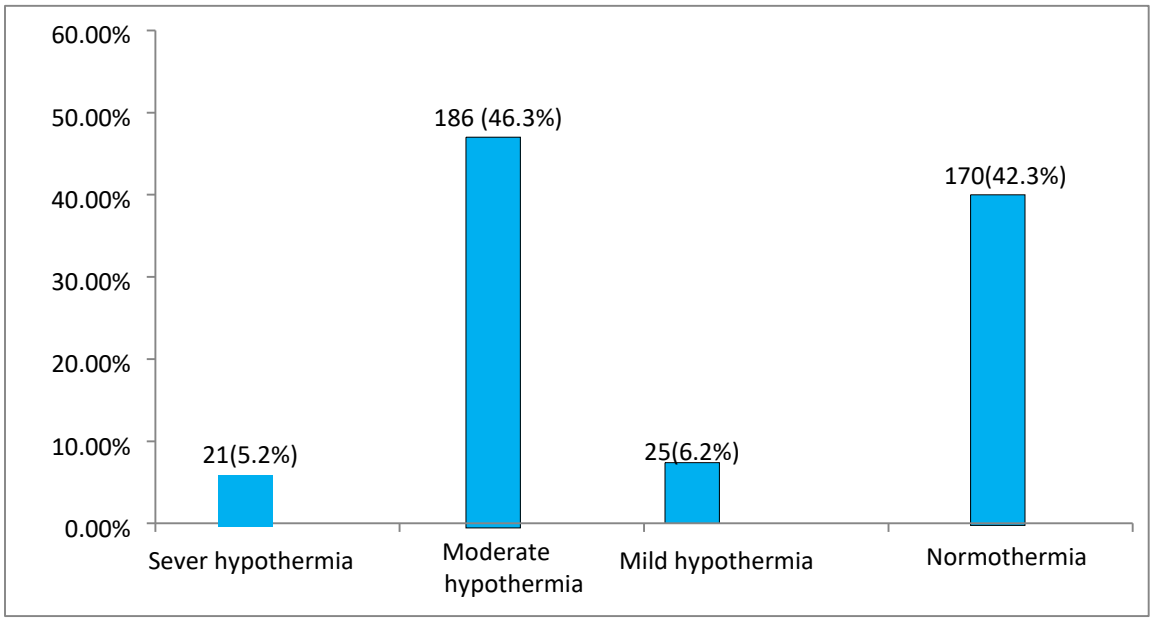

Figure 2 Classification of admission hypothermia among neonates admitted to Neonatal Intensive Care Unit of public Hospitals in Addis Ababa, Ethiopia, 2024.[n=402]

5.8. The prevalence of Neonatal Admission hypothermia

The prevalence of neonatal admission hypothermia among neonates had high which is two hundered thirty two (57.7%) were hypothermia among 402 neonates. One hundered eighty six (46.3%) Neonates had moderate hypothermia which is 80.1% among hypothermic babies.

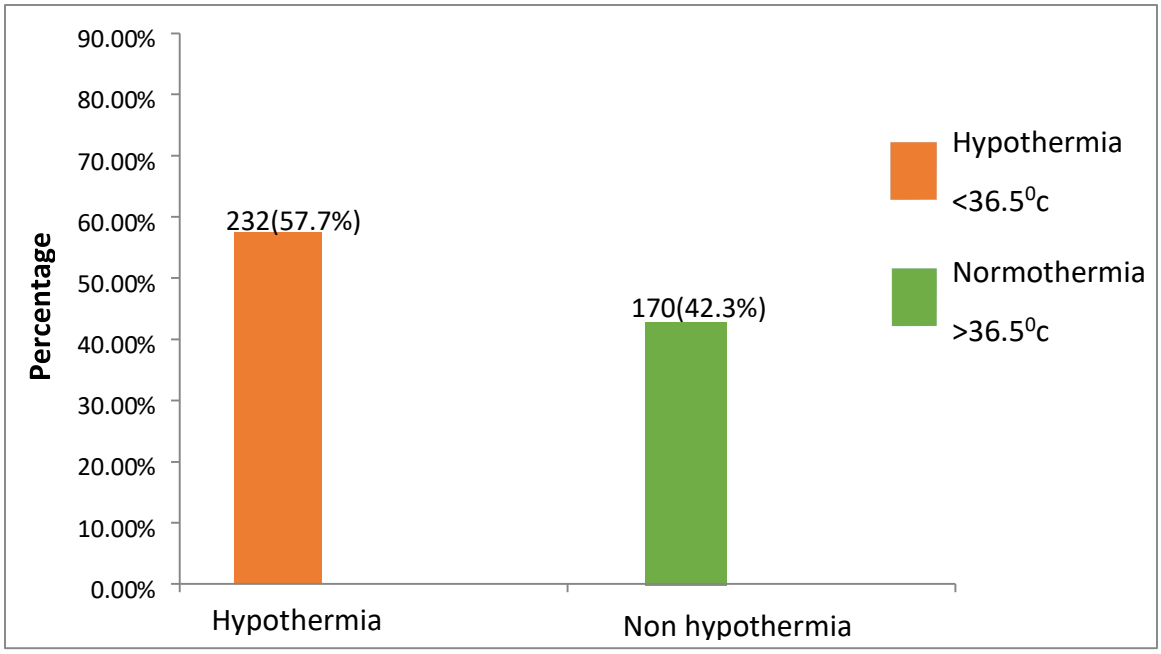

Figure 3 prevalence of Neonatal admission hypothermia among neonates admitted to Neonatal Intensive Care Unit in puplic Hospitals in Addis Ababa, 2024 [402]

The prevalence of hypothermia was high among preterm 292(72.6%), low birth weight 192(82.8%), age ≤24 hour 131(56.5%), and 146 (62.6%) were males.

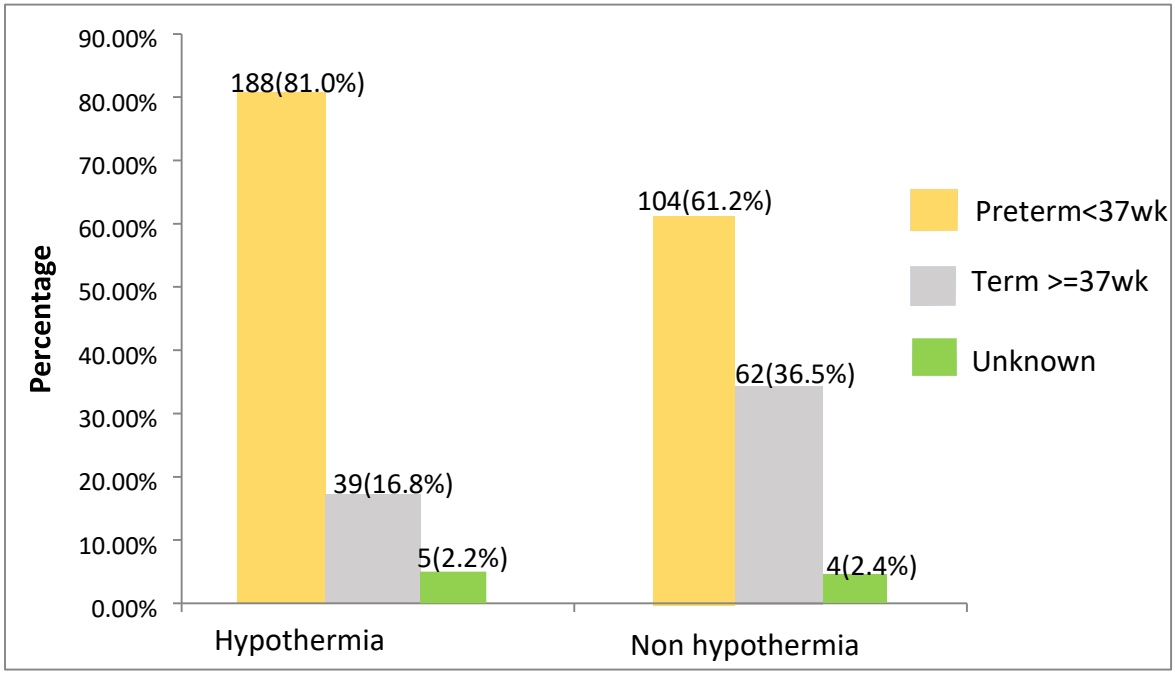

Figure 4 Admission Hypothermia and gestational age among Neonates admitted to Neonatal Intensive Care Unit in public Hospitals in Addis Ababa, Ethiopia, 2024.[n=402]

5.9. Factors associated with Neonatal Admission Hypothermia

After bivariate logistic regression analysis, P-value < 0.25 was taken as a cutoff point to select variable eligible for multiple logistic regression models. In bivariate logistic regression analysis factors which were significantly associated with admission hypothermia were multiple birth, sex of neonate, Apgar score, birth weight, baby cried after birth, received resuscitation, breast feeding initiation within 1 hour, ANC follow up, gestational age, mode of delivery, maternal chorioaminitis, antenatal steroid, neonates didn't received KMC, time of delivery, and month of delivery Variables revealed as significant on bivariate analysis were introduced into multiple logistic regression.

In multiple logistic regression analysis factors that were significantly associated with hypothermia were the neonates had low Apgar score at five minute, received resuscitation (CPR) at birth, neonates didn't received KMC, night time delivery and cold season delivery were associated with admission hypothermia.

Extremely low birth weight Neonates had 2.6 times more likely to have admission hypothermia compared to normal birth weight neonates AOR=2.604, 95%CI: 0.256, 26.454), And also Very low birth weight Neonates had 2.4 times more likely to have admission hypothermia compared to normal birth weight neonates. And neonates who had resuscitation at birth (CPR) were 5.01 times more likely to be hypothermic when compared to those who had no resuscitation (AOR= 5.01, 95%CI: 1.235, 20.33).

Table 8 Factors associated with admission Hypothermia with neonates admitted to Neonatal Intensive Care Unit of Governmental Hospitals in Addis Ababa, Ethiopia, 2024.[n=402]

Variables	Hypothermic (232)	Non Hypothermic (170)	COR(95%CI)	AOR(95%CI)	P - value
	N (%)	N (%)			
Age of Neonate(hour)					
≤ 24	131(56.5)	96(56.5)	1(0.671-1.490)	0.882(0.584-1.332)	0.552
>24	101(43.5)	74(43.5)	1.00	1.00	
Sex					
Male	146(62.9)	95(55.9)	1.340(0.895-2.006)	1.393(0.915-2.222)	0.192
Female	86(37.1)	75(44.1)	1.00	1.00	
Multiple Birth					
Single	178(76.7)	135(79.4)	0.132(0.017-1.043)	0.210(0.025-1.782)	0.348
Twins	44(19)	34(20)	0.129(0.016-1.61)	0.202(0.023-1.772	
Triplets	10(4.3)	1(0.6)	1.00	1.00	
Birth weight(grams)					
<1000	24(10.3)	6(3.5)	6.000(0.812-44.351)	2.604(0.256-26.454)	**0.050***
1000-1499	92(39.7)	23(13.4)	6.000(0.947-38.030)	2.490(0.286-21.706)	
1500-2499	76(32.8)	71(41.8)	1.606(0.261-9.892)	1.216(0.154-9.584)	
2500-4000	38(16.4)	67(39.4)	0.851(0.136-5.319)	0.619(0.086-4.452)	
>4000	2(0.4)	3(1.8)	1.00	1.00	
Apgar score					
>7	122(52.6)	129(75.9)	3.044(1.908-4.856)	**1.954(1.053-3.625)**	**0.034***
<7	95(40.9)	33(19.4)	1.983(0.812-4.843)	1.205(0.409-3.555)	
Unknown	15(6.5)	8(4.7)	1.00	1.00	
Baby cried immediately					
No	49 (21.1)	11(6.5)	3.870(1.946-7.698)	0.796(0.186-3.404)	0.759
Yes	183(78.9)	159(93.5)	1.00	1.00	
Received resuscitation					
No	177(76)	160(94.1)	1.00	1.00	

Yes	55(21.3)	10(5.9)	4.972(2.452-10.081)	5.012(1.235-20.337)	**0.024***
Breast feeding initiated within 1 hr.					
No	170(73.3)	64(37.6)	4.451(2.968-6.948)	0.649(0.346-1.221)	0.180
Yes	62(26.7)	106(62.4)	1.00	1.00	
Gestational age (weeks)					
< 37	188(81)	104(61.2)	1.446(0.380-5.503)	0.763(0.341-1.705)	0.548
≥ 37	39(16.8)	62(36.5)	0.503(0.127-1.989)	0.463(0.096-2.248)	
Unknown	5(2.2)	4(2.4)	1.00	1.00	
ANC follow-up					
No	43(18.5)	20(11.8)	1.706(0.963-3.024)	1.371(0.669-2.809)	0.389
Yes	189(81.5)	150(88.2)	1.00		
Maternal Chorioaminitis					
No	202(87.1)	140(82.4)	1.00	1.00	0.786
Yes	30(12.9)	30(17.6)	0.693(0.400-1.201)	1.100(0.553-2.189)	
Paraity					
Primi para	123(53)	83(48.8)	1.183(0.796-1.758)	1.211(0.804-1.823)	0.359
Multi para	109(47)	87(51.2)	1.00		
KMC					
No	157(67.7)	142(83.5)	0.413(0.253-0.674)	0.390(0.237-0.640	**0.001***
Yes	75(32.3)	28(16.5)	1.00		
Did the mother received Antenatal steroid					
No	89(38.4)	90(52.9)	0.553(0.371-0.826)	1.327(0.699-2.520)	0.387
Yes	143(61.6)	80(47.1)	1.00	1.00	
Time of delivery					
Day time	47(20.3)	84(49.4)	1.00	1.00	**0.001***
Night time	185(79.7)	86(50.6)	3.845(2.478-5.965)	3.688(2.168-6.273)	
Month of delivery					
Cold season delivery	162(69.8)	88(51.8)	2.156(1.429-3.253)	1.986(1.218-3.240)	**0.006***
Hot season delivery	70(30.2)	82(48.2)	1.00	1.00	

COR=Crude Odds Ratio, **AOD**=Adjusted odds ratio, **1**=Reference, ***significant at p – value < 0.05, **C.I**- confidence interval.

6. DISCUSSION

The prevalence of neonatal hypothermia among new born in this study was 57.7%. Which is almost similar with a study conducted in south west Ethiopia the prevalence of hypothermia was higher in Jinka General Hospital, it is 58.6%(19). Nevertheless it was lower than the study carried out in Brazil revealed that 68.2% of preterm newborns admitted to the neonatal intensive care unit (NICU) were found to have hypothermia(18). This variation might be due to the difference in temperature measuring instrument, study design, temperature measurement site, Ecological, Economical and cultural difference between the study areas.

In this study 46.3% of Neonates were moderate hypothermia which is 80.1% had moderate and 9% had sever hypothermia among hypothermic babies, it means our study result is lower prevalence however the finding of sever hypothermia is high, slightly similar findings on moderate hypothermia among hypothermic babies. However, after the first hour of admission, around 40.5% of the neonates were still experiencing hypothermia, with 37.5% having mild hypothermia and 3% having moderate hypothermia compared to study conducted in Jima it revealed that approximately 75.1% of the neonates admitted to the neonatal unit were hypothermic upon admission. Among those, 21.8% had mild hypothermia, while the remaining 78.2% had moderate hypothermia; no cases of severe hypothermia were reported. However, within the first hour after admission, around 53.1% of the newborns were still experiencing hypothermia, with 43.1% having mild hypothermia and 10.1% having moderate hypothermia(14).

Low birth weight at admission was found to be a risk factor for newborn hypothermia in this study. This finding is consistent with research done in Ethiopia's Arba Minch, South Nations and Nationalities, and Gondar, Amhara area(29, 30). This conclusion was also corroborated by research undertaken in Iran and Pakistan(31, 32). This could be due to a variety of factors, including radiant heat loss (when bare skin is exposed to a cooler environment), evaporative heat loss (when neonates are wet with amniotic fluid shortly after birth), conductive heat loss (when neonates are placed in contact with a cool surface or object) and convective heat loss (when a flow of cooler ambient air carries heat loss, a flow of cooler ambient air carries heat away from the neonate)(33).

These findings suggest that certain high-risk neonates, such as those with low Apgar scores (>7) or those requiring resuscitation at birth, may be more vulnerable to developing admission hypothermia similar to the study in Kenya Neonates with a low (0–3) APGAR score at birth also have significantly higher odds of experiencing hypothermia at admission compared to newborns with APGAR scores of 7–10(34). This variation may be due to difference in thermal care practice during resuscitation, warm resuscitation or not and difference in time of resuscitation.

The finding of this study is 79.7% neonates had delivered during night time and 69.8% of neonates had delivered during cold season, also the association with night time and cold season deliveries highlights the importance of environmental factors in contributing to neonatal admission hypothermia, it is similar to the study conducted in Jinka General Hospital revealed that Infants born at night had a higher likelihood of developing hypothermia compared to those born during the day. In Jinka General Hospital 61.1% of the newborns were admitted, over half of the newborns were born during the day, with 59.0% being admitted during daytime hours and 45.0% admitted during colder seasons of the year (19).

This study supported by the research from Oromia, western Ethiopia, The timing of delivery was also revealed to be a risk factor for neonatal admission hypothermia in this study. Those whose mothers gave birth at night had a greater chance of experiencing hypothermia than those whose mothers gave birth during the day.

Furthermore, neonatal hypothermia was associated with children who received resuscitation/CPR at birth. This result is consistent with research from Addis Ababa, Ethiopia, Iran and Bangladesh(35-37). This is because of neonates who require resuscitation have undergone birth asphyxia; there is insufficient oxygen for mitochondrial oxidation in brown adipose tissue, which is required for heat production(33). In addition, temperature regulation during resuscitation at birth may not be effectively addressed; in an emergency, resuscitation may be performed without wrapping the newborn and on a cold surface. This result, however, is contradicted by a research conducted in Arba Minch, southwest Ethiopia(29).

7. STRENGTH AND LIMITATION OF THE STUDY

7.1 Strength Of The Study

- This study was conducted on four different setting (Hospitals) hence the results can be generalized.
- Large sample size was taken, important for generalizability and representativness.

7.2 Limitation Of The Study

- The study was conducted with cross sectional study design so it does not show cause and effect relationship.

8. CONCLUSION AND RECOMMENDATION

8.1 CONCLUSION

The prevalence of Neonatal hypothermia among new born neonates admitted to Neonatal Intensive Care Unit of governmental hospitals in Addis Ababa was high 232 (57.7%).

In conclusion, this study found a high prevalence of neonatal hypothermia among newborns, with a significant number experiencing moderate to severe hypothermia. Low birth weight, low Apgar scores, Neonates had low Apgar score at five minute, received resuscitation (CPR) at birth, neonates didn't received KMC delivery during the night time, and colder seasons were identified as risk factors for newborn hypothermia. Environmental factors play a crucial role in contributing to admission hypothermia in neonates. These findings highlight the importance of implementing interventions to prevent and manage hypothermia in newborns, especially those at high risk.

8.2 RECOMMENDATION

- **For Health Professionals**
  - It is recommended to practice warm delivery room and warm resuscitation principle of warm chain for those neonates who need resuscitation to prevent hypothermia.
  - Enhanced monitoring of high-risk newborns: Infants with low birth weight, low Apgar scores, and those born during colder seasons or at night should receive enhanced monitoring for signs of hypothermia. This may involve more frequent temperature checks and targeted interventions to maintain thermal stability.
  - It is better to give priority for preterm and new born low birth weight and low Apgar score neonates during thermal protection.
  - Also it's better to give standard care during night time.

- **For Hospitals**
  - It is recommended to give attention to preterm neonates on thermal care and provide intensive care on separate room that has adjusted room temperature for preterm and low birth weight babies.
  - Implementation of standardized protocols: Hospitals and healthcare facilities should implement standardized protocols for the assessment, prevention, and management of neonatal hypothermia. These protocols should include guidelines for temperature monitoring, appropriate thermal care practices, and interventions for infants at high risk.
  - Promotion of kangaroo care: Encouraging and facilitating kangaroo care, which involves skin-to-skin contact between the newborn and the mother or caregiver, should be promoted as an effective method for preventing and treating neonatal hypothermia.
  - It is recommended to prepare room heater and warmers for the delivery room to prevent hypothermia during cold season
  - Hospital supervisors should be control the night time care of the delivery room.

- **For Ethiopian Minstery of Health**
  - It is better to facilitate all hospitals that provide delivery service to prepare their own organized NICU because most of hospital deliveries are high risk pregnancies that are referred from health centers which needs immediate intensive care but during referral to other hospital that had NICU heat loss will be occur during transportation.
  - Training and education: Healthcare providers, including nurses, midwives, and doctors, should receive training on the importance of maintaining thermal stability in newborns. This training should emphasize the use of appropriate warming techniques, early skin-to-skin contact, and the importance of maintaining a warm environment in delivery rooms and neonatal units.

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ANNEXE I: INFORMATION SHEET

Annex: Participant Information Sheet English Version

Good morning/Afternoon! My name is _____. I am working as a supervisor on Behalf of the principal investigator in a study conducted by the College of Health science, department of Nursing and Midwifery Addis Ababa University. You have selected and included in the study as part of the sample population to complete the questionnaire designed by the researcher on Admission hypothermia and associated factors among neonates admitted to NICU in Addis Ababa public hospital.

The objective of the study: Admission hypothermia and associated factors among neonates admitted to NICU in Addis Ababa public hospital.

Design of the study: Retrospective Cross-sectional study design

Risks and benefits: The result of the study helps programmers or policy makers to design intervention related to Admission hypothermia. In this way you may get benefit from the intervention policy. There is no payment and risk or discomfort as a result of Participating in this study except that you lost your time.

Confidentiality; All information given by you will be kept strictly confidential. Any of your personal information will not register. The information obtained in this study will be used only for research purposes.

Taking part is voluntary: Your participation is voluntary basis and you are not obligated to answer any question you do not willing to respond. Your honest participation will contribute a lot to generate information to come up with important findings. To complete, it will take about 35-45 minutes.

Address of the principal investigator:

Name –Abebe Hodie

Email – hailemelekot6@gmail.com

Phone- +251925333250

ANNEXE II: CONSENT FORM

Consent Form English Version I, the selected participant of the study has read and understood the information sheet carefully. I understood the purpose, benefit, and what is required from me and what are the consequences of the study with me if I take part in the study entitled on assessment of Admission hypothermia and associated factors among neonates admitted to NICU in Addis Ababa public hospital. I understood that personal information regarding me; like name will not register and all answers given by me should not be transferred to the third party without my permission. I also understand that I can decide whether or not to take part in the study or even withdraw from the study at any time so that I agree to participate in the study with my signature below.

The participant Sign_____

Supervisor: Name_____ Signature: _____

Date: _____

Thank you for your willingness!!!

ANNEX III: QUESTIONNAIRE

Admission hypothermia and associated factors among neonates admitted to NICU in Addis Ababa selected public hospitals Addis Ababa, Ethiopia, 2024.

CHECKLISTS

Section l. Socio demographic characteristics of Mother and Neonate of admission hypothermia

101	Age of Mother	_____
102	Multiple Birth	☐ Single ☐ Twin ☐ Triplate
103	Age of Neonate in hr.	_____
104	Sex of Neonate	☐ Male ☐ Female
Section ll. Neonatal factors on admission hypothermia		
105	Reason for Admission	_____
106	Birth Weight in grams	_____
107	APGAR Score	_____
108	Baby cried after birth immediately	☐ Yes ☐ No ☐ Unknown
109	Received Resuscitation After Birth	☐ Yes ☐ No ☐ Unknown
110	Breast Feeding Initiated within 1 hr. after birth	☐ Yes ☐ No ☐ Unknown

111	If no for No 110, what was the reason	_____
Maternal factors among neonates with admission hypothermia		
112	Gestational Age	☐ <28 weeks ☐ 28 – 32 weeks ☐ 32- 34 weeks ☐ 34-36 weeks ☐ 37 -42 weeks ☐ >42 weeks
113	Number of Antenatal care visit	☐ ≥4 ☐ 1-3 ☐ None
114	Chorioaminitis of mothers	☐ Yes ☐ No ☐ Unknown
115	Parity	☐ Primi para ☐ Multi
116	If the baby was less than 2000 grams, did the baby receive KMC?	☐ Yes ☐ No ☐ Unknown
117	Did the mother received antenatal steroid	☐ Yes ☐ No ☐ Unknown
Environmental factors of neonates with admission hypothermia		
118	Time of Delivery	☐ Day Time ☐ Night Time ☐ Unknown

119	Place of Delivery	☐ Health facility ☐ Home delivery ☐ Unknown
120	Month of Delivery of the mother	_____
Section lll. Treatment, complication and outcome of admission hypothermia		
121	Infant temperature measured at admission	_____º C
122	Infant temperature measured after 1 to 2 hour after admission	_____º C
123	The baby treated with radiant warmer	☐ Yes ☐ No ☐ Unknown
124	Treatment of neonate on admission hypothermia	☐ Oxygen ☐ CPAP ☐ KMC ☐ Antibiotics ☐ Maintenance fluid ☐ Blood transfusion ☐ Other _____
125	Immediate Problems identified after birth	☐ Prematurity ☐ Suspected sepsis ☐ Respiratory distress

		☐ PNA ☐ Jaundice ☐ Congenital malformation ☐ Meconium aspiration
126	After admission hypothermia the neonate had a complication	☐ Hypoglycemia ☐ Pulmonary hemorrhage ☐ Respiratory distress ☐ IVH ☐ NEC ☐ BPD ☐ Sepsis ☐ Others _____
127	Neonatal outcome after the treatment of admission hypothermia.	☐ Discharged ☐ Left against medical advise ☐ Death