MAGNITUDE &RISK FACTORS OF NEONATAL HYPOTHERMIAON ADMISSION, AFTER 1& 6HOURSIN NEONATES ADMITTED TO JUSH NICU

A SENIOR PAPER SUBMITTED TO DEPARTMENT OF PEDIATRICS AND CHILD HEALTH, JIMMA UNIVERSITY COLLEGE OF PUBLIC HEALTH AND MEDICAL SCIENCES, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE SPECIALTY CERTIFICATE IN PEDIATRICS AND CHILD HEALTH

By

Abdulkerim Osman (MD)

September, 2015

Jimma, Ethiopia.

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September, 2015

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ABSTRACT

Back ground:In both developed and developing countries, hypothermia is an important risk factor for morbidity and mortality in newborns especially in premature baby. According to WHO, Hypothermia is defined as axillary temperature <36.5ºC,However there are limited data available on the incidence of admission hypothermia &risk factors available in Ethiopia

Objective: The aim of this study is to assessthe magnitude & risk factors of neonatal hypothermia on admission, after 1 hour & 6 hours of stay amongneonatesaged <72 hours on admission to JUSH NICU.

Methods and Materials:A prospective longitudinal study design&Since our aim is to know the magnitude the sample size of 384 were determined by using single population proportion formula of calculating the minimum sample size, 95% CI.Assumption was also used. So according to this formula:- $n=Z^2\ p\ (1-p)/W^2$,so $n=(1.96)^2(0.5)(1-0.5)/(0.05)^2$ were conducted to collectClinical Data & Information on the independent variables by using structured questionnairefrom neonates admitted to JUSH NICU from June 1, 2015- August 30, 2015G.Cby a trained two nursesand data was checked for completeness and consistency &Data analysis was done by using SPSS version20. The research undertaking was funded by Jimma University student research program.All newborns admitted to NICU during the study period, except those meet the exclusion criteria, were included in the study.

Results: The Magnitudeofhypothermia on admission in this study was 75.1% which is one of the highest figures in the world&around 158/298(43.1%), & 50/298(16.8%) were remaining hypothermic at the 1st & 6th hours after admission, respectively,In the bivariable model, Independent variables like: Age on admission, Sex, GA, BW, 5TH minute APGAR- Score, number of towels, & maternal temperature have association butvariables like functioning radiant warmer in labor ward, resuscitation, mode of delivery, & type of towels (warm or not) have no effect in my study. However,Female sex, young age at admission, LBW, low 5^{th} minute APGAR score &number of towel (1 towel)were the factors, continued to have statistically significant association 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, in the multivariable logistic regression analysis during this study& ,therefore,Female sex, young age at admission, LBW, low 5th minute APGAR score &number of towel (1 towel) were the variables independently associated with the development of hypothermia according to this study.

Conclusion: TheMagnitudeof hypothermia on admission in this study is significantly high. There was a statistically significant positive association between majorities of the independent variables with the presence of hypothermia. The fact that this temperature measurement was done in NICU might give an impression that the actual magnitudewill be low; even then this figure is so high that it is recommended to measure temperature in Labor ward for hypothermia as that will open a window of opportunity to intervene before it is late. A more practical and achievable first step would be to at least conduct a routine temperature measurement for all newborns in labor ward, which is not happening at the moment; and it is the recommendation of this study to implement this strategy as it will pave the way for a more wider look in to the case.

Key words: Hypothermia, Neonates, Early neonatal death, NICU

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ABREVATIONS

AH: Hypothermia on admission

CPR : cardio-pulmonaryresuscitation

EDHS: Ethiopian Demographic and Health Survey

EVLBW: Extremely Very Low Birth Weight

IUGR: Intrauterine Growth Restriction

JUSH: Jimma University Specialized Hospital

LBW: Low Birth Weight

MDG-4: Millennium Development Goal

NICU: Neonatal Intensive Care Unit

SNNNPR: Southern Nation, Nationalities and peoples' Region

UNICEF: United Nations' Children's Fund

VLBW: Very Low Birth Weight

WHO: World Health Organization

CHAPTER ONE : INTRODUCTION

1.1 Background

Birth is associated with changes that affect the body temperature of the newborn. These include the ambient room temperature, multiple routes of heat loss (evaporative, convective, radiative&conductive), and increases in oxygen consumption with consequent heat production.(1,2, 3)

Since the first use of mercury in glass thermometers in 1798 (4,5), the importance of thermoregulation in clinical care has been appreciated. In no discipline is this more acute than in the management of premature neonates. Hypothermia at birth is a worldwide problem (6,7,8).

The EPICure study highlighted that for neonates less than 26 weeks' gestation a temperature of<35 °C on admission to a neonatal unit was independently associated with death (9). Heat loss is a particular problem at resuscitation (10). Hypothermia can also occur during transfer of infants to neonatal units, during routine care (11) and in operating theatres(12). Similarly, hyperthermia can have severe adverse consequences and should be avoided (10). Current routine neonatal practice is founded upon preventing significant temperature changes.

WHO defined néonatal hypothermiaas axillary temperature<36.5ºC &classified in to : Normal (36.5-37.5 ºC), MildHypothermia or Cold Stress(36-36.4 ºC) cause for concern ,ModerateHypothermia (32-35.9 ºC) danger, warm baby &,SevereHypothermia(<32 ºC) outlook grave, skilled care urgently needed(13)

After birth, deep body and skin temperature of the term newborn can drop at a rate of approximately 0.1°C and 0.3 °C per minute respectively unless immediate action is taken(14). Soon after birth, precipitous drop in body temperature occurs(15,16), especially in the absence of appropriate preventive measures. Some environmental &neonatal factors account for heat loss observed in newborn babies: the average delivery room temperature is considerably lower than that of the amniotic fluid by at least 10 °C(15),the infant is wet &his body surface area is large (17)relative to body weight, the body surface area of a newborn is approximately three times that

of an adult.(18)Heat loss depends on surface area. (18) Thus heat loss in newborns is approximately 4X.That of adult. (18) The preterm babies are particularly prone to heat loss because of low subcutaneous fat, lack of stratum corneum layer of the skin and inadequate development of the autonomic anatomic &chemical pathways.(16)Although the term newborn is able to increase heat generation up to twice the intrauterine rate in response to the cold stimulus of his new environment, (19) the increase is insufficient to prevent a fall in body temperature especially on the first day of life. (14) The rate of heat loss may be as high as 100-200 calories/kg/min,(20,21) with a corresponding drop in body temperature at a rate of 0.2 to 1.0 °C per minute. (15) When heat loss proceeds in excess of heat production, the body temperature drops below the normal range of 36.5 ° to 37.5 °C(22, 23,13)&hypothermia with its attendant consequences results.

Although cold stress may be important for initiating breathing and induced cooling may help protect the brain of asphyxiated term newborns, prolonged exposure to cold should be avoided. Extended periods of cold stress can lead to harmful side effects, which include hypoglycemia, respiratory distress, hypoxia, metabolic acidosis, coagulation defects, delayed readjustment from fetal to newborn circulation, acute renal failure, necrotizing enterocolitis, failure to increase weight or weight loss and in extreme cases death. Nayeri 2006 concluded that hypothermia at birth is one of the most significant risk factors causing death in newborn infants of all birth weights and gestational ages and particularly for vulnerable preterm infants.(24)

Hypothermia on admission (AH) is associated with increased morbidity and mortality in premature infants (25). In countries with limited health-care resources, achieving the fourth Millennium Development Goal recommended by the WHO requires the reduction of neonatal mortality. Of all neonatal deaths, three quarters occur in the first week of life(26)

Heat loss is observed even in newborns in relatively hot countries of sub-Saharan Africa.(27, 28, 29) Changes in core temperatures were observed within five minutes of delivery in some newborns in the relatively hot and humid part of southern Nigeria.(28). Therefore heightened vigilance is strongly recommended

Maintaining a normal body temperature is a critical function for newborn survival. Newborns achieve this through sophisticated mechanisms of body temperature regulation controlledby the hypothalamus &mediated by endocrine pathways through shivering &nonshivering thermogenesis(30). However, particularly in premature &low birth weight infants, thermoregulatory mechanisms areeasily overwhelmed, leading to metabolic deteriorationand direct death from hypothermia or indirect mortalityfrom associated mortalities such as severe infections (13)

Hypothermia is an important cause of morbidity, and occasionally mortality, in newborn(31,32). In 1958, Silverman et al (33) and in 1964, Buetow and Klein (34) reported the adverse effects of hypothermia on viability and hope for life in premature and low birth weight neonates. Low body temperature in newborns may lead to an increased rate of basal metabolism, peripheral vasoconstriction, decreased peripheral perfusion, tissue ischemia and finally metabolic acidosis.(35)Vascular changes in the lungs may lead to decreased ventilation, increased demand for oxygen and worsening of respiratory distress.(32)

Over 1.1 million neonatal deaths, comprising 28% of the global burden, occur in sub-Saharan Africa with Nigeria, Ethiopia, Democratic Republic of the Congo and Tanzania contributing 6%, 4%, 3%, and 2% of the global burden of neonatal deaths respectively. (36,16) Hypothermia plays a significant role in some of these deaths.(37,38) The recognition of the thermal needs of newborns and the interplay between warm and humid environment and the survival of low birthweight babies led to the development of incubators in the 1900s. (39) Aside this, the World Health Organization (WHO) has set up guidelines in response to the increasing challenges in the management of newborns at risk of hypothermia.(22)In spite of these developments, neonatal hypothermia has remained a challenge to newborn survival in developing countries. Although the exact incidence of the condition is unknown, it is estimated that 17 million newborns develop hypothermia annually in developing countries(40) and in some parts of the sub-Saharan Africa, incidence of 60% to 85% have been documented. (37,41)

Neonatal deaths are unequally distributed around the globe. Half of the world's newborns die at home, and more than 99% of all deaths occur in developing countries, where the average

neonatal mortality rate is 33 per 1,000, compared with 4 per 1,000 in high-income countries. Since neonatal deaths account for more than 40% of under-5 mortalities(42).

Daily mortality rates for the neonatal period are 30-fold higher than later during infancy(43). 25% to 45% of neonatal mortality occurring during the first 24 h(43)and 75% of neonatal mortality during the first week of life(44). Assuming that early deaths are caused mainly by prematurity and asphyxia, interventions addressing hypothermia management and resuscitation might have a substantial impact on neonatal mortality prevention.

1.2 Statement of the problem

The period ofbirth is associated with changes that affect the body temperature of the newborn. These include the ambient room temperature, multiple routes of heat loss (evaporative, convective, and conductive), and increases in oxygen consumption with consequent heat production.(21,14,30,3). Heat loss usually far exceeds heat production after birth, and if measures are not initiated to reduce heat loss, body temperature will fall.(1). An excessive fall in body temperature may impair the transition from intrauterine to extrauterine circulatory pathways given the effect of temperature on pulmonary vasomotor tone and acid-base homeostasis.(33,1). In general, effective interventions to prevent cold stress for the term infant are applied to the preterm infant, for example,drying and the use of radiant warmers(45); however, a higher surface area/weight ratio and skin characteristics make reducing heat loss for the preterm infant a more formidable challenge.(46) Current data on the relative success or failure in avoiding cold stress for preterm newborns has been limited to the extremes of prematurity(47) or small numbers of patients from third-world countries(8) is one of the most vulnerable in human life cycle.

There are multiple causes or risk factors for Hypothermia which could either exert an effect alone or which could have interrelated effects which is usually the case. Most of the risk factors are entirely preventable while others might be unavoidable(48).These diverse causes can be explored for associations with admission temperature included the following Variables: (a) maternal variables, including exposure to antibiotics (any use during the hospitalization for delivery), tocolytics, antenatal steroids (partial or complete course), and the presence of multiple births; (b) Intrapartum variables, including thepresence of labor, ruptured membranes>18 hours, and the mode of delivery; (c) infant characteristics, including birth weight, gestational age (obstetric criteria), and gender; (d) delivery room variables, including intubation and/or chest compression, Apgar scores and ambient room temperature; (e) Neonatal outcomes included late-onset sepsis, necrotizing enterocolitis (NEC; modified Bell's stage IIa or above),11grade III or IV and death within 7 days of age. The assigned cause of death reflects the purported underlying, proximate disease process contributing to death and is based on clinical findings using predefined causes in the manual of operations for the database(48)

The global neonatal deaths (newborns dying under the age of 28days) has decreased, from 4.6 million deaths in 1990 to approximately 3.1 to 3.6 million in 2009. However, neonatal mortality has declined at a lower rate than child mortality, so the proportion of newborn deaths among all child deaths has been increasing. Neonatal deaths are unequally distributed around the globe. Half of the world's newborns die at home, and more than 99% of all deaths occur in developingcountries, where the average neonatal mortality rate is33 per 1,000, compared with 4 per 1,000 in high-income countries. Since neonatal deaths account for more than40% of under-5 mortalities, reaching Millennium Development Goal (MDG) 4 will require a substantial reduction in newborn mortality. Although addressing neonatal hypothermia might facilitate this goal, it has so far been a neglected challenge(48)

The exact incidence of neonatal hypothermia in sub Saharan Africa is not known as there has been rarity of community-based study on the subject in the region. However, data emanating from hospital-based studies(37,41,27,49)[from various countries of sub-Saharan Africa suggest a high prevalence even though there are country-to-country variations.Neonatal hypothermia has also been reported from South African sub-region but unlike the high prevalence in West Africa, the incidence reported from Zambia(50)& Zimbabwe(37)ranged between 44% and 51.5%. In a more recent publication(51)from Johannesburg, South Africa, 3% of the 474 very low birthweight infants studied were hypothermic in spite of meticulous neonatal care, of which 61.5% died.

Furthermore, recent study from the horn of Africa (Eritrea) heightened the contribution of hypothermia to neonatal morbidity & mortality among newborns with pneumonia.(52)Ethiopia, being one of the countries with higher neonatal and infant mortality rates in the world, has a limited recent data on the prevalence of neonatal hypothermia howeverin a study done in the late 1970's shows the incidence of hypothermia in LBW (low birth weight) neonates were 53% (1291/2415) in Addis Ababa neonatal unit admissions with temperature of<36°C. & 59% of those with temperature<36 °C died compared to 15% with temperature of>/=36°C. According to this study, a high incidence of hypothermia(67%) occurred in low birth weight neonates on admission to the neonatal unit & also showed a linear increase in neonatal mortality with falling

body temperature at admission in all birth weight categories. (6) These all indicate that neonatal hypothermia is highly prevalent in the country. Thus an attempt to make an accurate estimate of the prevalence hypothermia is necessary at all health institutes as much as possible and identifying the factors which play a role is also very vital.

Preventing Hypothermia at birth in premature and low birthweight infants may be important to survival and long-term outcome. Babies rely on external help to maintain body and skin temperature particularly in the first 12 hours of life. For vulnerable infants born prematurely or that are very small, abnormally low body temperature (hypothermia) is a world-wide issue across all climates and can lead to a variety of diseases and even death. Preventative action is taken by reducing heat loss and/or providing warmth using external heat sources.(53)

1.3 Significance of the study

Neonatal hypothermia is a highly prevalent problem all over the world but putting more impact on the developing countries like Ethiopia. But unfortunately it is not widely studied in the developing countries like Ethiopia. While the factors associated with neonatal hypothermia, especially in premature neonates, have been well studied in the rest of the world, studies done so far in Ethiopia are not that much satisfactory for different reasons (first many studies are not done, and even those studies which tried to assess the problem did not consider most of the factors associated with hypothermia and also did not assess the complications of hypothermia. So, knowing the current level of the problem and identifying the associated factors at the local as well as the national level is very important in designing the possible interventions so that the level of the problem and associated complications could be lowered.

This study will also contribute to the studies available on the subject matter and so help in designing some interventional strategies. Based on the findings of the study, at an institutional level, interventions which could prevent the factors associated with hypothermia could be designed and also depending on the incidence of the problem, some readjustment could be made by the collaboration of the health care providers working in the department of pediatrics and child health and the labor ward so that emphasis will be given to these infants who are at a significantly higher risk of both acute and long term complications. The finding of the study could also be used to design similar interventions at the zonal, regional and national levels.

CHAPTER TWO: LITERATURE REVIEW

Even though more than sixty years have lapsed since Silverman and colleagues 1st showed neonatal hypothermia is associated with increased mortality, It has been estimated that prompt recognition of hypothermia and re-warming of hypothermic infants will avert up to 40% of neonatal deaths.(54) ,Even though Minimizing heat loss in low birth weight and premature infants is difficult because of high evaporative heat loss exacerbated by a large temperature gradient from the skin to the ambient air and physical characteristics of the premature infant(increased surface area/weight ratio, immature epidermal barrier, limited vernix caseosa, and subcutaneous fat). Thermal stability for premature infants in admission to the neonatal unit continues to be a problem requiring constant attention.(14,30,15,1)

Hypothermia on admission to the neonatal intensive care unit (NICU) is common among preterm infants. Depending on the selected temperature cutoff (usually ranging from 35.5°C to 36.5°C), the incidence of NICU admission hypothermia among very low birthweight (<1500g) infants ranges from 30-80% with significant inter-institution variability(55,1,56,57).

In developed countries most of the study of the prevalence of admission hypothermia was done in premature neonates. For instance, in a study done in Canada in very low birth weight (VLBW) infants, the prevalence of moderate to severe hypothermia(body temperature <35° C) on admission was 11.5%-12.5% among them(58,59)

In a prospective observational study done in a total of 4004 premature neonates, from March 1, 1995 to December 31, 1995 in the United Kingdom and the Republic of Ireland, among those admitted to the NICU, 66.7%,80%,58.3%,42.7%,&,29.6% were hypothermic at weeks 21,22,23,24,&,25 of gestational age respectively.(47)

In acohort study conducted Between January 1, 2002, and December 31, 2003, among 15 centers of the National Institute of Child Health and Human Development Neonatal Research Network at University of Texas Southwestern Medical Center, Dallas, Texas among the 5277LBW (low birth weight) neonates, The mean admission temperature was 35.91.0°C & the distribution of

admission temperatures shows 46.9% of the temperatures were 36°C. In contrast, the frequency of admission temperatures37.0°C was 10.8% and38°C was 1.3%.The distribution of admission temperatures was 14.3% at35°C, 32.6% between 35 and 35.9°C, 42.3% between 36 and 36.9°C, and 10.8% at37°C. On adjusted analyses, admission temperature was inversely related to mortality (28% increase per 1°C decrease) and late-onset sepsis (11% increase per 1°C decrease) but not to intraventricular hemorrhage, necrotizing enterocolitis, or duration of conventional ventilation. The mean age at the admission temperature was 23+/-14 minutes with a median value of 20 minutes.(1)

A study done in Spain in a total of 635 VLBW(very low birth weight) neonates The mean admission temperature was 35.8 ± 0.6◦C (range: 33.0-37.8◦C). The proportion of infants with a temperature <36◦C was44.4%. Independently associated perinatal variables were chorioamnionitis, birth weight, vaginal delivery, and advanced cardiopulmonary resuscitation (CPR). Admission hypothermia was associated with severe intraventricular hemorrhage (IVH) (grades 3 and 4) (OR: 0.377; 95% CI: 0.221-0.643; P<.001), and mortality (OR: 0.329; 95% CI: 0.208-0.519; P=.012).(60)

Neonatal hypothermia is an important contributing factor to neonatal mortality and morbidity in both developed and developing countries; (61,16,48,62.38) , A study from Tanzania has demonstrated a nearly four-fold increase in mortality in neonates with hypothermia.(37).

Reports from different Asian & African developing countries show that neonatal hypothermia is common & has been regarded as a major contributor cause of significant morbidity& mortality, In an Iranian study results showed that approximately one third of newborns became hypothermic immediately after birth. In addition, low birth weights, premature, low Apgar scores, infants of multiple pregnancies and those who received cardiopulmonary resuscitation had higher risk for being hypothermic. It was also found that hypothermia increases the risk of metabolic acidosis, jaundice, respiratory distress, hypoglycemia, pulmonary hemorrhage and death, regardless of the newborn's weight and gestational age.(32). In recent Iranian study in 522 neonates, Axillary temperature taken at the time period just after birth, 60, 120 and 240 min showed that 215 (41.2%), 248 (47.5%), 247 (46.4%) and 194 (37.2%) respectively were

hypothermic, defined as axillary temperature below 36.0°C. &: by Summing up the data for mild, moderate and severe hypothermia shows that 84.5% were hypothermic immediately after birth, 444 (85.1%) 1 h after birth, 452 (86.6%) 2 h after birth and 427 (81.8%) 4 h after birth based on WHO classification.(63)

In community-based studies (all conducted in Nepal or India), hypothermia prevalence ranged from 11% to 92%. Perhaps not surprisingly, lower ambient temperatures(64,65,48) and cold season(66,48)were associated with a higher incidence of hypothermia in Indian studies.

Several studies investigated the association between neonatal hypothermia and associated mortality risks. In my review, case fatality rates (CFR) for newborn hypothermia globally range from 8.5% to 52%(65,50,67,37,68). A study from India that included only hypothermic babies specifically investigated morbidities and mortalities and found CFRs that ranged from 39.3% for mild hypothermia to80% for severe hypothermia. This study demonstrated a dramatic effect of comorbidities and confirmed that hypothermia has a much worse outcome when associated with other newborn problems. Fatality rates increased to 71.4% with hypoglycemia, 83.3% with hypoxia, and 90.9% with shock (40).

In a community-based study conducted in Sarlahi, Nepal found that mortality increased by approximately 80% for every degree Celsius decrease in first observed axillary temperature and that relative risk of death ranged from 2 to 30 times within the current WHO classification for moderate hypothermia, increasing with greaterseverity of hypothermia(69,48).

At a study done in the Hospital of KualaLumpur in Malaysia to investigate the prevalence of hypothermia among very low birth weight infants (<1500 gm.) admitted to thirty two neonatal intensive care units in Malaysia. Almost two thirds (64.8%) were hypothermic at admission. & in a recent cohort study of 309 very low birthweight infants, Admission temperature<36°C occurred in 72% of patients <26 weeks & 44% of patients ≥26 weeks gestational age.(70)

The exact incidence of neonatal hypothermia in sub-Saharan Africa is not known as there has been rarity of community-based study on the subject in the region. However, data emanating

from hospital-based studies(37,41,27,49)from various countries of sub-Saharan Africa suggest a high prevalence even though there are country-to-country variations. In the West African sub-region, a study from Sagamu, Nigeria(41) recorded a prevalence rate of 62% among 150 babies at the point of admission, while a much earlier study from the same sub-region in 1981 reported a prevalence of 94.9% among a newborn population of 74 in Dakar, Senegal.(49)In another location, Guinea-Bissau, Sodemann et al.(38)Assessed the temperatures of 2926 babies and found that 8.1% of them had developed temperatures below 34.5°C within 12 hours of birth. In these studies(38,41) the risk of mortality was between two and five times higher in hypothermic babies than their normothermic counterparts(41,38)

Neonatal hypothermia has also been reported from South African sub-region but unlike the high prevalence in West Africa, the incidence reported from Zambia(50)&Zimbabwe(37)ranged between 44% and 51.5%. In a more recent publication(51)from Johannesburg, South Africa, 3% of the 474 very low birthweight infants studied were hypothermic in spite of meticulous neonatal care, of which 61.5% died. In another study(71)from Johannesburg metropolitan region, the prevalence of hypothermia was 21% among 96 newborns involved in inter-facility transport. Although these studies were not primarily on neonatal hypothermia, the figures from Johannesburg, South Africa further highlighted the ubiquitous nature of neonatal hypothermia. In the East African axis, report from Kenyatta National Hospital, Nairobi, Kenya,(72)revealed a neonatal hypothermia prevalence of 27.2% among 533 low birthweight babies on admission. In another study from Tanzania, Manji and Kisenge(73)reported an incidence of 22.4% among 1632 newborns on admission. Unlike the low prevalence in Tanzania, the report of Byaruhanga et al.(27)from Uganda showed that 83% of 300 newborns on admission developed a rectal temperature of less than 36°C at 1 hour of delivery.

Furthermore, recent study from the horn of Africa (Eritrea) heightened the contribution of hypothermia to neonatal morbidity &mortality among newborns with pneumonia.(52)Also in Ethiopia the incidence of hypothermia in LBW (low birth weight) neonates were 53% (1291/2415) in Addis Ababa neonatal unit admissions with temperature of<36°C. & 59% of those with temperature<36 °C died compared to 15% with temperature of>/=36°C. According to this study, a high incidence of hypothermia(67%) occurred in low birth weight neonates on

admission to the neonatal unit & also showed a linear increase in neonatal mortality with falling body temperature at admission in all birth weight categories.(6)

Although data on neonatal hypothermia is lacking in the Central African zone, it is unlikely to have newborn population devoid of hypothermia. Even in areas with low prevalence, under-reporting plays at least a minor role, thus there is need to awaken vigilance among health workers on this seemingly forgotten disease of newborns.

So the high burden of neonatal hypothermia especially in premature neonates in sub-Saharan African is an issue of public health importance because the factors predisposing newborns to the condition are prevalent in the region and are largely preventable,(74) even though, the facilities for prevention and treatment of neonatal hypothermia remain scarce and concentrated in secondary and tertiary institutions. Efforts at educating the community on the available low-tech preventive measures and early detection and referral will certainly provide, at least, a noticeable reduction in the incidence of hypothermia in newborns.

There are relatively few reports on the frequency of low temperatures at birth among premature infants. Among hospitals in third-world nations, the frequency of temperatures=36°C at 2 hours after birth can be as high as 60% for cohorts that include both term and low birth weight infants, &these observations are linked to a high incidence of hypothermia at 24 hours ofage.(8,37,73)

Qualitative studies from Africa and South Asia suggest that delivery and newborn care practices contributing to heat loss are still common globally. Various cultural and sometimes economic barriers often interfere with implementing simple steps to prevent hypothermia. Heating the birth place is costly for families in resource-poor countries (75), and drying and wrapping the baby is often not a priority when the mother needs attention after delivery (76). In Ghana, for example, the practice of bathing newborns immediately after delivery is sometimes rooted in concerns about‘ritual pollution’ (77)or the belief of helping the baby sleep and feel clean, and reducing body odor in later life; attitudes that informants felt would be difficult to change(78)

CHAPTER THREE: OBJECTIVES

General objective

To determine the Magnitude of Neonatalhypothermiaon admission, at 1& 6 hour of admission & associated factors among neonates admitted to NICU JUSH.

Specific objective

To determine the magnitude of Neonatal hypothermia on admission, at 1 & 6 hours of admission.

To determine factors associated with hypothermia among neonates admitted to NICU JUSH.

CHAPTER FOUR: METHODES AND MATERIALS

Study area and period

The study was conducted at NICU ward of Jimma university specialized hospital, Jimma zone Oromia region south west Ethiopia which is located 350 km from capital city, Addis Ababa. It is the only referral hospital for over 15 million people in the southwest region (source: from JUSH archive, 2000)& It is a teaching hospital with different public health services. The study period will be from June 1, to July 30, 2015 G.C.

The NICU ward is one of the units in this hospital where all neonates' aged≥14 days were admitted referred neonates from JUSH labor ward as well as from other nearby hospitals & health centers. The ward has 3 rooms for critically ill neonates &5 other rooms for both relatively ill neonates & the mother itself.

Study design

Prospective longitudinal studywas conducted on 298 newborns admitted to JUSH NICU over a period of six months (February 2 to August 2, 2015G.C).

Population

Source population:

All neonates admitted to Jimma university specialized hospital NICU over a period of three months from June 1, to August 30, 2015 G.C.

Study population*:*

All neonates<72 hours on admission to Jimma university specialized hospital NICU.

Eligibility criteria

Inclusion criteria

All newborns <72 hours on admission to NICU in the study period whose mothers or care takers were willing to participate in the study.

Exclusion criteria

All Newborns admitted to NICU in the study period with gross congenital anomalies

Sample size and sampling technique

All Neonates fulfilling the inclusion criteria was included in the study.

The minimum sample size needed for the study was calculated by using the single population proportion formula of calculating the minimum sample size. 95% confidence interval assumption was also used. So according to this formula:-

$n = Z^2 p (1-p) / w^2$ where:

n= the minimum sample size required

Z=the normal standard score corresponding to 95%CI=1.96

P=expected prevalence=22.5% from previous study in the Area

W=degree of accuracy required

So, $n=(1.96)^2(0.5)(1-0.5)/(0.05)^2 = 384$.

Variables

Dependent variable

Neonatal Hypothermia

Independent variables

Age

Sex

Gestational age

Birth weight

APGAR score

Mode of delivery

Number of towels

Type of towels

Infant feeding status

Maternal temperature

Warmer

Data collection

Data collection instrument and techniques

Data was collected by filling the structured questionnaires addressing, gestational age, anthropometry,&by measuring axillary temperature of all the newborns on admission, at 1,& 6hrs of admission and results wasrecorded on the data collection format by the data collectors.

Materials

Measuring digital thermometer &structured questionnaires was used.

Data collection quality control

During the data collection procedure, the investigator was checked whether information was recorded correctly & completely. The collected data waschecked for completeness, accuracy & clarity as well.

Data analysis procedures

Following the collection of all the necessary information, data wasprocessed, edited, coded, classified, cleaned and entered into a computer and analyzed by using statistical package for social sciences (SPSS) version 20.0 software. First descriptive analysis was done to determine the means and proportions. Then bivariate binary logistic regression wasdone to determine

associations. Then variables which had p values less than 0.25 on the bivariable analysis were further analyzed by multivariable logistic regression to see for associations. P value of 0.05 wasused. The result was presented by using tables, percentages and narratives.

Ethical Considerations

Ethical clearance wasobtained from Jimma University, College of Public health and Medical sciences Ethical Review Board. Verbal consent was obtained &all information's were kept confidential.

Limitation anticipated

As the study was conducted over a period of three months, it was not possible to assess the association between hypothermia and season.
It was difficult to assess the ambient temperature of the labor ward.
Figures from study based at single NICU may not represent the entire neonatal population in the community.

Operational definitions

Hypothermia: Axillary (body) temperature of neonate<36.5 ºc

Mild hypothermia:Axillary temperature of neonate between 35.9 & 36.5 ºc

Moderate hypothermia: Axillary (body) temperature of neonate between 32.0 & 36.5 ºc

Severe hypothermia: Axillary (body) temperature of neonate<32.0 ºc

Neonate: newborn infant of <28 days

Gestational age: will be estimated by using last normal menstrual period (LNMP) or by Ballard score.

Preterm: Gestational age<37 completed weeks

Term: Gestational age between 37 & 42 completed weeks

Post term: Gestational age>42 completed weeks.

Normal Birth weight: Birth weight between 2500 & 4000gm.

Low Birth weight: Birth weight<2500gm.

Macrosomia: Birth weight>4000gm.

Small for gestational age: newborn whose birth weight for gestational age $<10^{th}$ centile.

Large for gestational age: newborn whose birth weight for gestational age between 10^{th} & 95^{th} centile

Appropriate for gestational age: newborn whose birth weight for gestational age $>95^{th}$ centile.

Premature: those newborn who are preterm or/and low birth weight.

Early neonatal death: neonatal death with in the 1^{st} 7days of life.

CHAPTER FIVE: RESULTS

A total of 298 neonates<72 hours on admission to JUSH NICU, were fully participated, making the response rate 77.6%.The average age of those admitted neonates was2.66hours (SD= 1.23) with minimum & maximum age 1 & 4hours respectively. &162 (54.7%) of them were males.Over two-third 210(70.5) of them were term neonates whereas 88(29.5%)were found to be preterm & there was no post term neonates in my study period. (Table 1)

Table 1: Socio-demographic distribution of the study subjects

variable	categories	Frequency	Percentage (%)
Age in (hours)	≤1	*73*	*24.7*
	>1-3	*68*	*23.0*
	≥3-6	*37*	*12.5*
	>6-72	*118*	*39.9*
Sex	*Male*	*162*	*54.7*
	Female	*134*	*44.6*
Gestational Age(GA.)*(Weeks)*	<37	*88*	*29.5*
	37-42	*209*	*70.1*
	≥42	*1*	*.3*
*Birth Weight(*BW.) *in (grams)*	≤2500	*113*	*37.9*
	2501-4000	*176*	*59.1*
	≥4000	*9*	*3.0*
Anthropometry (BW. By GA.)	SGA	99	33.2
	AGA	190	63.8
	LGA	9	3
Religion	Muslim	*204*	*68.5*
	Orthodox	*69*	*23.2*
	Protestant	*25*	*8.4*
Overall Total for each variables above		*298*	*100.0*

One hundred seventy six (59.1) were having normal birth weight, 113(37.9%) were having low birth weight, only 9(3%) were macrosomic, based on the Anthropometry(BW. by GA.), majority of them were AGA 190(63.8%), around 99(33.2%) were SGA, & 9(3%) were LGA. Large number of the participants were follower of Muslim religion, 204(68.5%) followed by orthodox 69(23.2%) religion follower. (Table 1)

When we assess the mode of delivery of the neonates, the majority of them 167(56%) were delivered by SVD, followed by C/S delivery, which accounts for about 111(37.2%) & only 20(6.7%) were delivered by instrumental delivery (Table-2).

Those neonates were also assessed for their Apgar score in the 1^{st}& 5^{th}minutes & showed that, of the total 298 newborns, 242(81.2%) were found to have<7, the remaining 56(18.8%) were having<7 APGAR score in the 1^{st} minute. But this result were significantly changed in the 5^{th} minute that 202(67.8%) were having≥7& only 96(32.2%) were remained to have<7(Table-2).

From the essential newborn cares given during delivery, warm towels were used for all newborns for drying, & of the total, two towels were used only for 78(26.2%) & only single towels were used in the remaining 220(73.8%). Regarding the Initiation of breast feeding, more than half of the neonates 172(57.7%) were initiated breast feeding on their own mother, whereas around 126(42.3%) weren't initiated breast feeding during admission to NICU (Table-2)

From the additional newborn care, to maintain the body temperature of the newborn during this study period, functional radiant warmer were present only during the delivery of the 104(34.9%), whereas in the remaining more than half of the neonates 194(65.1%) the radiant warmer were either absent or non-functional based on this study (Table-2).

Table-2: Distribution of some of the independent Variables.

Variables	parameters	Frequency	Percent (%)
Mode of delivery	SVD	167	56.0
	Instrumental	20	6.7
	C/S	111	37.2
Apgar scoreIn the 1st minute	< 7	242	81.2
	≥7	56	18.8
Apgar scoreIn the 5th minute	< 7	96	32.2
	≥7	202	67.8
Resuscitation	Yes	*153*	*51.3*
	No	*145*	*48.7*
Initiation of breast feeding	Yes	*172*	*57.7*
	No	*126*	*42.3*
No. of towels	1	*220*	*73.8*
	2	*78*	*26.2*
Radiant warmer	Yes(functional)	*104*	*34.9*
	No(non-functional)	*194*	*65.1*
	Total	298	100.0
Maternal temperature	< 36.5	141	47.3
	36.5-37.4	120	40.3
	≥ 37.5	37	12.4
	Total	298	100.0

The axillary temperature (in degree Celsius) distribution of those neonates were taking at three different occasions after admission to NICU,1st immediately on admission, 2nd& 3rd, at 1 & 6 hours of admission to NICU respectly; the results were around 224(75.1%) of the admitted neonates were hypothermic during admission, of those hypothermic neonates, 49(21.8%) were having mild hypothermia whereas the remaining 175(78.2%) were having moderate hypothermia, but there was no admission with severe hypothermia.But at the 1st hour after admission, around 158(53.1%) were having hypothermia, of which, 128(43.1%) were having mild hypothermia whereas the remaining 30(10.1%) of hypothermic neonates were moderately hypothermic & there was no a neonate with severe hypothermia. When we assess the occurrence of hypothermia at 6th hours after admission, only 50(16.8%) were found to have hypothermia, of which, 48(16.1%) were having mild hypothermia, whereas the remaining 2(0.7%) were having moderate hypothermia. More than two-third, 238(79.9%) were having normal temperature at the 6th hour of admission (Table-3).

Table-3:Axillary temperature distribution of the neonates on admission, after 1hour & 6hours after admission to NICU JUSH from June 1- August 1/2015

Variables	During admission	After 1 hr. of admission	After 6 hour of admission
Temperature (ºc)	Number (%)	Number (%)	Number (%)
32-34.9	49 (16.4%)	30 (10.1%)	2(0.7%)
35-36.4	175 (58.7%)	128 (43.0%)	48(16.1%)
36.5-37.4	49 (16.4 %)	121 (40.6%)	238(79.9%)
37.5 -38.4	19 (6.4%)	18 (6.0%)	10(3.4%)
≥38.5	6 (2.0%)	1 (0.3%)	0
Total	298(100.0%)	298100.0	298

Out of the Total 224 hypothermic neonates found during admission, 120(53.6%) were NBW; 97(43.3%) were LBW & the remaining 7(3.1%) were macrosomic neonates. While 148(661%) were term, 76(33.9%) were preterm neonates. Based on the Anthropometry, 121(54.1%) were AGA, 96(42.8%) were SGS, & 7(3.1%) were LGA. After 1 hour of admission, there were a total of 158(53.4%) hypothermic neonates, of which, 75(47.5%) were AGA, whereas 81(51.3%) were LBW, & 2(1.2%) were LGA neonates. When we see the temperature record after 6 hours of admission, there were only 42 hypothermic neonates, of which, 35(83.3%) were LBW, whereas, the remaining 7(16.7%) were NBW, & there was no macrosomic neonate found to be hypothermic. While 36(85.7%) were preterm, & the remaining 6(14.3%) were term. Finally, when we assess the anthropometry of the hypothermic neonates after 6 hours of admission, around 38(90.5%) were SGA neonates, while 4(9.5%) were AGA neonates. (Table-4)

Table-4: Incidence of neonatal hypothermia, at admission, after 1 hour of admission, & 6 hours of admission to NICU based on birth weight, gestational age, & anthropometry(June 1-August 30/2015 G.C.

Variables	**Parameters**					
	Hypothermic (Tº C <36.5ºC)			Non-hypothermic (Tº C≥36.5ºC)		
	Frequency&Percent (%)			Frequency & Percent (%)		
	On admission	After 1hr.of admission	After 6hr.of admission	On admission	After 1hr.of admission	After 6hr.of admission
Birth Weight						
LBW	97(85.8%)	81(71.7%)	35(31%)	16(14.2%)	32(28.3%)	78(69%)
NBW	120(68.2%)	75(42.6%)	7(4%)	56(31.8%)	101(57.4%)	169(96%)
Macrosomic	7(77.7%)	2(32.3%)	0	2(32.3%)	7(77.7%)	9(100%)
Total	224	158	42	74	140	256
Gestational Age						
Preterm	76(86.4%)	68(77.3%)	36(40.9%)	12(13.6%)	20(22.7%)	52(59.1%)
Term	148(70.8%)	90(43.1%)	6(2.9%)	61(29.2%)	119(56.9%)	203(97.1%)
Post term	0	0	0	1(100%)	1	1
Anthropometry						
SGA	96(97%)	88(88.9%)	38(38.3%)	3(3%)	11(11.1%)	61(61.7%)
AGA	121(63.7%)	72(38%)	4(2.1%)	69(36.3%)	118(62%)	186(97.9%)
LGA	7(77.7%)	0	0	2(22.3%)	100(100%)	9

Regarding the newborn factors considered as a risk factor for hypothermia independently, out of the total 113 LBW neonates, 97(85.8%), 81(71.1%), & 35(31%) of them were hypothermic on admission, after 1hour & 6hours of admission, respectively. Of the total 88 preterm, 76(86.3%) were hypothermic on admission. After 1hour & 6 hour of admission, around 68(77.3%), & 36(41%) were remained hypothermic respectively.Out of the total 176(59.5%) normal birth weight admitted neonates, 120(68.2%), 75(42.6%), & 7(3.9%) were found to be hypothermic, while only 56(31.8%), 101(57.4%), & 169(96.1%) were normothermic, at admission, after 1 hour, & 6 hours of admission respectively. Similarly out of the total 209(70.1%) term neonates admitted to NICU, 148(70.8%), 90(43.1%), & 6(2.9%) were hypothermic, at admission, after 1 hour, & after 6 hours of admission respectively. but there was no hypothermic post term neonate at all.(Table-4)

Table-5: Bivariable model logistic regression

Variable	COR	95% CI
Age at admission (Reference (6-72hrs]	4.053*	1.836, 8.946
Sex. (Reference =Male,)	1.94*	1.116, 3.371
GA (Reference =Term)	2.65*	1.348, 5.222
Birth weight (Reference=LBW)	.353*	.191, .655
APGAR -5minute (Reference =>=7)	2.762*	1.432, 5.330
Number of towels (Reference = towel=2)	1.792*	1.014, 3.166
Maternal Temperature (low temperature)	.524*	.28, .99

Note= * represents those independent variables found to have association in the bivariable model logistic regression

In the bivariable model, Independent variables like: Age on admission, Sex, GA, BW, 5TH minute APGAR- Score, number of towels, & maternal temperature have association but variables like functioning radiant warmer in labor ward, resuscitation, mode of delivery, & type of towels (warm or not) have no effect in my study. (Table-5)

Table-6: Multivariable model logistic regression

Variable	AOR	95% CI
Age at admission (Reference (6-72hrs]	3.847	1.59, 9.32*
Sex. (Reference =Male,)	2.250	1.23, 4.13*
GA (Reference =Term)	2.579*	1.245, 5.344
Birth weight (Reference=LBW)	.358	.129, .991*
APGAR -5minute (Reference =>=7)	2.331	1.113, 4.880*

Note= * represents those independent variables found to have association in the multivariable model logistic regression

However, Female sex, young age at admission, LBW, low 5th minute APGAR score & No. of towel (1 towel) were the factors, continued to have statistically significant association 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 in the multivariable logistic regression analysis during this study & ,therefore, Female sex, young age at admission, LBW, low 5th minute APGAR score & No. of towel (1 towel) were the variables independently associated with the development of hypothermia according to this study.(Table-6)

Table-7: Comparison of both the Bivariable & Multivariable model logistic regression

Variable	COR	95% CI	AOR	95% CI
Age at admission (Reference (6-72hrs]	4.053*	1.836, 8.946	3.847	1.59, 9.32*
Sex. (Reference =Male,)	1.94*	1.116, 3.371	2.250	1.23, 4.13*
GA (Reference =Term)	2.65*	1.348, 5.222	2.579*	1.245, 5.344
Birth weight (Reference=LBW)	.353*	.191, .655	.358	.129, .991*
APGAR -5minute (Reference =>=7)	2.762*	1.432, 5.330	2.331	1.113, 4.880*
Number of towels (Reference = towel=2)	1.792*	1.014, 3.166		
Maternal Temperature (low temperature)	.524	.28, .99*		

CHAPTER 6: DISCUSSION

The magnitude of hypothermia on admission, after 1 hour, & 6 hours of admission in this study is 75.1%, 53.1%, & 16.8% respectively, which is one of the highest figures in the world, and is consistent with different studies done in different parts of the world. This result is consistent with the result done in Addis Ababa neonatal unit admissions several years ago with temperature of<36°C, theincidence of hypothermia were 67%from the 2415neonates on admission to the neonatal unit(6)

Similar study done in 300 newborns inAfrican countries having relatively the same socio-demographic setup, in Uganda, in a tertiary referral hospital located in Kampala in a periurban area, shows the incidence of hypothermia on admission were 83%, Which is comparable with our result.(27)In another study on 313 newborns admitted to a neonatal unit in Harare, Zimbabwe, it was found that the occurrence of hypothermia on admission was 85%.(37) In similar studies done in Zambia, in a prospective study at a university teaching hospital among 261 newborns aged 0-7 days admitted to neonatal unit during the warm season revealed that in 44% of the admitted neonates were hypothermic which is comparable with our results during 1 hour of admission, & in a study done in Nigeria on August 2008 during rainy season, showed that the admission hypothermia were 80.6%, among neonates less than 6 hours of age (41). In a recent study done In the West African sub-region, a study from Sagamu, Nigeria(41) recorded a prevalence rate of 62% among 150 babies at the point of admission, while a much earlier study from the same sub-region in 1981 reported a prevalence of 94.9% among a newborn population of 74 in Dakar, Senegal.(49)

From other developing countries in Asia, for instance, in a study done in 500 newborns about 85% of them were hypothermic during admission. In another similar study done in Malaysia, in Hospital of KualaLumpur revealed two thirds (64.8%) of the neonates were hypothermic at admission. (70)

Regarding the distribution of degrees of hypothermia, based on WHO classification of degree of hypothermia, Temperatures between36.0 and 36.4C were defined as mild hypothermia, while those between 32.0 and 35.9C as moderate hypothermia, and below 32.0C as severe hypothermia, sobased on those definition our study showed that moderate hypothermia were found in 16.4%, 10.1%, & 0.7%, on admission, after 1 hour, & 6 hours of admission

respectively, mild hypothermia were found in 58.7%, 43.0%, & 16.1%; on admission, after 1 hour, & 6 hours of admission respectively, this result is also consistent with studies done in resource limited countries, like Nepal, India, &some of the African counties discussed above. For instant in a study done in one of the hospital NICU in Tanzania showed that of the hypothermic neonates on admission 22.4% were having mild hypothermia, which is similar to our study. But unlike our study, sever hypothermia were reported in about 13% of these neonates, this may be due to the season or most of the neonates were preterm, unlike our study which includes both term as well as preterm neonates.(73)

When we assess the newborn risk factors for neonatal hypothermia, it is not unexpected that preterm infants and low birthweight babies had very high incidence of hypothermia,because these infants have poor subcutaneous tissue with a remarkably poor thermogenesis, so in our study, out of the total 113 LBW neonates85.8%, 71.1%, & 31% of them were hypothermic on admission, after 1hour & 6hours of admission, respectively. Of the total 88 preterm neonates 86.3% were hypothermic on admission. & of the total preterm neonates admitted to our ward during the study period, 77.3%, &41% were remained hypothermic After 1hour & 6 hour of admission respectively, This study was consistent with different reports that was done in different African, as well as Asia countries we discussed above, for instance, In the West African sub-region, in Nigeria out of the 150 babies, Preterm babies had significantly higher incidence of hypothermia 82.5% & also the incidence of hypothermia was also highest 93.3% among low-birth-weight babies, which is consistent with our study finding mentioned in the beginning of this paragraph. Similar studies done in a teaching hospital in Turkey in 60 low birth weight neonates revealed that 88% of them were hypothermic on admission which is also comparable with our findings (15)

Among the newborn factors& other independent variables considered to affect the newborns body temperature, Age on admission, Sex, GA, BW, 5TH minute APGAR- Score, number of towels, & maternal temperature have association but variables like functioning radiant warmer in labor ward, resuscitation, mode of delivery, & type of towels (warm or not) have no effect in my study. Some of those findings are consistent with several studies done in different African, Asian& also some developed countries. For instance in a cohort study done in 23,240 babies in rural southern Nepal risk factors like Female sex, Low Birth Weight neonates, and maternal

hypothermia were found to have strong association with the occurrence of neonatal hypothermia which is consistent with our finding.(64, 65) Similarly in other studies done at a referral university teaching hospital of Tehran,Islamic Republic of Iran,in a study done in 900 neonates, significant risk factors were found to be Low Birth Weight, preterm, of low Apgar score which is also consistent with our results.(32). Other consistent results with our results were found from a study done in 2310 babies in Bangladesh,age less than 24 hours on admission, low birth weight, resuscitation at birth, and C/S delivery were the Independent risk factors, having significant association with the occurrence of neonatal hypothermia on admission to the NICU.(48)

In another study done in Spain from a total of 635 neonates Independently associated perinatal variables were low birth weight, but unlike our study both vaginal delivery, and advanced cardiopulmonary resuscitation (CPR) were found to have association this may be because of the frequency of the different mode of deliveries were different & also the kind of neonatal resuscitation were different in those setup & in comparison to ours.(60)

In the Multivariable logistic regression only sex, GA, Age at admission, Birth weight, Apgar score at 5^{th} minute & No. of towels were found to be statistically significant association with hypothermia.

Females were at risk of hypothermia by 1.89 times than males (95 CI: 1.12, 3.37). Being Preterm were at high risk of hypothermia by 2.56times term neonates (95 CI: 1.35, 5.22), also having low Apgar score at 5^{th} minute were at risk for hypothermia by 2.76times (95 CI: 1.43, 5.33), usage of two towels were protective by 1.79 times (95 CI: 1.01, 3.17) & Normal BW were found to be protective by 65% times that of LBW neonates (95 CI: .19, .66).

CHAPTER 7: CONCLUSIONS AND RECOMMANDATIONS

7.1. Conclusions

The magnitude of hypothermia on admission, after 1 hour & 6 hours of admission in this study is one of the highest figures in the world, even though, there are improvement in body temperature after admission to NICU, & this is consistent with many studies done in different parts of the world, including most of African & Asian countries which have similar socio-demographic setups like ours, such as Zambia, Nigeria, Uganda, Zimbabwe, and also from Asian countries like Nepal and Bangladesh.

Female sex, early Age at admission, Low Birth Weight, low Apgar score in the fifth minute andusing single towels during newborn care are the risk factors found to have statistically significant association with Hypothermia on the multiple logistic regression analysis during this study.

Unlike the finding of other literatures variables like functioning radiant wormer in labor ward, mode of delivery, & type of towels (warm or not) have no effect in my study.

7.2. Recommendations

- Early preventive measuresand special attention should be given to high risk neonates like low birth weightneonates, premature neonates, &neonates having low Apgar score at 5th minute. Otherwise proper treatment should be given for hypothermic neonates.
- Practices such as using two warm towels for drying and wrapping of newborn immediately during delivery and also advising the mother to keep herself warm during delivery such as by providing hot drinks and wearing her body by hot blankets.
- Both the NICU and delivery room (labor) ward should have functional and if possible additional radiant warmers & if also possible plastic bags should be also available to prevent the occurrence of hypothermia in the neonates.
- Similar studies should be done with a large sample size and in multi-centers to study further the prevalence and association of neonatal hypothermia with mortality & morbidity.

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ANEXIES & QUESTIONARIES

1. Neonatal Characteristics

	Questions	Responses	Skip
1	Card No.		
2	Age of newborn at time of admission(in hours)	------ hour(s)	
3	sex	1. Male 2. Female	
4	Religion	1. Muslim 2. Orthodox 3. Protestant 4. Others(specify)	
5	Gestational age (in weeks)	---------- weeks	
6	Birth weight	---------- gm	
7.	APGAR score at 1st & 5th minutes respectly	---------- & ----------	
8	Axillary temperature of the newborn on admission to NICU, after 1hr, & 6hr of admission respectly	, _____ , _____ ,& _____	
9.	Mode of delivery	1. SVD 2. Instrumental 3. C/S	
10.	Initiation of breast feeding	1. Yes 2. No	
11.	From where was the neonate	1. JUSH labor ward	

	referred?	2. Shenengibie hospital 3. Private clinic 4. others specify	
12.	For these referred from JUSH labor ward, Who gave immediate care for the newborn?	1. Midwifery 2. Gyn/Obs. Resident 3. Medical intern 4. others(specify)	
	For these referred from JUSH labor ward, What is the room temperature of the labor ward?	_____	
	For these referred from JUSH labor ward, Does the room for immediate newborn care has room warmer?	1. Yes 2. No	
	For these referred from JUSH labor ward, What essential newborn cares are applied immediately after delivery? Use of towel for drying the neonate?	1. Yes 2. No	
	If your answer to the above is yes, How many towels were used?	1. one 2. two	
	If your answer to the above is yes,	1. Warm	

	what kinds of towels are used?	2. Not warm	
13.	Was the neonate resuscitate immediately after birth	1. Yes 2. No	
14.	Was the neonate dressed properly when he/she was admitted to NICU?	1. Yes 2. No	
15.	Does the newborn have any additional diagnosis?	1. Yes 2. No	
	If your answer to the above is yes, what is the additional diagnosis?	1. Perinatal asphyxia 2. Sepsis 3. Respiratory distress(MAS/HMD) 4. Others (specify)	

2. Outcome of the admitted newborn in the 1st 7days

	Questions	Responses	Skip
16.1	Day one	1. improved 2. Develop additional problem (LONS, NEC), or HAI. 3. death 4. the same	
16.2	Day two	1. improved 2. Develop additional problem (LONS, NEC), or HAI. 3. death 4. the same	

16.3	Day three	1. improved 2. Develop additional problem (LONS, NEC), or HAI. 3. death 4. the same	
16.4	Day four	1. improved 2. Develop additional problem (LONS, NEC), or HAI. 3. death 4. the same	
16.5	Day five	1. improved 2. Develop additional problem (LONS, NEC), or HAI. 3. death 4. the same	
16.6	Day six	1. improved 2. Develop additional problem (LONS, NEC), or HAI. 3. death 4. the same	
16.7	Day seven	1. improved 2. Develop additional problem (LONS, NEC), or HAI. 3. death 4. the same	

Maternal Socio demographic factors

	Questions	Responses	Skip
1	Age	_____ years	
2	Religion	1. Muslim 2. Orthodox 3. Protestant 4. Others(specify)	
3	What is the maternal body temperature	1. <36 ºc 2. 36-36.5 ºc 3. 36.5-37.4ºc 4. >/=37.5ºc	
4	Address	_____	
5	Level of education	1. No education at all 2. Primary education 3. Secondary education 4. College & above	

THANK YOU!!!

Name of data collector_____

Signature of data collector_____