



UNIVERSITY *of*
RWANDA

**PREVALENCE OF NEONATAL HYPOTHERMIA AND ASSOCIATED
RISK FACTORS AT A REFERRAL HOSPITAL IN NORTHERN
PROVINCE, RWANDA**

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College Of Medicine and Health Sciences

School Of Nursing and Midwifery

Master of Science in Nursing (Neonatology)

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By

MUGAMBINUMWE Didace

A dissertation submitted in partial fulfilment of requirements for the degree of MASTER OF
SCIENCE IN NURSING (Neonatology)

In the College Of Medicine And Health Sciences

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March 2022

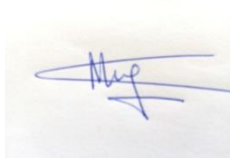
DECLARATION

I, Didace MUGAMBINUMWE, hereby declare that this research dissertation entitled” prevalence of neonatal hypothermia and associated risk factors at a Referral Hospital in Northern Province, Rwanda” submitted in partial fulfillment of the requirements for the degree of Master of Sciences in Nursing (Neonatology) to the University of Rwanda is my own work except where specifically acknowledged.

Didace MUGAMBINUMWE

220017065

Signature

A handwritten signature in blue ink, appearing to read 'Mug', with a horizontal line above and a vertical line below.

Date 23rd March, 2022

ACKNOWLEDGEMENTS

First of all, the praise is to the Almighty God, for having given me life, the resources and strength to go through this work, without his guidance nothing could have been possible.

I strongly acknowledge my family for their encouragement and their sacrifice during my studies.

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ABSTRACT

Background: Neonatal hypothermia is a global concern, common among those born at hospitals and homes, regardless of geographical environment. Hypothermia has a significant impact on neonatal mortality and is frequently associated with preterm birth, asphyxia, and severe neonatal infections. Lack of thermal protection in developing countries is a significant challenge for newborn survival, including those born in Rwanda. There is minimal data on neonatal hypothermia in Rwanda, particularly in regions other than Kigali city.

Aim: To determine the prevalence of neonatal hypothermia and associated risk factors in neonatology at a Referral Hospital in the Northern Province.

Methodology: A prospective cross-sectional design was used to search for neonatal hypothermia at a Referral Hospital in the Northern Province of Rwanda. A convenience sampling strategy was used to select 303 neonates admitted to neonatology from October, 2021 to January, 2022. The instrument was developed based on the literature review of neonatal hypothermia, a conceptual framework and the study's objectives. Bivariate analysis with chi-square test was used to analyse the relationship between categorical variables.

The prevalence of neonatal hypothermia was 65.3%. Born from adolescent mothers (OR=26.9), prematurity (OR = 9.4), not breastfed within 1 hour of delivery (OR = 9.7), having health problems (OR= 6.9), low birth weight (OR= 10.3), delivered at night time (OR = 6.0), and multiple births (OR = 29.7) showed significant association with neonatal hypothermia.

Conclusion: In this study, the prevalence of hypothermia was high in the period of study starting from October, 2021 to January, 2022. Therefore, special attention is needed for the thermal care of preterm neonates who has the risks said above and all neonates in general.

KEY WORDS

Hypothermia

Neonate

Neonatology

NICU

Hospital

Rwanda

LIST OF SYMBOLS AND ACRONYMS

APGAR: Appearance, Pulse, Grimace, Activity and Respiration

APH: Ante-partum hemorrhage

⁰C: Degrees Celsius

ELBW: Extremely low birth weight

LBW: Low Birth Weight

LMICs: Low-and-Middle Income Countries

NICU: Neonatal Intensive Care Unit

OR: Odds Ratio

%: Percentage

PPH: Post-Partum Hemorrhage

PPROM: Pre-term Premature Rupture of the Membrane

PROM: Premature Rupture of the Membrane

SPSS: Statistical Package for the Social Sciences

SSA: Sub- Saharan Africa

SSC: Skin-to-Skin Contact

VLBWI: Very Low Birth Weight Infant

WHO: World Health Organization

TABLE OF CONTENT

DECLARATION	iii
ACKNOWLEDGEMENTS	iv
ABSTRACT	v
KEY WORDS	vi
LIST OF SYMBOLS AND ACRONYMS	vii
TABLE OF CONTENT	viii
LIST OF TABLES	xi
LIST OF FIGURES AND GRAPHS	xii
CHAPTER ONE: INTRODUCTION	1
1.0 GENERAL INTRODUCTION	1
1.1 BACKGROUND OF THE STUDY.....	1
1.2 PROBLEM STATEMENT	2
1.3 THE AIM OF THE STUDY	2
1.3.1 Objectives	3
1.3.2 Research questions.....	3
1.6 SIGNIFICANCE OF THE STUDY	3
1.7 DEFINITION OF CONCEPTS.....	4
1.8 CONCLUSION.....	5
CHAPTER TWO: LITERATURE REVIEW	6
2.0 INTRODUCTION	6
2.1 THEORETICAL LITERATURE.....	6
2.1.1 Background of Neonatal Hypothermia	6
2.1.2 Risk factors Related to Neonatal Hypothermia	8
2.2 EMPIRICAL LITERATURE.....	9
2.2.1 Prevalence of Neonatal Hypothermia	9
2.2.2 Factors Associated with Neonatal Hypothermia.....	10
2.3 CONCEPTUAL FRAMEWORK OF THE STUDY	11
2.3.1 Socioeconomic factors	12

2.3.2	Physiological factors	12
2.3.3	Behavioural factors	12
2.3.4	Environmental factors	13
2.3.5	Obstetrical factors	13
CHAPTER THREE: RESEARCH METHODOLOGY		15
3.1	INTRODUCTION	15
3.2	RESEARCH APPROACH.....	15
3.3	RESEARCH DESIGN	15
3.4	RESEARCH SETTING	15
3.5	STUDY POPULATION	15
3.6	SAMPLING	16
3.6.1	Sampling strategy.....	16
3.6.2	Sample size	16
3.7	DATA COLLECTION.....	16
3.7.1	Data Collection instrument.....	16
3.7.2	Validity and reliability of the instrument.....	17
3.7.3	Data collection procedure.....	18
3.8	DATA ANALYSIS.....	18
3.9	ETHICAL CONSIDERATIONS	19
3.10	DATA MANAGEMENT.....	19
3.11	DATA DISSEMINATION	19
3.12	CONCLUSION.....	19
CHAPTER FOUR: PRESENTATION OF FINDINGS.....		20
4.0	INTRODUCTION	20
4.1	DISTRIBUTION OF NEONATES AND MOTHERS BY SOCIO-DEMOGRAPHIC CHARACTERISTICS	20
	TABLE 4.1a MATERNAL SOCIODEMOGRAPHIC CHARACTERISTICS (N=303).....	21
	TABLE 4.1b NEONATAL CHARACTERISTICS	22
4.2	PREVALENCE OF NEONATAL HYPOTHERMIA.....	22
	TABLE 4.2 PREVALENCE OF NEONATAL HYPOTHERMIA	23
4.3	RISK FACTORS ASSOCIATED WITH NEONATAL HYPOTHERMIA	24
	TABLE 4.3 RISK FACTORS ASSOCIATED WITH NEONATAL HYPOTHERMIA	25

4.4	CONCLUSION	26
CHAPTER FIVE: THE DISCUSSION OF RESULTS		27
5.0	INTRODUCTION	27
5.1	PREVALENCE OF NEONATAL HYPOTHERMIA ON ADMISSION	27
5.2	THE RISK FACTORS ASSOCIATED WITH NEONATAL HYPOTHERMIA ON ADMISSION	27
5.3	LIMITATION OF THE STUDY	30
5.4	CONCLUSION	30
CHAPTER SIX: CONCLUSION AND RECOMMENDATION		31
6.1	RECOMMENDATION	31
6.2	CONCLUSION	31
REFERENCES:		32
ANNEXES		35
I.	DATA COLLECTION TOOL	35
II.	CONSENT FORM.....	38
III.	ETHICAL CLEARANCE.....	39
IV.	ETHICAL COMMITTEE APPROVAL FROM RUHENGERI	40
V.	DECLARATION	41
VI.	PERMISSION TO USE AND ADAPT INSTRUMENT	42

LIST OF TABLES

Table 4.1a: Maternal sociodemographic characteristics

Table 4.1b: Neonatal characteristics

Table 4.2: Prevalence of neonatal hypothermia

Table 4.3: Risk factors associated with neonatal hypothermia

LIST OF FIGURES AND GRAPHS

Figure 1: Conceptual framework

Figure 2: Prevalence of neonatal hypothermia

CHAPTER ONE: INTRODUCTION

1.0 GENERAL INTRODUCTION

Hypothermia is a global health problem and a major contributing factor to neonatal morbidity and mortality, especially in low and middle-income countries (LMIC)(1–3). Neonatal hypothermia is the decrease in the newborn's body temperature less than 36.5°C(4).

This chapter consists of the background of the study, the problem statement, aim of the study, study objectives, research questions, study's significance and the definition of concepts.

1.1 BACKGROUND OF THE STUDY

Globally the World Health Organization (WHO) estimated that 2.4 million neonates died during the first month of extra-uterine life in 2020(3). However, if newborns were given thermal protection in a timely fashion many cases of hypothermia could have been prevented(3). The rate of neonatal deaths in LMIC could be reduced by more than 50% through cost-effective interventions including thermal protection to all newborns starting at birth and particularly through the first week when they are most vulnerable(2). Yet all newborns, including those small or ill, need to regulate their thermal control in order to survive and thrive(2).

The WHO classifies neonatal hypothermia as cold stress or mild hypothermia from 36.0°C to 36.4°C; moderate hypothermia from 32.0°C to 35.9°C and severe hypothermia below 32.0°C(4). Neonatal hypothermia is a pathological condition where the newborn's temperature drops below the recommended minimum normal temperature range of 36.5°C(4). The normal range of the neonates' temperature is 36.5°C to 37.5°C(5).

A study conducted by Wilson et al., in 11 European countries about admission hypothermia in very preterm infants and neonatal mortality and morbidity has found that over half of neonates (53,4%) are admitted with hypothermia and it is associated with neonatal mortality(6). A systematic review and meta-analysis of neonatal hypothermia conducted in East Africa found a prevalence of 57.2%(1). The associated factors with the high neonatal hypothermia prevalence included prematurity, low birth weight, night time delivery, neonatal health problems, and a delay in breastfeeding initiation(1).

Hypothermia is also reported in other studies in SSA, including Rwanda. Hypothermia is more prevalent in preterm neonates (95%), very low birth weight (VLBW) and low birth weight (LBW) neonates due to decreased subcutaneous fat and brown fat, and under-developed thermal

regulation system, according to a study done by Ukke et al., in Ethiopia(7). A study conducted in eastern part of Ethiopia by Alebachew et al., found that the prevalence of neonatal hypothermia was also high at 66.3%. The high prevalence was associated with a mother with an obstetrical condition, prematurity, absence of neonatal cap to keep head warm, absence of warm intra-facility transport, and no skin to skin contact(8). Neonatal hypothermia is a great concern and is associated with poor adherence to existing guidelines as a study conducted by Nyandiko et al. in Kenya showed that only 7.8% of newborns had accessed thermal care among 372 newborns(9). Adherence to the warm chain in the Kenyan study was found to be significantly associated with the hypothermia(9).

A study conducted in Rwanda by Urubuto reported a 27% prevalence of neonatal hypothermia on admission to the neonatology unit at a tertiary hospital in the capital city of Kigali and the main risk factor was prematurity(10). The study was conducted to gain information about the prevalence of neonatal hypothermia and associated risk factors in the Northern Province of Rwanda, which is the coldest part of the country.

1.2 PROBLEM STATEMENT

Neonatal hypothermia is a global health problem and was associated with 2.5 million deaths with in the first month of life in 2020(3). A systematic review and meta-analysis of 12 studies in East Africa revealed a high-pooled prevalence (57.2%) of neonatal hypothermia(1). A study conducted at a tertiary hospital in the capital city of Kigali reported a 27% prevalence of hypothermia on admission to the neonatology unit, leading to increased mortality and length of hospital stay(10). However, little is known about the prevalence of hypothermia and its associated risk factors among neonates born in a lower resource setting in Northern Province, which also is the coldest part of the country. Therefore, there is a need to conduct this study to determine the prevalence of hypothermia and associated risk factors among neonates from a region other than Kigali to bridge this gap in knowledge related to neonatal morbidity and mortality.

1.3 THE AIM OF THE STUDY

The aim of this study was to determine the prevalence of neonatal hypothermia and associated risk factors at one Referral Hospital in the Northern Province of Rwanda.

1.3.1 Objectives

1. To determine the prevalence of neonatal hypothermia at Ruhengeri Referral Hospital.
2. To identify the risk factors associated with neonatal hypothermia at Ruhengeri Referral Hospital.

1.3.2 Research questions

1. What is the prevalence of neonatal hypothermia at Ruhengeri Referral Hospital?
2. What are the factors associated with neonatal hypothermia at Ruhengeri Referral Hospital?

1.6 SIGNIFICANCE OF THE STUDY

This study was important to identify risk factors of neonatal hypothermia in order to improve neonatal care and prevent or lower the associated morbidity and mortality. Determining the prevalence and identifying the risk factors makes it easier to prevent neonatal hypothermia. A study done in Kenya provided the evidence that showed preventing neonatal hypothermia on admission increased the likelihood of neonatal survival by 20 times(9).

Nursing, Midwifery and other leaders and policymakers will use the study's findings to address specific issues contributing to neonatal hypothermia at Ruhengeri Referral Hospital in order to increase neonatal survival. Perhaps the immediate physical environment needs to be assessed to keeping neonates warm. The study will help to suggest interventions to be designed in order to improve quality newborn care specifically thermal protection for nursing profession based on the study's identified risk factors. The Northern Province, where the hospital is located, is at a highest altitude (1845 meters above the sea level) which leads to colder outdoors resulting in hypoxia and sudden infant birth syndrome for the babies(11). Therefore, the results of this study will inform Nurses and Midwives to develop protocols and guidelines to review and adapt as necessary to protect newborns in this region from hypothermia.

Researchers working at the hospital, or others employed outside the facility, should conduct interventional studies using the identified risk factors from this study. Their expertise could provide evidence and greatly affect the maternal and neonatal protocols, and moreover, significantly reduce the neonatal morbidity and mortality at the Ruhengeri Referral Hospital.

1.7 DEFINITION OF CONCEPTS

Hypothermia: The state of having body temperature below the normal range, an axillary temperature measurement below 36.5°C(4).

Birth: It is the process of complete expulsion or extraction of a product of conception from the mother(12).

Birth weight: The first weight of a live or dead product of conception, taken after complete expulsion or extraction from its mother. This weight should be measured in grams within 24 hours of birth, preferably within an hour of birth, before significant postnatal weight loss has occurred(12).

Low birth weight (LBW): Birth weight less than 2500 grams(13).

Very low birth weight (VLBW): Birth weight of less than 1500 grams(13).

Extremely low birth weight (ELBW):Birth weight of less than 1000 grams(13).

Live birth: A live birth is a complete expulsion or extraction from its mother of a product of conception, regardless of the pregnancy duration, which after separation, breathes or shows any other evidence of life, such as a heart beating, pulsation of the umbilical cord, or definite movements of voluntary muscles(12).

Neonatal period: Time from birth to 28 days. The early neonatal period refers to the period before seven days of age. The late neonatal period refers to the period from completion of seven days up to 28days after birth(13).

Neonate: A newborn infant from birth to 28 days post birth.

Term: Gestational age from 37 to less than 42 completed weeks.

Preterm: Gestational age of less than 37 completed weeks.

Extremely preterm: Less than 28 weeks

Very preterm: Between 28 to 32 weeks

Moderate preterm: 32 to 37 weeks

Post-term: Gestational age of 42 completed weeks and more.

Prevalence: It shows how much disease or condition is in a population at a particular point in time. It is calculated by dividing the number of persons with the disease or condition at a particular time point by examining the number of individuals.

Respiratory distress: Presence of at least 2 of the following criteria: Respiratory rate > 60/minute, Chest retractions, and expiratory grunt or groaning(15).

Day time: It is the time after sunrise and before sunset. (Time from 6:00 am to 6:00 pm)

Night time: It is the time between evening and morning or the time of darkness. (Time from 6:01 am to 5: 59 am)

1.8 CONCLUSION

Neonatal mortality and morbidity related to hypothermia remains high in Low-and-Middle Income Countries, including Rwanda. Rwanda has a neonatal mortality rate of 16 per 1000 live births and hypothermia is among the causes. Rwanda has committed to meet the Sustainable Development Goal by reducing preventable newborns deaths at least to as low as 12 deaths per 1,000 live births by 2030. In order to achieve this goal, the Rwandan Government has established effective interventions such as skin-to-skin contact after birth and KMC to reduce newborn mortality and morbidity related to neonatal hypothermia. Preventing hypothermia will increase neonatal survival by 20 times.

CHAPTER TWO: LITERATURE REVIEW

2.0 INTRODUCTION

This chapter presents a literature review of the topic of the prevalence and factors associated with neonatal hypothermia. It is divided into two sections, namely the Theoretical Literature Review and Empirical Literature Review. The theoretical literature reviewed is related to the theory supporting the topic and includes theoretical information from textbooks, guidelines, and protocols. The Empirical Literature includes the studies supporting the topics, and they include international, regional and local studies from Rwanda. A third part is the Conceptual Framework which is the foundation of the study, with the core element of hypothermia prevalence and five other elements associated with topic according to the previous theory and empirical studies. The Conceptual Framework could technically be in the Theoretical Literature Review or Empirical Literature Review.

2.1 THEORETICAL LITERATURE

2.1.1 Background of Neonatal Hypothermia

The WHO defines neonatal hypothermia as the abnormal thermal state in which the newborns body temperature is below 36.5°C (4). Humans are homothermic animals and must generate heat to maintain a body temperature at a constant level, regardless of environmental influences, using metabolic activity(16).

In utero, the core body temperature of the fetus is closely correlated with the mother, and as such, it is usually maintained at a consistent level and approximately 1°C above the mother. At birth, the wet newborn begins losing heat immediately unless heat loss is averted(4). The ambient temperature of the birthing room is often substantially cooler than where the newborn has just come from, namely, the warm environment of the mother. Unlike an adult, a newborn has a less mature thermal regulatory system and therefore heat dissipates more effortlessly(4). Newborns lose heat through the following four mechanisms(17).

- Evaporation - Heat loss occurs primarily due to evaporation of amniotic fluid from the newborns' wet body. Preterm neonates are more at risk with their thin, water permeable skin, and use of "artificial ventilation/nasal CPAP unless air/oxygen is heated and humidified"

- Convection – Heat loss occurs when the newborn is exposed to cool air in the delivery room, and also depends on the amount of skin exposed to the cool air, and movement created in the surrounding air, such as, a draught
- Conduction – Heat loss occurs when the newborn is in direct contact with a cold surface, such as placed naked on the table for resuscitation, or weighing scale
- Radiation – Heat loss occurs through indirect transfer from the newborns’ skin to cooler surrounding objects such as cool windows and walls in the room, and the incubator walls unless a “double wall”

Heat loss could be prevented through body regulatory processes that include vasoconstriction, shivering, and non-shivering thermogenesis. However, these responses are compromised because the thermoregulation system of the newborn is immature (13). The neonatal hypothermia is classified into three categories which include mild hypothermia, which ranges between 36°C and 36.4°C; moderate hypothermia, which ranges between 32°C and 35.9°C; and severe hypothermia, which is any temperature below 32°C(4).

In 1997, the WHO published a Safe Motherhood initiative called “Thermal Protection of the Newborn: a practical guide”. It was a set of ten recommendations to protect the newborn during the first few days from hypothermia and hyperthermia, and hence maintain homeostatis, with body temperatures relatively constant between 36.5°C and 37.5°C(4). The ‘warm chain’ principle is a set of appropriate measures to maintain the newborns’ body temperature by minimizing exposure to heat loss. The “warm chain” is comprised of 10 interconnected steps to prevent hypothermia in the newborn starting at birth(4):

1. Prepare birthing room, temperature must be warm ($\geq 25^{\circ}\text{C}$) and without draughts
2. Dry newborns’ skin immediately and covered with dry cloth and cap, as 25% of heat loss through uncovered head
3. Place newborn preferably on mothers’ chest or abdomen for skin-to-skin contact (SSC), or wrap and place in mothers’ arms
4. Begin breast-feeding within one hour of birth for warmth and calories to produce body heat, and continue breastfeeding “on demand” day and night
5. Delay bath and weight

6. Appropriate clothing or bedding, usually one or two layers of cloth more than mother
7. Mother and baby stay together 24 hours during day and night, known as “rooming-in”
8. Maintain warmth during internal or external transportation, if possible, stay with mother in SSC
9. Warm resuscitation on warmed surface, with only face and chest exposed, or radiant warmer
10. Regular training and awareness the “warm chain” and prevention of hypothermia

2.1.2 Risk factors Related to Neonatal Hypothermia

The Rwandan National Neonatal Protocol (2019) states that temperature regulation and thermal care are essential immediately following birth in order to prevent heat loss and hypothermia(18). Newborns who are born preterm, under 2500 grams, small for gestational age (SGA), ill newborns, and all others who are insufficiently warm are at a greater risk of hypothermia(18). Newborn hypothermia can cause adverse conditions - and sometimes a cascade of deadly events - such as, “hypoglycemia, metabolic acidosis, hypoxia with increased oxygen demands, increased metabolic rate, clotting disorders, shock, apnea, intraventricular hemorrhage, persistent pulmonary hypertension, decreased surfactant production and function”(18).

The neonatal period is a time of dramatic physiological changes, and the newborns’ extrauterine transition newborns’ greatly depends on their anatomy and physiology related to gestational age at birth, birth weight, and health status(17). Newborns have a greater surface to mass area ratio, therefore there is greater heat loss than heat generation. Their skin is thin and the skin barrier is less developed and permeable. Most have limited subcutaneous fat for insulation leading to heat loss, particularly LBW and preterm newborns. Newborns have little ability to generate heat mainly depending on insulation from subcutaneous brown fat in the neck, and back between the scapulae, kidneys and adrenal glands. They have limited capacity to shiver and produce heat, particularly preterm newborns less than two weeks of age. Preterm newborns also lack the capacity to flex their little bodies to reduce skin exposure to a cold environment(17).

2.2 EMPIRICAL LITERATURE

2.2.1 Prevalence of Neonatal Hypothermia

A cohort study conducted by Wilson et al., in 19 regions from 11 European countries found that admission hypothermia (53.4%) is a significant problem and that it is associated with an increased risk of early and late neonatal death(6). A study conducted by Lyu et al., (19) in Canada found that the average admission temperature is between 36.5°C and 37.2°C. A study done in India by Tanigasalam et al., (20) reported a 69.8% prevalence of hypothermia among in very preterm neonates in a tertiary care center, and 64.7% in moderate preterm neonates and 45.7% in term neonates. It was also found to be 70.4% in VLBW neonates and 58.5% in LBW neonates Tanigasalam et al., (20). A study conducted in China by Yu et al., (21) found that the prevalence of neonatal hypothermia on admission was very high and that VLBW infants had four times the risk (AOR of 4.148) of mortality and other poor outcomes such as respiratory syndrome (RDS), intra-ventricular hemorrhage (IVF) and late-onset neonatal sepsis.

The prevalence of neonatal hypothermia has also been very high in communities with tropical climates such as SSA. In an East Africa study by Beletew et al., (1) the prevalence of hypothermia was found to be 57.2% among a large study (n=20,911); neonates were four times at risk for hypothermia if premature (AOR: 4.01) or had a night delivery (AOR: 4.01). In a Ugandan study done by Mukunya et al., (22) the prevalence was 51% and that neonatal hypothermia increased the case fatality risk ratio compared to normo-thermic neonates. In a study conducted in Ethiopia by Demissie et al., (23) the prevalence of neonatal hypothermia was 64% and very high among preterm babies showing nearly a five times higher risk as term neonates (AOR:4.81) A cross-sectional study in the eastern part of Ethiopia by Alebachew et al., (8) found that within six hours of birth found and increased prevalence of hypothermia (78.4%) among newborns who had not had skin-to-skin contact (SSC) compared to neonates who did have SSC. A study of VLBW neonates conducted in a tertiary hospital in South Africa by Ng'eny and Velaphi (24). reported a 46.2% prevalence of hypothermia at time of admission of VLBWI to neonatal unit, and 38% having hypothermia within 24 hours of admission. The VLBW neonates at highest risk of hypothermia included vaginal births (aOR: 2.85), needed resuscitation at time of birth (aOR: 2.20), acquired metabolic acidosis (aOR 3.04) and first week demise (aOR 4.79) Ng'eny and Velaphi (24).

2.2.2 Factors Associated with Neonatal Hypothermia

A systematic review and meta-analysis conducted by Beletew et al (1) in East Africa on neonatal hypothermia and its associated factors found that it is associated with the delay in breastfeeding initiation, neonatal health problems, low birth weight, preterm, and night-time delivery. A study conducted by Tasew et al., (25) in Tigray, Ethiopia in 2017 of neonatal hypothermia among admissions to the NICUs of public hospitals reported independent risk factors of delayed breastfeeding initiation, preterm birth, LBW, low APGAR score at 5 minutes, night-time delivery, bathed within 24 hours of birth, and failure to practice SSC immediately after birth. A study by Mullany et al., (12) in Nepal showed that neonatal hypothermia has been associated with ambient room temperature and temperature measurement 60 minutes pre and post bath.

Birhanu Wondimeneh (11) in Ethiopia classified the risk factors of neonatal hypothermia into four groups such as environmental which includes ambient temperature and seasonal condition, physiological, behavioral, and socioeconomic. The environmental factors include environmental temperature and seasonal conditions. The literature has reported(26,27) a strong correlation between environmental temperature and neonatal hypothermia and also shown that environmental temperature varies with the seasons; the seasons assessed here were summer and winter. The environmental factors also are related to the geographical area in which the baby is born, as well as room temperature at time of birth(26).

A study in the NICU at Dessie Referral Hospital, Amhara Region, Northeast Ethiopia by Yitayew et al(26) reported that the physiological factors significantly associated with neonatal hypothermia include low birth weight, prematurity, intrauterine growth restriction (IUGR) and asphyxia where heat is lost due to lack of oxygenation and also heat is lost during reanimation. Another physiological factor found to be associated with hypothermia is hypoglycemia Yitayew et al (26). A study on newborns within the first six hours after birth by Alebachew et al., (8) in Ethiopia showed that prematurity predisposes a neonate to hypothermia because preterm babies have thinner and more immature skin that increases heat loss through radiation, poor hypothalamic control of their body temperature, lack of efficient neural mechanisms for temperature control by shivering, decreased glycogen stores, decreased subcutaneous fat for thermal insulation, less brown fat tissue, decreased ability to breastfeed effectively and decreased ability to regulate their body temperature through non-shivering thermogenesis.

The study by Birhanu Wondimeneh (11) found that behavioral factors associated with hypothermia include early bathing following birth, and application of oil or exposure to the environment due to massage. Bathing should be postponed until 24 hours of life or longer. A newborn exposed to the environment for massage or application of oil can also cause unnecessary hypothermia. In addition, some oils can cause skin damage and break down the skin barrier leading to loss of heat and nosocomial infection.

A systematic review by (26) identified socioeconomic factors related to neonatal hypothermia included adolescents or new mothers, born in poor-resource facility or country, low-income families, and mothers with a multiple birth and many other children (26). Lunze also reported that healthcare professionals have little knowledge on the management of hypothermia, have limited resource capacity to provide thermal care.

A study done in eastern part of Ethiopia by Alebachew et al (8) about neonatal hypothermia and associated factors within six hours of delivery revealed other factors associated with neonatal hypothermia including not wearing a cap, not using warm intra-facility transportation and being born from a mother who has had obstetrical complications as they less likely to breastfeed effectively leading to hypoglycemic and resulting in hypothermia.

2.3 CONCEPTUAL FRAMEWORK OF THE STUDY

This conceptual framework was adopted from a similar study in Addis Ababa, Ethiopia, by Birhanu Wondimeneh (11). The study was a cross-sectional design that measured neonatal hypothermia and associated factors among 356 newborns and mother pairs in the NICU of six public hospitals. The Ethiopian study was on the original framework by Henry and Lincoln Chen at Johns Hopkins University published in 1984 - entitled "An Analytical Framework for the Study of Child Survival in Developing Countries" - that has been widely used by researchers Mosley and Chen, 1984(28). Birhanu Wondimeneh (11) published his study with colleagues. The framework by Birhanu Wondimeneh (11) conceptualizes Neonatal hypothermia as a result of interaction between various social and biological variables, some of which are directly related to neonatal hypothermia while others are intermediate in nature. All those factors together increase the likelihood or prevalence of neonatal hypothermia, and potential impact on morbidity and mortality. The key construct of this study, which is prevalence of neonatal hypothermia, is the core framework element. The relationships between prevalence and other elements of the framework are represented by the arrows. This framework shows that prevalence of neonatal

hypothermia is influenced by various risk factors that prevent the neonates from maintaining their temperature in the normal range and therefore a key indicator of neonatal survival.

Besides the core element of neonatal prevalence, the framework (Figure 1) contains five other elements including Socioeconomic factors of the neonate's family, Neonatal physiological factors, Behavioral factors of the neonate's family, Environmental factors, and Maternal obstetrical factors. These factors are presented in rectangle casing in the framework. These five factors impact the development of hypothermia in the neonate and how they impact the neonate are explained in the paragraphs below Birhanu Wondimeneh (11).

2.3.1 Socioeconomic factors

The elements of the framework follow a clockwise direction start by socio-economic factors of the neonate's family which are being born from non-experienced mother, maternal age where a mother could be an adolescent, family income where a mother can be from the low-income family, the parity of the mother where a mother can be a primiparity or multiparity, mother's occupation and mother's residence where a mother can be from the rural area. Those factors cannot cause neonatal hypothermia, but they can prevent the mother's way of managing the neonate's body temperature and maintaining it in the normal range(11).

2.3.2 Physiological factors

The second element is the physiological factors of the neonate which are the neonate's birth weight where a neonate can be low birth weight (LBW) or very low birth weight (VLBW), prematurity, IUGR, hypoglycemia, and neonatal health problems such as asphyxia, congenital malformations, jaundice, respiratory distress, bleeding disorder, meconium aspiration syndrome or any other neonatal adverse condition. All these factors predispose a neonate to hypothermia because if they are present they will affect the way the body produces heat to prevent hypothermia(11).

2.3.3 Behavioural factors

The third element is the behavioral factors of neonate is family which are the application of oil and massaging the neonate, not practicing skin to skin contact with the mother, improper wrapping, being bathed before 24 hours and delay in initiation of breastfeeding. All these factors predispose the neonate to heat loss and lead to hypothermia(11).

2.3.4 Environmental factors

The fourth element is the neonate's environmental factors which are the time of delivery where a neonate can be delivered at night, place of delivery where a neonate can be delivered at home or low resource setting, seasonal condition where a neonate can be born in cold season and room temperature. All these factors predispose a neonate to hypothermia as they reduce environmental temperature and lead to heat loss through conduction, convection and radiation mechanisms(11).

2.3.5 Obstetrical factors

The last element is the obstetrical factors which include the mode of delivery where a neonate can be born by cesarean section, pregnancy type where the pregnancy can be multiple and being born from a mother who have had obstetrical complications during pregnancy. All these factors predispose a neonate to hypothermia as if they are present; they prevent the mother to adequately prepare her to prevent hypothermia to the neonate(11).

CONCEPTUAL FRAMEWORK

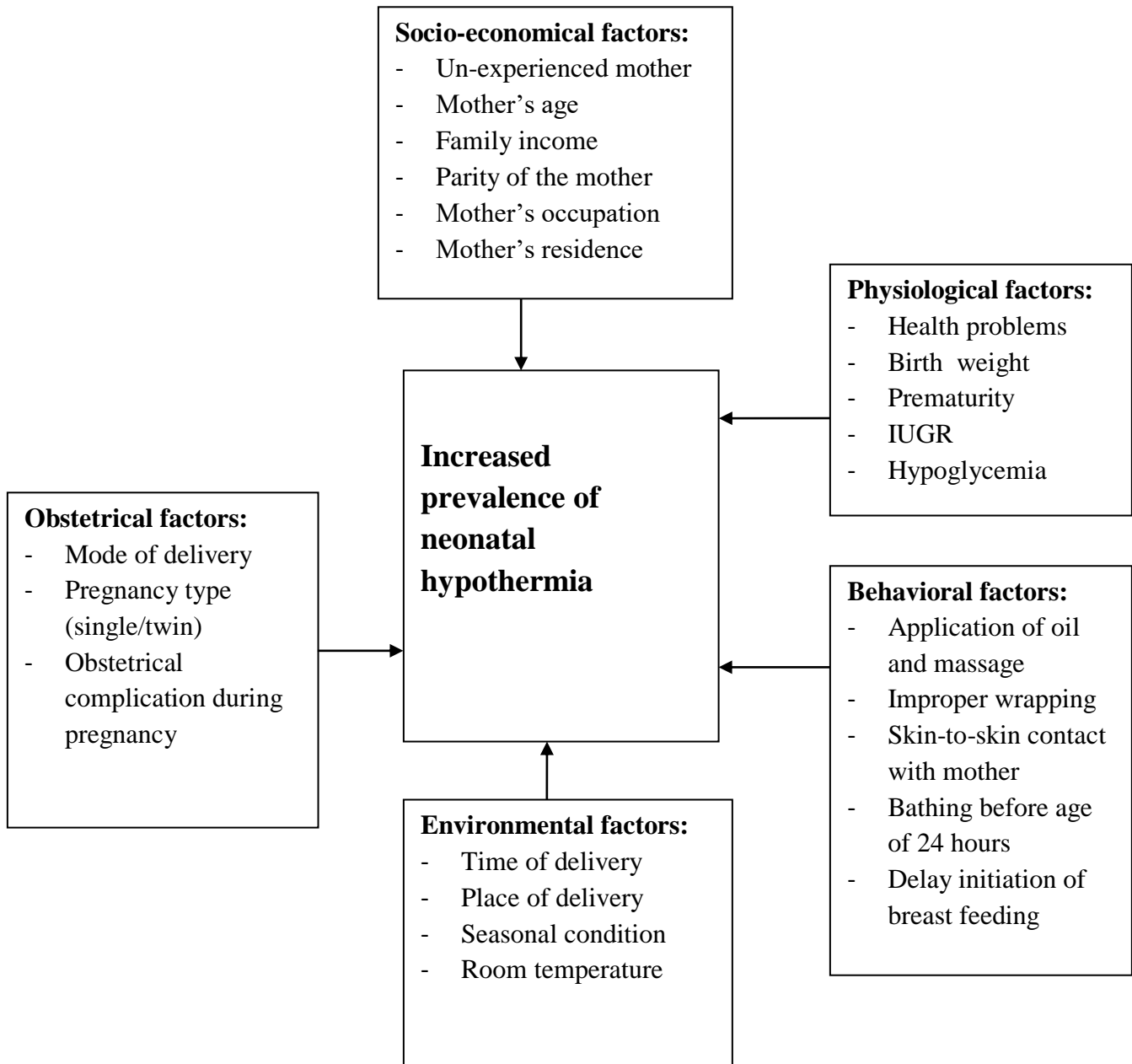


Figure 1: Conceptual framework by Birhanu Wondimeneh from Ethiopia (11)

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter describes the methodology that supported the research process and the analysis used to measure the results. It describes the research's details and organization using the following titles: design, study population, sampling strategy, and sample size, instrument, reliability and validity of the instrument, data collection procedures, and data analysis technique, and ethical considerations that guided the study.

3.2 RESEARCH APPROACH

This research used a non-experimental quantitative approach to determine the prevalence of neonatal hypothermia and associated risk factors among neonates on admission to the neonatology unit at a Referral Hospital in Northern Province, Rwanda. Quantitative methods were used for objective measurements including statistical, mathematical, or numerical methods; and data collection using a questionnaire.

3.3 RESEARCH DESIGN

A cross-sectional design was used to determine the prevalence of neonatal hypothermia and associated risk factors among neonates on admission in neonatology unit at one Referral Hospital in Northern Province, Rwanda.

3.4 RESEARCH SETTING

The study was conducted in Ruhengeri Referral Hospital located in the Northern Province, Musanze District, Muhoza Sector. The Hospital is a public hospital delivering quality services to the general population throughout most of the Northern Province and part of the Western Province. This setting was selected due to its high-altitude location, being the coldest region in Rwanda, and no other study has been done on this topic in this area. A study conducted in Ethiopia(8), reported the geographical area of where the baby is born is an environmental factors affecting neonatal hypothermia.

3.5 STUDY POPULATION

The study population for this study was composed of all neonates admitted to neonatology of Ruhengeri Referral Hospital from 4th October, 2021 to 4th January, 2022.

3.6 SAMPLING

3.6.1 Sampling strategy

A non-probability sampling strategy was used to select neonates who meet the study eligibility criteria. The consecutive sampling method was adopted and included all neonates who were admitted to the neonatology unit during study period and met the inclusion criteria.

3.6.1.1 Inclusion criteria

All neonates admitted to the neonatology unit of Ruhengeri Referral Hospital during the study period were included in the study.

3.6.1.2 Exclusion criteria

The neonates whose mothers or next of kin denied to declined consent or whose mothers were not available to give needed information during the data collection period were excluded.

3.6.2 Sample size

Sample size was calculated using the Cochran formula where $n = \frac{z^2 pq}{e^2}$. Based on a 95% confidence interval and a projected 27% prevalence from the similar study done in Kigali

$$n = \frac{1.96^2 \times 0.27(1 - 0.27)}{0.05^2} = 303$$

n: Desired sample size

z: standard normal deviation which equal to 1.96 for 95% confidence level

e: Desired level of precision which is 0.05

p: Prevalence of previous neonatal hypothermia study done (27%) = 0.27 **q**= 1-p = (1-0.27)

The desired sample was 303 neonates.

3.7 DATA COLLECTION

3.7.1 Data Collection instrument

Data Data were collected using a structured questionnaire, which consists of variables to determine the prevalence and risk factors associated with neonatal hypothermia. The questionnaire was adopted from a recently conducted Master's thesis study with the same objectives conducted by Birhanu Wondimeneh about neonatal hypothermia and associated

factors among newborns admitted to Governmental hospitals in Addis Ababa, Ethiopia, in 2016 (11). The same author also published the study BW Demissie in a BMC Pediatrics publication in 2018.

This data collection tool was also adopted due to a similar study setting and characteristics including seasonal conditions and history.

The questionnaire had two sections:

Section One included the participants’ demographic data which has the following variables: The age of the mother, religion of the mother, residence of the mother, education of the mother, occupation of the mother, ubudehe category of the family and the number of antenatal care contact done by the mother.

Section Two included information about hypothermia and related risk factors which has the following variables: Age of the newborn, sex of the newborn, admission diagnosis, birth weight, duration between taking temperature and bathing the newborn, gestational age, admission temperature, using warm intra-facility transportation, having health problem, putting the newborn on skin-to-skin, breastfeeding the newborn within the first hour, resuscitation of the newborn, having an obstetrical problem for the mother, pregnancy type, method of delivery, place of delivery and place of birth if out of hospital.

Both sections consist of a set of structured questions developed using language that respondents should easily understand. The questionnaire was developed in three languages used in Rwanda, which are Kinyarwanda, French and English to minimize the barriers of communication to the respondents.

3.7.2 Validity and reliability of the instrument

The validity is the extent to which an instrument appears to measure what it aims to measure. This instrument’s validity was tested using face validity. The reliability, the extent to which the instrument yields the consistent results, was tested by the original user as it was adopted from a published article in a peer reviewed journal but also checked in our country context.

Objectives	Research question	Corresponding alternatives
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To determine the prevalence of neonatal hypothermia at Ruhengeri Referral Hospital.	What is the prevalence of neonatal hypothermia at Ruhengeri Referral Hospital?	N ^o 2.07
To identify the risk factors associated with neonatal hypothermia at Ruhengeri Referral Hospital.	What are the factors associated with neonatal hypothermia at Ruhengeri Referral Hospital?	N ^o 2.01 to N ^o 2.6 and 2.08 to 2.20

3.7.3 Data collection procedure

Data collection started after obtaining approval from the Institutional Review Board at CMHS with the reference number CMHS/IRB/181/2021 and from the ethics committee at Ruhengeri Referral Hospital. The researcher met the General Director of the hospital and the manager of neonatology to introduce himself and explain the purpose of the study. All neonates admitted in the study period who met the study inclusion criteria were included in the study.

The researcher approached mothers with newborns in the neonatology unit about being in the study. They were given information about the purpose of the study, confidentiality and anonymity, and that they could withdraw at any time without penalty. If they agreed, they signed consent. Data were collected using a paper questionnaire by the researcher and coded using a study ID, instead of personal identifying information. The researcher collected the data from the neonates' mothers including birth and referral related history; and from neonates themselves, such as temperature and needed neonatal health parameters. The researcher entered the data daily in the Statistical Package for Social Sciences (SPSS) to prevent data loss. Data were collected three days a week (Monday to Wednesday) from 7:00 am to 5:00 pm to coincide with the master's program schedule for a period of three months.

3.8 DATA ANALYSIS

The data were analysed using SPSS (version 25). Descriptive statistics such as frequency tables and percentages were used to summarize data. Logistic regression was used to analyse the relationship between categorical variables and comparison of variables presented using odds ratios considering 95% confidence interval for significance and p-value of 0.05.

3.9 ETHICAL CONSIDERATIONS

The defence of ethical guidelines refers to whether a researcher demonstrates competency, protects the patient from harm, maintains honesty in the management of the resources, acknowledges sources and the input of supporters during the study, and presents an accurate report of the finding. The researcher respected the following ethical protocols: Requested permission to conduct the study from the University of Rwanda/CMHS and the Hospital's Research Committee. To maintain the participants' privacy, the researcher used a study ID to identify data instead of names and addresses. Confidentiality was maintained by protecting participants' identities and declining unauthorized access to the subjects' information or data. The results obtained from the study allowed the researcher to interpret the data, formulate conclusions, and present recommendations.

3.10 DATA MANAGEMENT

All data were collected, quantified, and entered in SPSS version 25 for data analysis and stored on a secured external hard disk, computer and Google drive memory. Maintaining confidentiality, data will be used for the purpose of research and kept for three years and then be destroyed.

3.11 DATA DISSEMINATION

After the research presentation at UR, the researcher will provide a final project report to the study setting to help prepare strategies to prevent neonatal hypothermia in the hospital. A copy of this research project will also be sent to the UR Library. The study results will be published in a peer-review journal to increase accessibility to others locally and internationally.

3.12 CONCLUSION

This chapter described the study's quantitative approach, the nonexperimental cross-sectional design, and the Referral Hospital setting. The sample consisted of neonates admitted to the neonatology unit. The neonates were selected using a convenience sampling method and sample size of 303. Data were collected via a questionnaire that was validated and reliable. Research ethical standards were maintained throughout data collection procedures, including informed consent. Data were entered and analyzed using SPSS, and descriptive and inferential statistics were conducted. Data management and ethical standards were maintained, and research dissemination will be completed as planned.

CHAPTER FOUR: PRESENTATION OF FINDINGS

4.0 INTRODUCTION

This chapter presents the study findings according to the objectives which were (1) To determine the prevalence of neonatal hypothermia at Ruhengeri Referral Hospital and (2) To identify the risk factors associated with neonatal hypothermia at Ruhengeri Referral Hospital. A total of 303 neonates and their mothers were included in the study with a response rate of 100%.

4.1 DISTRIBUTION OF NEONATES AND MOTHERS BY SOCIO-DEMOGRAPHIC CHARACTERISTICS (N=303)

Table 4.1a The respondents (mothers) were classified in to two age-groups, as defined by MINALOC Rwanda, with 233(76.9%) were in 21-55 age-group called mature mothers, and 70(23.1%) in the 16-20 age-group called adolescent mothers. There educational levels showed that the majority, 193(63.7%) had attended primary school, 70(23.1%) attended secondary, 34(11.2%) did not attend any school, and 6(2.0%) attended advanced diploma level. The majority, 243(80.2) were farmers, 29(9.6%) were private employees, 11(3.6%) were public employees, 16(5.3%) were students, and 4(1.3) had no occupation. The majority, 147(48.5%) Catholics, 77(25.4%) Protestants, 69(22.8%) Adventists, 8(2.6%) Muslims, and 2(0.7%) had no religion affiliation. The majority of respondents, 218(71.9%), were from rural area, and 85(28.1%) from urban area. The main Ubudehe category, 167(55.1%) were in category II, 79(26.1%) were in category III, 53(17.5%) were in category I, and 4(1.3%) were in category IV. The majority of respondents, 102(33.7%) attended three ANC visits, 75(24.8%) had four visits, 69(22.8%) attended two visits, 43(14.2%) attended one visit, and 14(4.6%) did not attend any visits.

TABLE 4.1a MATERNAL SOCIODEMOGRAPHIC CHARACTERISTICS (N=303)

Variables	n	(%)
Maternal age group (years)		
16-20	70	(23.1)
21-55	233	(76.9)
Maternal educational level		
No school attended	34	(11.2)
Primary level	193	(63.7)
Secondary level	70	(23.1)
Advanced diploma	6	(2.0)
Maternal occupation		
Public employee	11	(3.6)
Private employee	29	(9.6)
Student	16	(5.3)
Farmer	243	(80.2)
No occupation	4	(1.3)
Maternal religion		
No religion	2	(0.7)
Catholic	147	(48.5)
Protestant	69	(22.8)
Adventist	77	(25.4)
Islam	8	(2.6)
Maternal residence		
Urban	85	(28.1)
Rural	218	(71.9)
Maternal Ubudehe category		
I	53	(17.5)
II	167	(55.1)
III	79	(26.1)
IV	4	(1.3)
ANC visits attended		
0	14	(4.6)

1	43	(14.2)
2	69	(22.8)
3	102	(33.7)
4	75	(24.8)

Table 4.1b. The majority of neonates in the neonatology unit, 162(53.5%), were males, and 141(46.5%) were females. The majority, 170(56.1%) were pre-term and 133(43.9%) were term neonates. The majority of neonates,174(57.4%) were 1 to 7 days of age, 104(34.3%) were less than 1 day, and 25(8.3%) were 8 to 28 days of age.

TABLE 4.1b NEONATAL CHARACTERISTICS (N=303)

Variables	n	(%)
Neonates' gender		
Male	162	53.5
Female	141	46.5
Gestational age		
Preterm	170	56.1
Term	133	43.9
Neonatal days of life		
< 1	104	34.3
1 - 7	174	57.4
8 - 28	25	8.3

4.2 PREVALENCE OF NEONATAL HYPOTHERMIA

The prevalence is a common index which shows how much the disease or condition is in a population at a particular point in time. In this study, the prevalence was 65.3% (N=303) (Figure

1) equal $\frac{198 \times 100}{303} = 65.3\%$

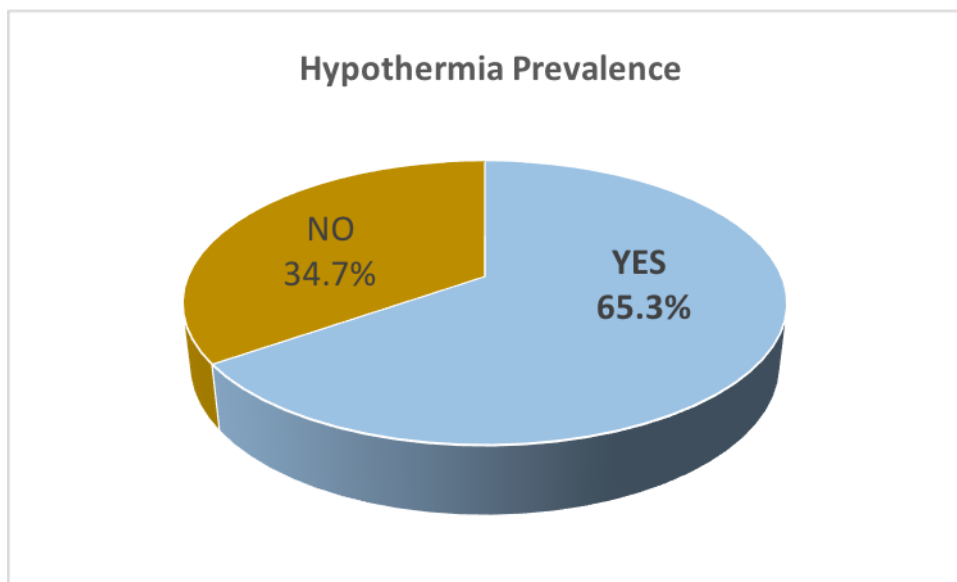


Figure2: Prevalence of neonatal hypothermia

Table 4.2 The majority of births, 124(62.0%) were in-born and (37.4%) were out-born. According to demographic characteristics: Based on age of the mother, it was more prevalent in infants born from adolescent mothers (16-20 years) where it was found to be 97.1% ; based on residence of the mother, it was more prevalent in infant born from mothers from rural area where it was found to be 67.9%; based on education level of mothers, it was more prevalent in infants born from farmers where it was found to be 70.4% and based on antenatal care contact attended by mothers, it was more prevalent among infants born from mothers who didn't attend any antenatal care contact where it was found to be 71.4%.

TABLE 4.2 PREVALENCE OF NEONATAL HYPOTHERMIA (N=303)

Variable	Hypothermia n (%)	
	Yes (n=198)	No (n=105)
Maternal age (years)		
16-20	68 (97.1)	2 (2.9)
21-55	130 (55.8)	103 (44.2)
Maternal residence		
Urban	50 (58.8)	35 (41.2)
Rural	148 (67.9)	70 (32.1)
Maternal education		
No school attended	24 (70.6)	10 (29.4)
Primary level	137 (71.0)	56 (29)
Secondary level	37 (52.9)	23 (47.1)

	Advanced level	0 (0)	6 (100)
	Public employee	4 (36.4)	7 (63.6)
	Private employee	13 (44.8)	16 (55.2)
Maternal occupation			
	Student	10 (62.5)	6 (37.5)
	Farmer	171 (70.4)	72 (29.6)
	Non occupation	0 (0)	4 (100)
ANC contacts			
	None	10 (71.4)	4 (28.6)
	One	30 (69.8)	13 (30.2)
	Two	42 (60.9)	27 (39.1)
	Three	69 (67.6)	33 (32.4)
	Four	47 (62.7)	28 (37.3)
Place of delivery			
	In-hospital	124 (62)	76 (38)
	Health center	54 (72)	21 (28)
	Private clinic	2 (66.7)	1 (33.3)
	Home	17 (70.8)	7 (29.2)
	Ambulance	1 (100)	0 (0)

4.3 RISK FACTORS ASSOCIATED WITH NEONATAL HYPOTHERMIA

Table 4.3. A bivariate analysis was used to determine the factors associated with neonatal hypothermia. Factors found to be associated with neonatal hypothermia included:

Being born from an adolescent mother (16-20 years) increased the risk of neonatal hypothermia 27 times than those born from a mature mother (21-55 years) (OR=26.93, $p<0.001$).

Being born with low birth weight (<2500 gr) increased the which is 10 times increase more likely compared to the neonates with normal birth weight (2500 gr \leq) (OR= 10.35, $p<0.001$).

Birth time was also found to be associated with hypothermia where being born in the night has 6 times increase likelihood of hypothermia compared to those born at daytime (OR= 6.03, $p<0.001$).

Being pre-term also increases the likelihood of hypothermia about 9 times compared to term neonates (OR= 9.47, $p<0.001$).

A neonate with health problems is associated with nearly 7 times increase of neonatal hypothermia compared to those without health problems (OR=6.90, $p<0.001$). The health problems included, congenital malformation, respiratory distress, jaundice, bleeding disorders or lymphoedema.

The neonates who were not breastfed within one hour after birth were found to be nearly 10 times more likely to have neonatal hypothermia compared to those breastfed within one hour after birth (OR= 9.75, p<0.001).

Being born from a mother who had an obstetrical complication during pregnancy, labour or delivery had over 10 times increased hypothermia compared to those who were born from mothers who did not have an obstetrical complication (OR= 10.51, p<0.001). An obstetrical complication was defined as one or more of the following: pre-eclampsia, obstructed labour, prolonged labour, ante-partum hemorrhage, PROM, PPRM, uterine myoma or oligohydramnios.

Multiple births were also found to have nearly 30 times increased likelihood of neonatal hypothermia compared to single birth (OR= 29.75, p<0.001).

There were some variables that were tested using bivariate analysis and found to be not statistically associated with hypothermia in the sample (P-value > 0.05). The variables included neonatal asphyxia, checking temperature after neonates' bath, not using warm intra-facility transportation to neonatology, not placed in SSC immediately after birth, low APGAR score at first minute, and Ubudehe category.

TABLE 4.3 RISK FACTORS ASSOCIATED WITH NEONATAL HYPOTHERMIA (N=303)

Variables	OR	HYPOTHERMIA		P-value
		Yes n(%)	No n(%)	
Maternal age (years)				
10-20	26.93	68(97.1)	2(2.9)	<0.001
21-55		130(55.8)	103(44.2)	
Neonatal asphyxia				
Yes	0.94	80(64.5)	44(35.5)	0.800
No		118(65.5)	61(34.1)	
Birth weight (grams)				
< 2500	10.35	132(88.6)	17(11.4)	<0.001
≥ 2500		66(42.9)	88(57.1)	
Birth time				
Night-time	6.03	140(82.4)	30(17.6)	<0.001
Day time		58(43.6)	75(56.4)	
Temperature to bath time				

Less 60 minutes		5(45.5)	6(54.5)	
60 or more minutes	0.42	193(66.1)	99(33.9)	0.158
Gestational age (weeks)				
< 37		146(85.9)	24(14.1)	
≥ 37	9.47	52(39.1)	81(60.1)	<0.001
Warm intra-facility transportation				
Not used		7(58.3)	5(41.7)	
Used	0.73	191(65.6)	100(34.4)	0.602
Health problems				
Yes		133(84.7)	24(15.3)	
No	6.90	65(44.5)	81(55.5)	<0.001
SSC immediately after birth				
No		102(65.0)	55(35.0)	
Yes	0.96	96(65.8)	50(34.2)	0.886
Breastfed ≤ 1 hour of birth				
No		186(100.0)	0(0.0)	
Yes	9.75	12(10.3)	105(89.7)	<0.001
APGAR at first minute				
Less than 7		57(64.0)	32(36.0)	
7 to 10	0.92	141(65.9)	73(34.1)	0.759
Maternal obstetrical complications				
Yes		104(91.2)	10(8.8)	
No	10.51	94(49.7)	95(50.3)	<0.001
Pregnancy type				
Twin		44(97.8)	1(2.2)	
Singleton	29.71	154(59.7)	104(40.3)	<0.001
Ubudehe category				
Category I&II		147(66.8)	73(33.2)	
Category III&IV	1.26	51(61.4)	32(38.6)	0.381

4.4 CONCLUSION

This chapter has described the demographic information of the respondents related to age, residence, religion, education, occupation, economic status; ANC contacts attended, gender for neonates, gestational age for neonates and their days of life at the time of admission.

The chapter also presented about the prevalence of neonatal hypothermia at Ruhengeri Referral Hospital which comes to 65.3% and it was more prevalent in neonates born from adolescent mothers where it comes to be 97.1%. The chapter again presented about the factors associated with neonatal hypothermia at Ruhengeri Referral Hospital whereby the bivariate analysis, we came to find that neonatal hypothermia is more likely associated with multiple births with thirtyfold increase compared to single births.

CHAPTER FIVE: THE DISCUSSION OF RESULTS

5.0 INTRODUCTION

This chapter presents the main findings of the study and makes comparisons with findings from other studies on the topic hypothermia. The discussion largely relied on the results of the study that were found to provide significant meaning and relevance to the objectives. The relevant literature was also used in making comparison of this study finding and those from other studies and making analysis and conclusions.

5.1 PREVALENCE OF NEONATAL HYPOTHERMIA ON ADMISSION

According to this study finding, the prevalence of neonatal hypothermia at Ruhengeri Referral Hospital was 65.3% on admission to neonatology (95% CI, P-value <0.001). Similar results were found by Yitayew (26) in a study conducted in Northeast Ethiopia that reported a 66.8% hypothermia prevalence rate among newborns admitted to the NICU at the Dessie Referral Hospital, in the Amhara region. In contrast, a study by Ukke (7) in Southwest Ethiopia reported a prevalence rate of 50.3%.

A systematic review and meta-analysis study by Beletew(1) conducted in East Africa about the prevalence of neonatal hypothermia reported a rate of 57.2% which is lower the findings of this study.

The study conducted by Urubuto (10) in Rwanda about the prevalence, risk factors and outcomes of neonatal hypothermia at admission at a tertiary neonatal unit, Kigali has reported a rate of 27%. The possible reason for this difference can be that Ruhengeri Referral Hospital is located in the Northern Province, a region with high altitude (1860 meter above the sea level) and the coldest area in Rwanda which leads to colder outdoors; and also that the study was conducted during the rainy season which could have an effect on the environmental temperature.

5.2 THE RISK FACTORS ASSOCIATED WITH NEONATAL HYPOTHERMIA ON ADMISSION

In this study, the age of the mother was significantly associated with neonatal hypothermia. The odds of neonatal hypothermia were nearly 27 times higher (OR: 26.93; $p < 0.001$) in neonates born from adolescent mother (16-20 years) than in neonates born from mature mothers (21-55 years). Similarly, other studies including a systematic review and meta-analysis in East Africa by

Beletew (1) and Musabyemariya and colleagues in Rwanda(29) reported being a young mother exposed the neonate to the risk of hypothermia. There are many possible reasons for this association. Many young mothers may not attend ANC for fear of stigma, may have poor knowledge about prevention of hypothermia, and lack other experience in caring for a newborn. Furthermore, they will likely be single and no support, which exposes them to lack of help before recovering from postpartum period, not enough energy and resources to care for the neonate and themselves.

Another factor associated with neonatal hypothermia was birth weight, where the odds of neonatal hypothermia were over 10 times (OR: 10.35; $p < 0.001$) higher in LBW neonates than those with a birthweight 2.5 kg or more. Similar findings were found in two other studies including the study by Ukke(7), done in Southwest Ethiopia and a systematic review and meta-analysis study done in East Africa(1). The possible reason for this finding might be due to their thin and permeable skin exposing the newborn to heat loss according to another study conducted in Rwanda(29).

Birth time was the other risk factor significantly associated with neonatal hypothermia found in this study. The odds ratio of neonatal hypothermia for the neonates delivered at night-time was six times (OR: 6.03; $p < 0.001$) more likely to develop hypothermia than neonates delivered at daytime. This finding was similar to a study by Yitayew(26) in the Northeast Ethiopia among newborns admitted to NICU at Dessie Referral Hospital. This might be due to the temperature difference at night and daytime, and also less surveillance and observation of the neonate at night.

Gestational age was also significantly associated with neonatal hypothermia. The odd of neonatal hypothermia was more than nine times (OR: 9.47; $p < 0.001$) higher in preterm than term neonates. The possible reason for this finding might be that preterm neonates have a large surface area to body mass, minimal subcutaneous fat stores and limited capacity to generate heat from fat stores. This finding is in line with other studies conducted in Northeast Ethiopia(26), Rwanda(10), and the systematic review and meta-analysis East Africa(1).

Other factors associated with neonatal hypothermia include having a health problem. A neonate with a health problem is almost seven times (OR: 6.90; $p < 0.001$) more likely to have neonatal

hypothermia than a neonate without a health problem. This was also found in the systematic review and meta-analysis in East Africa(1). This might be possibly the reason that a neonate with health problems is sometimes unable to be fed, which increases the risk of hypoglycemia that may lead to hypothermia; and also the capacity to maintain body temperature may be related to the type of neonatal health problem as in a Rwandan study(29).

Another variable that showed significant association in this study was being breastfed within one hour after birth. The odds of hypothermia were nearly 10 times (OR: 9.75; $p < 0.001$) more likely in neonates who did not breastfeed within one hour than those who did breastfeed within one hour of life. This finding is similar to the study done by Ukke (7) in Southwest Ethiopia. This might be the reason that breastfeeding increases the glycaemia to maintain the body temperature. So those who are not breastfed lack the glycaemia needed to produce heat energy and lead to hypothermia(29). Furthermore, mother's body heat, particularly after labor, helps warm up the neonate and increases their likelihood of thermoregulation, according to Nyandiko in Kenya(9).

The other risk factor associated neonatal hypothermia is being born from mothers who have obstetrical complications during pregnancy, labour or delivery. According to this study, those neonates were more than 10 times (OR: 10.5; $p < 0.001$) more likely of having hypothermia compared to those from mothers who do not have obstetrical complications. This finding was similar to the study conducted by Ukke (7) in Southwestern Ethiopian study showing obstetrical complications in pregnancy or labor. This might be the reason that women who developed obstetrical complications are more likely to need special management such as caesarean section or instrumental delivery (vacuum or forceps) or the mother might be too sick to be in close contact with their infant in order to prevent hypothermia. Additionally, some obstetrical complications like PROM might have resulted in neonatal sepsis where fall in body temperature is one of its clinical features Ukke (7).

The last risk factor found in this study associated with neonatal hypothermia was multiple births. The odd of having hypothermia was nearly 30 times (OR: 29.71; $p < 0.001$) higher being born in multiple births than those born a singleton. A similar finding by Beletew (1) reported in a systematic review and meta-analysis in East Africa. This might be a reason that multiple

pregnancy is at risk of preterm labour which leads to preterm delivery and expose the newborns at risk of hypothermia as premature babies can have health challenges. The other reason might be that mothers with multiple pregnancies are at high risk of different obstetrical problems like preeclampsia, gestational diabetes, placental problems and fetal growth problems; all these expose newborns from multiple births at high risk of neonatal hypothermia. In addition, mothers with multiple births may not be able to do SSC as frequently so the newborns do not benefit from mother's heat and related thermoregulation.

5.3 LIMITATION OF THE STUDY

A limitation is that the study was only conducted at one hospital, and not multiple health facilities including private hospitals and other public health facilities that cover different areas of Northern Province. Also, it did not incorporate qualitative methods to address cultural and behavioral factors that may affect neonatal hypothermia. Also, a randomization method was not used as data collection time was limited and even though a consecutive sample method was used, the sample is relatively small. Another limitation or bias was that this study was conducted in the rainy season when temperatures are typically colder.

5.4 CONCLUSION

This chapter discussed about the findings of this study which was about the prevalence of neonatal hypothermia and associated risk factors at Ruhengeri Referral Hospital. The study found that the prevalence of neonatal hypothermia at Ruhengeri Referral Hospital is high. The studies also found that the risk factors associated to this hypothermia are being born from young mothers, low birth weight, night-time delivery, having health problems, not being breastfed within the first hour of life, being born from a mother who had obstetrical complication and multiple births.

CHAPTER SIX: CONCLUSION AND RECOMMENDATION

6.1 RECOMMENDATION

➤ To Ruhengeri Referral Hospital staff and researcher

To adhere strictly to the WHO and MOH recommendations for thermal care in newborns, especially those at risk of neonatal hypothermia. To set measures for parent education about prevention of neonatal hypothermia and make follow-up of its implementation. The researcher will present the findings to staff and the administration.

➤ To Academic healthcare institutions

Lecturers need to emphasize the importance on maintaining thermal care with all newborns, but particularly those at higher risk. Nurses and midwives should be encouraged to do interventional pretest/posttest studies at multiple hospitals in increase healthcare providers knowledge and skills and prevent hypothermia from happening in their facilities.

➤ To the researchers

Make more quantitative and qualitative researches about risk factors of neonatal hypothermia and its prevention in different areas of the country taking into account the variability of seasons.

➤ To Ministry of Health

To update guidelines for prevention of neonatal hypothermia by addressing all risks and set parents guidelines for prevention of neonatal hypothermia which will help in increasing parents' knowledge in prevention of neonatal hypothermia.

6.2 CONCLUSION

The prevalence of hypothermia in this study was high at 65.3%. Born from young mothers, prematurity, not breastfed within 1 hour of delivery, neonatal health problems, LBW, night-time delivery, and multiple births were significant risk factors associated with neonatal hypothermia. Therefore, health care providers should pay special attention to thermal care of neonates at risk, in colder regions such as Northern Province, and neonates throughout Rwanda.

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ANNEXES

I. DATA COLLECTION TOOL

A questionnaire developed to collect information about the prevalence and risk factors of neonatal hypothermia at Ruhengeri Referral Hospital.

General instruction

The data collector should tick in the box corresponding to the best alternative among the alternatives proposed to complete this questionnaire.

If there is another alternative that should be the best among the alternatives listed for the section but not listed, the data collector should tick in the box named **other** and write below the box that alternative in the full words.

SECTION 1: Maternal Socio-demographic information

N ^o	Variables	Alternatives
1.1	Age of mother in years	a. [10-20[b. [20-30[c. [30-40[d. [40-50[
1.2	Religion of mother	a. Catholic b. Muslim c. Protestant d. Other
1.3	Residence of mother	a. Urban b. Rural
1.4	Education of mother	a. No school attended b. Primary c. Secondary d. Advanced diploma e. Bachelor f. Master and above
1.5	Occupation of mother	a. House wife b. Government employee c. Private/Own business employee d. Student e. Farmer f. Other

1.6	Ubudehe category of family	a. Category I b. Category II c. Category IV d. Category V
1.7	Did a mother have antenatal care visit?	a. Yes b. No If yes, how many times?

SECTION 2: Hypothermia and related risk factors

Nº	Variables	Alternatives
2.01	Age of the newborn	a. 24hrs≤ b.]24hrs-7days] c.]7days-14days] d.]14days-21days] e.]21days-28days]
2.02	Sex of the newborn	a. Male b. Female
2.03	Admission diagnosis
2.04	Birth weight
2.05	Time of birth	a. Day time (6:00 am-18:00 pm) b. Night time (18:01 pm-5:59 am)
2.06	Duration between the time the temperature was taken and bathing a neonate	a. 30 minutes b. 60 minutes c. >60 minutes
2.07	Room temperature	a. 8:00 am b. 10:00 am c. 12:00 pm d. 3:00 pm

		e. 5:00 pm
2.08	Gestational age (GA)
2.09	Admission temperature (Axillary)
2.10	Warm intra-facility transportation was used? (if he is from the other facility)	a. Yes b. No
2.11	Did a baby have a health problem (congenital malformation, asphyxia, jaundice, respiratory distress, bleeding disorders or meconium aspiration)?	a. Yes b. No If yes, which one?
2.12	Skin-to-skin contact immediately after birth	a. Yes b. No
2.13	Breastfed within one hour after birth	a. Yes b. No
2.14	Resuscitated immediately after birth	c. Yes d. No
2.15	APGAR score at birth	a. Between 7-10 b. ≤ 7
2.16	Did a mother have maternal obstetrical complication during pregnancy or labor and delivery (Preeclampsia, eclampsia, diabetes, obstructed/prolonged labor, APH, PROM or PPRM, sepsis, PPH, etc)?	a. Yes b. No If yes, specify?
2.17	Pregnancy type	a. Single b. Twine c. Triple d. Quadruple
2.18	Method of delivery	a. Spontaneous vaginal delivery b. Instrumental c. Cesarean section
2.19	Place of delivery	a. In-hospital b. Out of hospital facility
2.20	Place of birth if out of hospital	a. Another hospital b. Health center c. Health post d. Private health facility e. In ambulance f. Home

II. CONSENT FORM

Introduction

The study seeks to find out the prevalence of neonatal hypothermia and associated risk factors at a Referral Hospital in Northern Province, Rwanda.

Purpose of the Study

This study aims to determine the prevalence of neonatal hypothermia and associated risk factors in the neonatology unit a hospital in the Northern Province.

Voluntary Participation

Your participation in this research is entirely voluntary. It is your choice whether to participate or not. All the services you and your baby receive in this context of care will continue, and nothing will change. If you choose not to participate in this research project, you may withdraw at any time without risk of penalty

Confidentiality

The information that we collect from this research project will be kept confidential. Information about you and your baby that will be collected during the research will be put away and none except the researchers will be able to see it. Any information about you and your baby will have a number on it instead of your names. Only the researchers will know what your number is and we will lock that information up with a lock and key. It will not be shared with or given to anyone except who will have access to the information

The knowledge that we get from doing this research will be shared with Ruhengeri Hospital staff in order to improve the way they manage hypothermia among neonates. Confidential information will not be shared.

If you have any questions, you may ask them now or later, even after the study has started. If you wish to ask questions later, you may contact any time on: 0785397739/0731516990.

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it, and any questions that I have asked to, have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Name of Participant _____

Signature of Participant _____

Date _____ Witness _____

III. ETHICAL CLEARANCE



UNIVERSITY of
RWANDA

COLLEGE OF MEDICINE AND HEALTH SCIENCES
DIRECTORATE OF RESEARCH & INNOVATION

CMHS INSTITUTIONAL REVIEW BOARD (IRB)

Kigali, 9th/6/2021

Ref: CMHS/IRB/181/2021

MUGAMBINUMWE Didace
School of Nursing and midwifery, CMHS, UR

Dear **MUGAMBINUMWE Didace**

RE: ETHICAL CLEARANCE

Reference is made to your application for ethical clearance for the study entitled "*Prevalence of Neonatal Hypothermia and Associated Risk Factors at a Provincial Hospital in Northern Province, Rwanda*".

Having reviewed your application and been satisfied with your protocol, your study is hereby granted ethical clearance. The ethical clearance is valid for one year starting from the date it is issued and shall be renewed on request. You will be required to submit the progress report and any major changes made in the proposal during the implementation stage. In addition, at the end, the IRB shall need to be given the final report of your study.

We wish you success in this important study.


Dr Stefan JANSEN
Ag Chairperson Institutional Review Board,
College of Medicine and Health Sciences, UR



Cc:

- Principal, College of Medicine and Health Sciences, UR
- University Director of Research and Postgraduate studies, UR

Email: researchcenter@ur.ac.rw

P.O Box 3286 Kigali, Rwanda

www.ur.ac.rw

IV. ETHICAL COMMITTEE APPROVAL FROM RUHENGERI

<p>REPUBLIC OF RWANDA</p>  <p>MINISTRY OF HEALTH</p>	<p>RUHENGERI REFERRAL HOSPITAL NR 4, RD 45 Po. Box: 57, MUSANZE Ruhengeri.Hospital@moh.gov.rw</p>	<p>Client centered Service Integrity Teamwork Innovation</p>
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Musanze, 04 OCT 2021

Ref. 832.../RRH/DG/2021

MUGAMBINUMWE Didace
University of Rwanda
Tel: 0785397739

Re: Your request for Data Collection

Dear Elyse,

We acknowledge receipt of your letter dated on 16th June, 2021 requesting for permission to collect data for the research project entitled "*Prevalence of Neonatal Hypothermia and associated risk factors at a provincial Hospital in Northern Province, Rwanda*".

We have the pleasure to inform you that you are allowed to conduct the above mentioned project research. However you are obliged to have all the required equipments for use.

Best regards,


Dr MUHIRE Philbert
Director General of Ruhengeri Referral Hospital



Cc:

-Chair of ethic committee

V. DECLARATION

THE FORM FOR SUBMISSION OF THE DISSERTATION

UR-COLLEGE OF MEDICINE AND HEALTH SCIENCES, P.O.BOX 3286 KIGALI DECLARATION AND AUTHORITY TO SUBMIT THE DISSERTATION

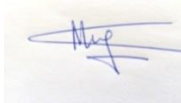
Surname and First Name of the Student: Didace MUGAMBINUMWE

Title of the project: **PREVALENCE OF NEONATAL HYPOTHERMIA AND ASSOCIATED RISK FACTORS AT A REFERRAL HOSPITAL IN NORTHERN PROVINCE, RWANDA**

a. Declaration by the Student

I do hereby declare that this *dissertation* submitted in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE** in **NURSING**, at the University of Rwanda/College of Medicine and Health Sciences, is my original work and has not previously been submitted elsewhere. Also, I do declare that a complete list of references is provided indicating all the sources of information quoted or cited.

Date and Signature of the Student: **15/04/2022**



b. Authority to Submit the dissertation

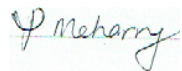
Surname and First Name of the Supervisor

MEHARRY, Pamela

In my capacity as a Supervisor, I do hereby authorize the student to submit his **dissertation**.

Date and Signature of the Supervisor/Co-Supervisor

11 September 2022



VI. PERMISSION TO USE AND ADAPT INSTRUMENT

Compose

Inbox 23

Starred

Snoozed

Sent

Drafts

More

Labels +

← → 1 of 1

Asking permission to adapt questionnaire **Inbox**

Didace MUGAMBINUMWE <mdidasafi2@gmail.com>
to birhanuwondimeneh, mr.hearta, Yefaste2005, felekeh86

Oct 19, 2020, 5:11 PM

Dear Sir,
My name is Didace MUGAMBINUMWE, a master student in the University of Rwanda, track of neonatology. I wish to do my thesis on the topic called: Assessment of factors associated with neonatal hypothermia and its prevention in Rwandan hospitals. I am interested in adapting your questionnaire used in the research topic called: Neonatal hypothermia and associated factors among neonates admitted to neonatal intensive care unit of public hospitals in Addis Ababa, Ethiopiaand, so that I can use it in my study.
I am asking your permission to use your questionnaire in my study. If you allow me give me it in full.
Thanks!

Birhanu Wondimeneh <birhanuwondimeneh@gmail.com>
to me

Oct 21, 2020, 12:43 AM

Greetings!
Thank you for your Permission request and you can access the full version of the questionnaire from Addis ababa university page, with the following link address.
<http://std.aau.edu.et/bitstream/handle/123456789/5803/Birhanu%20Wondimeneh.pdf?sequence=1&isAllowed=y>
with regards!

Birhanu Wondimeneh Demisse
Assistant professor of Pediatrics Health Nursing
Head, Department of Pediatrics and Neonatal Nursing
College of Medicine and Health Science
Wolaita Sodo University,Ethiopia