EARLY OUTCOMES AND ASSOCIATED FACTORS IN NEONATES WITH EXTREMELY LOW BIRTH WEIGHT AT SELECTED REFERRAL HOSPITALS IN KIGALI, RWANDA

BY

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A dissertation submitted in partial fulfillment of the requirements for the degree of Master in Nursing (Neonatology) in College of Medicine and Health Sciences, School of Nursing and Midwifery.

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DECLARATION

I, Mechtilde Bankundiye, a Masters student in Nursing (Neonatology), hereby declare that the work entitled "Early outcome in neonate with extremely low birth weight at selected referral hospital in Kigali Rwanda' from January 2020 to December 2020 is my original work. I was not have copied from any other students' work or any other sources except where due to references, acknowledgement was made explicit in the text, nor has any part been written for me by other person.

I declare that this Dissertation contains my own work except where specifically acknowledged.

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ABSTRACT

Background:

The prematurity, is the leading cause of childhood death and a global health challenge. Globally, 15 million babies are born prematurely every year. **Purpose**: To assess the early outcomes and associated factors of ELBW neonates at selected referral hospitals in Kigali/ Rwanda. **Methods**: A retrospective and descriptive cross-sectional design with quantitative approach was used. The study population included 108 ELBW neonates admitted in three referral hospitals in Kigali during the year 2020. A checklist was utilized to gather data and the statistical packages for STATA-12 was computed to analyze collected data. Analysis was descriptive statistics and Inferential statistics like, Chi-square test. Significance level of <.05 was considered as statistically significant. **Findings:** Findings from the present study showed that the proportion of ELBW neonate was 2.08%. Survivor and death of ELBW neonate were related to gestational age, birth weight and APGAR score. Death was found to be at 47.2% of all ELLBW neonates within 20 days, while 52.8% survived within 28 days. Surviving days were minimum 10 and 28 maximum). The minimum birth weight was 500grs and 1000grs for maximum with average of 881.32grs. The most mothers associated factors was malaria (10.1%), preeclampsia (38.8%) and, alcohol consumable (33.3%). The most major morbidity was infection (70.3%) and RDS (69.4%). Surviving was associated with receiving CPAP and being on ventilator machine ($p<0.05$). **Conclusion:** The present study findings revealed that ELBW proportion was high, survival rate was low, death rate was high and there were high morbidities in ELBW neonates. The more birth weight was low the less chance of surviving was. Also, advanced gestational age, receiving CPAP, being treated under ventilator machine were associated with survivor chance within 28 days. **Recommendation:** There should be innovative strategies in place such as availability of ventilator machine in all District and referral hospitals and conducting many researches on ELBW neonates' outcomes and related factors would help to reduce morbidity and mortality in ELBW neonates.

Key words: Early outcome, neonates, extremely low birth weight, referral hospital

ACRONYMS

ELBW	Extremely Low Birth Weight
HIE	Hypoxic Ischemic Encephalopathy
ICU	Intensive Care Unit
IMR	Infant Mortality Rate
IVH	Intraventricular Hemorrhage
LIMC	Low Income and Middle Country
NEC	Necrotizing Enterocolitis
NICU	Neonatal Intensive Care Unit
NMR	Neonatal Mortality Rate
RDS	Respiratory Distress Syndrome
VLBW	Very Low Birth Weight
SSA	Sub-Sahara Africa
PDA	Patent Ductus Arteriosus
DIC	Dissemination, Intra ventricular Coagulation
KFH	King Faisal Hospital Kigali
CHUK	Centre Hospitalier Universitaire de Kigali
RMH	Rwanda Military Hospital

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CHAPTER ONE
INTRODUCTION

1.1. BACKGROUND

Neonatal ELBW is neonate having a birth weight of less than 1000 grams(1). On worldwide, 2.4 million children died in the first month of life in 2019. Neonatal mortality was highest in sub-Saharan Africa and South Asia, with the neonatal death rate was ranging between 27 and 25 deaths per 1,000 live births in 2019 (2). The ELBW comprise a unique subclass of the population of low birthweight babies with weight < 2500 grams are at high risk of morbidity(3). While ELBW neonates account for only about 1% of all live births, combined with other VLBW, they contribute to 90% of all neonatal and infant mortality (4). It is suggested that newborn at a healthy weight are more likely to survive and thrive – while the 20.5 million newborn at low birthweight enter the world at a marked disadvantage. This report indicates that nearly 15 per cent of all infants worldwide are born with low birthweight, jeopardizing their survival, health and development. Ninety-five percent (95%) are born in less developed countries.

Neonates designated as ELBW, as well as prematurity in general, continues to be a global health challenge. The designation of ELBW is argued to be an important indicator of a newborn health status and a principal aspect that determines newborn survival and the child's future physical and mental development (5)(6). The outcome of ELBW neonates has improved markedly over the past decade. This achievement is primarily related to improved neonatal health care, and the availability of antenatal steroids, synthetic pulmonary surfactants, and the setting up for intensive care units with appropriate equipment (ICUs) (7)(6)(8). However, the surviving of the ELBW neonates in developing countries, such as Sub-Sahara Africa (SSA) public hospitals, is still low (1).

Neonates are vulnerable subgroup that is predisposed to a higher rate of morbidity and which lead long-term survival if anticipated and timely managed. Ensuring the survival of ELBW neonates requires level III neonatal intensive care units (NICU Despite the fact that there has been a significant improvement, in ELBW newborn survival in developed nations, ELBW neonates' survival in developing countries remains suboptimal.

This situation is mainly linked to the limited required skilled staff, infrastructures, and perinatal units equipped with high-technology. In addition, the morbidity rate of ELBW

neonates in low income countries is higher comparing the morbidity rate of ELBW in high income countries (9–13).

The same regions of the world that bear the most significant burden of preterm births are the least able to afford it. In the U.S. alone, the financial impact of preterm births (especially ELBW), measured in terms of medical and educational expenditure and lost productivity, was estimated at $26.2 billion in 2005(14). In developed countries, such as the U.S., the neonatal death rate and the mortality rate in infants decreased from 1988-2005. However, since the time ELBW neonates under <500g were considered viable in 2005, there has been no significant decrease in developed country in regards of mortality rate amongst neonates.

In a 2007-2015 study undertaken in 11 developed countries, morbidity in ELBW neonates decreased (except for neonates with bronchopulmonary dysplasia [BPD]) due to advances in neonatal treatment technologies. Ten of the 11 developed countries in the study showed a decrease in ELBW NMR, and one was static. The Vermont Oxford Network reported a similar decreased NMR for ELBW neonates in developed countries from 13.7% in 2007 to 10.9% in 2014 (10).

In the developing world, this group of ELBW neonates is still regarded as non-viable; therefore, their mortality is not recorded and contributes to decreasing NMR in high income countries (15,16). In South Africa, the rates of perinatal mortality and underweighted newborn during birth were previously reported for neonates weighing 1000 g at birth. This situation is because underweighted neonates are frequently considered as miscarriages, the reason why are not reported. However, with measures taken to improve maternal and neonatal health care, more ELBW neonates are expected to survive. Recent data in South Africa showed that these ELBW neonates die due to complications that could have been anticipated and managed earlier (17,18).

In Sub Sahara Africa, the rate in NMR was decreased compared to IMR. It is suggested that more than 50% of all births in SSA occur outside in health care facilities (19,20). In 2012, a meta-analysis study conducted in four district projects within East Africa (E.A.) revealed that 52% of all neonatal deaths in Eastern region of Africa (Kenya, Uganda, and Tanzania) were associated with the preterm births. ELBW and VLBW neonates constituted 99% of these neonatal deaths, either directly or as a result of later complications(19).

Many neonatal and infant mortality studies in SSA revealed that low birth weight (<2500 g [LBW]) neonates lead to neonatal deaths. While the LBW and ELBW are primarily leading causes of most neonatal deaths, several studies revealed other leading causes, such as birth asphyxia, infections, and preterm birth (20).

In Rwanda, as in many developing countries, data paucity for records in health facilities (hospital registries) makes it problematic to identify the prevalence of ELBW neonates and related mortality causes or outcomes (21). Between 2010-2015, studies showed that 6 percent of neonates in Rwanda were LBW, with neonates born in the countryside more likely to be ELBW neonates.

The neonatal death and complication rates for ELBW neonates were higher for the less wealthy, less educated, and rural parents(21). Another study conducted at the University Teaching Hospital-Kigali (CHUK) in Rwanda found that 63.7% of neonates born with ELBW died. However, it did not report early or late complications that lead to those deaths (22–24).

1.2. PROBLEM STATEMENT

Neonates designated as ELBW, as well as prematurity in general, continues to be a global health challenge. Two million and four hundred children died in the first month of life in 2019 in the worldwide. ELBW is smaller neonates are often regarded as miscarriages, thus not recorded.

The existing research conducted in Rwanda placed the emphasis on neonatal mortality while little was found about published studies on outcome of ELBW neonates within 28 days of life. Thus, there is paucity of underreporting for ELBW neonates that make poor understanding of their actual outcomes.

Although neonatal ELBW exists in Rwanda, there is scarcity of data related to outcome and related factors. The researchers have realized a poor perception and limited knowledge regarding early outcome and related factors in neonate with ELBW. In addition, slight is available, regarding maternal and neonatal related factors associated with neonatal ELBW. However, in others countries study have been done to show the magnitude of the problem.

A study conducted in India found that neonates' survival rate at or below 1000g was 25%. Various studies have shown that the ELBW neonate has the highest neonatal mortality rate, as it is associated with numerous morbidities.

Therefore, this study was assessed in- hospital early outcome and related factors of ELBW neonate at three referral hospitals in Kigali. This study was provided the accurate data at the study settings which can be the basis in answering the problem as well as taking measures of increasing antenatal care, prevention of maternal and neonatal related factors associated to ELBW, and measures of advanced neonatal care in setting area like using CPAP and Ventilator machine. These referral hospitals were selected because they have specialized neonatal units and many ELBW neonates.

1.3. RESEARCH, OBJECTIVE AND QUESTIONS

1.3.1. General objective

Aim of the present study is the assessment of early outcomes and related factors in neonates with ELBW at three selected referral hospitals in Kigali.

1.3.2. Specific Objectives

The objectives for the present study are to:

1. estimate the proportion of ELBW neonates hospitalized in selected referral hospitals in Kigali (Neonatology and NICU).
2. identify the outcome of ELBW neonates hospitalized in selected referral hospitals in Kigali (Neonatology and NICU).
3. determine the maternal related factors associated with ELBW neonates hospitalized in selected referral hospitals in Kigali (Neonatology and NICU).
4. identify the neonatal related factors associated with ELBW neonates hospitalized in selected referral hospitals in Kigali (Neonatology and NICU).
5. determine the institution related factors associated with ELBW neonates hospitalized in selected referral hospitals in Kigali (Neonatology and NICU).

1.3.2. Research questions

1. What is the proportion of ELBW neonates hospitalized in selected referral hospitals in Kigali (Neonatology and NICU)?
2. What is the outcome of ELBW neonates hospitalized in selected referral hospitals in Kigali (Neonatology and NICU)?
3. What are the maternal related risk factors related to ELBW neonates hospitalized in selected referral hospitals in Kigali (Neonatology and NICU).
4. What are the institution related factors with ELBW neonates hospitalized in selected referral hospitals in Kigali (Neonatology and NICU)?
5. What are the neonatal related factors associated with ELBW neonates hospitalized in selected referral hospitals in Kigali (Neonatology and NICU)?

1.4. RESEARCH SIGNIFICANCE

Education

Findings of the present study serve as a reference in teaching medical and nursing students about the improved care of the ELBW neonates, which ultimately save lives and minimize morbidities. It also helps usher in a new era in ELBW neonatal care, not only in Rwanda but also in other developing countries.

Profession

The data resulting from this study could help health care professionals better understand the factors associated with ELBW morbidities and mortality. It could support the development of improved ELBW treatment guidelines. Furthermore, it will be used to counsel parents of ELBW neonates in Rwanda and other developing countries.

Policymakers

Once published, findings from this study could provide policymakers with data on common ELBW co-morbidity and complications to enable evidence-based clinical decisions-making. It can also serve to direct medical equipment purchasing decisions, helping save ELBW neonates' lives.

Research

Data from this study could be used as primary source by other health care researchers in their empirical and theoretical chapters. It will also serve as baseline research data in Rwanda regarding the outcome of ELBW neonates

1.5.DEFINITION OF TERMS

Birth weight (B.W.):

The weight at birth is the bodyweight of a neonate at birth.

Extremely low birth weight (ELBW):

Extremely low birth weight is a term used to describe neonates having the weight during that is below 1000 g.

Neonate:

Newborn infant within 28 days of birth.

Neonatal period:

From day of birth to day 28.

Early outcomes:

These are the results of the treatment of neonates within the first month after birth.

Necrotizing enterocolitis (NEC):

This is very common and serious intestinal condition in neonates born before term. This occurs in the small or large intestine tissue which is injured or inflamed then becomes necrotized.

Intraventricular hemorrhage (IVH):

It is the bleeding inside or around the ventricles in the brain. The IVH is commonly occurring in babies with prematurity. They are four levels of the IVH, based on the quantity or the amount of the bleeding.

CHAPTER TWO

LITERATURE REVIEW

2.1. INTRODUCTION

A literature review involves a body of research relevant to the research question. It shows what the researchers revealed about the study topic and recommends further studies to respond to questions that are not addressed (25). This chapter includes a review of theoretical literature and empirical literature, and the conceptual framework.

2.2. THEORETICAL LITERATURE

2.2.1. Literature search history

A literature search was undertaken using the search terms in Appendix 1. This revealed more than 4000 results; therefore, the "most relevant" filter was used to identify papers related to the study objectives.

Neonatal mortality in Rwanda is high, especially in ELBW neonates. Also, there is a low - nurse –to- patient ratio. Therefore, identifying the risk factors and indicators of short and long-term poor outcomes will possibly lower the number of ELBW at birth and the poor outcome. The aim of the study is to assess the proportion, morbidities, maternal related factors and early outcomes of ELBW neonates while hospitalized during the first 28 days at selected referral hospitals in Kigali.

2.2.2. Theoretical Literature

Extremely low birth weight (<1000kg) has influenced the neonatal outcome, where it reflects the image of the standard of neonatal care within each country(26,27). In a study conducted in South Africa, birth weight (B.W.) and gestational age (G.A.) were the furthermost important predictors of neonatal survival ($p<0.001$). Finding is sound documented in the literature in studies performed in both high and low income countries (14)(17,18)(22)(24)).

Various studies have shown that the ELBW neonate has the highest neonatal mortality rate, as it is associated with numerous morbidities (19,20)(24)(26). This understanding in contrast

to a significant study that was conducted in China tracking the rate of survival and morbidity of ELBW infants over six years (5).

The study found that infection was a main contributor to deaths, responsible for 41% of mortality rate. This study also showed that Hypothermia and death have been linked. . The association has been well documented previously (17)(28).

Another study conducted in India found that neonates' survival rate at or below 1000g was 25%. At 25–26 weeks of pregnancy, only one-third of infants survived. It increasing to >60% more than 80% at 27 and 28 weeks, and more than 80% after 28 weeks. Similarly, weight-specific survival increased from 14.3% at 500 g to over 90% in the 900–999g weight band. There are no important morbidities (severe BPD, NEC stage III, IVH grade III, or more) in ELBW neonates, the survival to discharge was less than 10% (29,30).

2.2.3. Conceptual framework

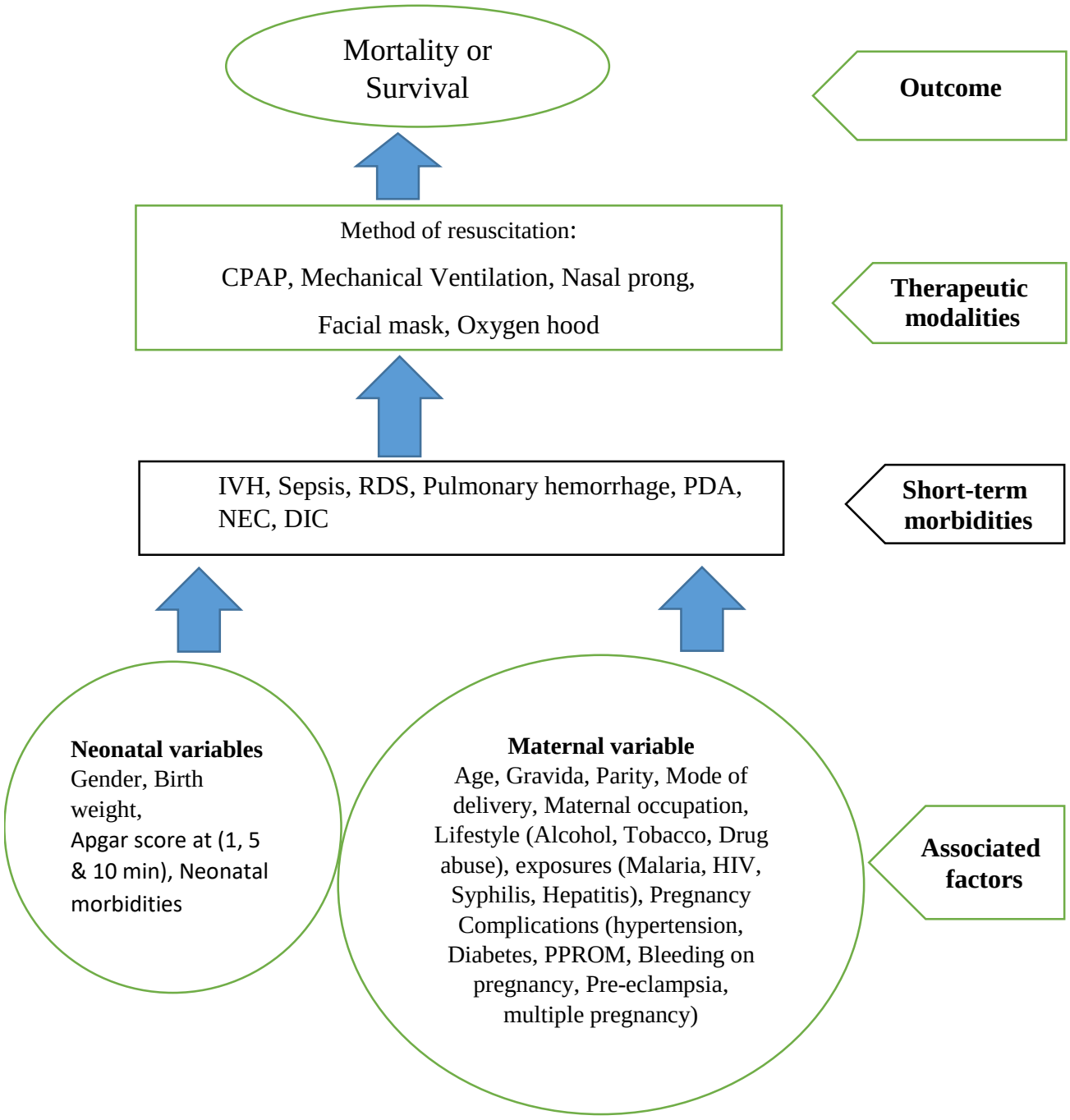


Figure 1*:* Conceptual framework supporting the study

This study's conceptual framework (Figure1) has been adapted from and compared to the UNICEF Conceptual framework for maternal and neonatal mortality and morbidity. (31).

This study is designed to evaluate the outcome, the morbidities, and predictors of death in ELBW neonates. The following information was collected on ELBW neonates in this study:

- Demographic variables of the mother (age, parity, gestational age, associated medical conditions, antenatal steroids, and obstetric details mode of delivery);
- Demographic variables of neonates (gender, birth weight, and method of resuscitation, Apgar score at 1 and 5 min);
- Immediate morbidities (intraventricular hemorrhage [IVH], respiratory distress syndrome [RDS], pulmonary hemorrhage, patent ductus arteriosus [PDA], necrotizing enterocolitis [NEC], and sepsis);
- Therapeutic modalities such as ventilation, surfactant replacement, blood product transfusion, steroids, and antibiotics are used for sepsis and treatment of different neonatal conditions during a hospital stay.

2.3. EMPIRICAL LITERATURE

2.3.1. Morbidities in ELBW

A study performed in the Sergipe state of Brazil found the following major morbidities in ELBW neonates: in breathing pattern 99.4% existing hyaline membrane disease; in the circulatory system 39.4% had patent ductus arteriosus; and with nervous system morbidities, intracranial hemorrhage had a incidence of 17.1%; sepsis with 32.3%; from estimated metabolic diseases, hypoglycemia, hypothermia, and jaundice were present at a incidence of 52.9%, 47.8%, and 44.1%, respectively (27).

2.3.2. Major causes of death in ELBW

In a study conducted in South Korea, the primary cause of death in ELBW neonates was the most common infection (50%), followed by RDS/BPD (22%), congenital defects (13.5%), IVH of grade 3 or 4, and NEC with its complications.

Immaturity and birth asphyxia were considered as secondary causes of death(32). A study carried out in Eritrea revealed that the major causes of admission of ELBW neonates, in addition to their low birth weight, infection (35.5%), RDS (15.4%), and perinatal asphyxia (10%). The major causes of death were RDS (48.1%), with ELBW (40.9%) and VLBW

(30.5%). Congenital abnormalities were expressively associated with ELBW neonatal death (33).

2.3.3. Maternal related factors associated to ELBW neonates

Maternal condition is one of the determinants of birth weight infant which are the significant health indicators has a connection with the growth- process of evolution and survival of infants in the future, because underweight children are vulnerable and at high risk of mortality and infection and other diseases.

In 2014 the study conducted in Odisha revealed that, Primiparity was one of the maternal risk factors linked to the birth of VLBW babies (58.06%), low socio economic status (40.86%), multiple pregnancies (36.83%), Premature rupture of membranes (26.34%), HTN (13.44%) and malnutrition (12.36%) (34).

Meanwhile, other factors of ELBW have been discovered which include maternal diseases, early labor, multiple pregnancies, and genetics (i.e. infections, diabetes, and hypertension brought on by pregnancy), drug use (including alcohol and tobacco) maternal age, height and dietary variables (underweight, overweight and obesity). Low socioeconomic status mothers typically give birth to babies that are underweight.

In addition, poor fetal growth is also a result of physically intensive employment during pregnancy. Women who are malnourished when they are pregnant have a higher risk of getting sick.; their health typically depends on access and consumption of a healthy diet. , due to their high nutritional requirements during pregnancy, they are unlikely to be able to resist. (35).

In developed countries and developing countries were found to be different, Low birth weight where it is due to prematurity in developed countries and IUGR in developing countries. The maternal risk factors responsible for prematurity in the study was hypertension, stress, history of multiple pregnancy, and psychological related condition such as anxiety, gender bases violence whereas maternal risks associated with IUGR was found to be anemia, malnutrition at time of conception and throughout the course of pregnancy as well

as increasing energy expenditure. In both prematurity and IUGR maternal infection was discovered to be a risk.(36)

According to the study done by Moradi other factors that increase the risk of low birth weight , namely mother's age usually less than 20 Years of Age, level of education of the mother, Daily activity of mother(Occupation), Living place, times mother did antenatal care, maternal height <150m (22%), maternal weight gain >12kg/month and gestational age are factors associated to underweight neonate.(37)

The study conducted in Iran, found that urinary tract infections and anemia were the most common, Cardiovascular disease was the sickness that occurred the least frequently. Additionally, mothers were estimated to have a 5.6 % prevalence of mental problems. The results of mothers' recent pregnancies showed that the most common consequence of LBW neonates was connected to early rupture of membrane, accounting for 27.8% of cases. The least common consequences, however, were abdominal injury and placental abruption.. However, maternal occupation has impact on low birth weight with 20% of self-employed,12.5% mother smokers, 65%of obesity mothers and 3.1% of mothers with mental disorder. Others maternal factors affected the fetus underweight relating to the history of hypertension, preeclampsia, hemorrhage, using assisted reproductive technologies, taking drugs during pregnancy, and oligohydramnios (38).

2.4 Institution related factors

To ensure that spontaneous breathing works effectively and there is enough gas exchange, the premature babies needs respiratory support. Current neonatal resuscitation recommendations advise positive pressure ventilation (PPV) utilizing a face mask or nasal prongs and a ventilation device when a newborn infant fails to establish spontaneous breathing at birth.
At lower gestational ages, intubation rates increased: 76% of newborns between 26 and 28 weeks; 33% between 29 and 32 weeks; and 16% between 33 and 34 weeks. Within 3 hours of delivery, about 75% of individuals under 28 weeks gestation were intubated. Rate and frequency of endotracheal intubation.
The use of NIV has gained traction as an alternative to the use of CPAP for both primary and post extubation respiratory sustenance 38,39 NIV delivers related baseline increasing pressures as CPAP with the count of superimposed PIP and moreover time-cycled or

harmonized ventilator breaths. NIV may provide benefits such as less work of breathing, improved tidal volume (VT), minute volume, and mean airway pressure, with described enhancements in SPO2 and carbon dioxide elimination.

The increasing of use of NIV for main respiratory sustenance, About 50% of babies under 28 weeks of gestation end up needing intubation and mechanical ventilation. Reductions in breathing work are among the NIV stages, the risk rising in direct proportion to gestational age. In addition, prior to the start of CPAP in the delivery room, 70% of newborns undergo invasive mechanical ventilation. Invasive mechanical ventilation is therefore continues for premature newborns with RDS, to serve as the cornerstone of respiratory support. Therefore, it's crucial to distinguish between newborn who need SRT and those who still need to use a mechanical ventilation from those who can be effectively controlled.

Meanwhile several study have been revealed that Significant mask leaks occurred during mask ventilation in between 24 and 59% of recordings, and 51% of recordings occurred within the first two minutes of PPV. However, CPAP and ventilation compared to bag and mask ventilation, endotracheal intubation and mechanical ventilation of extremely low birth weight infants were performed at lower rates in the delivery room using a nasopharyngeal tube. When performing PPV in the delivery room, a nasal interface may provide an advantage over a face mask (39,40).

2.5. Neonatal related factors in neonates with ELBW

2.5.1 APGAR score, Gestational age and birth weight

The APGAR score, reflects the status of the fetus and the influence of factors present during delivery and is based on a clinical evaluation of the respiratory, circulatory, and neurological systems in the first minute of a newborn's life. Normally it is thought to correspond strongly with fetal health indicators that are present during pregnancy. The state of the fetus in utero and several labor-related aspects are determined by the assessment of infants using the Apgar scale within the first minute after delivery. A child's future development is considered to be directly correlated with a low 5-minute Apgar score. However, the Apgar score's value in assessing preterm infants' health is becoming more and more apparent, as well as ELBW significant shows the clarification and further management related to the condition(41).

Meanwhile survival of newborns with extremely low birth weights (ELBW) has steadily improved as a result of developments in prenatal and neonatal care. The mode of delivery is considerable related to the high-risk deliveries in a tertiary perinatal center, offers the

coordinated, collaborative, expert and specialized care needed by these mothers and their infants(42) (Ref). The primary newborn morbidities continue to have a significant impact on ELBW/EP infants' overall prognosis despite recent trends toward declining prevalence of these conditions. ELBW was categorized into two classes: (1) Newborns who are extremely premature (EP), and appropriate for gestational age (AGA) and (2) Newborns with intrauterine growth restriction, being small for gestational age (SGA) but not always very premature (< 27 wks). This dissimilarity is significant because of the changed pathophysiologic developments at play in these classes, with possibly very dissimilar consequences on the developing fetus and neonate. The earliest gestational age and lightest birth weight at which resuscitation should begin are still hotly debated topics.

However, for newborns weighing less than 750 grams, a more gradual weaning strategy may be more effective and allow for the development of intravenous and oral nourishment. This would involve continuing respiratory support for a few extra days at very low PIPs of 10 to 12 mmHg and rates of 30 to 40 per minute. The personal cost to the ELBW and their families as well as the economic cost to society are both enormous. More ELBW are still alive and return home. (42).

2.6. SUMMARY

This chapter emphasized literature relating the theoretical literature review also empirical literature review about the ELBW neonates. The theories on socio demographic factors, the causes of death of ELBW, maternal associated factors, morbidities and mortality.

The study's methodology is explained in chapter three.

CHAPTER THREE
METHODOLOGY

3.1. INTRODUCTION

The methodology involves the methods that the researcher used in data collection and considered the theories that motivate those methods. (43) This chapter was included the following components : Study design, Research setting, Population Sampling Strategy, Data collection, Data analysis, Data management, and the Ethical considerations.

3.2. STUDY DESIGN

A retrospective descriptive study design was used to conduct this study. Data were collected for all ELBW neonates born or admitted to the three selected hospitals in Kigali; including Centre Hospitalier Universitaire de Kigali (CHUK), Rwanda Military Hospital (RMH), and King Faisal Hospital, (KFH) all in Kigali, Rwanda. The data were extracted from both electronic and hard copy files.

3.3. STUDY SETTING

The three tertiary hospitals have neonatal care units, which are the most advanced in Rwanda. All hospitals have two levels of neonatal care. AT CHUK, Level III has 11 incubators, four CPAP, two resuscitation lamps, and two jaundice lamps. Level II has nine neonatal beds. Level I has five neonatal KMC beds.

The hospitals have professional health care nurses that provide care to the neonates the whole9day (24 hours), the whole day in a week (7 days) and also, specifically qualified neonatology nurses, pediatric residents, pediatricians. There is also support from various other disciplines such as neurosurgery, pediatric surgery, ophthalmology, ear nose and throat (ENT), internal medicine, emergency, and anesthesia are among the medical specialties. The nurse -to -neonate ratio at CHUK, RMH, and KFH, K is 1:1 for Level II care units and 1:3–4 for Level I care units. In the hospital, the nurse- to- neonate ratio is 1:5. The data are kept both electronically and in hard copy files.

3.4. STUDY POPULATION

The target population were all ELBW (<1000 g) neonates (birth to 28 days) admitted (and recorded in the register) to the NICU and Neonatology in three referral hospital in Kigali. The study population was all ELBW neonates admitted to CHUK, KFH, K and RMH between 1st January and 31st December 2020.

3.5. INCLUSION CRITERIA AND EXCLUSION CRITERIA

Inclusion criteria

All neonates less than 1000g BW admitted to NICU and Neonatology during the year 2020.

Exclusion criteria

Neonates born greater than 1000g BW.

Neonates discharged against medical advice.

Neonates referred to the other centers

Congenital anomalies incompatible with life

3.6. SAMPLING STRATEGY AND SIMPLE SIZE

The sampling strategy is non-probability sampling with a convenience sample of all neonates in the study population. Therefore, every neonate weighing less than 1000 g and admitted to NICU and Neonatology at one of the three hospitals during the year 2020 was included in the sample.

3.7. DATA ABSTRACTION INSTRUMENT

Data were collected using a data abstraction tool with closed-ended questions consisting of biographical data, neonates' characteristics, and NICU and Neonatology hospitalization course. The tool was adapted from a study by Dusingizimana , Small , Teteli , Rulisa , and Magriples from their research paper entitled, "Maternal and Neonatal Morbidity and mortality associated with preterm premature rupture of the membrane between 24 to 34 weeks' gestational age at a tertiary hospital, at University Teaching Hospital-Kigali", and other research which assessed neonatal mortality.(44)

The data instrument consisted of the following three parts:

Part A: The demographic data comprised: age of the mother, marital status, level of education, religion, occupation, residential area, economic status, and insurance coverage.

Part B: Neonatal characteristics included: APGAR score at 1min, 5min, and 10min; type of resuscitation performed; weight at birth; gender; neonatal age; the presence of meconium-stained fluid; other neonatal risks of infection.
Part C: NICU and Neonatology hospitalization course and level of care included: neonatal composite morbidity, other morbidities, neonate requiring respiratory support, length of neonatal hospital stay, date of neonate death, and probable cause of death.

3.8. RESEARCH TOOL VALIDITY AND RELIABILITY

Validity expresses how well the research tool measures the phenomena under study. It refers to the nearness of what the researcher believes is being measured to what he or she planned to measure. (45)
Content validity assessed whether the tool illustrated all the concepts in the study.(46) Evidence for content-based validity of the tool was obtained from the literature, from representatives of the relevant population, and content experts. The research tool was developed based on the literature review of "Maternal and Neonatal Morbidity and mortality and other research tool used by other researchers for similar studies". This study adopted the common elements used by other researchers to assess the ELBW neonatal outcomes.(47)

Construct validity is the Level to which the tool measured the construct that it is aimed to measure. The construct validity was determined by piloting six checklists at both CHUK, KFH, K and RMH. Patient files were assessed to complete the data abstraction tool (three from CHUK, KFH and RMH). This pilot study facilitated a better understanding of the tool and the need to make adjustments of which there were few. The reliability test was computed and found a Cronbach's Alpha of .98, suggesting very good internal consistence reliability for the checklist with the sample. According to Pallant (2013), values above .70 are considered acceptable. However, value above .8 are preferable.
Criterion validity referred to the relationship between the concepts under study and other variables.(45)(47) In this study, criterion validity was explained by the relationship between ELBW neonates' outcomes with other variables, such as neonatal mortality or survivability.

3.8 DATA COLLECTION

The data were gathered from the neonate's file who were hospitalized in the NICU or neonatology during the year 2020 at the three study sites, CHUK, KFH and RMH. No consent was required. A code number was placed on each tool instead of any personal identifying information to provide anonymity and confidentiality

Data collection was done using the tool that had three sections. Section one obtained maternal demographic data (maternal age, economic category, maternal occupation, obstetrical history, maternal life style, exposure, antenatal care visit and pregnancy complication) and section two neonatal characteristics (admission hospital, place of birth, type of delivery, APGAR score, birth weight, gender, gestational age) and section three and hospitalization course (neonatal morbidity, neonatal respiratory support, neonatal hospital stays, neonatal death and probable cause of neonatal death. The maternal and neonatal demographics were considered as independent variables while the hospitalization course was considered dependent variables.

3.9. STATISTICAL ANALYSIS

STATA 12 was used to enter and analysed the data (College Station, TX, USA) Descriptive statistics (frequency distribution, mean, standard deviation, minimum and maximum values) were used to describe the sociodemographic of newborns and maternal variables. Chi-square test was used to compute association between variables. Relationships were realized as significant when they were less than 0.05 ($p=<0.05$).

Data were entered into the Software for Statistics and Data Science (STATA), Version 21 using a codebook. The demographic data was coded and converted into numerical values and entered as categorical scales. To describe and synthesize data, and calculate parameters, descriptive statistics included graphic representations of distribution and frequency counts. The arithmetic mean was measured and Measures of central tendency and distribution included the range (minimum and maximum), mode (most commonly occurring score), median (the middle score when the score are ranked from smallest to largest and sometimes known as the midpoint).

3.10 DATA MANAGEMENT

Information processing processes made up the field of data management. The data management involved the retrieval of information, gathering, manipulation and storage. Confidentiality was maintained by assigning a code for each patients' file. The computer was locked with a password to protect patients' information.

3.11 POTENTIAL BIASES

There was a potential for bias of the care services provided to neonates in the three hospitals (CHUK, KFH and RMH). Other forms of bias may include minimal risk to patient files (including safeguards to mitigate these risks) and others observing the collected information.

Measures to minimize the risk included the elimination of personal identifying information (e.g., names and cell numbers). Instead, the patient files were given a code number based on chronological entry to the study. The data were secured in a password-protected computer.

3.12. THE RISK TO RESEARCHERS

The risk to researchers include safeguards to mitigate these risks. However, in this research there were no significant risk factors that have been identified.

3.13. ETHICS

Ethical and administrative approval was obtained from the University of Rwanda, College of Medicine and Health Sciences, Institutional Review Board (IRB), and CHUK Research and Ethics Committee (REC). Written informed consent was not required.

The data gathered for this study project was protected confidential in a password-protected database. No identifiable patient data was collected during this research project.

3.14. SUMMARY

The research methodology for this study was described in this chapter. This comprises descriptions of the study design and approach, research setting, population, sample and sampling method, and data gathering tools. It provided details on the process used to gather the data. It also described how data were analysed and managed, as well as ethical measures to protect the neonates' personal identifying information in this study. The presentation, analysis, and interpretation of the results will be highlighted in the following chapter.

CHAPTER FOUR
ANALYSIS OF DATA

4.1. INTRODUCTION

The purpose of this study was to assess the early outcomes of neonates with ELBW at the three selected referral hospitals in Kigali (CHUK, KFH, and RMH). The specific objectives were to estimate the prevalence of ELBW neonates, identify the medical conditions reported in the files of ELBW neonates and to determine the maternal risk factors associated with ELBW neonates admitted to the NICU and Neonatology at three selected referral hospitals. The sample of 108 ELBW neonates was the total number of neonates admitted to the referral hospitals during the year 2020.

The data were presented according to the conceptual framework, research objectives and research questions for readability and clarity of the data analysis process. A description of the sample, including birth weight, gender, birth order, social class, referral hospital, birth weight, gestational age, APGAR for newborn was performed.
Lastly, Statistical analyses were performed using STATA (version 14.2, Stata Corp, College Station, TX). Two-tailed table and Chi-square test were performed to compute the relationship between variables.

4.2. DESCRIPTION OF THE SAMPLE

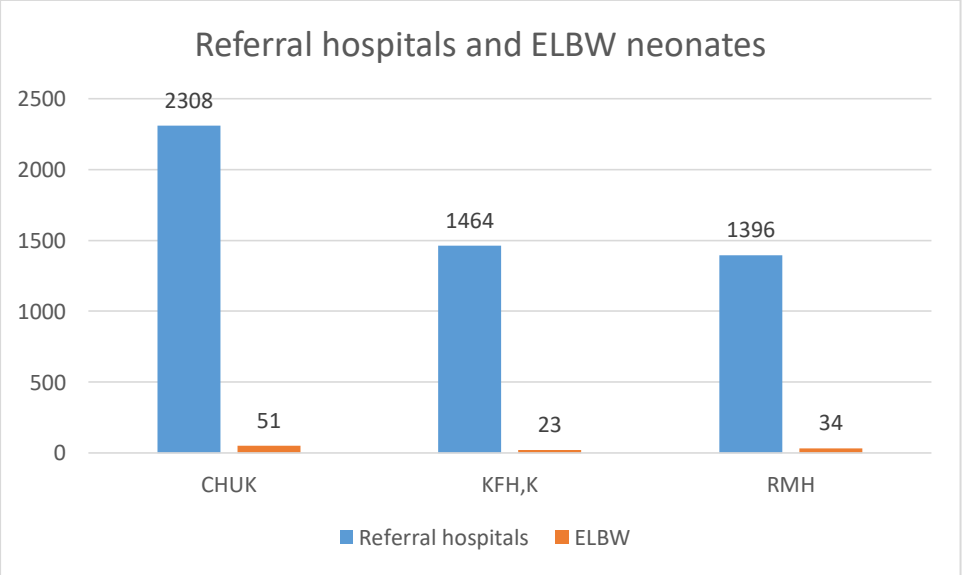
The total number of newborns admitted to the in NICU and neonatology units of the referral hospitals in Kigali was 108. This number included 47.2% (n=51) at CHUK, 21.3% (n=23) at KFH, and 31.4% (n=34) at the RMH.

4.3. THE PROPORTION OF ELBW NEONATES

The total number of live births at the three referral hospitals (were the study was conducted) was 5168. This number included 2308 live births at CHUK with 51 ELBW, 1464 live births at KFH with 23 ELBW, and 1396 live births at RMH (maternity unit) with 34 ELBW. The proportion of ELBW neonates was calculated from all newborns (live births) during the

period from 1 January to 31 December 2020. The calculation was based on the total number of the live births (5168) and ELBW neonates at three referral hospitals in Kigali and admitted in NICU and Neonatology units. The findings from this study revealed that the proportion of ELBW neonates admitted to the NICU and Neonatology at three selected referral hospitals was 2.08%. This proportion was obtained as follows; 108 ELBW neonates/ 5168 live births X 100= 2.08%.

Figure 2: Live birth and ELBW at referral hospitals in Kigali



4.4. NEONATAL OUTCOMES

Table 1: Outcomes ELBW neonates

Variables	n	(%)	Min. days	Max. days
Surviving	57	(52.78)	10	28
Death	51	(47.22)	1	20
Total	108	(100)		

Findings revealed that the majority of ELBW neonates survived, 52.7%, whereas the death rate was 47.2% (Table 1.). The duration of stay in the hospital ranged from 10 to 28 days for those who survived. with an average stay of 26 days (M=26.7193; SD 3.599377). The neonates that died stayed 1 to 20 days, with an average of four days (M=4.352941; SD 4.524703). In addition, the maximum life days for those who survived was 28 days and the minimum was 10 days; while the maximum life days of the neonates who died was 20 days and the minimum of 1 day.

4.4.1. THE MORBIDITY EXPERIENCED BY ELBW NEONATES

Table 2: Major and minor morbidities experienced by ELBW neonates

Neonatal morbidities	Yes (%)	No (%)
Major conditions		
Respiratory Distress syndrome	75 (69.44)	33 (30.56)
Hypoxic ischemic encephalopathy	4 (3.70)	104 (96.30)
Neonatal sepsis	76 (70.37)	32 (29.63)
Intraventricular hemorrhage	17 (15.74)	91 (84.26)
Necrotizing enterocolitis	5 (4.63)	103 (95.37)
DIC	2 (1.85)	106 (98.15)
Patent ductus arteriosus	1 (0.93)	107 (99.07)
Minor morbidities		
Hypoglycemia	12 (11.11)	96 (88.89)
Hypothermia	29 (26.85)	79 (73.15)
Hyper bilirubinemia	32 (29.63)	76 (70.37)
Apnea episode	34 (31.48)	74 (68.52)
Feeding difficulties	17 (15.74)	91 (84.26)
Anemia	35 (32.41)	73 (67.59)
Hyperkalemia	4 (3.70)	104 (96.30)

DIC Dissemination intraventricular coagulation

Findings from the study showed that Neonatal infection was the most prevalent morbidity experienced by ELBW neonates with 70.3%) (Table 2). It is followed by respiratory distress syndrome (RDS) with 69.4%); Intraventricular hemorrhage (IVH) with 15.7%); Necrotizing enterocolitis with 4.6%). The study revealed that the less prevalent major morbidity experienced by ELBW neonates were Hypoxic ischemic encephalopathy (HIE) with 3.7%), disseminated intraventricular coagulation (DIC) 1.8%) and patent ductus arteriosus (PDA) with 0.9%).

Regarding minor morbidities experienced by ELBW neonates, the findings revealed that the most frequent condition was anemia (32.4%) and the apnea episode comes on the second position (31.4%). The Hyper bilirubinemia 29.6%) and Hypothermia 26.8%) followed. Feeding difficulties were found in 15.7%) and hypoglycaemia in 11.1%). Hyperkalaemia was the less frequent morbidity 3.7%) among ELBW neonates.

4.4.2. CAUSES OF DEATH AMONG ELBW NEONATES

Table 3: Causes of death among ELBW neonates

Items	Yes n (%)	No n (%)
Hypoxic ischemic encephalopathy	0 (0)	51(100)
Respiratory distress syndrome	15 (29.41)	36 (70.59)
Neonatal infections	17 (33.33)	34 (66.67)
Pulmonary hypoplasia	0 (0)	51 (100)
Necrotizing enterocolitis	6 (11.76)	45 (88.24)
Severe prematurity	23 (45.10)	28 (54.90)
Bronchopulmonary dysplasia	0 (0)	51 (100)
Cardiorespiratory failure	1 (1.96)	50 (98.04)
Dissemination intraventricular coagulation	1 (1.96)	50 (98.04)
Intraventricular Hemorrhage	3 (5.88)	48 (94.12)

As displayed in table 3, the major cause of death in ELBW neonates 45.1% was severe prematurity, followed by neonatal infection 33.3% and respiratory distress syndrome 29.4%. Necrotizing enterocolitis was found in 11,7% intraventricular hemorrhage 5,5% and cardiorespiratory failure and dissemination intraventricular dissemination 1.9%. However, the findings revealed that Hypoxic ischemic encephalopathy, bronchopulmonary dysplasia and pulmonary hypoplasia were not found among the causes of death among ELBW neonates.

4.5. NEONATAL RELATED FACTORS

As described in the introduction section, the demographic categorical variables included admission hospital, place of birth, type of delivery, gender, and demographic continuous variables (birth weight and gestational age) and discrete variables (APGAR score). Descriptive statistics were used to analyse the neonatal related factors and displayed in the form of tables and graphs.

4.5.1. NEONATAL RELATED FACTORS (gender, social class and place of birth)

Table 4: Gender, Social class and Place of birth

Variables	n	(%)
Gender		
Male	57	(52.78)
Female	51	(47.22)
Total	108	(100)
Social class		
Class 1	6	(5.56)
Class 2	56	(51.85)
Class 3	46	(42.59)
Class 4	0	(0.0)
Total	108	(100)
Place of birth		
Referral hospital	91	(84.26)
District hospital	13	(12.04)
Health Centre	3	(2.78)
Home	1	(0.93)
Total	108	(100)
Type of delivery		
Spontaneous vaginal delivery	23	(21.30)
Caesarean section	85	(78.70)
Total	108	(100)

Findings revealed that the majority of ELBW neonates was 52.7% male while 47.2% were female (Table 4). Regarding social classes, the majority ELBW neonates was born in second class' families 51.8%, followed by the third class 42.5% and the first social class was the last

with 5.5%. There were no ELBW neonates who were born in the fourth social class family. The majority of ELBW neonates was born in referral hospitals 84.2% while 12% were born in District hospitals and referred in Referral hospital for further management. ELBW neonates who were born in Health centers were 2.07% and 0.9% were born at home and later admitted at a Referral hospital.

In addition, the majority of deliveries was caesarean section at 78.7% and spontaneous vaginal delivery at 21.3%.

4.5.2. NEONATAL RELATED FACTORS (birth weight and gestation)

Table 5: Birth weight and Gestation age

Variables	n	%	Min.	Max.	Mean	SD	Median
Birth weight (grs)							
500-600	6	5.5	500	1000	881.32	132.6	910
601-700	4	3.7					
701-800	18	16.7					
801-900	23	21.3					
901-1000	57	52.8					
Total	108	100					
Gestational age (days)							
< 168 (24 wks.)	1	0.93	156	245	199.57	13.77	197
169-196 (24-28 wks.)	51	47.22					
197-224 (28-32 wks.)	55	50.92					
>224 days (> 32 wks.)	1	0.93					
Total	108	100					

The table 5 represents the neonatal related factors such as birth weight and gestational age (Table 2). Birth weight of ELBW neonates was categorized into four classes, 901-1000 grs with 52.7%; 801-900 grs with 21.3%; 701-800 grs with 16.6%; 500-600 grs with 5.5%. The less representative class was 601-700 grs with 3.7%. In addition, descriptive statistics

showed that the maximum birth weight was 1000 grs 37%; and the minimum birth weight was 500grs 0.9%. Also, the distribution of ELBW neonates in regard of birth weight was confirmed by the central measure tendencies (M=881.3241; SD 132.5959; Me=910).

Regarding the gestational age of ELBW neonates, the gestational age was categorised into four classes that include the first class (< 168 days [24 Weeks], the second class (169-196 days [24-28 weeks]), the third class (197-224 days [28-32 weeks]) and the fourth class (>224 days [> 32 weeks]). The most representative class is 197-224 days (28-32 weeks) with 50.9% followed by the class between 169 -196 days (24-28 weeks) with 47.2%. Both first and four classes (< 168 days [24 Weeks]) and (>224 days [> 32 weeks]) were less represented in the sample with 0.9% for each. This distribution was confirmed by the central measure tendencies (M= 199.5741; SD = 13.76926, Me=197). Also, the table below displays the maximum gestational age of 245 days (35 weeks) with 0.9% and minimum of gestational age of 156 days (22 weeks and 3 days) with 0.9%).

4.5.3. NEONATAL RELATED FACTORS (Newborn APGAR score)

Table 6: APGAR score

APGAR score	n (%)		Minimum	Maximum
APGAR at 1 min.				
1-5	34	(36.17)	1	9
6-7	43	(45.74)		
8-10	17	(18.09)		
Total	94	(100)		
APGAR at 5 min.				
1-5	18	(19.15)	1	10
6-7	34	(36.17)		
8-10	42	(44.68)		
Total	94	(100)		
APGAR at 10 min.				
1-5	11	(11.70)	1	10
6-7	25	(26.60)		
8-10	58	(61.70)		
Total	94	(100)		

`

Table 6 represents that APGAR score at 1 minute, at 5 minutes and at 10 minutes. The ELBW neonates were born at referral hospitals, district hospitals, health centres and at home. Thus, some ELBW neonates were admitted without information on the APGAR score at birth. Only 87.03% were admitted with APGAR score information and 12.9% were admitted without APGAR score information.

The APGAR score at 1 minute, 5 minutes and 10 minutes was categorised into three classes, namely class 1 (1-5 score), class 2 (6-7 score) and class 3 (8-10 score).

At 1 minute the majority of ELBW neonates was born with the APGAR score between 6-7 score (45.7%); the second was score was categorised between 1-5 score (36.1%) and the last score was categorised between 8-10 score (18.09%). At 5 minutes after delivery, the majority of ELBW neonates reached the APGAR score between 8-10 score (44.6%); the second score was categorised between 6-7 score (36.1%) and the last score was categorised between 1-5 score (19.1%). The maximum APGAR score at 1 minute after delivery was 9 and the minimum was 1 and the maximum APGAR score at 5 minutes after delivery was 10 and the minimum was 1. Lastly, the APGAR score at 10 minutes after delivery, the majority of ELBW neonates had achieved the APGAR score between 8-10 score (61.7%); followed by the APGAR score between 6-7 score (26.6%) and the last score was categorised between 1-5 score (11.7%). The maximum APGAR score at 10 minutes after delivery was 10 and the minimum was 1.

4.6. MATERNAL RELATED FACTORS ASSOCIATED WITH ELBW NEONATES

Maternal risk factors were classified into four categories as follows; maternal exposure, pregnant complications, maternal life style and maternal obstetric history.

4.6.1. Maternal exposure, pregnancy complication and life style

Table 7: Maternal Exposure, pregnancy complication and lifestyle

Maternal factors	Yes (%)	No (%)
Maternal exposure		
Malaria	11 (10.19)	97 (89.81)
HIV	10 (9.26)	98 (90.74)
Syphilis	0 (0)	108 (100)
Hepatitis B	4 (3.70)	104 (96.30)
Pregnancy complications		
Hypertension, includes chronic cases	46 (42.59)	62 (57.41)
Diabetes mellitus	6 (5.56)	102 (94.4)
Premature rupture of membranes	40 (37.04)	68 (62.96))
Bleeding	21 (19.44)	87 (80.56)
Previous preterm	1 (0.93)	107 (99.07)
Preeclampsia	42 (38.89)	66 (61.11)
Maternal lifestyle		
Alcohol	36 (33.33)	72 (66.67)
Tobacco	9 (8.33)	99 (91.67)
Drug abuse	0 (0)	108 (100)

The table 7 displays the distribution of maternal Exposure, pregnancy complication and lifestyle in regard with the ELBW neonates (Table 5). Malaria and HIV were the most frequent maternal exposures during pregnancy, with malaria at 10.1%) and HIV at 9.2%. The least common maternal exposures included hepatitis (B) at 3.7%. Also, preeclampsia and premature rupture of membranes are the most common maternal pregnancy complications; preeclampsia at 38.8% and 37.04% for premature rupture of membranes (PROM). Whereas, bleeding during pregnancy at 19.4%), diabetic mellitus at 5.5%), previous preterm at 0.93% and chronic hypertension (3.7%) were less prevalent maternal pregnancy complications. Lastly, the results, revealed that maternal lifestyle was dominated by alcohol use with 33.3% and tobacco use with 8.3%. While, maternal drug abuse was not characterized in the file of the ELBW neonates

4.6.2. Maternal obstetric history (Gravida, term and preterm)

Table 8: Obstetric history (Gravida, term and preterm)

Variable	n	(%)
Gravida		
G1	43	39.81
G2	19	17.59
G3	13	12.04
G4	13	12.04
G5	10	9.26
G6	6	5.56
G7	3	2.78
G8	1	0.93
Term		
0	52	48.15
1	18	16.67
2	19	17.59
3	7	6.48
4	10	9.26
5	2	1.85
Preterm		
1	99	91.67
2	4	3.70
3	5	4.63

Regarding term and preterm status, the findings showed that the majority of mothers did not reach a term pregnancy, 48.1%. Only 9.2%had four pregnancies that achieved term, 6.4% had three pregnancies that achieved the term and 1.8% had five pregnancies that achieved term status. Lastly, the majority of mothers had one preterm pregnancy at 91.67% , while 4.63% had two preterm pregnancies.

4.6.3. Maternal obstetric history (abortion, living children and ANC visits)

Table 9: Maternal obstetric history (abortion, living children & ANC visits)

Variable	n	%
Abortion		
0	85	78.70
1	15	13.89
2	6	5.56
3	1	0.93
4	0	0
5	0	0
6	1	0.93
Living children		
0	26	24.8
1	31	28.70
2	23	21.30
3	14	12.96
4	8	7.41
5	5	4.63
6	1	0.93
ANC visit		
1	18	16.67
2	66	61.11
3	19	17.59
4	3	2.78
5	1	0.92
6	0	0
7	0	0
8	1	0.93

The table 9 displays the obstetric history of mothers with ELBW neonates, which included the number of abortions, living children and ANC visits (Table 9). Regarding abortion, the majority of mothers did not have an abortion in their obstetric history (78.7%). Whereas, two mothers had 3-6 abortions in their obstetric history 0.9%) for each. Regarding living children, the majority of mothers had only one living child at 28.7%) and 24.08%) had no living children. Only one mother had six living children. The majority of mothers had only two ANC visits 66.1%), while only one mother had five ANC visits 0.9%) and another had eight visits 0.9%.

4.7. INSTITUTION RELATED FACTORS TO ELBW NEONATES

Table 10: Respiratory support performed for ELBW neonates

Respiratory support	**Yes** **n(%)**	**No** **n(%)**
CPAP	88 (81.48)	20 (18.52)
Ventilator machine	16 (14.81)	92(85.19)
Nasal prongs	4 (3.70)	104 (96.30)
Facial mask	4 (3.70)	104 (96.30)
Oxygen hood	0 (0)	108 (100)

Table 10 displays findings related to respiratory support for ELBW neonates. The most frequently used respiratory support was the continuous positive airway pressure (CPAP) at 81.4% and the respiratory machine at 14.8%. The least frequently used respiratory support was nasal prongs and facial mask with 3.7%. Furthermore, the oxygen hood was not used as a method of respiratory support.

4.8. RELATIONSHIP

4.8.1. Associations between demographic factors and outcome of ELBW neonates

Table 11: Associations between demographic factors and outcome of ELBW neonates (n=108)

	Outcomes			
Demographics	**Survival n(%)**	**Death n(%)**	**Total n(%)**	**p**
Gender				
Male	32 (56.15)	25 (43.85)	57 (100)	0.459
Female	25 (49.01)	26 (50.99)	51 (100)	
Birth weight				
500-600 grs	2 (33.33)	4 (66.67)	6 (100)	0.004
601-700 grs	1 (25)	3 (75)	4 (100)	
701-800 grs	5 (27.78)	13 (72.22)	18 (100)	
801-900 grs	9 (39.13)	14 (60.87)	23 (100)	
901-1000 grs	40 (70.17)	17 (29.8)	57 (100)	
Gestational age				
< 168 days (24 Weeks)	0 (0)	1 (100)	1 (100)	0.224
169-196 days (24-28 weeks)	23 (45.09)	28 (54.91)	51 (100)	
197-224 days (28-32 weeks)	33 (60)	22 (40)	55 (100)	
>224 days (> 32 weeks	1 (100)	0 (0)	1 (100)	

Demographic variables (gender, birth weight, gestational age) were seen as independent variables and outcome of ELBW neonates as dependent variables. Finally, as stated in the introduction, associations were seen as significant when the p value was less than 0.05 ($p<0.05$) and the chi-square test was used to compute the relationships between variables.

As displayed in the table 11, the Chi-square test showed a significant association between birth weight and outcome of ELBW neonates (p=0.004). The associations between gestational age and outcome of ELBW neonates (p=0.224), and gender and outcome of ELBW neonates (p=0.459) were not statistically significant.

In addition, the table below displays the proportions showing how different categories of gender, birth weight and gestational age were associated with the neonatal surviving and death. For example, the survival rate of male ELBW neonates was higher than female ELBW neonates (male=56.15% vs female= 49.01%).

Regarding birth weight of ELBW neonates, the proportion of ELBW neonates who survived according the birth weight categories (500-600 grs, 601-700 grs, 701-800 grs, 801-900 grs, 901-1000 grs) was 33.3%, 25%, 27.7%, 39.1% and 70.1%, respectively.

While gestational age of ELBW neonates, the proportion of ELBW neonates who survived according the gestational age categories <168 days (24 Weeks), 169-196 days (24-28 weeks), 197-224 days (28-32 weeks), >224 days (> 32 weeks) was 0%, 45.09%, 60%, and 100%, respectively

4.8.2. Associations between APGAR and outcome of ELBW neonates

Table 12: Associations between APGAR and outcome of ELBW neonates (n=108)

	Outcomes				
APGAR score	**Survival n(%)**	**Death n(%)**	**Total n(%)l**	***X2***	**p**
APGAR at 1 minute					
1-5 score	8 (23.53)	26 (76.47)	34 (100)	22.37	0.000
6-7 score	29 (67.42)	14 (32.56)	43 (100)		
8-10 score	14 (82.35)	3 (17.65)	17 (100)		
APGAR at 5 minutes					
1-5 score	4 (22.22)	14 (77.78)	18 (100)	17.59	0.006
6-7 score	19 (55.88)	15 (44.12)	34 (100)		
8-10 score	28 (66.67)	14 (33.33)	42 (100)		
APGAR at 10 minutes					
1-5 score	2 (18.18)	9 (81.82)	11 (100)	19.61	0.000
6-7 score	7 (28)	18 (72)	25 (100)		
8-10 score	42 (72.41)	16 (27.59)	58 (100)		

Table 12 shows the relationship between APGAR score at 1 minute, 5 minutes and 10 minutes after delivery and the outcome of ELBW neonates using the the Chi-square test. The test showed significant associations between APGAR at 1 and outcome (p=0.000), APGAR at 5 and outcome (p=0.006) and APGAR at 10 minutes and outcome after delivery (p=0.000). Furthermore, the proportions of different categories of APGAR score showed how the APGAR score at 1 minute, APGAR score at 5 minutes and APGAR score at 10 minutes were associated with the outcome of ELBW neonates. For example, the proportion of categories of APGAR score at 1 minute (1-5 score, 6-7 score and 8-10 score) was 23.5%, 67.4% and 82.3%, respectively. The proportion of categories of APGAR score at 5 minutes (1-5 score, 6-7 score and 8-10 score) was 22.2%, 55.8% and 66.6%, respectively. Lastly, the proportion of categories of APGAR score at 10 minutes (1-5 score, 6-7 score and 8-10 score) was 18.18%, 2% and 72.4%, respectively.

4.8.3. Association between respiratory support and outcomes of ELBW neonates

Table 13 Association between respiratory support and outcomes of ELBW neonates

	Outcomes				
Interventions	**Surviving n(%)**	**Death n(%)**	**Total n(%)**	**X2**	**p**
CPAP					
Yes	48 (54.55)	40 (45.45)	88 (100)	0.59	0.440
No	9 (45)	11 (55)	20 (100)		
Ventilator machine					
Yes	5 (31.25)	11 (68.75)	16 (100)	3.49	0.062
No	52 (56.52)	40 (43.48)	92 (100)		
Nasal prongs					
Yes	2 (50)	2 (50)	4 (100)	0.01	0.910
No	55 (52.88)	49 (47.12)	104 (100)		
Facial mask					
Yes	3 (75)	1 (25)	4 (100)	0.82	0.364
No	54 (51.92)	50 (48.08)	104 (100)		

The Chi-square test was used to compute the associations between neonatal respiratory support and outcome of ELBW neonates (table 13). The types of neonatal respiratory support included CPAP, respiratory machine, nasal prongs and facial mask. The findings did not show any significant relationship between continuous positive airway pressure (p=0.440), respiratory machine (p=0.062), nasal prongs (p=0.910), or facial mask (p=0.364) and outcome of ELBW neonates.

Though the findings showed no statistical significance, they did show some differences between the type of respiratory support and the outcome of the ELBW neonates (survival and death). The ELBW neonates who received CPAP had a higher survival rate more than the ELBW neonates who did not (54.5% who received CPAP vs 45% who did not). And the

ELBW neonates who received the facial mask had a higher survival rate than those that did not (75% who received the facial mask vs 51.9% who did not).

Other respiratory support had a less favorable outcome. The ELBW neonates who received the ventilator machine showed a lower survival rate than those who did not (31.2% who received the ventilator machine vs 56.5% who did not). Also, the ELBW neonates who received nasal prongs had a lower survival rate that those who did not (50.0% who received the nasal prongs vs 52.8% who did not).

4.9. SUMMARY

Descriptive statistics were used to describe independent and dependent variables, and the Pearson Chi-square test was used to test the association between variables (independent and dependent). The results revealed that the proportion was 2.08% while the most mother risk factor was malaria (exposure), hypertension (pregnancy complication), alcohol (lifestyle), primiparous (obstetric history). The most frequent major morbidity among ELBW neonates was infection, while the minor morbidity was apnea episode and severe prematurity, neonatal infection was the major cause of neonatal mortality.

A p-value of <.05 was considered statistically significant in this study. There was a significant association between the birth weight and neonatal outcome, and the APGAR score at the three different time periods (1, 5, and 10 minutes) with neonatal outcome. The next chapter contains the discussion of findings, limitation of the study, conclusion and recommendations.

CHAPTER FIVE
DISCUSSION

5.1. INTRODUCTION

Discussion of the findings is done according to the research objectives and research questions and the discussion is followed by the conclusion and recommendations within the context of the limitations of the study.

The present study was done within referral hospitals in Kigali-Rwanda to estimate the prevalence of ELBW neonates hospitalized in referral hospital in Kigali (NICU and Neonatology); to identify morbidities experienced by ELBW neonates hospitalized, and to determine the maternal risk factors related to ELBW neonates hospitalized in referral hospital in Kigali.

5.2. DISCUSSION

5.2.1. Proportion of ELBW neonates

The findings from the present study revealed a proportion of 2.08% (n=108) among ELBW neonates hospitalized. The proportion of ELBW neonates was calculated from all newborns (birth life) from January, 2020 to December, 2020. This number is not surprising as these referral hospitals admit mothers transferred by provincial and district hospitals who were already suspected of having a pregnancy complication as suggested by the Rwanda's health system (48). These mothers are referred for further management of mothers and their neonates as well. These findings are not consistent with a research conducted in Mexico that revealed the prevalence of 3.1 per 1000 newborns.(49)

5.2.2. The outcome of neonate with ELBW

5.2.2.1. The major and minor morbidities experienced by ELBW neonates

The current study revealed that infection was the major morbidity experienced by a neonate with ELBW and apnea episode as minor morbidity. Findings from the present research are consistent with researches conducted in India suggesting that respiratory distress syndrome,

neonatal sepsis and hyperbilirubinemia, intraventricular hemorrhage and NEC as the most common morbidities.(50–52) However, a study conducted in China revealed differences in terms of neonatal morbidity, suggesting that respiratory distress syndrome and intraventricular hemorrhage are the most common morbidities among ELBW neonates.(53) The findings from the present research are inconsistent with the research conducted in Brazil, suggesting that most common morbidities during hospitalization included patent ductus arteriosus, intraventricular haemorrhage, sepsis, hypothermia, and hypoglycemia (54). In India, another study found similar findings to the current study suggesting that respiratory distress, neonatal hyperbilirubinemia, and sepsis were the most common morbidity among ELBW neonates (55).

5.2.2.2. Causes of death among ELBW neonates

The present research revealed major cause of death of neonates with ELBW as severe prematurity followed by neonatal infection. With regards to the cause of death of neonates with ELBW, the results are similar to the study conducted locally internally, suggesting causes of death among ELBW neonates. For example, in South Korea, the primary cause of death in ELBW neonates was the most common infection, followed by RDS/BPD, and congenital defects. A study conducted in Mexico revealed that neonates weighing <1000g died mostly from prematurity.(49) However, a study carried out in Eritrea revealed that main causes of death included respiratory distress syndrome, with extremely low birth weight. In India, pulmonary hemorrhage and neonatal infection as the main prevalent cause of mortality among ELBW neonates and respiratory distress syndrome (50). In an Ethiopian study revealed similar findings to the current study in terms of causes of death among ELBW neonates. These findings suggested hypothermia, sepsis, RDS, jaundice, congenital anomaly morbidities are main causes of death.(34)

5.2.3. Neonatal related factors

Findings revealed that the majority of ELBW neonates was male. Regarding social classes, the majority ELBW neonates was born in second class' families, where the economic category was low. The majority of ELBW neonates was born in referral hospitals because they transferred for further management where they find advanced care.

In addition, the majority of deliveries was caesarean section due to emergency health care for the mother and foetus in critical condition

The surviving rate of ELBW is due to advanced gestational age and birth body weight of more than 32 weeks. More birth weight increased surviving rate will. The major birth weight was between 901-1000 grs

In addition, descriptive statistics showed that the maximum birth weight was 1000 grs 37%; and the minimum birth weight was 500grs 0.9%. Also, the distribution of ELBW neonates in regard of birth weight was confirmed by the central measure tendencies (M=881.3241; SD 132.5959; Me=910). The ELBW neonates were born at referral hospitals, district hospitals, health centres and at home. Thus, some ELBW neonates were admitted without information on the APGAR score at birth for some born at home or hospitals but needed of emergency neonatal care. Only 87.03% were admitted with APGAR score information

The APGAR score found at first one minute, first five minutes and first ten minutes was categorised into three classes, namely class 1 (1-5 score), class 2 (6-7 score) and class 3 (8-10 score).

At 1 minute the majority of ELBW neonates was born with the APGAR score between 6-7 score. At 5 minutes after delivery, the majority of ELBW neonates reached the APGAR score between 8-10 score (44.6%). The maximum APGAR score at 1 minute after delivery was 9 and the minimum was 1 and the maximum APGAR score at 5 minutes after delivery was 10 and the minimum was 1. Lastly, the APGAR score at 10 minutes after delivery, the majority of ELBW neonates had achieved the APGAR score between 8-10 score (61.7 The maximum APGAR score at 10 minutes after delivery was 10 and the minimum was 1.

5.2.4. Maternal related factors associated with ELBW neonates

Findings from the present research showed that most mothers of ELBW neonates were exposed to malaria and HIV. However, the mothers were less exposed to Hepatitis B, while no mother was exposed to Syphilis. Hypertension, preeclampsia and PROM were the most pregnancy complications found among mothers of ELBW neonates, while previous preterm and diabetes mellitus were the less prevalent among mothers of ELBW neonates. Lastly, alcohol was most prevalent among mother of ELBW neonates. These findings are in line with a research conducted in USA which reported that 34% subjects who reported of have been exposed the the alcohol. Within the exposed group, 15% reported drinking ≥7 drinks/week and 85% of the subjects reported drinking <7 drinks/week.(56) No one used drugs in her previous life. The

results from the present research are similar to the study suggesting the most pregnancy complications that were PROM; hypertension (34). Also, a study conducted in India stressed that preterm and gestational hypertension are classified among the most pregnancy complications of mothers of ELBW neonates (52).

5.2.5. Institution related factors

Findings from this study revealed that continuous positive airway pressure and Ventilator machine are the most respiratory support related to the increasing of neonatal surviving. The results from the present research are consistent to the study conducted in India that reported that the most common respiratory support was nasal CPAP and conventional ventilation. These findings are consistent with international findings suggesting the necessity of neonatal respiratory support to ELBW neonates (39).

A study conducted by Mangat A, et al suggest that mask leaks occurred in 51% of recordings within just the first 2min of PPV while the substantial mask leaks ranging from 24% to 59% during mask ventilation. However, continuous positive airway pressure (CPAP) ventilation using nasopharyngeal tube in the in maternity may result into low rates of endotracheal intubation and mechanical ventilation in extremely low birth weight neonates in comparison of bag and mask ventilation (40). Wheeler and colleagues showed that the utilization of NIV for respiratory support, almost 50% of infants < 28 weeks gestational age go on to require intubation and mechanical ventilation, with risk increasing with gestational age. In addition, 70% of infants receive invasive mechanical ventilation preceding initiation of CPAP when they are in Maternity room. Invasive mechanical ventilation continues to be the pillar of respiratory support for premature infants with RDS (39)

5.3. RELATIONSHIP BETWEEN VARIABLES

5.3.1. Associations between sociodemographic factors and outcome of ELBW neonates

Findings from this study revealed a significant association between birth weight and outcome of ELBW neonates (p=0.004), suggesting that a higher number of ELBW neonates died with birth weight < 700grs. Also, the current study showed that an important number of ELBW neonates who died were between 24-28 weeks and less than 24 weeks of gestational age. These findings are almost similar to international studies conducted in India and China, suggesting that high number of non-survivors were < 750g and < 28 weeks of gestational age

(47)(53)(57). Roy, suggested that the mortality rate was high in the 26-30 weeks of gestation babies, with weight below 800grs.(52) A study conducted in the USA revealed that the death rate was ranged between 0.2% for 36 weeks of gestation age to 76.5% for 22 weeks of gestation age.(58) The same situation was revealed in research conducted in China, suggesting an association between sociodemographic (gender, birth weight and gestation age) and outcome of ELBW neonates (59). Also, the same findings were revealed in a study conducted in Central Saudi Arabia, Hong Kong, and Mexico suggesting association of outcome (surviving and death) rate with the age of pregnancy and the weight at birth (60–62). The findings are supported by Indian researchers who confirmed that newborns >750 g or > 26 weeks of gestation had higher survival rates than newborns less than 750g or 26 weeks gestation at birth (55).

5.3.2. Association between APGAR score and outcome of ELBW neonates

Findings from the current study revealed that an APGAR score was correlated with the outcome of ELBW neonates, suggesting that an increase in APGAR score correlate with an increase of ELBW neonatal survival and a decrease in APGAR score correlates with an increase of death of ELBW neonates. These findings are similar to the research done in the USA, suggesting that increase in the Apgar score between 5 minutes and 10 minutes are correlated with a decrease neonatal mortality rate (58). Whereas, the study conducted in Central Saudi Arabian revealed a correlation of outcome of ELBW neonates with the APGAR score (60).

5.3.3. Association between institution related factors and outcome of ELBW neonates

Findings from the current study revealed that respiratory support (CPAP, ventilator machine and facial mask) was associated with the outcome of ELBW neonates (surviving of ELBW neonates). The finding of the present research is similar to the research conducted in China, suggesting a correlation between CPAP and mechanical ventilation and the outcome of ELBW neonates (59).

5.4. LIMITATIONS OF THE STUDY

Firstly, the limitation of the present research was that it was done in only Kigali city. Thus results cannot be generalized to the whole country (Rwanda). Secondly, colleagues and management was very kind and supportive of the data collection process and would be due to the employee status of the researcher. Lastly, COVID19 restrictions were hindering the process of data collection.

5.5. CONCLUSIONS

This study finding showed that ELBW proportion was high, survivor rate was low and death rate was high and there was high morbidity in ELBW neonates. The high proportion would be related to the fact that referral hospitals in Kigali admit pregnant women referred by District hospitals as they are in critical condition and risk of premature delivery for advanced care. The more birth weight was low the less chance of surviving was. Also, male gender advanced gestational age, APGAR score, receiving CPAP, being treated under ventilator machine were associated with survivor chance within 28 days. Results from the present research may contribute to the literature about the ELBW neonates in Rwanda regarding their proportion, neonatal morbidity, maternal related risk factors, causes of death and factors associated to the outcome of ELBW neonates (surviving and death).

5.6. RECOMMENDATIONS

It is recommended to put in place innovative strategies, measures like availability of ventilator machine in all District and referral hospitals and conducting many researches on ELBW neonates' outcomes and related factors would help to reduce morbidity and mortality in ELBW neonates.

Additional research is recommended to clarify maternal and medical interventions to increase the rate of neonatal (ELBW) surviving. Also, interventional studies, specifically with health professional working in neonatology and NICU, are recommended to obtain empirical data related to ELBW neonates. It is important to explore the outcome of ELBW neonates after 28 days and follow up at home after being discharged from health institutions. Within the School of Nursing and midwifery in UR/ CMHS and other higher learning institutions, it is

recommended that curricula include the exposure of students to ELBW neonates via clinical placement by increasing their collaboration with the specialist in neonatology in Rwanda, which in return will increase the capacity of understanding. Availability of ventilator machines in District and referral hospitals are recommended.

REFERENCES

1. Mabhandi T, Ramdin T, Ballot DE. Growth of extremely low birth weight infants at a tertiary hospital in a middle-income country. BMC Pediatr. 2019;19(1):1–9.
2. UNICEF. Neonatal mortality - UNICEF DATA. unicef. 2019.
3. Chawanpaiboon S, Vogel JP, Moller AB, Lumbiganon P, Petzold M, Hogan D, et al. Global, regional, and national estimates of levels of preterm birth in 2014: a systematic review and modelling analysis. Lancet Glob Heal. 2019 Jan;7(1):e37–46.
4. Yasmin S, Osrin D, Paul E, Costello A. Neonatal mortality of low-birth-weight infants in Bangladesh. 2017.
5. Tripathy SK, Chatterjee K, Behera N. Mortality and morbidity of very low birth weight and extremely low birth weight babies in neonatal period Mortality and morbidity of very low birth weight and extremely low birth weight babies in neonatal period. 2019;(February).
6. Smith LK, Draper ES, Field D. Long-term outcome for the tiniest or most immature babies: Survival rates. Vol. 19, Seminars in Fetal and Neonatal Medicine. W.B. Saunders Ltd; 2014. p. 72–7.
7. Tripathy SK, Chatterjee K, Behera N. Mortality and morbidity of very low birth weight and extremely low birth weight babies in neonatal period. Int J Contemp Pediatr. 2019;6(2):645.
8. Lakshmi CVS, Pramod G, Geeta K, Subramaniam S, Rao MB, Kallapur SG, et al. Outcome of very low birth weight infants with abnormal antenatal doppler flow patterns: A prospective cohort study. Indian Pediatr. 2013;50(9):847–52.
9. Morris M, Cleary JP, Soliman A. Small baby unit improves quality and outcomes in extremely low birth weight infants. Pediatrics. 2015 Oct;136(4):e1007–15.
10. Lui K, Lee SK, Kusuda S, Adams M, Vento M, Reichman B, et al. Trends in Outcomes for Neonates Born Very Preterm and Very Low Birth Weight in 11 High-Income Countries. J Pediatr. 2019;215:32-40.e14.
11. Dusingizimana V, Small M, Teteli R, Rulisa S, Magriples U. Maternal and neonatal morbidity and mortality associated with preterm premature rupture of membranes prior to 34 week gestation at kigali university teaching hospital: A retrospective and prospective study. Rwanda Med J. 2019;76(4):1–5.
12. Ogawa M, Matsuda Y, Kanda E, Konno J, Mitani M, Makino Y, et al. Survival Rate of

Extremely Low Birth Weight Infants and Its Risk Factors : Case-Control Study in Japan. 2013;2013.

13. Sahoo T, Anand P, Verma A, Saksena M, Sankar MJ, Thukral A, et al. Outcome of extremely low birth weight (ELBW) infants from a birth cohort (2013–2018) in a tertiary care unit in North India. J Perinatol [Internet]. 2020;40(5):743–9. Available from: http://dx.doi.org/10.1038/s41372-020-0604-6
14. Behrman RE, Butler AS, Outcomes I of M (US) C on UPB and AH. Societal Costs of Preterm Birth. 2007;
15. Lau C, Ambalavanan N, Chakraborty H, Wingate MS, Carlo WA. Extremely low birth weight and infant mortality rates in the United States. Pediatrics. 2013;131(5):855–60.
16. Chang C, Chen W, Mcaleer M. Survival Analysis of very Low Birth Weight Infant Mortality in Taiwan. 2014;
17. Kalimba EM, Ballot DE. Survival of extremely low-birth-weight infants. SAJCH South African J Child Heal. 2013;7(1):13–6.
18. Pattinson R, Kerber K, Waiswa P, Day LT, Mussell F, Asiruddin S, et al. Perinatal mortality audit: Counting, accountability, and overcoming challenges in scaling up in low- and middle-income countries. In: International Journal of Gynecology and Obstetrics. John Wiley and Sons Ltd; 2009. p. S113-21.
19. Marchant T, Willey B, Katz J, Clarke S, Kariuki S, ter Kuile F, et al. Neonatal Mortality Risk Associated with Preterm Birth in East Africa, Adjusted by Weight for Gestational Age: Individual Participant Level Meta-Analysis. PLoS Med. 2012 Aug;9(8).
20. Arunda MO, Agardh A, Asamoah BO. Survival of low birthweight neonates in Uganda: Analysis of progress between 1995 and 2011. BMC Pregnancy Childbirth. 2018;18(1):1–12.
21. Making Every Baby Count Audit and review of stillbirths and neonatal deaths. 2016.
22. Waiswa P, Kallander K, Peterson S, Tomson G, Pariyo GW. Using the three delays model to understand why newborn babies die in eastern Uganda. Trop Med Int Heal. 2010 Aug;15(8):964–72.
23. 1 RW, 2 TP, 3 AL, 4 NVM, 5 PCR, 6 DNM, et al. Trends in Neonatal Mortality in Rwanda, 2000–2010 Further Analysis of the Rwanda Demographic and Health Surveys. ICF Int Calverton, Maryland, USA. 2013;(August):2000–10.
24. Musafili A, Persson LÅ, Baribwira C, Påfs J, Mulindwa PA, Essén B. Case review of perinatal deaths at hospitals in Kigali, Rwanda: Perinatal audit with application of a

three-delays analysis. BMC Pregnancy Childbirth. 2017 Mar;17(1):85.
25. Beck CT. Critiquing qualitative research. AORN J. 2009;90(4):543–54.
26. Neonatal Mortality Risk Associated with Preterm Birth in East Africa, Adjusted by Weight for Gestational Age: Individual Participant Level Meta-Analysis.
27. Sousa DS, Sousa Júnior AS, Santos ADR, Melo EV, Lima SO, Almeida-Santos MA, et al. Morbidity in extreme low birth weight newborns hospitalized in a high risk public maternity. Rev Bras Saúde Matern Infant. 2017;17(1):139–47.
28. Wilson-Costello D. Is there evidence that long-term outcomes have improved with intensive care? Semin Fetal Neonatal Med. 2007 Oct;12(5):344–54.
29. Sritipsukho S, Suarod T, Sritipsukho P. Survival and outcome of very low birth weight infants born in a university hospital with level II NICU. J Med Assoc Thail. 2007 Jul;90(7):1323–9.
30. Survival and morbidity in extremely low birth weight (ELBW) infants - PubMed.
31. UNICEF. The State of the World's Children | UNICEF. 2021.
32. Lim JW, Chung SH, Kang DR, Kim CR. Risk factors for cause-specific mortality of very-low-birth- weight infants in the Korean Neonatal Network. J Korean Med Sci. 2015;30(Suppl 1):S35–44.
33. Andegiorgish AK, Andemariam M, Temesghen S, Ogbai L, Ogbe Z, Zeng L. Neonatal mortality and associated factors in the specialized neonatal care unit Asmara, Eritrea. BMC Public Health. 2020;20(1):1–9.
34. Kebede BF. Morbidity and Mortality Pattern of Preterm Low Birth Weight Neonates Admitted in Amhara Region Refferal Hospitals of Ethiopia Retrospective Follow- Up Study Introduction : Methodology : 2021;1–14.
35. Desta SA, Damte A, Hailu T. Maternal factors associated with low birth weight in public hospitals of Mekelle city, Ethiopia: A case-control study. Ital J Pediatr. 2020;46(1):1–9.
36. Girma S, Fikadu T, Agdew E, Haftu D, Gedamu G, Dewana Z, et al. Factors associated with low birthweight among newborns delivered at public health facilities of Nekemte town, West Ethiopia: A case control study. BMC Pregnancy Childbirth. 2019;19(1):1–6.
37. Moradi G, Khazaei Z, Esmailnasab N, Roshani D, Zokaii M, Ghaderi E, et al. The relationship between maternal diseases during pregnancy and low birth weight: A nested case-control study in rural areas of Kurdistan province (West of Iran). Int J Pediatr. 2017;5(8):5501–14.

38. Manouchehri E, Fathi Najafi T, Vafaee Najar A, Alirezaei S, Molkizadeh M, Larki M. Maternal Factors Associated with Low Birth Weight in Kashmar, Iran. J Midwifery Reprod Heal. 2021;9(1):2621–7.
39. Wheeler CR, Smallwood CD. 2019 year in review: Neonatal respiratory support. Respir Care. 2020;65(5):693–704.
40. Mangat A, Bruckner M, Schmölzer GM. Face mask versus nasal prong or nasopharyngeal tube for neonatal resuscitation in the delivery room: A systematic review and meta-analysis. Arch Dis Child Fetal Neonatal Ed. 2021;106(5):561–7.
41. Kornacka MK, Musialik-Swietlińska E, Swietliński J, Ksiazyk J, Migdał M, Brozek G, et al. Usefulness of the Apgar score: a national survey of Polish neonatal centers. Ginekol Pol [Internet]. 2011;82(1):39–43. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21469520
42. Papageorgiou A. Management and outcome of extremely low birth weight infants. J Perinat Med. 2017;45(Supplement 2):190.
43. Williams JR, Lueke SB. 360° feedback system effectiveness: Test of a model in a field setting. J Qual Manag. 1999 Jan;4(1):23–49.
44. Dusingizimana V, Small M, Teteli R, Rulisa S, Magriples U. Maternal and neonatal morbidity and mortality associated with preterm premature rupture of membranes prior to 34 week gestation at Kigali University Teaching Hospi-tal: A retrospective and prospective study.
45. Moser A, Korstjens I. Series: Practical guidance to qualitative research. Part 3: Sampling, data collection and analysis. Vol. 24, European Journal of General Practice. Taylor and Francis Ltd; 2018. p. 9–18.
46. Conceptual framework for maternal and neonatal mortality and morbidity.
47. Suresh K, Chandrashekara S. Sample size estimation and power analysis for clinical research studies. Vol. 5, Journal of Human Reproductive Sciences. Wolters Kluwer -- Medknow Publications; 2012. p. 7–13.
48. MNCH. Maternal Newborn and Child Health Strategic Plan. Matern Newborn Child Heal Strateg Plan. 2018;(July).
49. Iglesias-Leboreiro J, Bernardez-Zapata I, Ramírez-Haua J, González-Morán R, Rendón-Macías ME. Mortality in Extremely Low-Birth-Weight Neonates in México City (1985–2009). Int J Pediatr. 2010;2010:1–8.
50. Tagare A, Chaudhari S, Kadam S, Vaidya U, Pandit A, Sayyad MG. Mortality and morbidity in extremely low birth weight (ELBW) infants in a neonatal intensive care

unit. Indian J Pediatr. 2013;80(1):16–20.

51. Eichenwald EC. Predictors of mortality and morbidity in extremely low birth weight neonates. Indian Pediatr. 2013;50(12):1088–9.
52. Roy KK, Baruah J, Kumar S, Malhotra N, Deorari AK, Sharma JB. Maternal antenatal profile and immediate neonatal outcome in VLBW and ELBW babies. Indian J Pediatr. 2006;73(8):669–73.
53. Lin HJ, Du LZ, Ma XL, Shi LP, Pan JH, Tong XM, et al. Mortality and morbidity of extremely low birth weight infants in the mainland of china: A multi-center study. Chin Med J (Engl). 2015;128(20):2743–50.
54. Sousa DS, Duarte A, Santos R, Melo EV, Reis FP. Morbidity in extreme low birth weight newborns hospitalized in a high risk public maternity. 17(1):139–47.
55. Mukherjee S, Shaw SC, Devgan A, Srivastava AK, Mallige A. Survival and morbidities in very low birth weight (VLBW) infants in a tertiary care teaching hospital Survival and morbidities in very low birth weight (VLBW) infants in a tertiary care teaching hospital. 2017;(October).
56. Gauthier TW, Guidot DM, Kelleman MS, McCracken CE, Brown LAS. Maternal Alcohol Use During Pregnancy and Associated Morbidities in Very Low Birth Weight Newborns. Am J Med Sci [Internet]. 2016;352(4):368–75. Available from: http://dx.doi.org/10.1016/j.amjms.2016.06.019
57. Tagare A, Chaudhari S, Kadam S. Mortality and Morbidity in Extremely Low Birth Weight (ELBW) Infants in a Neonatal Intensive Care Unit. 2013;80(January):16–20.
58. Cnattingius S, Johansson S, Razaz N. Apgar Score and Risk of Neonatal Death among Preterm Infants. N Engl J Med. 2020;383(1):49–57.
59. Thakur N, Saili A, Kumar A, Kumar V. Predictors of mortality of extremely low birthweight babies in a tertiary care centre of a developing country. Postgrad Med J. 2013;89(1058):679–84.
60. Abolfotouh MA, Al Saif S, Altwaijri WA, Al Rowaily MA. Prospective study of early and late outcomes of extremely low birthweight in Central Saudi Arabia. BMC Pediatr. 2018;18(1):1–9.
61. Hon KL, Liu S, Chow JCY, Tsang KYC, Lam HS, So KW, et al. Mortality and morbidity of extremely low birth weight infants in Hong Kong, 2010-2017: A single-centre review. Hong Kong Med J. 2018;24(5):460–5.
62. Unit N. Conditions associated with mortality in neonates weighing < 1000 g at the Obstetrics-Gynecology. 2006;

APPENDIX:

APPENDIX 1: DATA ABSTRACTION INSTRUMENT

Study number…….Date…… Data collection initials…….

PART I. Maternal demographics (Fill in space, or Tick correct box)

1. Maternal Age (years)

2. Economic category:

1	2	3	4

3. Maternal occupation

Jobless	Public worker	Self- occupation	Housewife	Private sector

Obstetrical History – (*any information would be helpful)*

Gravida	Term	Preterm	AB	Living children

4. Lifestyle use:

Alcohol	Tobacco	Drug abuse

5. The exposures:

Malaria	HIV	Syphilis	Other (specify)

6. Maternal blood group

7. ANC (visit times)

1	2	3	4

8. Use of Traditional medicine

9. Pregnancy Complications

HTN	Diabetes	PPROM	Bleeding	Previous preterm	Rupture of membranes	Other

PART II. Neonatal characteristics

10. Hospital NICU and Neonatology

CHUK	KFH	RMH

11. Place of Birth

Hospital	Health center	Home

12. Date of Birth

13. Type of delivery

SVD	C/S

14. APGAR

1 min:	5 min:	10 min:

15. Any resuscitation done

None	Positive pressure ventilation	Chest compression	Adrenaline	Others

16. Birth weight: (g)

17. Gender:

1. Female	2. Male

18. Gestational age:

Weeks:	Days:

21.Admission diagnosis

22.Preferred feeding

Breast milk	Formula

PART III. NICU and neonatology hospitalization course

19. Neonatal composite morbidity :(Tick what applies)

1. Major Morbidities

RDS	HIE	Infection	IVH	NEC

2. Minor morbidities

Hypoglycemia	Hypothermia	Hyper-bilirubinemia	Apnea episodes	Feeding difficulties	Others

20. Neonate Needing Respiratory Support

CPAP	Respiratory machine	Nasal Prongs	Facial mask	Oxygen hood

21. Neonatal hospital stays (days):

<1 or less than 23hrs	1-6	7-13	14-20	21-27	>28

22. Neonate died (days from birth):

Day 1 of birth	Day 2-6	Day 7 -13	14-20	21-28

23. Probable cause of death

HIE	RDS	NI	Pulmonary hypoplasia	Necrotizing enterocolitis	Other:

APPENDIX 2: Research Ethical Clearance from CMHS IRB

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/191/2021

BANKUNDIYE Mechtilde
School of Nursing and midwifery, CMHS, UR

Dear BANKUNDIYE Mechtilde

RE: ETHICAL CLEARANCE

Reference is made to your application for ethical clearance for the study entitled ***"Early Outcomes in Neonates with Extremely Low Birth Weight at Selected Referral Hospitals in Kigali, 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

APPENDIX 3: Review approval notice from CHUK

CENTRE HOSPITALIER UNIVERSITAIRE
UNIVERSITY TEACHING HOSPITAL

Ethics Committee / Comité d'éthique

3rd Sep.2021 Ref: EC/CHUK/103/2021

Review Approval Notice

Dear Mechtilde Bankundiye,

Your research project: ***"EARLY OUTCOMES IN NEONATES WITH EXTREMELY LOW BIRTH WEIGHT AT SELECTED REFERRAL HOSPITALS IN KIGALI, RWANDA "***

During the meeting of the Ethics Committee of University Teaching Hospital of Kigali (CHUK) that was held on 3rd Sep.2021 to evaluate your request for ethical approval of the above mentioned research project, we are pleased to inform you that the Ethics Committee/CHUK has approved your research project.

You are required to present the results of your study to CHUK Ethics Committee before publication by using this link:www.chuk.rw/research/fullreport/?appid=410&&chuk.

PS. Please note that the present approval is valid for 12 months.

Yours sincerely,

Dr Emmanuel Rusingiza Kamanzi
The Chairperson, Ethics Committee,
University Teaching Hospital of Kigali

ETHICS COMMITTEE
CHUK

Scan code to verify

" University teaching hospital of Kigali Ethics committee operates according to standard operating procedures (Sops) which are updated on an annual basis and in compliance with GCP and Ethics guidelines and regulations "

Web Site : www.chuk.rw ; B.P. 655 Kigali- RWANDA Tel : 00 (250) 252575462 E-Mail: chuk.hospital@chuk.rw

APPENDIX 4: Ethical approval from King Faisal Hospital

KING FAISAL HOSPITAL KIGALI

KING FAISAL HOSPITAL, RWANDA
ETHICS RESEARCH COMMITTEE

Patient Centered Care

12th July, 2021

ETHICAL APPROVAL

Dear Mechtilde BANKUNDIYE

We acknowledge receipt of your study protocol: **"Eraly outcomes in Neonates with extremely low birth weight at selected referral Hospitalsin Kigali, Rwanda"**

After a thorough review, the reviewers of KFH Ethics Research Committee consider this study relevant. The investigator is allowed to start data collection.

N.B.

- The investigator is ***requested to submit one hard copy of his final research results*** in the office of the Directorate of Education, Training and Research at King Faisal Hospital, Kigali

Best Regards

Dr. Dushimiy mana Jean Marie Vianney
Consultant ENT surgeon
Chair, Ethics Research Committee
King Faisal Hospital, Rwanda.

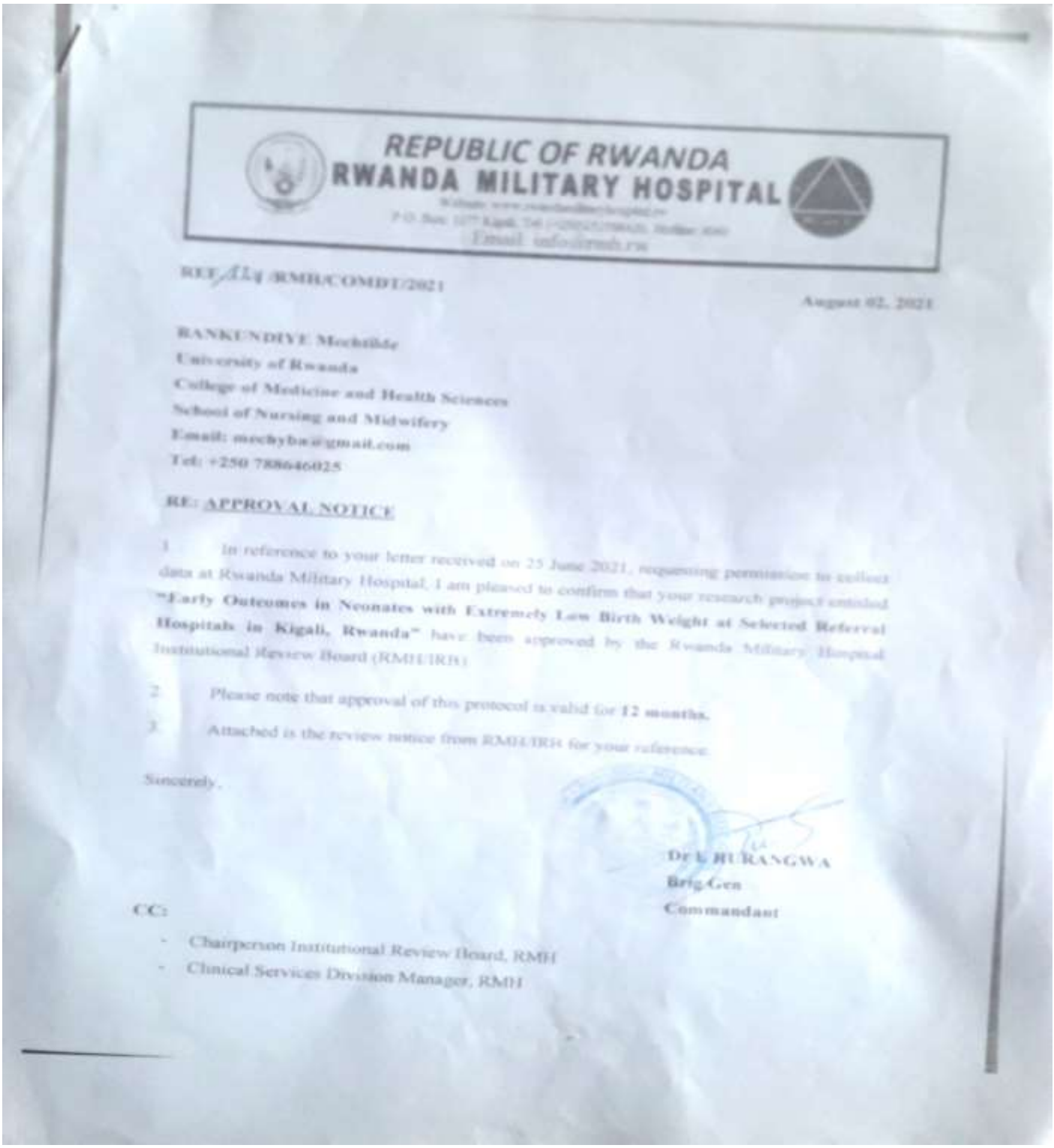
CC:

1. Chief Executive Officer_ KFH-Rwanda
2. Director of Education, Training & Research_KFH- Rwanda
3. Members of the Ethics Research Committee_KFH- Rwanda

King Faisal Hospital Kigali will become a Centre of Excellence in health services provision and clinical education in Africa

• TEL: +250 252 56[illegible] • FAX: +250 [illegible] • EMAIL: info@kfh.rw • Website: www.kfh.rw
GASABO DISTRICT, P.O. Box 2934 KIGALI, RWANDA

APPENDIX 5: Approval notice from Rwanda Military Hospital



REPUBLIC OF RWANDA
RWANDA MILITARY HOSPITAL
P.O. Box: 1077 Kigali, Tel (+250)
Email: info@rmh.rw

REF/[illegible]/RMH/COMDT/2021

August 02, 2021

RANKUNDIYE Mechtilde
University of Rwanda
College of Medicine and Health Sciences
School of Nursing and Midwifery
Email: mechybm@gmail.com
Tel: +250 788646025

RE: APPROVAL NOTICE

1. In reference to your letter received on 25 June 2021, requesting permission to collect data at Rwanda Military Hospital, I am pleased to confirm that your research project entitled **"Early Outcomes in Neonates with Extremely Low Birth Weight at Selected Referral Hospitals in Kigali, Rwanda"** have been approved by the Rwanda Military Hospital Institutional Review Board (RMHIRB).

2. Please note that approval of this protocol is valid for **12 months.**

3. Attached is the review notice from RMHIRB for your reference.

Sincerely,

DUKURANGWA
Brig Gen
Commandant

CC:

- Chairperson Institutional Review Board, RMH
- Clinical Services Division Manager, RMH

APPENDIX 6: Authorization of using the data abstraction instrument

Dr Vincent Dusingizimana
Senior Gynecologist
Kigali Teaching Hospital
Kigali
Email: vindus2005@gmail.com
Tel: 0788214231
04/12/2020

Mechtilde Bankundiye
University of Rwanda
College of Medicine and Health Sciences
Master's Program

Subject: AUTHORIZATION OF USING THE COLLECTION TOOL

Dear Mechtilde Bankundiye,

Thank you for being interested in my research entitled "Maternal and neonatal morbidity and mortality associated with preterm premature rupture of membranes prior to 34-week gestation at Kigali University Teaching Hospital" and looking forward to use our data collection tool in your study project for academic purpose entitled as "Outcome of neonatal extremely low birth weight at referral hospital in Rwanda"

I am here to authorize you to use the collection tool, I used in the above-mentioned research. Please good luck in your studies.

Best Regards,
Dr Vincent Dusingizimana

APPENDIX 7: Submission approval from supervisor

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:

BANKUNDIYE Mechtilde

Title of the project:

Early outcome in neonates with extremely low birth weight at selected referral hospitals in Kigali Rwanda

a. *Declaration by the Student*

I do hereby declare that this ***dissertation*** submitted in partial fulfilment of the requirements for the degree of **MASTERS 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: ----------

14th March, 2022

b. *Authority to Submit the dissertation*

Surname and First Name of the Supervisor:

Dr. Pamela Meharry

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

Date and Signature of the Supervisor/Co-Supervisor

14 March 2022