

**SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
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**DETERMINANTS OF THE OUTCOMES OF PRETERM INFANTS AT THE
KORLE BU TEACHING HOSPITAL NEONATAL INTENSIVE CARE UNIT.**

BY

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DECLARATION

I declare that this dissertation is the result of my own original research work conducted under the supervision of Dr. Deda Ogum Alangea and no portion or whole of this work has been published or presented elsewhere for another degree. Published literature of other researchers cited in my work has been duly acknowledged by means of referencing.

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DATE

DEDICATION

This research is dedicated to my dear husband, Mr. Kwasi Adu Boahen for his unflinching support. And to my wonderful kids: Uriel and Annemarie Adu Boahen, you are a great source of inspiration.

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ABSTRACT

Introduction: Preterm births are deliveries that occur before 37 completed gestational weeks with its lower cut off limit of viability varying based on the geographic location. Preterm births may be as a consequence of obstetric interventions from fetal or maternal indications or spontaneous preterm labor with no apparent precursors. This study sought to determine the outcomes of preterm infants managed at the Korle Bu Teaching Hospital Neonatal Intensive Care Unit (NICU) and the factors affecting the outcomes.

Method: A retrospective analysis of data from all medical records of preterm infants admitted to the Korle Bu Teaching Hospital NICU between January 2017 and May 2019. A data extraction form was used to extract relevant available information on both mother and infant, characteristics, health status and infant outcome at discharge. Univariate analyses of categorical variables were expressed as frequencies and proportions. Chi square analysis and logistic regression were used to determine factors associated with outcomes of preterm births. P-values less than 0.05 were considered to be statistically significant.

Results: Out of the 1274 preterm neonate's data reviewed in this study, 70.3% survived and were discharged from the NICU. Reasons for admission to NICU included being preterm only (87.5%), being preterm with asphyxia (8.7%) and being preterm with respiratory distress (2.4%). Less than half (43.5%) of the neonates were resuscitated prior to admission at NICU. More than a third (36.3%) were very low birth weight (<1.5kg to 1kg), almost half (45.3%) were low birth weight (<2.5kg to 1.5kg) with 8.4% being normal weight babies (2.5kg and above). With respect to gestational age, almost half (48.9%) were born moderate to late preterm with only 7.1% born extremely preterm.

Increasing trend in preterm infant admissions had corresponding increased trend in preterm deaths. Factors influencing outcome of preterm deliveries include being an extremely low birth weight infant <1kg (AOR=22.03, 95%CI: 9.23-52.57, $p<0.001$), being a very low birth weight infant (AOR=3.24, 95%CI: 1.64-6.39, $p<0.001$), being low birth weight (AOR=1.21, 95%CI: 0.63-2.37, $p<0.001$), being born extremely preterm (AOR=12.02, 95%CI: 5.47-26.44, $p<0.001$), and being born very preterm (AOR=1.85, 95%CI: 1.33-2.59, $p<0.001$). Non-resuscitated babies (AOR=0.53; 95%CI: 0.40-0.71; $p<0.001$) and absence of congenital anomalies (AOR=0.18; 95%CI: 0.09-0.34; $p<0.001$) were also predictors of outcomes of preterm infants.

Conclusion: Preterm babies admitted to the Korle Bu Teaching Hospital NICU have high chances of survival. Low birth weight, low gestational ages, congenital anomalies as well as need for resuscitation remain major factors influencing death or survival of preterm babies.

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LIST OF ABBREVIATIONS

A and D Book	Admissions and Discharges Book
AOR	Adjusted Odds Ratio
BMI	Body Mass Index
CDC	Centre for Disease Control
CI	Confidence Interval
CPAP	Continuous Positive Airway Pressure
COR	Crude Odds Ratio
ELBW	Extreme Low Birth Weight
GHS	Ghana Health Service
IMR	Infant Mortality Rate
JHS	Junior High School
KBTH	Korle Bu Teaching Hospital
LBW	Low Birth Weight
MOH	Ministry Of Health
NDD	Neurodevelopmental Disability
NICU	Neonatal Intensive Care Unit
NMR	Neonatal Mortality Rate
SHS	Senior High School
VLBW	Very Low Birth Weight
WHO	World Health Organization

DEFINITION OF TERMS

Preterm	A baby born alive before 37 completed weeks of gestation
Gestational Age	Length of pregnancy from the first day of a woman's last menstrual cycle to the current date. It is measured in weeks. A normal gestation is 37 completed weeks
Extreme Preterm	A preterm with a gestational age of < 28 weeks
Very Preterm	A preterm with gestational age of 28 weeks and above but < 32 weeks (31 weeks + 6 days)
Moderate Preterm	A preterm with gestational age of 32 weeks and above but < 34 weeks (33 weeks + 6 days).
Late Preterm	A preterm with gestational age of 34 weeks and above but < 37 weeks (36 weeks +6 days).
Normal birth weight	The first weight obtained after birth ideally within the first hour of life before any postnatal weight loss. Normal birth weight is 2.5kg (2500g) and above.
Extreme low birth weight	Birth weight below 1kg (1000g).
Very Low birth Weight	Birth weight of 1kg and above but < 1.5kg (1500g)
Low birth weight	Birth weight of 1.5kg but < 2.5kg
Neonate	Baby aged 28 days and below

Neonatal Mortality Rate	Number of neonates who die before 28 days of life in a given year per 1000 live births in that year.
Infant	A baby, from birth to 12 months of age.
Infant Mortality Rate	Number of deaths of babies before their first birthday in a given year per 1000 live births in that year
Under Five Mortality Rate	Measures the probability of children dying between birth and their fifth birthday expressed per 1000 live births.
Pulmonary Surfactant	Complex specific proteins, carbohydrates and lipids that lines the alveoli (air-liquid interface for gaseous exchange) to reduce surface tension and hence the work required for breathing. Full differentiation occurs between 24 to 34 weeks of gestation. Deficiency in the preterm infants born before 34 weeks is the cause of respiratory distress they manifest. Exogenous surfactant is the artificial surfactant introduced into the lungs within the first 2 hours of life to help with breathing.
Antenatal Corticosteroids	Course of steroids recommended for pregnant women with imminent preterm birth before 34 weeks of gestation. This has been found to significantly lower the severity and frequency of respiratory distress in preterm infants compared to mothers who are not given.
Continuous Positive Airway Pressure CPAP	A type of breathing support offered by a machine by continuously introducing airflow to constantly open the airways at a specific pressure. This is used in patients with spontaneous breathing.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Preterm births are deliveries that occur before 37 completed gestational weeks with its lower cut off limit of viability varying based on the geographic location. Preterm births may be as a consequence of obstetric interventions from fetal or maternal indications or spontaneous preterm labor with no apparent precursors. Globally, the preterm birth rate is estimated at 5-18% with the highest incidence in parts of Africa (Blencowe et al., 2012).

Risk factors for preterm births include fetal factors such as congenital anomalies, in-utero infections like TORCHES (toxoplasmosis, rubella, cytomegalovirus, herpes virus and syphilis infections), poor fetal growth and fetal distress. Other risk factors identified to be associated with preterm births include maternal obstetric and gynecologic conditions that compromise pregnancies such as pre-eclampsia/eclampsia and cervical incompetence. Multiple pregnancies and maternal lifestyle choices such as smoking, substance abuse and obesity are all risks associated with preterm births. Maternal socio-demographic factors such as age (extremes of maternal age; below 18 years and above 38 years of age), ethnicity, marital status, and education have all been linked to preterm births (Environmental Protection Agency & Center for Environmental Economics, 2017; Fuchs, Monet, Ducruet, Chaillet, & Audibert, 2018b; Shah, Zao, Ali, & Knowledge Synthesis Group of Determinants of preterm/LBW births, 2011).

Prematurity is the leading cause of deaths in children below 1 year globally. It also contributes the most to neonatal mortality rate (NMR). The bulk of neonatal deaths is contributed by deaths from preterm complications and second to pneumonia as the major cause of death in children under 5 years (World Health Organization, 2012a). Children are most vulnerable in the first 28 days of life, making survival in this period very crucial. This vulnerability is greater for preterm neonates due to their fragility and increased risk of complications beyond that of full-term neonates. One of the principal causes of death in the neonatal period in Ghana include death from preterm complications. From the Ghana National Newborn Health Strategy and Action Plan 2014-2018, death from preterm complications (29%) is one of the leading causes of neonatal mortality` second to infections which constitutes 31% of the neonatal deaths (Ghana Ministry Of Health, 2014). Hence about two - thirds of deaths in the pediatric unit with origins from the neonatal period will have a significant contribution from preterm birth complications.

According to a 2016 World Health Organization (WHO) report, 75% of the approximately one million deaths that occurred in the year 2015 are preventable with geographical disparities in death and survival rates (Althabe, Howson, Kinney, Lawn, & World Health Organization, 2016). Survival of extreme preterm infants has considerably increased in babies with gestational ages of 24 to 25 weeks from 1994 to 2005 (Field, Dorling, Manktelow, & Draper, 2008; Patel et al., 2015). These good outcomes are seen more in high income countries with less than 10% of those below 28 gestational weeks dying as against more than 90% dying in low income countries (World Health Organization, 2012a). The risk of morbidity and mortality increases with decreasing

gestational age and birth weight with the brain, lungs, intestines and eyes being most vulnerable to injury.

Surviving this period however comes with its peculiar morbidities. Apart from the risk of morbidity and mortality to the preterm infant, the mother, family and the health system, also suffer repercussions (Heida et al., 2016; Hodek, von der Schulenburg, & Mittendorf, 2011; Ionio et al., 2016). There are reports on an association between cognitive impairment and the long-term outcome of being born premature (Breeman et al., 2015). Hence, the need for long term follow-up to diagnose any cognitive disabilities. Preterm babies who survive the neonatal period are still at risk of death even after discharge (Field et al., 2008).

Documented risks for poor outcomes for preterm infants include lower extremes of gestational age and birth weights, congenital anomalies and the initial care given to the infants. The ethnicity/race of the preterm infant's mother has also been linked to the outcome (Mandy, 2019). Worldwide, survival for a given gestational age depends largely on the initial active evidence based care (Zeitlin et al., 2016). However, there are gaps that behold the factors that influence preterm outcomes owing to the cultural contrasts and the differences in care that exist in diverse parts of the world with the shift to evidence based medicine. The dissimilarities between countries has occurred due to scarcity of resources, such as skilled workers, ambulance services and equipment such as continuous positive airway pressure (CPAP) machines, mechanical ventilators and interventions with surfactant. Improved outcomes associated with initial evidence based care have been well researched (Mandy, 2019b).

A thorough use of evidence-based intervention such as administration of antenatal corticosteroids to pregnant women with imminent labor, the prevention of hypothermia, use of exogenous surfactant within the first 2 hours of life and use of an appropriate health facility for delivery have been associated with considerable gains.

1.2 Statement of the Problem

Current trend shows that preterm births are on the rise globally from 9.77% in the year 2000 to 10.60% in 2014 with Ghana recording 11.97% in 2014 (Chawanpaiboon et al., 2019). According to a report by WHO, (2018), the rate of preterm births across 184 countries ranges from 5% to 18% with most of the births contributed by sub-Saharan Africa and South Asia (World Health Organization, 2018b). Ghana's current profile on preterm birth rate is estimated at 14% (United States Agency for International Development (USAID), 2019). The anecdotal evidence from Korle Bu Teaching Hospital, a tertiary hospital in Accra, Ghana shows preterm infant admission estimates increasing from 46% in 2015 to 66% in 2017, out of which 48% died, which is an alarming death rate. With this trend of increase coupled with gaps in executing evidence-based care in the African sub-region and specifically Ghana, there is no doubt that NMR will be negatively affected since preterm infant deaths form a major proportion of this indicator.

Statistics from UNICEF, (2018) states that the global NMR in 2017 was 18 per 1000 live births with preterm deaths contributing about 34.8% in 2016, an increase from 31.2% recorded in the year 2000. Europe has recorded very good statistics over the past decade. For example, Netherlands recorded 3.2 per 1000 live births in 2007 and 2.3 per 1000 live

births in 2017. Africa over the years has recorded higher rates. However, Namibia with rates of 19.7 per 1000 live births in 2007 and 17.5 per 1000 live births in 2017 is one of the African countries with relatively low rates. Ghana on the hand has recorded recent reductions with 24.2 per 1000 live births in 2017 compared to 32.7 per 1000 live births recorded in 2007. Even though these rates have seen some improvement over the past decade, these gains are still not adequate, considering the Sustainable development Goal 3 targets, which aims to reduce NMR to 12 per 1000 live births and as well as deaths from prematurity by a third (UNICEF, 2018).

Halving the 2017 estimates will require massive efforts and understanding of the factors that contribute to the outcomes in order to achieve the target. This research is designed to illuminate the important associations of preterm infant death, which will be useful in care of these babies, which eventually culminates in decreased NMR.

1.3 Significance of the Study

The ability of the health sector to manage these preterm infants will depend on evidence such as what will be measured in this study. Evidence from this study will highlight the critical points or conditions that will require targeted efforts for increased successes at management.

1.4 Objectives of the Study

The general objective is to assess the outcomes of preterm infants managed at the Korle Bu Teaching Hospital Neonatal Intensive Care Unit (NICU) between January 2017 and May 2019.

1.4.1 Specific objectives

1. To determine the proportion of preterm infants who survived during admission at the Korle-Bu Teaching Hospital NICU.
2. To compare preterm infant admissions and deaths in Korle-Bu Teaching Hospital NICU.
3. To assess the factors that influence the deaths of preterm infants managed at the Korle-Bu Teaching Hospital NICU.

1.5 Research Questions

1. What proportion of preterm infants managed at the Korle Bu Teaching Hospital NICU survived?
2. What are the differences in the preterm infant admissions and deaths at the Korle-Bu Teaching Hospital NICU?
3. What are the contributory factors to the deaths of preterm infants managed at the Korle Bu Teaching Hospital NICU?

1.6 Conceptual Framework Narrative

The graphical representation of the factors that influence the outcome of preterm infants managed at the Korle Bu Teaching Hospital NICU in Ghana can be seen in Figure 1.

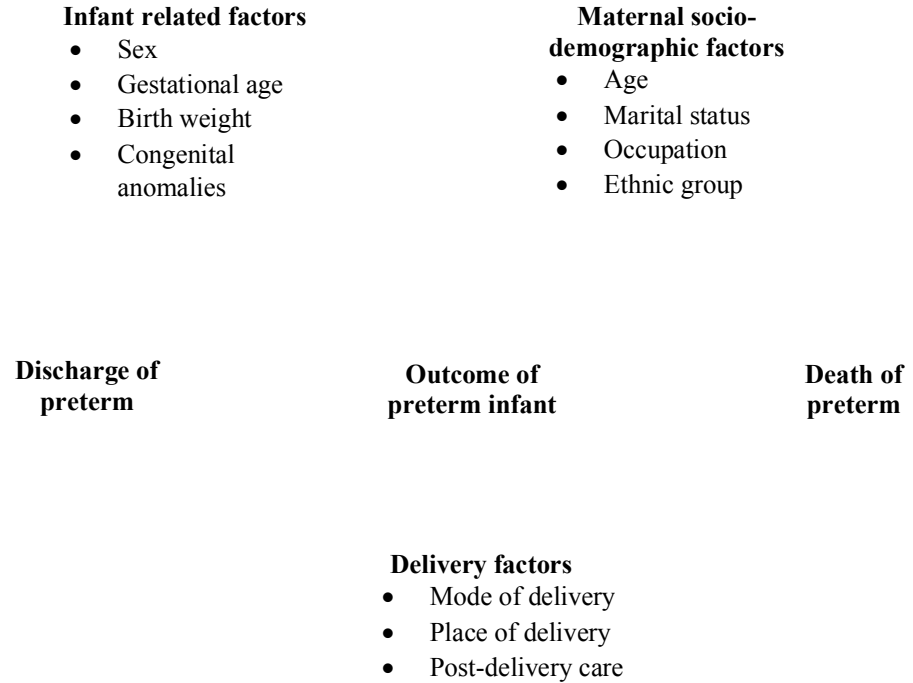
The etiologies of preterm births are multifactorial encompassing maternal socio-demographic factors, delivery related factors, and infant related factors. The complex interplay between these factors often determines the survival of preterm babies beyond

the first 28 days of life. The conceptual framework comprises of Independent variables (maternal socio-demographic, infant related, delivery) and Dependent variable (Outcome of Preterm deliveries). These independent variables originated from review of related studies where outcome of preterm deliveries (survival, death), is affected by delivery related factors, maternal socio-demographic factors, and infant related factors (Environmental Protection Agency & Center for Environmental Economics, 2017; López & Bréart, 2013; United States Agency for International Development (USAID), 2019).

Infant related factors assessed in the study are sex, gestational age, birth weight, and congenital anomalies. A direct effect on the outcome of the neonate has shown to be exerted by presence of congenital anomalies or any dysmorphism, sex gestational age and birth weight (Kent, Wright, & Mohamed, 2012; Watkins, Kotecha, & Kotecha, 2016).

Studies have documented an association between some maternal-socio-demographic factors and preterm infant outcomes (Mathews & MacDorman, 2007; Otterblad Olausson, Cnattingius, & Goldenberg, 1997; Voss, Jungmann, Wachtendorf, & Neubauer, 2012). The maternal socio-demographic factors measured in this study include age, marital status, ethnicity, and maternal occupation.

The delivery related factors such as mode of delivery, place of delivery, and post-delivery care have been identified to influence the outcome of preterm deliveries (Fischer et al., 2019a). Deliveries in hospitals, supervised by trained nurses and obstetricians with availability of fully equipped resuscitative tools and use of evidence-based care increase the chances of survival (Zeitlin et al., 2016). This assertion of improved outcomes linked with hospital deliveries is confirmed in a study by (Lorch, Baiocchi, Ahlberg, & Small, 2012). Their effect on the preterm infant will be examined in this study.



Source: Adapted from (Olusanya & Ofovwe, 2010)

Figure 1: Conceptual framework

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

Every pregnancy is associated with an outcome. Majority are uncomplicated but some may be adversely affected (Mother and Infant Home Visiting Program Evaluation (MIHOPE), 2018). The American College of Obstetricians and Gynaecologists and the Society for Maternal-Foetal Medicine classify a normal term pregnancy into; early term: 37 weeks + 0 days to 38weeks + 6days; full term: 39weeks + 0 days - 40 weeks +6 days; and late term: 41weeks + 0days – 41weeks + 6days (American College of Obstetricians Gynecologists, 2013).

Pregnancy outcomes include premature births, low birth weight and mortalities which may be perinatal, neonatal, post-neonatal or infant mortality depending on timing of the death (Centre For Disease Control, 2017). According to the Environmental Protection Agency & Center for Environmental Economics, (2017), preterm and post term births, low (2.5kg) and high birth weight (>4.0kg), neonatal deaths and presence of malformations at birth can be classified as adverse birth outcomes. Weng, Yang, & Chiu, (2014), also state low birth weight, preterm births, macrosomia, birth defects, intrauterine growth restriction, still birth and death within the first 28 days of life as adverse birth outcomes (Weng et al., 2014).

In summary, birth outcomes may include normal birth weight, low birth weight, macrosomia (high birth weight), congenital malformation, small for gestational age (intrauterine growth restriction), preterm birth, post term, neonatal death (death within the first 28 days of life) or still death. A newborn baby that results from a pregnancy that ends before or after a normal term pregnancy is labelled a preterm or post term infant respectively.

2.2 Preterm Infants

A preterm infant is a live baby born before normal term which is 37 completed weeks. (World Health Organization, 2016). The American College of Obstetricians and Gynecologists, (2019), defines it as “a baby born between 20 and 37 weeks of gestation” (Ref). The lower limit of viability varies with geographical location, hence authorities like the World Health Organization and specifically health departments in several countries do not have a mutual lower limit basically due to the care the newly born preterm infant receives and other factors documented to affect survival. Preterm infants can be categorized into extremely preterm, which is below 28 weeks, very preterm, which is 28 weeks to < 32weeks and moderate/late preterm being 32weeks to <37weeks (World Health Organization, 2012c).

The WHO estimates that about 15 million babies are born preterm annually with a rise in this figure. The rate of preterm deliveries ranges from 5% to 18% of all newborn babies across 184 countries (World Health Organization, 2018a). The causes of preterm births vary. However, most preterm births occur spontaneously while others happen due to early induction of labour or due to caesarean births. Obstetric conditions, such as multiple pregnancies, infections and chronic health conditions, such as high blood pressure and

diabetes, have also been known to influence preterm birth though no cause is often identified. There are other assertions that this adverse birth outcome may be influenced by genetics. A deeper understanding of the mechanisms and causes will help in developing solutions to prevent preterm delivery (Liu, Oza, Hogan, et al., 2016). Though preterm delivery is a global problem, more than half (60%) of preterm births are recorded in South Asia and Africa. In addition, about 12% of babies are born preterm in lower-income countries compared to 9% in high income countries. However, within countries, poor families have a heightened risk of having preterm babies (Blencowe et al., 2012). The WHO reports, there is a difference in survival rates of preterm infants depending on their location of birth. The organization reports that majority (90%) of extremely preterm babies who are born in low-income countries die a few days within the neonatal period whereas, just 10% of the same kind of preterm babies die in high-income countries (World Health Organization, 2018a).

2.3 Outcomes of preterm infants

Preterm delivery is an adverse birth outcome of public health concern. This is because it is a major cause of child morbidity and mortality in both developing and developed countries. The burdens of mortality and morbidity associated with preterm delivery are manifested by pregnancy outcomes. This adverse birth outcome is responsible for 75% of neonatal mortality as well as 50% of long term neurological impairments reported in children. (Radhanpuri, Desai, Sharma, & Kaur, 2014). Though there have been improvements in maternal and child health care, preterm delivery still lingers even in developed countries.

The health needs of preterm babies are extensive with reference to both post-natal support for preterm babies and their families as well as for some, lifelong support. It has been reported that preterm babies have a more increased risk for death compared to more matured babies. More so, those that survive are often impaired emotionally or cognitively and physically or both (Platt, 2014). Mortality and morbidity are two major outcomes of preterm babies. Globally, preterm infant complications are the predominant cause of neonatal deaths.

2.3.1 Mortality as an outcome of preterm infant births

It is reported that about 3.1 million babies die each year from premature deaths (World Health Organization, 2012). Research also shows that infants born below 23 weeks have the greatest risk of mortality (Mathews & MacDorman, 2010). However, there is 80% survival for those born at 26 weeks and more than 90% survival for those born after 27 weeks of gestation. Furthermore, infants born between 34 to 36 weeks have been reported to have a survival rate of 99%. This is comparable with a study conducted in Nigeria on the prevalence and outcome of preterm admissions in Nigeria among 634 babies. The study documented that 24% of the babies were delivered preterm. Findings from this study also showed that the most common morbidities reported among these preterm babies were respiratory problems, jaundice and sepsis (Kunle-olowu, Peterside, & Adeyemi, 2014).

Though survival of preterm babies increases with increase in gestational age, their mortality rate is more than 3 to 5 times that of full-term babies (Allen, Kim, & Cristofalo, 2011). The neonatal mortality associated with preterm infants reported in both developing and developed countries show variations. It is estimated that in developed countries, about 50% of preterm babies born at 24 weeks survive the first 28 days of life. This increases to 90% at 28 weeks of gestation. However, there is a sharp contrast in developing countries where about less than 10% of infants born at 28 weeks survive with only those born at 34 weeks or later that have more than 50% rate of survival (Allen et al., 2011; World Health Organization, 2012). A Nigerian study conducted on outcomes of preterm infants revealed that survival rate of preterm children was 65.9%. The study further reported survival varied based on the type of preterm birth. Children who were born in the mild preterm category had a significantly higher survival rate compared to those born very preterm and extremely preterm (Kunle-olowu et al., 2014).

2.3.2 Morbidity as an outcome of preterm infant births

Babies who are born preterm have a heightened risk of both long term and short-term problems. A deeper comprehension of long-term morbidities associated with preterm delivery has come from longitudinal studies particularly long-term abnormalities in children born before 26 weeks of gestation. Children who are born preterm are at risk of both infectious and non-infections respiratory difficulties with almost 40% of preterm survivors developing bronchopulmonary dysplasia (Platt, 2014). A population-based study conducted revealed that about 7% of preterm babies were discharged home on

oxygen. Again, preterm babies in their early years are often readmitted to the hospital due to complications of prematurity and or due to respiratory infection (Arpino et al., 2012).

Preterm delivery has also been linked with injuries to organ systems such as gastrointestinal tract, lungs, and eyes. Injuries to organ systems result in complications of prematurity, such as chronic lung disease, central nervous system injury and retinopathy of prematurity (Allen et al., 2011). Furthermore, studies have shown that neonatal morbidities tend to occur mostly in premature babies who are born at lower limits of viability. Also, these morbidities are linked with increased rates of mortality and adverse neurodevelopmental outcomes and overall health (Stoll, Hansen, Poindexter, & Finer, 2010).

The Centre for Disease Control and Prevention, (2017) opines that preterm babies who survive the neonatal period are at an increased risk for behavioral problems, developmental delays and disabilities and cognitive impairment (Centre For Disease Control, 2017). For instance, babies who are born preterm have an increased risk of depression, anxiety, attention-deficit-disorder and more autistic features compared to others born at term (Blair, Pickler, & Anderson, 2017; Sullivan, Msall, & Miller, 2012). Another growing concern associated with preterm deliveries is the increased risk of language delays, visual processing difficulties as well as executive dysfunctions. These impairments culminates in poor intellectual capabilities and extensive use of special educational resources which may be needed in adult life (Barre, Morgan, Doyle, & Anderson, 2011). These reports are further reinforced by empirical evidence that the neurocognitive impairments suffered by preterm survivors during childhood lingers on

into adulthood. Such individuals have been reported to demonstrate impaired visual and learning abilities as well as slow psychomotor processing speed (Maddalena, 2013).

Though these have been reported in extremely low birth weight babies, recent studies have found that there is also an increased risk of developmental delays as well as school-related problems even among healthy preterm infants who are born between 34 and 36 gestational weeks of pregnancy (Litt, Margevicius, Schlucter, Andreias, & Hack, 2012).

In conclusion, though babies who are born premature are bound to suffer unfavorable outcomes there are still interventions that can help reduce their burden. The WHO has published recommendations for pregnant women who have imminent preterm births. These interventions include antibiotics, the use of antenatal corticosteroids and magnesium sulfate. Also, care for preterm babies such as oxygen therapy, surfactant administration, temperature control as well as continuous positive airway pressure can help improve preterm birth outcomes (Vogel, Oladapo, Manu, Gulmezoglu, & Bahl, 2015). Additionally, WHO recommends that in order to gain grounds with the outcomes of preterm babies, health providers and health systems should be well equipped to readily assess gestational age, identify the signs of preterm labor, render compelling newborn care and implement interventions safely (Vogel et al., 2015).

2.4 Factors influencing outcomes of preterm infants

Different studies have reported varying factors that influence the outcomes of preterm infants. Allen and colleagues in 2011, conducted a study in the United States on outcomes of preterm infants. The study reported that outcomes such as injury to organs of preterm babies are due to factors which precipitated the preterm delivery such as

infections or inflammations. Their study also reported that insufficient protective factors such as thyroxin and cortisol also influenced outcomes in preterm infants. Another factor itemized by the study that influences outcomes in infants was the known and unknown side effects of treatments used during pregnancy (Allen et al., 2011).

2.4.1 Standard of preterm infant care

The scale of medical care received by preterm babies influences their outcomes. A study on the trends in static encephalopathy (cerebral palsy) in infants born prematurely and with a low birth weight revealed that the risk of static encephalopathy in these infants who survive the preterm deliveries varies, based on medical care received. The study further stated that preterm babies who received medical care at the institutional level or improved neonatal care over time had a lower risk of developing static encephalopathy (Platt et al., 2007). The factors influencing static encephalopathy reported by Platt are different from what other studies have reported. Advances in the initial care given to preterm infants has enhanced survival rates and this evidence based management varies based on geographical location as shown by improved survival in higher centers with well- equipped facilities. According to a study from Finland, preterm infants born in tertiary hospitals had higher chances of survival than their counterparts in level 2 hospitals (Helle, Hallman, & Tammela, 2007).

The WHO has outlined specific interventions which are malleable for use even in low resource settings. They involve simple every day methods such as kangaroo mother care which can be used for conserving heat in the preterm infant since they are prone to hypothermia, infection prevention practices, like hand washing with soap and water and

effective resuscitation at birth. Care for babies with respiratory difficulties or anticipated respiratory difficulties include continuous positive airway pressure ventilation (CPAP), exogenous surfactant administration as a substitute for the naturally occurring surfactant in the lungs, which reaches its full complement level by 34 weeks of gestation, and expert management of expectant mothers with imminent preterm deliveries with antenatal corticosteroids and antibiotics (World Health Organization, 2012b).

2.4.2 Preterm infant birth weight

The magnitude of prematurity with reference to gestational age and birth weights has an inverse relationship with survival. Therefore, a decline in the birth weight and gestational age is linked with decreased chances of survival. Low birth weight and poor preterm infant outcome have been documented to be linked. A study in Tanzania on the risk of death in the first 28 days of life and the first year of life in low birth weight babies revealed that these children have a greater risk of mortality in the neonatal period. The study further concluded that low birth weight babies have an increased risk of dying in the first year of life (Sania et al., 2017). Low birth weight as a correlate of outcomes of preterm delivery is again demonstrated in a study on neonatal mortality risk associated with preterm birth in East Africa. The study revealed that 99% of 445 low birth weight babies were born preterm or small for gestational age (SGA). In the same study, the findings indicated 52% of 87 deaths within the first 28 days of life occurred in SGA and preterm infants (Marchant et al., 2012).

2.4.3 Preterm infant gestational age

Outcomes, such as neurodevelopmental disability (NDD) among preterm babies have been reported to be influenced by gestational age. The risk of NDD increases with lower gestational age (McCormick & Litt, 2017). A study on early-childhood neurodevelopmental outcomes among children born less than 25 weeks of gestation revealed that male gender, intrauterine growth restriction, surgery and sepsis were strong predictors of cerebral palsy among preterm infants (Hintz et al., 2011).

2.4.4 Sex of preterm infant

Male preterm infants have been observed to have higher morbidity and mortality in infancy compared to their female counterparts. A study conducted on all-cause mortality of low birth weight infants in infancy, childhood and adolescence in England and Wales indicated that male children born preterm and having low birth weight had higher mortality rates up to the age of 18 years compared to females (Watkins et al., 2016). This is consistent with another study in Japan on how sex plays a role in morbidity and mortality of infants born prematurely. It was reported that the fundamental outcome, a complex of mortality and any other preterm complication such as neurologic injury, lung injury, retinopathy and necrotizing enterocolitis was worse in male preterm infants. The study further reported a heightened risk of bronchopulmonary dysplasia in these male preterm infants. The authors concluded male preterm infants were more likely to die from respiratory complications compared to female preterm infants (Ito, Tamura, & Namba, 2017).

2.4.5 Congenital anomalies

Congenital anomalies, an important predictor of infant mortality coupled with premature birth as an adverse birth outcome heightens the risk of mortality. A 10-year analysis of birth defects in a cohort of infants born with a very low birth weight revealed an increased risk of death within the first 28 days of life when compared with similar infants without birth defects (Adams-Chapman et al., 2013). Apart from the risk of mortality, there is also an increased risk of morbidity which is documented in a study conducted to determine milestone attainment and growth in extremely low birth weight infants. More than a 3-fold increased risk of repeated hospitalizations and a 2-fold increased probability of delayed milestones were documented when compared to other infants with same characteristics but without congenital anomalies (Walden et al., 2007).

2.4.6 Maternal socio – demographic characteristics

Maternal characteristics have also been reported to influence the outcomes of preterm infants. A study conducted in India on preterm birth and its outcome stated maternal socio-demographic characteristics such as race and age as some factors, which influence the outcomes of preterm birth (Radhanpuri et al., 2014). A retrospective study conducted among Canadian women also revealed maternal age influences preterm delivery. The study included records from 184,000 births from 32 different hospitals from 2008 to 2011. In the study, it was found that advanced maternal age of 40 years and more was associated with preterm delivery. However, women who were aged between 30 and 34 years had the lowest risk of birthing preterm babies. Again, the study reported that though preterm delivery was spontaneous among younger women, it was frequently iatrogenic in older women (Fuchs, Monet, Ducruet, Chaillet, & Audibert, 2018a).

Race is a factor which influences outcomes of health, in this case, outcomes of preterm delivery. Women who are classified as black, Afro-Caribbean and African-American have been consistently reported to have an increased risk of delivering preterm babies. Rates of preterm delivery range from 16% to 18% among black women compared to lower rates of 5% to 8% for white women. Furthermore, compared to women from other races, black women are three to four times more likely to birth very early preterm babies (Goldenberg, Culhane, Iams, & Romero, 2008). Aside the risk of preterm birth as an adverse birth outcome, race tends to have an effect on preterm infant survival. A description of the data of deaths within the first year of life in the United States of America revealed highest survival in preterm infants born to white mothers. Mortalities amongst preterm infants born to black mothers irrespective of whether they were Hispanics or non-Hispanics was higher than in the white mothers (Mathews & MacDorman, 2007).

Furthermore, maternal weight has been identified to be a predictor of preterm delivery and outcomes of preterm birth. A study on maternal obesity and risk factors for preterm delivery showed that higher rates of preterm delivery was reported in women with low body mass index (BMI) compared to normal weight women. Again, the study reported the higher the BMI of a woman, the higher the risk of preterm delivery. However, the study concluded that the mechanisms behind these observations remain unclear (Cnattingius et al., 2013). It has been described that a previous history of preterm delivery is a significant influencer of preterm deliveries and outcomes of preterm birth. Multiple pregnancies are also reported to influence outcomes of preterm delivery. Studies have shown that more than 50% of women with multiple pregnancies deliver

their babies at less than 37 weeks of gestation. Again, the studies reveal that women with multiple pregnancies contribute to about 20% of all preterm deliveries and to even a larger proportion of preterm infants (Abbott, Radford, Seed, Tribe, & Shennan, 2013; Koullali, Oudijk, Nijman, Mol, & Pajkrt, 2016). A Cameroonian study also reported multiple gestation increases the risk of preterm delivery by 3.8 folds (Chiabi et al., 2013).

Pregnancy and health conditions during pregnancy have also been identified to influence the outcome of preterm births. A study on maternal factors affecting the birth of preterm infants, revealed that uterine problems, placenta previa, placenta abruption and cervical incompetence increase the risk of preterm birth outcomes among pregnant women (Dadipoor, Alavi, & Golnam, 2017). This is consistent with a study conducted in Cameroon on risk factors for premature births among 1894 preterm children over a period of 7 years. In the study, conditions such as urinary tract infection and congenital malformations increased the risk of neonatal mortality among these preterm babies. Furthermore, findings from the study indicated the main causes of neonatal mortality among preterm babies were neonatal infections, neonatal asphyxia and congenital malformations (Chiabi et al., 2013). A study in Nigeria reported that premature- rupture of fetal membrane was a common risk factor for preterm births. In the same study, lack of antenatal care also increased the risk of adverse outcomes of preterm birth (Kunle-olowu et al., 2014).

Maternal lifestyle practices have also been established to influence the outcome of preterm babies. Smoking, the use of tobacco and heroine have been reported to increase the risk of adverse preterm outcomes (Dadipoor et al., 2017; Radhanpuri et al., 2014). Smoking, in relation to outcomes of preterm delivery has been correlated to the number

of cigarettes smoked in a day. A study by McCowan et al. (2009), hypothesized that smoking in pregnancy is strongly associated with systemic inflammatory response resulting which leads to adverse preterm birth outcomes (McCowan et al., 2009). The study further revealed the existence of a strong association between smoking and preterm delivery to be more common in children born less than 32 weeks (very preterm birth) of gestation compared to those born after 32 weeks of gestation (moderate preterm birth).

In conclusion, the outcomes of preterm births are influenced by a constellation of factors. Deep understanding of these factors is required to reduce the risk and burden of preterm deliveries. This will help reduce the long-term health impairments associated with preterm birth.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Design

The study design was a retrospective review of data on preterm outcomes at the Korle Bu Teaching Hospital NICU in Ghana. The review covered data on preterm births within a defined period spanning from January 2017 to May 2019. The study also used the quantitative research approach for data collection and analysis. Folders with complete data on preterm infants from the Korle Bu Teaching Hospital (KBTH) over the period were analyzed.

3.2 Study Area

The study was conducted at the Korle Bu Teaching Hospital NICU which is a tertiary referral centre in Accra, Ghana. It is equipped with 20 incubators, 20 cots and 10 radiant warmers. The NICU admits babies less than 24 hours old who have not yet received the oral polio vaccine. The unit manages approximately 2500 newborns annually with about 10 new admissions each day. Preterm babies account for 50 - 60 % of all new admissions. About 80% of the newborns admitted at the unit are referred from the KBTH labour wards and obstetric theatre. The rest are referred from peripheral hospitals. The newborns admitted are managed based on KBTH NICU protocols and guidelines until discharged.

3.3 Study Population

The study included all preterm infants admitted to the Korle Bu Teaching Hospital NICU in Ghana between January 2017 and May 2019.

3.4 Inclusion and Exclusive Criteria

3.4.1 Inclusion Criteria

1. All preterm admissions at Korle Bu Teaching Hospital NICU between the period of January 2017 and May 2019.

3.4.2 Exclusion Criteria

1. All preterm infants pronounced dead on arrival at the Korle Bu Teaching Hospital NICU between January 2017 and May 2019.
2. All preterm infants on admission at the Korle Bu Teaching Hospital NICU with incomplete medical records (50% and above of the variables of interest missing).

3.5 Study Variables

The variables in this study comprised dependent variable and independent variables. The dependent variable was outcome of preterm infants admitted to the NICU. The independent variables were delivery related factors, infant related factors and maternal socio-demographic factors.

Table 1.1 Scale of measurement of study variables

	Name of variable	Scale of measurement
Dependent variable	Outcome of Preterm infant	Binary
Independent variables	Maternal Socio-demographic factors	
	Age (years)	Continuous
	Educational level	Nominal
	Marital status	Nominal
	Occupation	Nominal
	Religion	Nominal
	Parity	Nominal
	Infant related factors	
	Sex	Nominal
	Gestation age (months)	Continuous
	Birth weight (kg)	Continuous
	Congenital anomalies	Nominal
	Delivery related variables	
	Mode of delivery	Nominal
	Place of delivery	Nominal
	Post - delivery care	Nominal

Definition of variables:

- **Outcome of preterm infants:** Death or survival of preterm infant before discharge from NICU
- **Maternal Socio-Demographic factors**
 Age categories: <20years; 20-34 years; 35-49years; 50 years and above
 Marital Status categories: Single; Married; Co-habiting
 Occupation categories: Unemployed; Public sector; Private sector
 Educational Status categories: None; Primary; JHS; SHS; Tertiary
 Religion categories: Christianity; Islam; Traditional; Others
 Parity categories: 1; 2; 3; 4; 5 or more children

- **Infant Related Factors**

Sex: Male; female

Gestational Age categories: Extreme preterm- less than 28weeks

Very preterm - 28weeks to < 32 weeks

Moderate preterm- 32weeks to < 34 weeks

Late preterm - 34 weeks to < 37 weeks

Birth Weight categories: Low birth weight (LBW) - < 2.5 kg to 1.5kg

Very low birth weight (VLBW) - < 1.5kg to 1.0kg

Extremely low birth weight (ELBW) - < 1.0kg

Congenital Anomaly categories: Presence; Absence

- **Delivery Related Factors**

Mode of delivery categories: Spontaneous vaginal delivery; Caesarean section

Place of delivery categories: Korle-Bu Teaching Hospital; Peripheral hospitals;
Home

Post-Delivery Care categories: Resuscitated; Not resuscitated

3.6 Data Source

Since it was a retrospective study, information was extracted from the medical records of all the preterm infants admitted to the KBTH NICU between January 2017 and May 2019. The records preceding January 2017 were not used because it was incomplete.

3.7 Data collection tool and extraction

Data extraction forms (Appendices A and B) were used to capture relevant information on maternal, infant and delivery related characteristics and also feature the outcome of preterm infants admitted to the KBTH NICU. The maternal section of the extraction form comprised of the socio-demographics of the mother of the preterm infant. This was

composed of age, occupation, marital status, religion and parity. It also obtained information about any maternal medical conditions including their HIV status. Information surrounding the circumstances around the delivery period was extracted using the place of delivery, mode of delivery and whether any resuscitation was done in an attempt to stabilize the newly delivered preterm.

The preterm register section captured information on the sex, birth weight and existence of congenital anomalies. The management aspect of the preterm register highlighted the commonly administered therapies at the NICU from which multiple choices could be made. Finally, the last portion featured the dates of birth and admission the preterm infants and the dichotomous outcome of dead or alive.

The variables of interest were obtained from patient folders, which were kept in a designated records room manned by personnel who were able to retrieve the folders based on unique codes or numbers. Duplicates of death certificates which were kept at the NICU could reliably serve as database for the preterm infants who died since they were filled by resident doctors under supervision of doctors, senior to them. The department also keeps a database of the patients in a special book (admission and discharge books - A and D books) placed at the nurses' station. These reliably contain the variables of interest such as sex, gestational age, birth weight, place of delivery, mode of delivery and outcome which are updated at the time of discharge or death.

The unique folder numbers belonging to each preterm infant was identified, by referring to the A and D book which was used to retrieve the individual folders belonging to them at the records unit in the paediatric department. These folders contained information

beyond the socio-demographics of the patients. The folders gave an in-depth information on the complications and management of these preterm infants as well as their outcomes while on admission. The extraction form was then used to collect the relevant information on these infants. Folders which could not be retrieved were considered missing and hence excluded from the study. The period of data collection took 5 weeks with the support of 5 research assistants.

3.8 Quality Control

Four individuals who had received training in the extraction of data from medical records supported the primary investigator in the review of documents and data capturing. Pre-testing of the data extraction tool was done on the medical records of preterm infants at the Koforidua Regional Hospital NICU as a quality control measure for the study. The extracted data sheets were reviewed by the principal investigator on daily basis for completeness and assigned unique serial numbers to prevent double entry.

3.9 Data processing and Analysis

The data collected from the medical records was cleaned, coded and entered into a Microsoft excel 2010 spreadsheet and exported into STATA version 15. Descriptive statistics such as percentages, proportions, frequency tables were determined for the mean age, educational status, occupation, marital status, religion, parity, mode of delivery, sex of the preterm infant, maternal health conditions, reasons for being admitted to NICU and resuscitation status. Maternal HIV status, preterm birth weight and treatment offered at the NICU were determined in a similar manner. A pie chart was used to determine and illustrate the determined preterm outcome of death and alive.

A bivariate analysis was used to test the association between the preterm outcome of death or alive on discharge and various independent variables such as the maternal socio-demographic factors, infant related factors and delivery related factors. Both simple and multivariable logistic regression analysis were used to assess predictors of the outcome of preterm infants. The multiple logistic regression to determine the significant factors that influenced the death of the preterm infants controlled for all maternal, infant and delivery related characteristics. Odds ratios were reported with their 95% CIs. The statistical significance was determined at p-value of 0.05.

3.10 Ethical Considerations

The study sought for ethical clearance from the Korle Bu Teaching hospital Institutional Review Board for approval before commencement (see appendix C). Permission was then sought from the Department of Child Health with a letter issued by the Institutional Review Board. Letters were dispatched to the various units involved in the data collection process such as the NICU and the Records Department from the office of the Head of Department of Child Health.

The research did not pose any risks to the staff and patients of the Korle Bu Teaching Hospital. The data retrieved from the medical records during the study was treated as confidential. Patient information was well protected as much as possible and final data used in statistical analysis and results could not be traced to patients since names were never collected as part of data. In view of this, the preterm infants were given codes for identification instead of using their names. Under no circumstance was the information retrieved shared with a third party. Also, files linking medical record numbers and

assigned study numbers were kept in a cabinet under lock and key, accessible to the principal investigator only.

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

This chapter presents findings on the outcomes of preterm infants managed at the Korle Bu Teaching Hospital NICU between January 2017 and May 2019 and associated factors.

4.2 Background characteristics

Records for a total of 1274 mothers who delivered between the study period were included into this study. The mean age of mothers was 30.0 ± 6.31 years. More than half (69.1%) of the mothers were aged between 20 and 34 years and those aged between 35 and 49 years constituted 25.3. A small proportion (3.8%) of the mothers had no formal education. Only 20.6% had primary education and 18.6% had tertiary education. With respect to employment status, a greater proportion (67.5%) of mothers was employed in the private sector with 14.8% being public sector workers. Majority (83.2%) of the mothers were married with less than a tenth (7.5%) being single and co-habiting (9.3%). A greater proportion (88.5%) of mothers was Christians with 11.0% professing Islamic religion. More than half (54.6%) were primiparous mothers and 5.1% had given birth to 4 live children. A little more than half (54.2%) of the preterm infants were born via Caesarean section with 45.8% delivered via vaginal birth. Majority (93.3%) of the vaginal births were spontaneous. More (51.0%) of the preterm babies were females.

Table 4.1 Demographic characteristics of study population

Characteristic	Frequency (n=1274)	Percentage (%)
Mean age (SD) years	30.0(6.31)	
Age (years)		
< 20	71	5.6
20-34	881	69.1
35-49	322	25.3
Education		
None	48	3.8
Primary	263	20.6
JHS	499	39.2
SHS	227	17.8
Tertiary	237	18.6
Occupation		
Unemployed	226	17.7
Private sector	860	67.5
Public sector	188	14.8
Marital status		
Single	96	7.5
Married	1060	83.2
Co-habiting	118	9.3
Religion		
Christianity	1128	88.5
Islam	140	11.0
Other religions	6	0.5
Parity		
1	696	54.6
2	287	22.5
3	179	14.0
4	65	5.1
5+	47	3.7
Mode of delivery		
Vaginal (SVD)	584	45.8
Caesarean section	690	54.2
Type of SVD		
Induced	39	6.7
Spontaneous	541	93.3
Place of delivery		
Home	1	0.1
Korle Bu	1116	87.6
Other hospitals	157	12.3
Sex of child		
Male	624	49.0
Female	650	51.0

4.3 Maternal and Child health characteristics

Maternal and child health characteristics are summarized in table 4.2 below. Half (50.9%) of mothers had some form of health condition. These health conditions ranged from Pre-eclampsia/eclampsia (34.6%), pregnancy induced hypertension (17.7%) premature rupture of membrane (PROM) (14.8%) and chronic hypertension. Other reported health conditions were gestational diabetes (5.6%) and G6PD (3.1%). The major reasons why the infants were admitted to the NICU of Korle Bu Teaching Hospital were being a preterm baby only (87.5%), being preterm with Asphyxia (8.6%) and being preterm with respiratory distress (2.4). Less than half (43.5%) of the infants required resuscitation.

With regard to maternal HIV infection, only 1.3% of mothers were positive for the disease. Only 3.8% of preterm infants at the NICU had congenital anomalies. More than a third (36.3%) were very low birth weight with 8.4% being normal weight babies. With respect to gestational age, almost half (48.9%) were born moderate to late preterm with only 7.1% born extremely preterm. Treatments given to the infants included oxygen only (34.85), Continuous Positive Airway Pressure (CPAP) (24.6%), blood transfusion (8.3%) and Vitamin K injections (2.4%). FPPs were the most common transfusion given to the infants.

Table 4.2 Maternal and child health characteristics

Characteristics	Frequency n=1274	Percentage
Maternal health conditions present		
No	626	49.1
Yes	648	50.9
Maternal conditions		
Antepartum haemorrhage	19	2.9
Chronic hypertension	43	6.6
Pre – eclampsia / eclampsia	224	34.6
G6PD	20	3.1
Gestational diabetes	36	5.6
Pregnancy induced hypertension	115	17.7
Hepatitis B	14	2.2
Premature rupture of membrane	96	14.8
Others*	81	12.5
Reasons for admission to NICU		
Preterm only	1115	87.5
Preterm/Asphyxia	110	8.7
Preterm/Respiratory distress	31	2.4
Others**	19	1.4
Resuscitation given		
Yes	554	43.5
No	720	56.5
Maternal HIV status		
Positive	16	1.3
Negative	1258	98.7
Presence of congenital anomaly		
Yes	48	3.8
No	1226	96.2

Continue

Table 4.2 Maternal and child health characteristics

Characteristics	Frequency	Percentage
Birth weight		
Extremely low birth weight: < 1kg	126	9.9
Very low birth weight: < 1.5kg to 1kg	462	36.3
Low birth weight: < 2.5kg to 1.5kg	579	45.4
Normal weight: 2.5kg and above	107	8.4
Gestational age		
Extremely preterm <28weeks	90	7.1
Very preterm: 28weeks to <32weeks	561	44.0
Moderate to late preterm: 32weeks to <37	623	48.9
Birth weight		
Extremely low birth weight: < 1kg	126	9.9
Very low birth weight: < 1.5kg to 1kg	462	36.3
Low birth weight: < 2.5kg to 1.5kg	579	45.4
Normal weight: 2.5kg and above	107	8.4
Gestational age		
Extremely preterm <28weeks	90	7.1
Very preterm: 28weeks to <32weeks	561	44.0
Moderate to late preterm: 32weeks to <37	623	48.9

*Uterine rupture, Urinary tract infection, Syphilis, polyhydramnios, oligohydramnios, Teenage mother, retroviral infection, anemia, Asthma, Invitro fertilization, Sickle cell disease , cervical incompetence, Vulvovaginal Candidiasis, Cardiomyopathy;

**Intrauterine growth restriction (IUGR), Preterm with macrosomia, Hypoglycemia, Meconium Stained liquor, Congenital Anomalies, Neonatal sepsis, Neonatal Jaundice;

***A combination of oxygen, CPAP, Transfusions, Vitamin K injections and Surgery

4.4 Outcomes of Preterm Infant

About 70% (95% CI: 67.6%-72.7%) of the preterm infants survived and were discharged from the NICU.

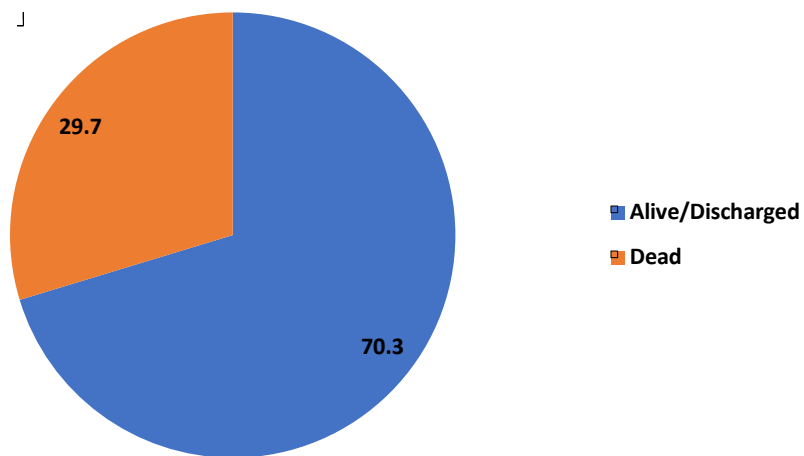


Figure 2: Outcomes of Preterm Infants

4.5 Comparison of preterm infant admissions and outcomes

This section summarizes the relationship between total preterm infant admissions and their outcomes that is deaths or discharges (alive).

4.5.1 Comparison between quarterly admission, deaths and discharges

Quarterly preterm infant estimates are shown in Table 4.3 below. Estimates of admissions in 2017 are lower than that in subsequent years.

Table 4.3 Quarterly admissions and deaths between January 2017 and May 2019

Year	Died N (%)	Alive/ discharged N (%)	Total admissions N (%)
2017			
1 st quarter	2 (28.6)	5 (71.4)	7 (100.0)
2 nd quarter	2 (3.9)	49 (96.1)	51 (100.0)
3 rd quarter	16 (11.8)	120 (88.2)	136 (100.0)
4 th quarter	53 (27.6)	139 (72.4)	192 (100.0)
2018			
1 st quarter	107 (41.1)	153 (58.9)	260 (100.0)
2 nd quarter	57 (32.9)	116 (67.1)	173 (100.0)
3 rd quarter	33 (29.5)	79 (70.5)	112 (100.0)
4 th quarter	45 (60.8)	29 (39.2)	74 (100.0)
2019			
1 st quarter	36 (22.4)	125 (77.6)	161 (100.0)
2 nd quarter	28 (25.9)	80 (74.10)	108 (100.0)

4.5.2 Comparison between admissions and deaths

Quarterly preterm infant admission and deaths are summarized in figure 3 below. In 2017, an increasing trend in the number of admissions was observed throughout the year. The 4th quarter recorded the highest admissions of 192 with the first quarter recording the least admissions. Similarly, the same trend was observed for preterm infant deaths. The 4th quarter had the highest number of deaths (53) with the least deaths in the first quarter. The first quarter recorded the highest admissions and deaths; 260 and 107 respectively. The lowest admissions for that year were in the 4th quarter (74) with the lowest number of deaths in the third quarter (45). Out of the 161 admissions in the first quarter of 2019, 36 deaths were recorded.

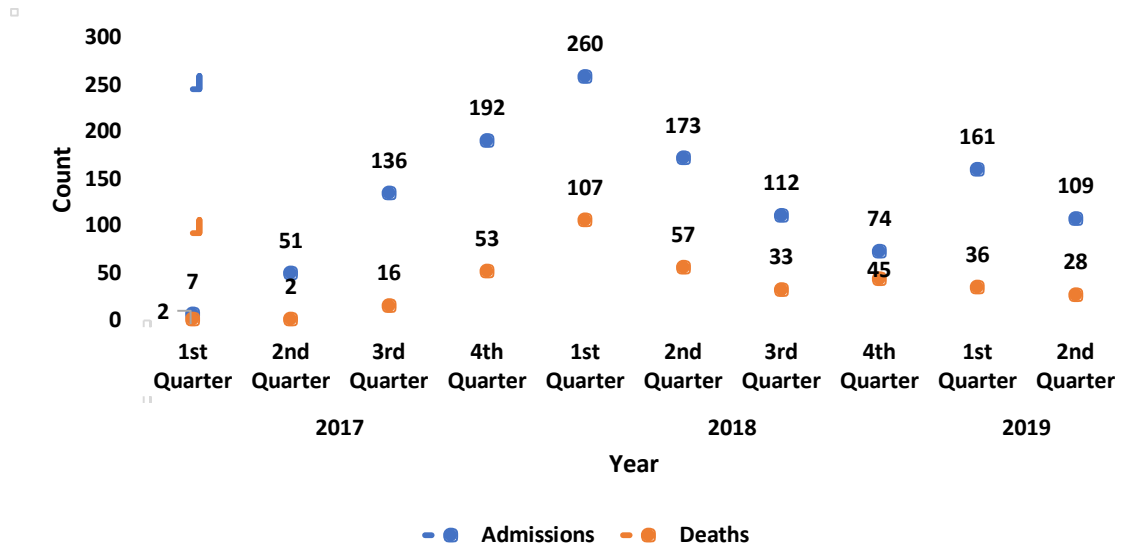


Figure 3: Trend in Admissions and deaths at KBTH NICU between January 2017 and May 2019

4.6 Association between preterm infant outcome and maternal and Maternal Factors

Table 4.4 below shows there was no significant association between outcome of preterm birth and maternal age ($\chi^2 (2) = 0.01, p=0.999$), educational level ($\chi^2 (4) = 8.47 p=0.076$), parity ($\chi^2 (4) = 4.66, p=0.324$) and death of a preterm infant. Also, there was no statistically significant association between place of delivery and death of a preterm infant ($\chi^2 (2) = 5.40, p=0.067$). However, there were significant differences between occupation ($\chi^2 (2) = 7.83, p=0.020$), mode of delivery ($\chi^2 (1) = 4.51, p=0.045$) and death of a preterm infant.

Table 4.4 Association between Outcomes of preterm infant and maternal socio-demographic characteristics

Variable	Outcome of Preterm birth		χ^2	p-value
	Alive/Discharged N (%) [n=895]	Dead N (%) [n=379]		
Age (years)			0.01	0.999
< 20	50 (70.42)	21 (29.58)		
20-34	619 (70.26)	262 (29.74)		
35-49	226 (70.19)	96 (29.81)		
Education			8.47	0.076
None	41 (85.42)	7 (14.58)		
Primary	187 (71.1)	76 (28.9)		
JHS	357 (71.54)	142 (28.46)		
SHS	153 (67.4)	74 (32.6)		
Tertiary	157 (66.24)	80 (33.76)		
Occupation			7.83	0.020
Unemployed	160 (70.8)	66 (29.2)		
Private sector	619 (71.98)	241 (28.02)		
Public sector	116 (61.7)	72 (38.3)		
Marital status			6.04	0.050
Single	58 (60.42)	38 (39.58)		
Married	748 (70.57)	312 (29.43)		
Co-habiting	89 (75.42)	29 (24.58)		
Religion			0.78	0.677
Christianity	789 (69.95)	339 (30.05)		
Islam	101 (72.14)	39 (27.86)		
Other religions	5 (83.33)	1 (16.67)		
Parity			4.66	0.324
1	489 (70.26)	207 (29.74)		
2	210 (73.17)	77 (26.83)		
3	115 (64.25)	64 (35.75)		
4	48 (73.85)	17 (26.15)		
5+	33 (70.21)	14 (29.79)		
Mode of delivery			4.51	0.045
Vaginal	394 (67.47)	190 (32.53)		
Caesarean section	501 (72.61)	189 (27.39)		
Place of delivery			5.40	0.067
Home	0 (0)	1 (100)		
Korle Bu	776 (69.47)	341 (30.53)		
Other hospitals	119 (76.28)	37 (23.72)		

4.7 Association between Outcomes of preterm infant outcome and maternal and child conditions

There was no statistically significant difference between sex of child ($\chi^2 (1) = 0.04$, $p=0.841$), presence of maternal health conditions ($\chi^2 (1) = 1.16$, $p=0.282$), maternal HIV status ($\chi^2 (1) = 0.17$, $p=0.676$) and death of a preterm infant. Birth weight ($\chi^2 (3) = 228.01$, $p=0.000$), gestational age weight ($\chi^2 (2) = 227.08$, $p=0.000$) and resuscitation ($\chi^2 (1) = 35.49$, $p=0.000$) were significantly associated with death of a preterm child.

Table 4.5 Association between outcomes of preterm delivery and maternal and child conditions

Variable	Outcomes of preterm delivery		χ^2	p-value
	Alive/Discharged N (%) [n=895]	Dead N (%) [n=379]		
Sex of child			0.04	0.841
Male	440 (70.51)	184 (29.49)		
Female	455 (70)	195 (30)		
Maternal health conditions present			1.16	0.282
No	431 (68.85)	195 (31.15)		
Yes	464 (71.6)	184 (28.4)		
Birth weight			9.93	0.002
Extremely low birth weight	16 (12.7)	110 (87.3)		
Very low birth weight	292 (63.2)	170 (36.8)	288.01	0.001
Low birth weight	493 (85.15)	86 (14.85)		
Normal weight	94 (87.85)	13 (12.15)		
Gestational age			227.08	0.001
Extremely preterm	10 (11.11)	80 (88.89)		
Very preterm	356 (63.46)	205 (36.54)		
Moderate to late preterm	529 (84.91)	94 (15.09)		
Resuscitation given			35.49	0.000
Yes	341 (61.55)	213 (38.45)		
No	554 (76.94)	166 (23.06)		
Reasons for admission to NICU			3.50	0.321
Preterm only	774 (69.42)	341 (30.58)		
Preterm/Asphyxia	83 (75.45)	27 (24.55)		
Preterm/Respiratory distress	23 (74.19)	8 (25.81)		
Other reasons*	15 (83.33)	3 (16.67)		
Maternal HIV status			0.17	0.676
Positive	12 (75)	4 (25)		
Negative	883 (70.19)	375 (29.81)		
Presence of congenital anomaly			11.9	0.001
Yes	23 (47.92)	25 (52.08)		
No	872 (71.13)	354 (28.87)		

4.8 Factors influencing death of preterm infants

A multiple logistic regression model was used to predict factors that influence the death of infants managed at the Korle Bu Teaching Hospital NICU. Birth weight, resuscitation, gestational age and the presence of congenital anomalies were identified as factors that significantly influence the death of preterm infants. The regression model showed that preterm infants had reduced odds of dying with increasing birth weight. Extremely low birth weight infants were 22 times more likely to die compared to normal birth weight babies (AOR=22.03, 95CI%: 9.23-52.57, $p<0.001$). Similarly, very low birth weight babies were 3 times more likely to die compared to normal weight babies (AOR=22.03, 95CI%: 9.23-52.57, $p<0.001$).

Infants who were born extremely preterm had increased odds of dying compared to those born moderate to late preterm (AOR=12.02, 95CI%: 5.47-26.44, $p<0.001$). Furthermore, those born very preterm were also 85% more likely to die compared to their counterparts born moderate to late preterm (AOR=1.85, 95% CI: 1.33-2.59; $p<0.001$). The logistic regression model also predicted that preterm infants that did not require any resuscitation were 47% less likely to die while on admission compared to those who were resuscitated (AOR=0.53; 95% CI: 0.40-0.71; $p<0.001$). Additionally, preterm infants with no congenital anomaly were 82% less likely to die while on admission at the NICU compared to those born with congenital anomalies (AOR=0.18; 95% CI: 0.09-0.34; $p<0.001$).

Table 4.6 Factors influencing death of preterm infants

Variable	Crude Odds Ratio COR (95% CI)	Adjusted Odds Ratio AOR (95% CI)
Age (years)		
< 20	<i>Ref</i>	<i>Ref</i>
20-34	1.01(0.59-1.71)	1.10(0.55-2.20)
35-49	1.01(0.57-1.78)	0.92(0.43-1.97)
Education		
None	<i>Ref</i>	<i>Ref</i>
Primary	2.38(1.02-5.54) *	1.36(0.54-3.46)
JHS	2.33(1.02-5.31) *	1.75(0.71-4.31)
SHS	2.83(1.21-6.61) *	1.81(0.71-4.60)
Tertiary	2.98(1.28-6.95) *	1.73(0.68-4.39)
Occupation		
Unemployed	<i>Ref</i>	<i>Ref</i>
Private sector	0.93(0.68-1.30)	0.77(0.50-1.19)
Public sector	1.50(0.99-2.26)	1.68(0.70-4.03)
Marital status		
Single	<i>Ref</i>	<i>Ref</i>
Married	0.64(0.41-0.98) *	0.46(0.25-1.02)
Co-habiting	0.50(0.28-0.89) *	0.37(0.30-1.29)
Religion		
Christianity	<i>Ref</i>	<i>Ref</i>
Islam	0.90(0.61-1.32)	1.06(0.66-1.70)
Other religions	0.46(0.05-4.00)	0.56(0.06-5.47)
Parity		
1	<i>Ref</i>	<i>Ref</i>
2	0.87(0.64-1.18)	0.90(0.61-1.33)
3	1.31(0.93-1.85)	1.85(0.89-2.86)
4	0.84(0.47-1.49)	1.19(0.59-2.41)
5+	1.00(0.53-1.92)	1.38(0.60-3.17)
Mode of delivery		
Vaginal	<i>Ref</i>	<i>Ref</i>
Caesarean section	0.78(0.61-0.99) *	1.05(0.78-1.40)
Sex of child		
Male	<i>Ref</i>	<i>Ref</i>
Female	1.02(0.81-1.30)	0.88(0.66-1.17)
Maternal health conditions present		
No	<i>Ref</i>	<i>Ref</i>
Yes	0.88(0.69-1.11)	1.05(0.76-1.45)

Continue

Table 4.6 Factors influencing death of preterm infants

Variable	Crude Odds Ratio COR (95% CI)	Adjusted Odds Ratio AOR (95% CI)
Birth weight		
Extremely low birth weight	49.11(22.74-108.65) ***	22.03(9.23-52.57) ***
Very low birth weight	4.20(2.28-7.75) ***	3.24(1.64-6.39) ***
Low birth weight	1.26(0.67-2.35)	1.21(0.63-2.37)
Normal weight	<i>Ref</i>	<i>Ref</i>
Gestational age		
Extremely preterm	12.02(22.5-90.03) ***	12.02(5.47-26.44) ***
Very preterm	3.24(2.45-4.28) ***	1.85(1.33-2.59) ***
Moderate to late preterm	<i>Ref</i>	<i>Ref</i>
Resuscitation given		
Yes	<i>Ref</i>	<i>Ref</i>
No	0.48(0.37-0.61) ***	0.53(0.40-0.71) ***
Reasons for admission to NICU		
Preterm only	<i>Ref</i>	<i>Ref</i>
Preterm/Asphyxia	0.74(0.47-1.16)	0.76(0.44-1.29)
Preterm/Respiratory distress	0.79(0.35-1.78)	0.90(0.31-2.62)
Other reasons	0.45(0.13-1.58)	1.27(0.33-4.89)
Maternal HIV status		
Positive	<i>Ref</i>	<i>Ref</i>
Negative	1.27(0.41-3.97)	1.34(0.56-4.23)
Presence of congenital anomaly		
Yes	<i>Ref</i>	<i>Ref</i>
No	0.37(0.21-0.67) *	0.18(0.09-0.34) *

COR: Unadjusted odds ratio

AOR: Adjusted odds ratio

Adjusted for all items in the table

* p < 0.05; ** p < 0.01; ***p < 0.001.

CHAPTER 5

5.0 DISCUSSION

5.1 Introduction

The aim of the current study was to determine the outcome of preterm infants managed at the Korle Bu Teaching Hospital NICU within the period of January 2017 and May 2019 and to investigate factors associated with those outcomes. The study found that majority (70.3%) of the preterm infants survived and were discharged from NICU. However, almost a third of the preterm infants died while on admission at NICU. Results from the multiple logistic regression showed birth weight, gestational age, resuscitation and presence of congenital anomalies as factors influencing the death of preterm babies.

5.2 Proportion of preterm survivors

A similar study conducted in Kenya to determine the short term survival of premature infants admitted to a Teaching Hospital in a low resource setting revealed an overall survival rate of 60% (Okwako, Nyandiko, & Oyungu, 2017). This study's finding of high survival of preterm babies could be attributed to offering evidence-based care such as thermoregulation through the use of simple techniques like kangaroo mother care and the ability of doctors to promptly detect complications in these newborns as they arise and following infection prevention protocols.

5.3 Comparison of preterm admissions with deaths

The study reveals that preterm admission is on the rise which is in harmony with several studies (Martin & Osterman, 2018; Tucker & McGuire, 2004; World Health Organization, 2018b). There is an increase or decrease in deaths which is commensurate with a rise or fall in admissions respectively and this is demonstrated by the shape of the admissions and deaths of preterm infants' graph.

Deaths from preterm infant complications are a significant contributor to neonatal deaths. It comes as no surprise that neonatal mortality has not seen reductions measurable to the reductions seen in infant mortality rates and under-five mortality rates. For instance, while the global under-five mortality has seen about 63% reduction from 1990 to 2017, neonatal mortality has realized about 50% reduction from 1990 to 2017 (UNICEF, 2018). This presupposes that as long as preterm birth rate rises, neonatal mortality will also rise as a result of subsequent increase in complications that are a sequel of preterm births as an adverse birth outcome. Neonatal mortality will only realize a considerable decline with active efforts aimed at preventing preterm births through effective preconception and antenatal services as well providing evidence-based care irrespective of geographical location at reduced cost of health care to promote equity.

5.4 Factors that influence preterm death: Gestational age

Gestational age was among the significant predictor of preterm death. Approximately 89% of extremely preterm infants (<28 weeks) died before discharge which is similar to the statistics provided by the WHO on survival of extreme preterm infants being as low as 10% in low income countries and a staggering high of 90% survival in similar preterm

infants in high income countries (World Health Organization, 2016). This resonates with evidence from a cohort of babies in Bangladesh which found 46% of all neonatal death in the study occurring among preterm infants (Baqui, Rosen, Lee, Applegate, El Arifeen, et al., 2013). Additionally, this finding is supported by a global study conducted by Liu and colleagues. The study reported that prematurity was the major cause of death in neonates (Liu, Oza, D, et al., 2016). These deaths were ascribed to complications associated with preterm birth such as asphyxia, respiratory distress and infection (Baqui, Rosen, Lee, Applegate, Arifeen, et al., 2013; Liu, Oza, D, et al., 2016). The data analyzed in this study supports reported preterm complications ascribed to neonatal deaths among preterm babies in this study. This study found asphyxia as well as respiratory distress among preterm to be the main reasons for admission to NICU. It is plausible to say that; these reported reasons could have contributed the death among preterm infants in this study.

5.5 Birth weight

The study also revealed a significant inverse association between birth weight and death of preterm infants. Preterm babies delivered with normal birth weight were less likely to die compared to their counterparts with low birth weight. Similar to this, a study done in Tanzania on neonatal and infant mortality risk associated with preterm babies revealed that infants with low birth weight and are preterm, are more prone to the risk of neonatal mortality compared with normal weight babies (Sania et al., 2017). Although, not always the case, birth weight of babies is influenced by mother's weight and feeding practices. Cnattingius et al., (2013) identified that maternal weight is a predictive factor for preterm delivery and poor outcome of management (Cnattingius et al., 2013). Abubakar et al.,

(2015), in their cross-sectional study in Northern Ghana found that infants whose mothers had excess weight are less likely to be born with low birth weight (Abubakari, Kynast-Wolf, & Jahn, 2015). Nevertheless, Cnattingius et al., (2013) again argued that mothers with too high BMI also have the tendency for high preterm deliveries (Cnattingius et al., 2013). This explains that there is still some level of uncertainty regarding the link between maternal weight and babies' birth weight and preterm death.

However, in this study, mothers' weights and BMIs were unavailable for such an association to be tested. Maternal lifestyle with regards to diet intake, smoking, alcohol intake, and certain maternal chronic conditions such as hypertension, anemia, malaria in pregnancy, maternal infections with subsequent infection of the fetuses, and other myriad of factors cannot be underestimated as far as birth weight is concerned. On the contrary, a study done to determine the mortality and morbidity of preterm infants weighing 401 to 1500g at birth by the National Institute of Child Health and Human Development Neonatal Research Network in the United States of America found over 80% of the preterm infants weighing below 1500g surviving until discharge (Stoll et al., 2010). This is most likely explained by the gaps that exist in the initial evidence-based care received by the preterm infants in different settings. Reasons for the high survival is most likely based on guidelines for management, which include interventions such as infection prevention, lung maturation through provision of antenatal antibiotics and corticosteroids in mothers with imminent preterm labor or birth. Adequate thermoregulation, administration of surfactant within the first 2 hours of birth and actively supporting the ventilation of these infants through continuous positive airway pressure, has been attributed to the excellent performance in these higher centers.

5.6 Congenital anomalies

In this study, one of the major factors implicated in the outcome of preterm babies is presence of congenital anomalies, which increased risk of deaths. The findings from this study is commensurate with an earlier study conducted in Cameroon, which featured congenital anomalies as one of the main causes of preterm deaths (Mungyeh et al., 2013). This research found that congenital malformations together with urinary tract infections increase the risk of neonatal mortality among preterm babies. It is worth noting that in addition to preterm deliveries, congenital anomalies can also lead to still births (World Health Organization, 2012b).

The causes of some of these congenital anomalies are as a result of infections and inflammations. In addition, insufficient protective hormones as well as known and unknown side effects of some drugs used during pregnancy have the tendency for death of preterm babies (Allen et al., 2011). One study that found congenital anomalies in preterm infants as a risk factor for deaths in the neonatal period attributed 15% of the deaths to congenital malformations (Linhart et al., 2000). This study however shows about 50% increased risk of dying in preterm infants with congenital anomalies. Although both studies reveal an increased proportion of neonatal mortality in preterm infants with congenital anomalies, the variation in the statistics may be as a result of varying degrees of anomalies ranging from those incompatible with immediate extra-uterine life to those that can thrive on supportive care for a period. Evidence indicates that preterm babies are more prone to risk of disabilities and mortalities if not cared for meticulously as compared to normal babies (Platt, 2014). Survival of preterm infants therefore relies on massive initial care at birth.

Pregnancy and its associated health conditions are likely to influence outcome of preterm births. This is supported by a similar study which found that uterine problems such as placenta previa, placenta abruption, and cervical incompetence increase the risk of negative outcomes from preterm birth management (Dadipoor et al., 2017).

The link between pregnancy-related conditions and the management and survival of preterm births necessitates early booking for antenatal care during pregnancy. Timely access to optimal care during pregnancy ensures the receipt of essential micronutrients and detection and prompt treatment of infections and conditions that may put both mother and baby in danger. It is also important that women receive medical interventions like vaccinations, for instance, rubella and improved management of chronic disease conditions as well as close monitoring for women placed on medications contraindicated in pregnancy. Early booking should also be accompanied with high quality radiological investigations for timely detection and management of fetal defects. The reason why Kunle-olowu et al., (2014) opined that lack of antenatal care increases the risk of negative outcomes from management of preterm infants (Kunle-olowu et al., 2014).

5.7 Post - delivery care: resuscitation

Preterm infants who did not require any form of resuscitation in this study were less likely to die. A study done by Fischer et al., (2019), on cardiopulmonary resuscitation (CPR) of preterm neonates at birth and their outcomes concluded that these infants had higher rates of mortality (Fischer et al., 2019b). A similar study done by Deulofeut and colleagues in 2007, revealed comparable findings (Deulofeut, Sola, Lee, & Rogido, 2007). This means infants requiring resuscitation were born with a state of health that had been compromised by way of respiratory difficulty, infections, neurological impairment

from toxins in-utero or stress from the birthing process or some form of congenital anomaly (Queensland Clinical Guidelines, 2016). One key issue is whether the resuscitation these infants were subjected to was optimum enough to increase their chances of survival. This emphasizes the need for an initial evidence-based care which first of all should have structures in place for emergency preparedness. Generally about 10% of newborns require some form of resuscitation and 1% requiring extensive resuscitation (Wyckoff et al., 2015). Preterm infants are a vulnerable group that may even require more help than term babies.

Skilled staff is needed to promptly detect those who require specialized care and effectively resuscitate within the first golden minute of life within which a newborn should breathe well or have some form of assisted ventilation to prevent any long-term neurological sequelae. This is imperative for adequate oxygenation of brain tissues to allow for a successful transition from intrauterine life to extrauterine life. Therefore, in deliveries involving imminent preterm births, it is necessary to have equipment that can provide some form of thermoregulation, an uninterrupted supply of oxygen, appropriately sized bag and masks and nasal prongs that can effectively help with resuscitation. Adequate and functioning machines to deliver continuous positive pressure ventilation, prewarmed incubators and availability of surfactant and emergency drugs for resuscitation in higher centers like the Korle-Bu Teaching Hospital are all important resuscitative measures that may improve survival and subsequent quality of life.

The study found no association between death of preterm infants and maternal socio-demographic factors, place of delivery and sex of the preterm infant even though studies suggest otherwise (Helle et al., 2007; Kotecha, Lowe, & Kotecha, 2018; Mandy, 2019b;

Mathews & MacDorman, 2007). The male sex of the preterm infant for instance did not have a significant effect on death as an outcome because of the uneven distribution of the sex of the infants admitted at the NICU (51% females and 49%males).

5.8 Conclusion

The study has revealed high positive outcome of management of preterm babies. Majority of the preterm babies survived and were discharged from NICU. However, factors such as lower birth weights and gestational ages, presence of congenital anomalies, and resuscitated preterm infants are associated with death as an outcome. Nevertheless, frequent antenatal attendance by pregnant women is more likely to lead to an early detection of congenital anomalies as well as educating mothers on good diet and healthy living which can help ameliorate some issues arising from pregnancies with poor outcomes.

5.9 Study Limitations

Limitations of this study include the retrospective nature of the design which only allows establishment of associations rather than causation. Also, this study used the presence or absence of congenital anomaly and whether or not babies were resuscitated. The oversimplified definition of resuscitation and congenital anomalies may have poorly characterized the actual risk of death due to the prevailing degree and medical attention required. Nevertheless, the classification used in this study is useful for identifying factors that influence survival of preterm babies.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

In conclusion, preterm babies admitted to the Korle-Bu Teaching Hospital NICU have higher chances of survival. Nevertheless, birth weight, congenital anomalies, gestational age and the need for resuscitation remain major factors influencing outcomes of preterm babies.

By this reason, it is essential that pregnant women book early for antenatal care early enough for early detection and management of congenital anomalies and pregnancy related complications. In addition to antenatal clinics, pre-conception clinics may serve as avenues for counselling and sensitization on dietary habits and other pregnancy related topics. Effective resuscitation done by highly skilled staff will also serve as an avenue to decrease mortalities in these preterm infants and also decrease the incidence of disabilities.

6.2 Recommendations

1. The Ghana Health Service (GHS) and Ministry Of Health (MOH) should organize pre- and in-service training for midwives and nurses who conduct deliveries for effective monitoring of labour and resuscitation of preterm infants who require some help with breathing.
2. GHS and MOH should ensure health facilities which conduct deliveries to acquire cheaper bubble Continuous Pressure Airway Pressure machines and other cheaper ways of providing care to aid survival of these preterm infants who require assistance with

ventilation.

3. There should be evidence-based guidelines and protocols monitored by GHS and MOH to foster strict adherence to promote standard care for pregnant women with imminent preterm labour and for preterm babies at peripheral hospitals before referral to higher centres.

4. National ANC guidelines should include an anomaly scan done at the end of the first trimester by radiologists and sonographers who have been well trained to do such scans to readily detect foetal anomalies so that planned interventions can be made.

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<https://doi.org/10.1136/bmj.i2976>

APPENDICES

APPENDIX A: DATA EXTRACTION FORM


ID
Age
Education	1-None
	2-Primary
	3-JHS
	4-SHS
	5-Tertiary
Occupation	1. Unemployment
	2.Private sector
	3.Public sector
Marital Status	1-Single
	2-Married
	3-Divorced
	4-Co-habiting
	5-Widowed
Religion	1-Christinity
	2-Islam
	3-Traditional
	4. Buddhism
	5. others
Parity	1. 1
	2. 2
	3. 3
	4. 4
	5. 5 or more
Mode of delivery	1-Vaginal
	2-CS
Type of SVD	1.Induced
	2.Spontaneous
Maternal medication conditions
Place of delivery	1. KBTH
	2. Peripheral hospital
	3. Home
Resuscitation	1. Yes
	2. No
Reason to NICU
HIV status	1. Positive
	2. Negative

APPENDIX B: PRETERM REGISTER EXTRACTION FORM

Sex	1. Male
	2. Female
Birthweight	1. Extremely low birth weight: < 1kg
	2. Very low birth weight: < 1.5kg to 1kg
	3. Low birth weight: < 2.5kg to 1.5kg
	4. Normal weight: 2.5kg and above
DOB
DOA
Gestational	1. Extremely preterm <28weeks
	2. Very preterm: 28weeks to <32weeks
	3. Moderate to late preterm: 32weeks to <37
Preterm anomaly	1. Yes
	2. No
if yes state preterm anomaly
Treatment (multiple selection allowed)	1. Oxygen only
	2. CPAP
	3. Transfusion
	4. Vitamin K injection
	5. Surgery
	6. None
	7. Others. Specify....
if Transfusion from above	1. FFPs
	2. Blood
	3. Other
Complications on Admission
Preterm outcome	1. Dead
	2. Alive

APPENDIX C: ETHICAL APPROVAL

In case of reply the number
And the date of this
Letter should be quoted
My Ref. No. KBTH/IRB/19
Your Ref. No.



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29th March, 2019

DR. HENRIETTA NTIAMOAH TAYLOR
DEPT. OF POPULATION, FAMILY AND REPRODUCTIVE HEALTH
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LEGON

**OUTCOMES OF PRETERM BABIES AT THE KORLE BU TEACHING HOSPITAL
NEONATAL INTENSIVE CARE UNIT**

KBTH-IRB /00010/2019

Investigator: Dr. Henrietta Ntiamoah Taylor

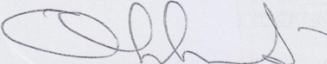
The Korle Bu Teaching Hospital Institutional Review Board (KBTH IRB) reviewed and granted approval to the study entitled "Outcomes of preterm neonates at the Korle Bu Teaching Hospital Neonatal Intensive Care Unit"

Please note that the Board requires you to submit a final review report on completion of this study to the KBTH-IRB.

Kindly, note that, any modification/amendment to the approved study protocol without approval from KBTH-IRB renders this certificate invalid.

Please report all serious adverse events related to this study to KBTH-IRB within seven days verbally and fourteen days in writing.

This IRB approval is valid till 28th February, 2020. You are to submit annual report for continuing review.

Sincere regards,

MR OKYERE BOATENG
CHAIR (KBTH-IRB)

Cc: The Chief Executive Officer
Korle Bu Teaching Hospital