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DETERMINANTS OF NEONATAL MORTALITY, BRONG AHAFO REGION, GHANA

BY

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DECLARATION

I, Momodou Lamin Waggeh, author for this thesis, hereby declare that apart from specific references which have duly been acknowledged, this research is my own independent work undertaken under the supervision of Dr. Priscillia Nortey. I further declared that no part of this thesis, either in the whole or part has been submitted elsewhere for the award of another degree.

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Date……

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DR. PRISCILLIA NORTEY

(ACADEMIC SUPERVISOR)

DATE…….

DEDICATION

I dedicate this work to the Almighty Allah for preserving my life, ensure my security in Ghana and gave me good Health and strength to be able to do this work.

To my parents for their endless prayers and my family for their encouragement and patience for being away from home.

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LIST OF ACRONYMS

ANC	Antenatal Care
AVD	Assisted vaginal delivery
BAR	Brong Ahafo Region
CHAG	Christian Association Ghana
CHPs	Community-Based Health Planning and Service
GDHS	Ghana Demography and Health Survey
LBW	Low Birth Weight
LMICS	Low and Middle Income Countries
MDG	Millennium Development Goal
NGO	Non-Governmental Organization
NMR	Neonatal Mortality Rate
NNM	Neonatal Mortality
SSA	Sub-Saharan Africa
SVD	Spontaneous vertex delivery
WIFA	Women in Fertility Age

DEFINITION OF TERMS

A neonatal death is defined as a death during the first 28 days of life (0-27 days)

Early neonatal deaths occurring during the first seven days of life (0-6 days).

Late neonatal deaths occurring after the seventh day but before the 28th day of life (7-27 days).

Low birth weight (LBW) is defined as a birth weight of a live born infant of less than 2,500 g regardless of gestational age.

Birth weight is the first weight of the fetus or newborn obtained after birth. For live births, birth weight should ideally be measured within the first hour of life before significant postnatal weight loss occurs**.**

Low birth weight infants are those born weighing less than 2500 g. These are further subdivided into:

- **Very Low Birth Weight (VLBW)**: Birth weight <1,500 g
- **Extremely Low Birth Weight (ELBW):** Birth weight <1,000 g

Infant mortality is the death of children less than 1 year.

Post neonatal period is between 28 to 364 days of life.

Infant is defined as from 0 to 1 year.

A household is a person or a group of people living together and having the same catering arrangements.

A case is a death less than 28 days of life in a neonatal intensive care unit (NICU) hospital.

A control is a life post neonatal (28 days to 11 month) infants in the communities of cases

Neonatal mortality rate is defined as the number of neonatal deaths per 1000 live births.

ABSTRACT

Background: Worldwide an estimated four million babies die in the first 4 weeks of life (the neonatal period), however almost all of these deaths (99%) occur in low- and middle-income countries, and about half of the deaths occur at home(Lawn, Osrin, Adler, & Cousens, 2008)**.**

Neonatal mortality contributes to 60% of the under-five mortality in Brong Ahafo. It is among the regions in Ghana with highest under five mortality rate. According to the demographic and health survey report (DHS) 2014, the under-five mortality was reduced from 111 per 1000 live births in 2003 to 60 per 1000 live birth in 2014, However, despite the numerous interventions in the region such as "Kangaroo mother care", "helping babies breathe" integrated management of child and neonatal illnesses and postnatal care, neonatal mortality still continue to be high in the region (Profile, 2012).

Objective: This study aimed to determine the causes and factors associated with neonatal mortality in Brong Ahafo Region.

Method: An unmatched case control study was conducted in which a total of 226 neonatal deaths of singleton live born babies from June to December 2015 was recorded from 13 hospitals with neonatal units in the region. The variables extracted were the cause of death, the birth weight, address of the mother or caregiver including any land mark, telephone number of mother, father or landlord.

Out of 226, a total of 80 cases were selected based on availability of specific cause of death of the case and reliable contact of the mother or caregiver (reliable address or land mark and telephone number of parent or landlord).

A total of 80 mothers with neonatal deaths (cases) were followed in their homes and from where 160 controls (post neonatal) were also selected and their mothers interviewed using the same structured questionnaire as the mothers of the cases.

Univariate analysis was done to determine the frequencies, bivariate to determine the variables that were associated with neonatal mortality and multivariate logistic regression was done to find determinants of neonatal mortality in the region.

Results: The main causes of neonatal mortality in the region were birth asphyxia (32.5%), neonatal sepsis (23.75%), prematurity (18.75%) and neonatal jaundice (6.25%).

Multivariate analysis indicated that determinants of neonatal mortality in the region were birth weight, postnatal care and household size were statistically significant to neonatal mortality in the region.

The following were found to be associated with neonatal mortality.

Birth weight (aOR 18.4, 95% CI 5.03-64.62); postnatal care (aOR 0.01, 95% CI 0.00-0.001) and Household size (aOR 0.06, 95% CI 0.01-0.064)

Conclusion: The main causes of neonatal mortality in the region were birth asphyxia, neonatal sepsis, prematurity, and neonatal jaundice and the determinants of neonatal mortality were birth weight, postnatal care and household size.

Birth asphyxia, neonatal sepsis and prematurity are keys to the substantial reduction of neonatal mortality in Brong Ahafo region**.**

Keywords: Neonatal mortality, determinants, Brong Ahafo region.

CHAPTER ONE

INTRODUCTION

1.1 Definition

Definition: Death between birth and 28 days of life (0-27))(Barfield, 2012) ("WHO | Infant, Newborn," 2016)

Early is 0-7 days and late 8-27 days.

Worldwide 130 million babies are born and 4 million die annually. The global under five mortality rate was at 30 per 1000 live births. This constitute of over 60% of the infant deaths and 40% of under five deaths, 99% of these deaths occur in low and middle income countries (LMICs).

Sub Saharan Africa (SSA) makes up of 38% of the global burden, with under five mortality a rate of 34 per 1000 live births.

Africa, with 11% of the world's population has over 25% of global figure, however, the under-five mortality rate in West Africa 46 per 1000 live births.

According the multiple cluster indicator survey (MICS) 2011, Ghana was among the countries in West Africa with significant decline in Neonatal mortality, however the northern region, upper east region, upper west region and Brong Ahafo region (BAR) have the highest under five mortality among the 10 regions in Ghana, with 66 per 1000, 58 per 1000, 67 per 1000 and 66 per 1000 live births respectively.(Ezeh, Agho, Dibley, Hall, & Page, 2014a).

1.2 The Critical Period of the New Born

Worldwide over 130 million babies are born every year [2], and three quarters of all newborn deaths occur in the first week of life. The first week of life is the most dangerous

week for newborns, and yet countries are only just starting postnatal care programmes to reach mothers and babies at this critical time (Målqvist, 2011). Each year an estimated four million babies die, half occur at home, often unnamed, uncounted [4], and invisible to national and regional policies and programmes.

However, many factors account for this high death toll, such as lack or limited data for evidence-based intervention. Most publications on newborn survival, were based on the 1% of deaths in rich countries, and LMICs with the most neonatal deaths have the least information and the least access to cost-effective interventions to prevent them [5]

1.3 Global Trend

Globally, neonatal mortality accounts for two thirds of all the deaths before the first birth day and more than 40% of the total under-five mortality [1, 2]. The overall neonatal mortality rate is about 30 per 1000 live births worldwide [4]. 99% of all Neonatal deaths are occurring in the low and middle income countries of the world such as South Asia and Sub Saharan Africa (Titaley, Dibley, Agho, Roberts, & Hall, 2008).

1.4 Global Causes of Neonatal Death

According to the World Health Organization (WHO), preterm birth accounts for 30% of global neonatal deaths, sepsis or pneumonia 27%, birth asphyxia 23%, congenital abnormality 6%, neonatal tetanus 4%, diarrhea 3%, and other causes 7% of all neonatal deaths [2, 4, 5]. These estimates are based on limited datasets as most births and neonatal deaths occur in the home or outside formal health settings in most low and middle income countries [4, 5]

1.5 African Region

Sub-Saharan Africa, which constitute of 38% of neonatal deaths in the world, has the highest neonatal mortality rate (34 deaths per 1000 live births in 2011). The region has demonstrated the lowest progress in cutting the rate in the last two decades and it accounts for about 33% of under-five deaths [5](Tachiweyika et al., 2011)

However, in low-income countries neonatal mortality (NNM) rates, trends, and causes have attracted relatively little attention compared to maternal deaths or deaths among older children under-five. As far as international public health policy and programs are concerned neonatal deaths still do not receive attention commensurate with their burden [5]. A specific focus on NNM is required as the epidemiology, cause-of-death distribution, and health interventions differ from those of older children.

Information on the timing and causes of neonatal deaths can help direct appropriate interventions to prevent or mitigate avoidable mortality.

Africa houses 11% of the world's population but contributes more than 25% of the world's neonatal mortality.

Globally, Nigeria ranks second to India with the highest number of neonatal deaths, with the highest reported number in Africa [5]. Each year in Nigeria, more than a quarter million neonates die, which translates to approximately 700 neonates every day [5]. Neonatal mortality remains disturbingly high in Nigeria, despite the significant decline in most parts of the developing world, including some sub-Sahara African countries, such as Ghana and Uganda [6].

Child survival programs have typically focused on diseases affecting children aged over one month primarily pneumonia, malaria, diarrhea, and vaccine preventable diseases and safe motherhood programs have tended to focus on the mother and not her newborn [6].

Despite the reduction in under-five mortality over the past years, Millennium Development Goal 4 [7] that targeted reducing of under-five mortality by two-thirds by 2015 could not to be achieved because neonatal survival chances remained the same [4](Yang et al., 2015). Thus, it is crucial that health policy makers and program managers pay attention to the epidemiology of neonatal deaths, mainly in low and middle income countries where most of NNM takes place.

1.6 Slow Decline of Neonatal Mortality Rate

The under-five mortality rate is reducing at a rate of 2.9%, while neonatal mortality is declining at a rate of 2.1% per year lagging behind the rate of reduction among older age children [1, 4, 5]. The increased rate of the neonatal death is one of the reasons why the Millennium Development Goal (MDG-4) for reducing under-five mortality by two thirds by the year 2015 could not be achieved [6] (Bashir et al 2013). However, most of the data/interventions for the realization of MDG-4 were developed in high income countries where the prevalence of under-five mortality is low. Epidemiologic data on neonatal mortality are not easily available in communities where neonatal mortalities are high as well as reduced accessibility to prevent their occurrence [7].

1.7 Prevention of Neonatal Deaths

Previous studies have revealed that many neonatal deaths are preventable with existing low-cost interventions [6, 7]. However, before implementing these innovations, specific factors which influence the neonatal mortality in specified region in a country should be examined.

Knowledge of the factors associated with neonatal mortality is essential to public health intervention so that the prevention efforts of neonatal mortality can be properly directed to

the cause based on the evidence [3]. In addition, the availability of reliable epidemiological information at the national level would have been an important factor in meeting as well as measuring progress toward the MDGs for child survival [1].

In Ghana, neonatal mortality is an important public health issue, accounting for 30 deaths per 1000 (rank 11th in Africa) live births within the first 28 days of life [16] (Kayode, et al 2014). MDG 4 neonatal mortality could have been attained if Neonatal mortality was substantially reduced to more than half of the infant and under-five mortality [16]. Most studies only assessed the factors influencing under-five and infant mortality in LMICs [17], leaving Neonatal mortality at the back seat.

Further, studies carried out in LMICs found out that neonatal (low birth weight, male infant, multiple pregnancy and prematurity) [19-21], maternal (single, nulliparous mothers and short birth spacing) [19-21], and health service factors (delivery and postnatal services) were reported to have statistically significant associations with neonatal mortality [19, 20].

Ghana was ranked forty-seventh (47th) in the world in terms of under-five mortality rate in 2002, with a rate of 100 per 1000 live births (down from 126 per 1000 live births in 1990) and an infant mortality rate (IMR) of 57 per 1000 live births (UNICEF, 2004).

The majority of these deaths are caused by preventable or treatable diseases, such as infectious diseases, which contribute to approximately 36% of these deaths [3]. Previous studies have shown that the global decline in neonatal mortality rates has been slower compared with infant and under-5 years of age mortality rates, especially in the sub-Sahara African region [1, 2, 4].

Study conducted in Ghana (Kintampo 2007), revealed that the top three main causes of Neonatal death are Birth asphyxia 41%; Neonatal sepsis 15% and Preterm/low birth weight accounting for 15%.

The same study revealed that 60% die less than 24 hours, 32% between 24hrs to 7days and 9% between 7 to 28days of life.

Despite the growing proportion of Neonatal mortality in the under-five mortality in recent decades, most studies have focused on infant and child mortality putting Neonatal mortality on the rear seat.

The aim of this study is to investigate the causes and determinants associated with neonatal mortality in Brong Ahafo. The findings will help stakeholders to implement evidence-based interventions for newborn survival in the region (Brong Ahafo) and improve the targeting of the program to the most vulnerable populations.

1.8 Problem Statement

In Ghana the under-five mortality rate (U5MR) was 82deaths per 1000 live births and neonatal mortality constitute 38.8% of the under-five mortality. However 60% occur in first 24 hours of life and the rest as late neonatal mortality. In Brong Ahafo region (BAR), the under-five mortality rate accounts for 124 per 1000 live births and neonatal mortality constitute 68% of the under-five mortality. However, the under-five mortality will to rise if nothing is done about neonatal mortality.

Child survival programs have typically focused on diseases affecting children over one month primarily pneumonia, malaria, diarrhea, and vaccine preventable diseases and neonatal mortality is left at the back seat.

Special attention needs to be focused on neonatal mortality if under five mortality can be reduced, therefore an assessment of factors contributing to neonatal mortality is important to institute evidence based interventions.

However, in Brong Ahafo Region NNM rates trends and causes have attracted relatively little attention compared to maternal deaths or deaths among older children under-five. As far as National public health policy and programs are concerned neonatal deaths still do not receive attention commensurate with their burden [5].

A specific focus on NNM is required as the epidemiology, cause-of-death, and its health interventions differ from those of older children.

Therefore to reduce the under-five mortality, it is important to focus more on Neonatal mortality. This therefore calls for a thorough assessment of the current factors so that appropriate interventions can be instituted.

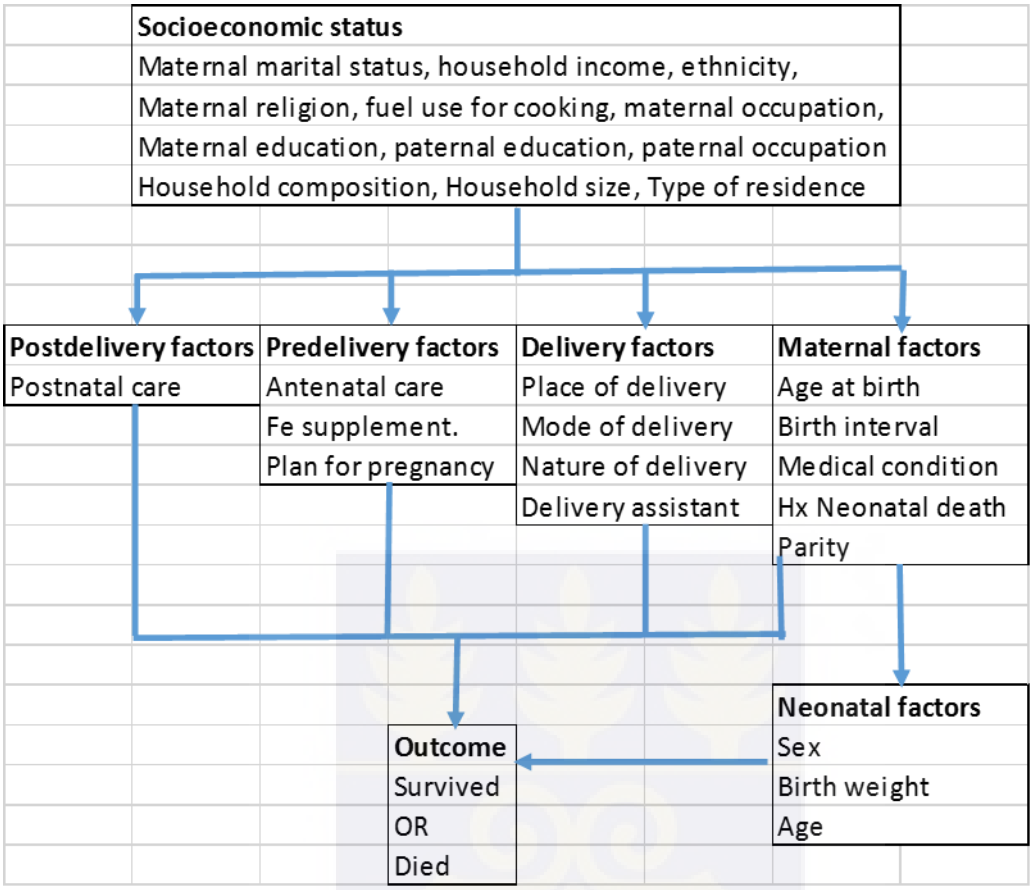
1.9 Justification

The study will aim to determine causes and determinants of Neonatal mortality in Brong Ahafo region (BAR). The findings can help policy makers and program implementers at Regional level to design a more evidence-based intervention strategies to mitigate Neonatal mortality.

Understanding the factors associated with neonatal mortality is important so that public health intervention efforts to prevent neonatal mortality can be properly focused, based on the evidence.

In addition, the availability of valid epidemiological information at the Regional level will be an important determinant of success in meeting and in measuring progress toward child survival in the region.

Figure 1: The Conceptual Framework



Mosley and Chen conceptual framework for the study of child survival in developing countries [6], was adapted in the study of determinants of neonatal mortality in Brong Ahafo Region. The figure 1.1 depicts determinants of neonatal mortality and are grouped as socioeconomic variables (maternal marital status, household income, ethnicity, household size, maternal religion, fuel use for cooking, maternal occupation, maternal education, paternal education, paternal occupation and house composition and type of residence); maternal factors (maternal age at birth, birth interval, medical condition, history of neonatal death and parity); Predelivery factors (antenatal care, iron supplementation and plan for pregnancy); delivery factors (place of delivery, mode of delivery, nature of delivery and delivery assistant); neonatal factors (sex, birth weight and age); post-delivery factors (postnatal care); outcome (survived or died). Socioeconomic

variables do not directly influence neonatal outcome per se but affect it through association with other factors as shown by the arrows.

A woman's marital status of an individual can resulting improved socioeconomic status, better nutrition and source of income to access health services. For example; an illiterate woman who marries a literate man can have an improved health status such that her attitude may be influenced by her husband. He would cause her to provide nutritious meals for her family, better care for the children and have better knowledge about diseases and access to health services. Studies have also shown that women not in a proper union are perceived to have low health status [36] For example; teenage mothers are usually, dropouts from school and poor. These women are emotional and psychologically vulnerable because they lack both financial and social support from their families or society. Several studies have shown increased risk of mortality in pregnancies that lack of social and emotional support, especially from the husband or partner [37;38] The mother's education level affects child survival [39] by influencing the choices she makes with regard to nutrition, hygiene, preventive care and treatment for diseases. For example; women who have some education tend to reside in urbanized areas, utilize effectively available health service if their children fall ill. Being educated enables one to get better paid job to buy nutritious food and it enhances high compliance to treatment which is a key factor in the healing process. Also they can alert physician if they observe unusual signs or behavior seen in their newborn. [40;41]. A study in Australia showed that children born to socioeconomically disadvantaged mother's had the worst health status [42](Akweongo, 2001).

1.10 Research Questions

1. What are the causes of Neonatal deaths in the Region?

2. What are the socioeconomic determinants of neonatal mortality?

3. What are the proximate determinants of neonatal mortality?

1.11 Objectives

1.11.1 General:

To determine causes and factors associated with neonatal mortality in Brong Ahafo Region.

Specific:

1. To determine the causes of Neonatal death in Brong Ahafo region

2. To determine socioeconomic factors associated with Neonatal mortality

3. To determine maternal factors associated with Neonatal mortality;

4. To determine the delivery factors associated with Neonatal mortality.

CHAPTER TWO

LITERATURE REVIEW

2.1 Global Burden of Neonatal Mortality

Globally 4 million new born deaths every year which makes up of about 40% of child mortality with an annual figure of 130 million new borns. This corresponds to an overall neonatal mortality rate of 30/1000 live births. This figure has not change significantly for the past 5 decades. One major reason for this stagnation is global inequity. For instance, in Sweden and most of the industrialized countries neonatal mortality rate is between 2 – 3 /1000 and it is surprising that this rate reaches over 60/1000 in the poorer regions of the world. 99% of all children who died during the first 4 weeks of life are in the poorer segments of the world (sub-Saharan Africa and south Asia) (Nisar & Dibley, 2014).

2.2 Approaches to Neonatal Mortality

In order to combat this problem and improve neonatal survival, adequate resource allocation and capacity building of health care providers is paramount, as well as improve health seeking behaviors. Readiness and willingness to utilize the existing health systems by all families. Encouragement of skilled attendance at birth which means presence of a skilled personnel, adequate supplies, equipment, transport and effective communication between health care givers. The time for intervention during child birth is short and therefore must be at the right time, place and the right care giver.

Another important factor for safe motherhood and delivery care is decision to seek appropriate care at the time of delivery and ensuring a safe delivery is an important determinant of neonatal outcome.

Two third of the world's neonatal deaths occur in just 10 countries, mostly Asia and Pakistan, which is third among the African countries accounting for 7% of the global

figure(Mahmood, 2002). Three quarters of neonatal deaths occur in the first week of life and more than a quarter occur in the first 24 hours.

2.3 Global Causes of Neonatal Mortality

Globally the main causes of neonatal deaths are: Infections 36% example, sepsis, pneumonia, and meningitis; Preterm birth 28% and Birth asphyxia 23%, together they constitute 87% of all causes of neonatal deaths(Lawn et al., 2008). The causes of neonatal mortality are different between countries and in regions within the country [2, 9]. There is inadequate information about the direct causes of neonatal deaths in low-income communities to inform policy for any meaningful intervention. Population-based information in these areas mostly dependent on verbal reports or autopsies of variable quality. Global estimates are only possible through statistical modelling [2] or by using the proportion of the high income countries.

2.4 Evidenced-based Interventions

A large proportion of neonatal deaths could prevent by appropriate resuscitation, such as clearing the airways, drying and stimulating baby by rubbing with a towel to make the baby cry, and, in some cases, by positive pressure ventilation either through mouth-to-mouth breathing or through use of bag and mask.

The available evidence-based interventions that can improve the survival of premature/low birthweight babies are promotion of early and exclusive breastfeeding [25, 26], prevention and treatment of hypothermia, such as kangaroo mother care [26-28], topical skin-cleansing with chlorhexidine [30] may reduce morbidity and mortality among low-birth weight and premature infants (Chowdhury et al., 2010)

Further evidence from India have shown that evidence that home-based management of low-birthweight and preterm neonates with supportive care and treatment of infections is feasible and effective in improving the survival of new borns [22].

Infectious causes (sepsis/meningitis and pneumonia) were the major contributor to late neonatal deaths in many studies, but are also important in early neonatal mortality. Most early infections are usually acquired from the mother, and management of maternal reproductive and urinary tract infections can helpful in effectively preventing infections in neonates [32]

Community based studies in developing countries have reported that clean delivery practices (hand-washing and cleaning birth-passages with chlorhexidine) and neonatal care practice just after delivery (clean cord cutting, applying chlorhexidine over the cord, and skin cleansing) can also reduce neonatal infections and infection related mortality [25, 30, 31].

Late neonatal deaths due to neonatal tetanus can be prevented by tetanus toxoid immunization of the pregnant mother [25, 30].

2.5 Neonatal Mortality in African Region

African continent is 11% of the world's population but more than 25% of the world's neonatal mortality. Each year in Africa approximately 1 million babies are still born, of whom around 300,000 die during labor. A further 1.16 million babies die in their first month of life. Of these the 20 countries with the highest risk of neonatal mortality, 15 (75%) are in Africa.

Liberia has the highest risk of neonatal deaths 6.6% and lowest risk in Africa is Seychelles 0.9%. Many of these African countries have experience wars or other disasters. In Ghana an annual burden of 29,200 neonatal deaths was recorded.

In Africa, 30% of still births occur during labor, 30 to 50% of neonatal mortalities occur on the first day of life. Under five mortality among African children tend to be decreasing, however, there has been little progress in reducing neonatal deaths and 25% of under five deaths are neonatal deaths (K C et al., 2015). There has been no meaningful progress in reducing deaths during the first week of life.

2.6 Neonatal Mortality in Ghana

In Ghana according to Mid cluster indicator survey 2011, the Northern Region, Upper East, Upper West and Brong Ahafo regions have the highest child mortality among the ten regions in Ghana; 66/1000, 58/1000, 67/1000 and 66/1000 respectively.

Quality health care is important to curb with the challenging health needs of the mentioned regions. These high figures are probably few and under resourced Health facilities. Most Neonatal units lack equipment such as incubators and radiant heaters. Health facilities should be equipped and resourced to improve the quality of health care to pregnant women and infants.

At least two third of the deaths could be prevented in Ghana through skilled delivery, early initiation of breastfeeding and exclusive breast feeding.

To achieve MDG 4 new born deaths must be reduced to 40/1000 live births. This requires strengthening of both maternal and child health services and integration with other programs.

The first 4weeks of life remain the most critical period for an infant to survive during childhood;(Nisar & Dibley, 2014). [1] Approximately 10,000 newborns die every day during this period [2]. As a result of the devastating effects of under-five mortality especially in low and middle income countries (LMICs), 189 United Nations member states unanimously agreed to adopt reduction of under-five mortality by two-thirds between 1990 and 2015 as the Millennium Development Goal 4 (MDG 4) [3].

In Ghana, neonatal mortality is an important public health challenge; 30 per 1000 live births are dying within the first four weeks of life (Kayode et al., 2014) [16]. In order to attain MDG 4, neonatal mortality has to reduce substantially because it accounts for more than half of the infant and under-five mortality [16]. Most studies to date mainly examined factors influencing under-five and infant mortality in LMICs [17], only a limited number of studies have specifically assessed factors associated with neonatal mortality in sub Saharan Africa.

Early initiation of breastfeeding was well shown to be associated with reduced neonatal mortality in Ghana [18], however in LMICs, neonatal (low birth weight, male infant, multiple pregnancy and prematurity) [19-21], maternal (single, nulliparous mothers and short birth spacing) [19-21], and health service factors (delivery and postnatal services) were reported to have independent associations with neonatal mortality [19, 20].

Study conducted in Indonesia about determinants of neonatal mortality showed a significant difference in neonatal mortality among different regions of the country. A decline in the odds of neonatal death was found as the percentage of deliveries assisted by trained delivery attendants increased whereas it was found to be high for infants born to working mothers and fathers and for infants born to fathers who were unemployed. More neonatal mortality was found for higher rank infants with a short birth interval, male

infants, smaller than average-sized infants and infants of mothers with delivery complications. Infants receiving any postnatal care were significantly protected from neonatal death (Titaley et al., 2008) [4].

Another study in Burkina Faso showed that the main predictors of neonatal mortality were twin birth, having a nulliparous mother and birth into a polygynous household [5].

2.7 High Risk Factors

Other maternal factors including in-vitro fertilization, earlier still birth, higher maternal age, maternal diabetes and smoking during pregnancy and being a single mother were found to be associated with increased risk of peri-natal mortality [6]. The struggle towards having a better NMR is closely linked to identifying the factors associated with an increased mortality. There are few studies in Sub-Saharan Africa about predictors of neonatal mortality, and those which have been reported so far were done with a small sample size (K C et al., 2015).

The inverse relationship between socio-economic variables of the parents and infant and child mortality is well established by several studies [Muhuri, (1995), Forste (1994), Hobcraft, et al. (1984), Caldwell (1979), Sathar (1985, 1987)]; and it holds true irrespective of the overall level of mortality in the national populations (Ruzicka, 1989). The influence of parental education on infant and child health and mortality has proved to be universally significant [Bicego and Boerma (1993); Caldwell, et al. (1990)]. The father's education, mother's education and their work status each have independent effects upon child survival in developing countries [Sandiford, et al. (1995); Forste (1994); Caldwell, et al. (1983)]. Economic conditions of the household also help in explaining the variation in infant and child mortality. The nature of housing, diet, access to and availability of water and sanitary conditions as well as medical attention all depend on the

economic conditions of the household. For example, poor families may reside in crowded, unhygienic housing and, thus, suffer from infectious disease associated with inadequate and contaminated water supplies and with poor sanitation [Esrey and Habicht (1986)].

Maternal factors, which are biological attributes of birth, such as the age of mother at the time of childbirth, birth order and birth interval [Forste (1994); Rutstein (1984)], have significant effects on child survival. Infant and child mortality are also affected by the sex of the child, and infants born to mothers who have lost a child are at greater risk of dying during infancy [Cleland and van Ginneken (1988)].

Moreover, some of the studies found that, within a family, deaths of infants are correlated [Curtis, et al. (1993); Das Gupta (1990); Gubhaju (1985); Majumder (1989)].

Study in Nigeria showed that neonates delivered by caesarean section had a higher relative risk of neonatal mortality compared with vaginal deliveries. This result contradicts previous reports, which indicated a statistically insignificant relationship between the mode of delivery and neonatal mortality [29]. A similar study conducted in Swaziland reported a higher risk of death for neonates delivered by caesarean section than vaginal delivery, but this was not significant [30] (Ezeh et al., 2014a).

The significantly high risk of caesarean section observed in the study conducted in Nigeria may be attributed to negative perceptions, such as misconception, fear, and aversion to caesarean section among mothers in Nigeria [31, 32]. This could explain why pregnant mothers are presented to health facilities after experiencing labor at home or elsewhere, with life-threatening complications for emergency caesarean section [33]. This is also supported by a recent study on caesarean section and perinatal mortality in South Western, Nigeria, which found that nearly 84% of early neonatal deaths occurred in pregnant mothers who delivered their newborns by emergency caesarean section [34].

Previous studies have revealed that neonatal mortality is associated with male babies, advanced maternal age, family poverty, and delivery of baby by Caesarean section and delivery complications (Nisar & Dibley, 2014). Advanced maternal age was associated with preterm delivery and antepartum complications in another study [13] and further studies have found that delivery complications were determinant of poor perinatal outcomes [14,15]. Obstetric complications, particularly in labor, have been reported as risk factors for early neonatal deaths [6, 16] and poverty and delivery complications have also been identified as risk factors for neonatal death [7].

2.8 Skilled Delivery

Studies have observed a progressive reduction in the neonatal death odds as the percentage of deliveries assisted by trained birth attendants in the communities increase (Awour, Abed, & Ashour, 2012). Knowledge of determinants of neonatal deaths is important to provide guidance for the development of evidence-based interventions directed at reducing neonatal mortality in communities.

2.9 Parity

Complications tend to increase with increasing parity thereby increasing the risk of Neonatal death. Parity greater than four is a risk factor for poor obstetric outcome. Pregnancy Induced Hypertension (PIH) and ante-partum hemorrhage (APH) increase the risk of birth outcomes (Nisar & Dibley, 2014). PIH reduces nutrient supply to the fetus due to restricted blood flow leading to intrauterine growth restriction (IUGR). Such fetuses are too small and have high risk of dying in the Neonatal period [14-15].

In another study primiparity was found to be associated with neonatal mortality. In contrast, multiparty (≥ 5) has been reported as a risk factor for neonatal mortality [3].

Another result was the high neonatal mortality risk associated with babies born by Caesarean section, because most are emergencies following prolonged attempted vaginal deliveries.

2.10 Gender

Male neonates are at an increased risk of dying in the first month of life compared to females. This may be attributed to higher susceptibility to infectious diseases in males [25], however, the possible reason for the high rate of death among male neonates in the first week of life [26], which is the time when sex differences in neonates plays a role [33]. The risk factors that have been implicated with this increased neonatal deaths in male infants include immunodeficiency [32], increasing the risks of infectious diseases in males, late lung maturity [33] resulting in a high prevalence of respiratory diseases in males, and congenital malformations of the urogenital system.

2.11 Caesarian Section

Study conducted in Nigeria on determinants of Neonatal mortality revealed that neonates delivered by caesarean section had a higher relative risk of neonatal mortality compared with vaginal deliveries (Y. Nisar, et al, 2014). This result contradicts previous reports, which indicated a statistically insignificant relationship between the mode of delivery and neonatal mortality [29].

2.12 Maternal Education

Studies conducted in Ethiopia on determinants of Neonatal mortality showed a significant association between Neonatal mortality and maternal education. It was discovered that neonatal death is more likely to occur among mothers with no education than the educated

Socioeconomic factors of under-five mortality

A study in parts of rural Ghana and another in Tanzania did not find any significant effect of household socio economic status on child mortality [18,19] while a study using Nigeria Demographic and Health Survey for 2008, found that relatively prosperous households were less likely to experience child death than the poorest households in rural Nigeria [13]. Existing literature has documented mixed results, such as place of delivery, birth order and sex of child. For example numerous evidence suggest that women who deliver at health facilities have a lower risk of child death as compared to those who deliver at home due to the use of skilled delivery at health facilities and the none existence of such at home [6,12-14]. However, studies in South Africa and parts of Nigeria suggest that place of delivery does not have significant effect on either perinatal or under-five mortality [16,17].

In Ghana, just as in many other countries in Sub- Saharan Africa with low socio economic development, under-five mortality is relatively high with a recent reported national figure of 90 per 1000 live births [21].

Moreover within Ghana, disparities exist in under-five mortality rates between regions. In the more resource rich regions of southern Ghana, under-five mortality rate ranges from 75 per 1000 live births whiles in the poorest and deprived regions of the north such as the Upper East Region it is as high as 128 per 1000 live births [21]. Therefore there is the need for concerted efforts especially in resource poor settings if we hope to achieve the desired improvements in under-five mortality(Kanmiki et al., 2014) mothers. This means that there is no doubt that educated mothers can provide better care for their neonates than those with no education or a lower level of education. In the same study paternal employment status was significantly associated with neonatal death (Wakgari & Wencheko, 2011).

Other studies showed that maternal education was not associated with neonatal mortality, which is in contrast with another study which has found maternal education to be an important determinant of Neonatal outcomes [17]. This may be due to mothers with higher levels of education using more antenatal care [18].

2.13 Paternal Employment

Neonatal death was less likely to occur among employed fathers than unemployed fathers. Similar study in Indonesia also yields the same results [10]. Employed fathers would have a protective effect on neonatal mortality by increasing household income and economic status of the family resulting to increased frequency of health institution visit for antenatal care, delivery and postnatal care (Titaley et al., 2008)

2.14 Maternal Employment

Mothers who are employed have reduced risk of neonatal mortality than the unemployed. This finding showed consistency with the results obtained from other studies [10, 25]. This is obvious because unemployed women might not financially stable to get better health care for themselves during pregnancy and for their newborns.

2.15 Wealth Index

Neonatal death was observed to be less likely to occur in the richest wealth index than the poorest wealth index. Similar result was obtained from the same study in Republic of the Sudan [26 - 28] (Bashir, Ibrahim, Bashier, & Adam, 2013).

2.16 Maternal Age at Birth

It was also observed that neonatal death was less likely to occur among mothers who gave birth in the age group 20 - 34 years old compared to mothers below age 20 years old. This could be explained due to the complication occurred among adolescent mothers during pregnancy and delivery, and babies born might be premature and underweight. It might be also explained as older mothers not only had better knowledge of pregnancy and child birth but also are psychologically and physically ready compared to younger mothers (Nkyekyer, Enweronu-Laryea, & Boafor, 2006)

2.17 Type of Residence

The type of place of residence was also found as a determinant of neonatal death in studies carried out in Bangladesh, Ghana and Gambia [25, 35, 36].The studies found that neonatal death was more likely to increase among newborns, born in the rural residence compared with urban areas. This is probably because urban areas have better infrastructure for health care services than rural areas.

2.18 Household Size

Studies have shown that neonatal death was more likely to increase among households whose number of children was above four [37, 38].

2.19 Birth Interval

With regard to birth interval, the study showed that the shorter the birth interval (below 36 months), the probability of neonatal death will be more likely to increase in relative with those whose birth interval was 36 months and above [10, 39 - 41]. This could be linked to maternal health problems where women with short birth intervals between two

pregnancies have insufficient time to restore their nutritional reserves (maternal depletion syndrome) which is thought to adversely affect fetal growth.

2.20 Abortions

Studies on abortion in the Korle-Bu Teaching Hospital on the epidemiology and complications of induced abortions [Ampofo7 and Lassey8] showed that the majority of women with induced and spontaneous abortions were in the 15–24 and 27–32year group respectively.

Ampofo7 showed that the only significant difference in characteristics was that patients with induced abortions had a higher educational status. This finding was in line by the fact that the main reason for an induced abortion was the desire to complete school or training.

Patients with complications of induced abortion are younger, lower parity, more educated, with lower economic potential, in less stable relationships, and with a higher knowledge of modern contraceptive methods than the group with spontaneous abortions.

2.21 Birth Weight

Birth weight is one of the strongest determinants of neonatal mortality. This finding was supported by a study in Bangladesh reported that approximately 75 per cent of neonatal deaths associated with low birth weight were due to preterm birth rather than small for gestational age infants [28] (Bhaskar, Ravi Kumar, 2010)

Low birthweight (LBW)

Defined by WHO as weight at birth of less than 2.5 kg [1]. By international agreement, LBW has been defined as a birth weight of less than 2500 grams, with the measurement being taken preferably within the first hour of life, before significant postnatal weight loss

has occurred [2]. It contributes substantially to neonatal, infant, and childhood mortality and morbidity [3].

Across the globe, neonatal mortality is 20 times more likely for LBW babies compared to normal birth weight (NBW) babies (>2.5 kg) [4]. It is now a well-established fact that birth weight is not only an important determinant of child survival, growth, and development, but also a critical indicator of maternal health, nutrition, and quality of life [5]. The incidence of LBW accounts for 16% worldwide, 19% in the least developed and developing countries, and 7% in the developed countries. The incidence of LBW is 31% in South Asia followed by East and North Africa (15%), Sub- Saharan Africa (14%), and East Asia and Pacific (7%). Asia accounts for 75% of worldwide LBW followed by Africa (20%) and Latin America (5%).](Bhaskar et al., 2015)

Low birth weight babies were more likely to die of hypothermia and respiratory distress syndrome, during neonatal period. Studies have revealed that Premature and low birth weight babies were however more likely to die during the neonatal period than low birth-weight term babies. Term babies would have higher immunity and mature respiratory systems with adequate surfactant production and better body temperature regulation [17].

Birth weight

Globally, an average of 14% of babies are born with low birthweight (LBW)- less than 2500grams.

LBW may be caused by preterm birth or growth restriction in full term babies, or a combination of the two. Preterm infants have a risk of neonatal death that is around 13 times greater than full-term infants [54] and at least one-half of neonatal deaths are in preterm babies. Babies who are both preterm and growth-restricted have an even greater risk of death [54]. LBW infants in Africa are at greater risk of being born preterm.

Regional estimate for preterm birth is around 12%, which is almost double the frequency of preterm birth in European countries and probably related to infections, particularly sexually transmitted infections, malaria and HIV/ AIDS [55]

This differs markedly from the situation in South Asia, where the LBW rate is almost twice that in Africa.

Coinfection during pregnancy with HIV and malaria is more than "double trouble": the 2 infections act synergistically, with serious consequences for maternal and newborn health, especially increasing the LBW rate.

Identifying small infants and providing extra support for feeding, warmth, care and KMC has great potential to reduce neonatal deaths in the short term [50]

2.22 Maternal Infection

Maternal infections increase the risk of neonatal mortality. Malaria causes placental insufficiency resulting to and sometimes intra-uterine fetal death.

Maternal HIV infection will compromise the mother's immune system and the infant depends on maternal antibodies to fight infection. The chances of survival are very low because of the low immunity passed on from the mother, thereby increases the risk of neonatal death. [19].

2.23 Delivery Complication

Neonates born to women experiencing complications such as vaginal bleeding, fever or convulsions during childbirth had remarkably higher odds of dying compared to those born to women without any complications. A study in Bangladesh showed that Neonates born to women without severe delivery complications had better survival than those born

to women with eclampsia, intra-partum hemorrhage, cord prolapse, mal-presentation, APH or even prolonged labor [29].

2.23.1 Antenatal Care

Appropriate antenatal care can play a role by educating women and their families to recognize early delivery complications that require referral to health care services to achieve a better delivery outcome for both mothers and Neonate.

2.23.2 Postnatal Care

Studies have shown that postnatal care services received by the infants yielded a significant protective effect. This result demonstrated that of postnatal care service is linked with the reduction of neonatal mortality (Abdellatif, et al 2013).

Different kinds of postnatal care interventions have been proven to be effective in preventing neonatal deaths, such as facility based, population outreach, or family-community based interventions [13, 39, 40]. In Indonesia, each newborn is recommended to receive at least two basic-health care checks within the periods of 0–7 days and 8–28 days, to assess the newborn for illness and give appropriate Health information to the mothers.

Health facility delivery was found to reduce the risk of neonatal mortality by 29% in developing countries [38], however, if done routinely at both community and facility level; hygienic cord care, proper thermal care and early initiation of breastfeeding practices is known to reduce newborn deaths by up to 30% [39](Hibstu, Ayele, & Mengesha, 2014).

2.23.3 Distance

Distance naturally prevents them from accessing health care services even if they are knowledgeable of the importance of ANC but becomes a barrier for early identification and management of pregnancy related complications and may further dictate their choice of place of delivery.

2.24 Malnutrition

Malnutrition increases susceptibility to infection which results to LBW babies with greater probability of dying in the neonatal period [21]. People living in regions where poverty and unemployment are common, the risk of neonatal death is also increased exponentially [13, 22, 23]. This is true for most rural areas in developing countries.

2.25 Barriers to Newborn Care

Barriers to care goes beyond the health service and include issues such as distance, cultural beliefs, financial and transport constraints. High cost of transportation and health care were key hindrance to seeking health care, both for pregnancy and labor/delivery complications and for newborn illnesses. Research suggest a need to subsidize the costs of health care and transport by government or organization to ameliorate the cost of accessing health care services. Several suggestions were given; one is the possibility to provide finance, either at the central or at the local level, to cover the costs of transport, and user fees. Others are Conditional cash transfers programs, community insurance schemes, coupons and vouchers, and facility funds for cost reimbursements are possible mechanisms [46–48].

Neonatal infections

Deaths in the neonatal accounts for 41% (3.6 million) of all deaths in children under 5 years [1]. The majority of these deaths occur in low income countries and about 1 million of these deaths are due to infectious causes such as neonatal sepsis, meningitis and pneumonia [1]. These deaths occur because of lack or inadequate preventive care (clean birth care, breastfeeding) and appropriate case management [2].

Delays in illness recognition and care seeking, and treatment of neonatal infections of even a few hours may be fatal inadequate primary health care providers, and limited access to facility care contributed to these deaths [3]. Studies have demonstrated the effect of community-based packages for prevention and treatment of neonatal bacterial infections.

Management in neonatal nurseries at the primary health care level is the hall mark of the management of neonatal sepsis and pneumonia, with strong conviction that oral therapy saves lives, given the limited access to care for sick neonates in low income countries, it is important to assess the treatment effect of oral antibiotics delivered at the primary care settings.

Case management for hospitalized neonates is more expensive compared to care delivered at home or in primary care settings.

Neonatal sepsis, meningitis and pneumonia are responsible for almost a million neonatal deaths annually. Neonates are more susceptible to severe infections and the progression of disease is faster due to developmental immunodeficiency. A significant proportion of infections may arise early, after vertical transmission from the mother [73]. Therefore, early identification and appropriate treatment with antibiotics is an important measure to reduce the burden of neonatal mortality due to infections. (Zaidi et al., 2011)

Child birth practices

The remarkable decline in neonatal mortality rates in the middle of the 20th century in high income countries is attributed to the advent of hygienic childbirth practices and modern obstetric care [1], with additional reductions since the 1970s due to increasingly intensive neonatal care.

In low income countries, where skilled deliveries are less than half, each year 60 million births occur outside facilities [2], the burden of neonatal morbidity and mortality related to childbirth remain exponentially high [3]. Intrapartum-related events in term babies associated with hypoxic injury (previously loosely termed "birth asphyxia") are responsible for an estimated 814,000 neonatal deaths [4] [5] each year, with perhaps one million disabled survivors with long-term neuro-developmental injury, including cerebral palsy, mental retardation, blindness, long term intellectual impairment and behavioral problems [6,7. Skilled attendance at delivery and emergency obstetric care are the basis of modern obstetrics to prevent neonatal loss.

Emergency obstetric care coverage remains extremely low, especially in rural areas, only 5% of births in rural South Asia and 1% in rural Sub-Saharan Africa are by Caesarean section [10]. This low coverage is mainly due to poverty because skilled attendance is expensive.

However, data on neonatal mortality is critical in designing evidence-based interventions to inform the investment choices and design. (Lee et al., 2011)

Globally over half a million newborns are estimated to die each year from serious neonatal infections, accounting for about 15% of all neonatal deaths [1].

The most critical time for newborn is during birth and in the neonatal period. About 75 percent of neonatal deaths occur during the first week of life, predominantly within the

first 48 hours of life [2]. In populations with very high neonatal mortality, up to half of neonatal deaths may be due to infectious causes [4,5]. It is estimated that 30-40% of infections are transmitted during childbirth and symptoms set in within 72 hours after birth [6,7]. In low income countries, about 60% of births occur without a skilled attendant, at home [8] and globally, 60 million births happen outside facilities. However even for facility births hygienic practices may be sub-optimal in most cases.

The unhealed umbilical cord is an important entry point for local and invasive infections during this period and is rapidly colonized by bacteria from the maternal genital tract and from the environment.

Localized umbilical infection (omphalitis) can spread to the abdominal wall, the peritoneum, or through the umbilical or portal vessels leading to systemic infection, which, if untreated, has a high case-fatality rate [11]. Omphalitis with redness extending to the abdominal wall was associated with a 46% increased risk of mortality in rural Nepal [12].

Neonatal tetanus

The global burden of neonatal tetanus has decreased from over 600,000 neonatal deaths in 1990 to fewer than 60,000 in 2008 [1,13], because of increased tetanus toxoid vaccination coverage, hygienic intrapartum and postnatal practices, particularly cord care [14,15]. Clean birth practices have been associated with dramatic reductions in the incidence of neonatal tetanus in the absence of immunization, for example in high income countries where tetanus was virtually eliminated before the vaccine was introduced and in China, training of traditional birth attendants (TBAs) and providing them with a ‘clean birth kit’ in the 1950s led to a reduction in neonatal tetanus rates from 32/1000 in 1948 to 2/1000 in 1961 [19].

Clean birth and postnatal care practices in accordance with World Health Organization's (WHO) "six cleans"

1. Hand washing of birth attendant before birth,
2. Clean birth surface,
3. Clean perineum,
4. Cutting of the umbilical cord using a clean implement
5. Clean cord tie
6. Clean cloth for drying

These practices may be influenced by a number of programmatic approaches including behavior change communication, commodity provision, or training of attendants, or both.

Hand-washing with soap results in a large reduction in hand contamination, even when washed with unclean water [20], and birth attendant and maternal hand washing have been associated with reductions in neonatal mortality [21]. However cultural factors frequently dictate practices and may influence willingness to adopt new clean practices [22-24].

Many populations commonly rub potentially harmful substances on the umbilical cord or skin despite WHO recommendations for dry cord care [11,25-29].

Chlorhexidine, a broad-spectrum topical antiseptic, has residual effect for up to 72 hours and may be a used in addition to basic cleaning practices in home and facility level.

Although such hygienic practices at birth and during the postnatal period are accepted as a standard of care but there is very limited evidence regarding their effect to guide policymakers in the potential mortality effect size (Blencowe et al., 2011)

Although there has been considerable improvement in child health globally, it is increasingly evident that important gaps and disparities still exist, such as a disproportionate burden of infant and under-five mortality relates to deaths within the neonatal period. However, the vast majority of perinatal and neonatal deaths occur in conditions of socioeconomic deprivation in developing countries.

The health of the newborn infant is tied to the health of the mother, strategies to improve the health and care of women in low-resource communities and countries are also expected to improve both pregnancy and neonatal health outcomes. However, poverty, illiteracy, poor status of women and dysfunctional health systems are important underlying factors that adversely affect maternal and child health in many developing countries. Moreover, in sub- Saharan Africa, the devastating epidemic of human immunodeficiency virus (HIV)/acquired immuno- deficiency syndrome (AIDS) threatens to reverse many of the gains achieved during decades from child survival programs.

Pragmatic reality in most developing countries dictates the need for wide scale implementation of evidence-based, cost effective health programs and interventions to improve child health outcomes. Moreover, achievement of Millennium Development Goal 4 to reduce under-5 mortality by two thirds by the year 2015 could have dependent on a substantial reduction in neonatal mortality over the next decade. (Bhutta, Darmstadt, Hasan, & Haws, 2005).

Millennium development goals (MDGs)

The total number of under-five children's deaths was 6.6 million in 2013, of which 80% occurred within 48 hours postpartum [1]. Only one-third of the 68 Countdown Countries were on track to achieve MDG4 (reduce child mortality. Moreover, neonatal care programs are often vertical in nature; because newborn health is largely dependent on

maternal health, care for both the mother and newborns should be provided in a continuous manner [9]. Indeed, around 20% of diseases among infants can be attributed to the mother's poor health status, malnutrition, and inadequate care during the perinatal period [10]. For instance, maternal treatment of infectious diseases such as HIV and malaria influences infants' health [11, 12]. The continuum of care has been well known as a potential means of improving child survival.

Previous studies estimated that up to 67% of neonatal deaths could be prevented by improving the coverage of common maternal, neonate and child health care (MNCH) to 90% of reproductive age women [7, 20]. However, as resources are limited, providing all possible MNCH services is unrealistic, particularly in LMICs providing a total continuum of care package from antenatal care to postnatal care to prevent 38–67% of neonatal deaths in Sub-Saharan Africa [20]. Therefore identification of the most effective MNCH package must be prioritized in health policies to ensure more effective use of continuum of care. The frequency and timing of care delivery are important considerations in defining continuum of care. The recommended standards of MNCH care are Four antenatal care visits [21–24]; delivery assisted by skilled birth attendants [25–27]; and Postnatal care within 48 hours [28–32], (4) at seven days [31, 33–37], and (5) at six weeks [31]. Regarding antenatal care, fewer visits have often been the standard in LMIC trials [24]. Compared to five antenatal care visits, fewer than five antenatal care visits does not significantly increase maternal and neonatal mortality [21, 38], which led the World Health Organization (WHO) to define four antenatal care visits as the standard in their guidelines [39].

The WHO's practical guidelines from 1998 encourage mothers with babies to access postnatal care services at "six hours, six days, six weeks, and six months" [41]. This formula targeted "crucial" moments of need for the mother and baby but evidence was not

given. In 2006, the timings were within the first week, preferably 2–3 days after delivery, and 4–6 weeks [42], and in 2009, within the first 24 hours after birth, on day three, and on day seven, if necessary [30]. This was based on evidence indicating high maternal deaths on the first and second days after birth [43]. Additionally, almost 40% of under-five deaths occur within the first 28 days of life [30, 44], and three-quarters of neonatal deaths occur during the first week of life, with 25–45% (Kikuchi et al., 2015)

Under-five mortality decline has drop from 1.2% per year between 1990 and 1995, to 3.9% per year between 2005 and 2012 [1]. However despite this substantial decrease in global child mortality rate, about 6.6 million children still die every year before their fifth birthday worldwide which implies 18,000 under-five children die each day [1]. There are huge difference in child mortality among low and middle income countries and the affluent world; with Sub-Saharan Africa and South East Asia carrying the highest burden of under-five mortality [2-4].

Children in sub-Saharan Africa have the highest risk of death in the first month of life and are still leading in under-five mortality rates with one in every nine children dying before their fifth birthday as of 2011 [2]. It is worth noting that the year 2008 recorded a rate of one in seven children (144 per 1000 live births) dying before their fifth birthday with the highest levels occur- ring in West and Central Africa. Within 34 countries where under-five mortality exceeded 100 out of 1000 live births in 2008, all except one are in sub-Saharan Africa [5]. The rate of progress in child survival in Sub- Saharan Africa is insufficient to meeting United Nations Millennium Development Goal 4 of reducing under-five mortality rate by two-thirds between 1990 and 2015 as it has the highest risk of death in the first month of life and is among the regions showing the least progress globally [1,2]. In order to expedite the decline in under-five mortality rate, evidence-based interventions would have to target important causes of child death [6-8]. Previous studies

have shown that various factors influence child health and survival including place of residence, mothers age, mother's education, place of delivery, birth order, sex of child, religion of parents, household headship and household socio economic status [9,12-18]. Though poverty is well acclaimed as an essential factor influencing child mortality [4, 14, 19, 20], findings on the effect of household socio economic differentials on child mortality have been mixed.

The countdown to 2015 decade report (2000–2010) has shown that child mortality rates have been declining worldwide; however; 49 out of 68 countdown countries were off track for achieving the millennium development goal 4 (reduce child mortality by two-thirds by achieving a 4.4% annual rate of decline) primarily due to persistently high perinatal mortality in general and high neonatal mortality in particular (1). It was also revealed that out of 8.8 million under five child mortality globally, 40% and 30% occur during the neonatal and early neonatal periods, respectively (1, 2). In other words, in low and middle-income countries, the reduction in neonatal mortality in general and in early neonatal mortality in particular has been slower than the reduction in post neonatal mortality (3, 4).

In the majority of low income countries, for every neonatal death, there is another fetal death (5, 6). This is because the causes of early neonatal deaths and stillbirths are very closely linked, and are usually obstetric in origin and strongly associated with causes of maternal mortality and morbidity (7, 8). As a result, examining the association of perinatal deaths with potential obstetric and related factors can help identify the highest risk factors, and is used as an indirect measurement of the availability and quality of care provided to pregnant women and neonates in a given society (9, 10).

Risk factors for perinatal mortality were multiple, however, several studies have shown a strong correlation with perinatal mortality with asphyxia, preterm delivery, neonatal

infections, during pregnancy and maternal anemia (11–15). The review of other studies on the association of perinatal mortality with some of the other obstetric risk factors (antenatal care and mode of delivery) has shown inconsistent results; some demonstrated that antenatal care was not associated with a reduction in perinatal mortality (16–18), and some others have shown a marked reduction in perinatal mortality (19–25, It was noted that women who lost their babies during the perinatal period were less likely to receive prenatal care, and babies were less likely to be delivered by cesarean section, but more likely to be delivered as breech (26). Furthermore, the association of perinatal mortality with parity and the sex of the baby was not clear. ("A Meta-Analysis of Selected Maternal and Fetal Factors for Perinatal Mortality," n.d.)

Globally, about 6.6 million children die before celebrating their 5th birthday annually. Close to 5 million of this occurs in the first year of life and nearly 3 million die within the first 28 days of birth. This indicates that about 44% of under-five deaths and 60% of infant deaths as neonatal mortality. Moreover, the share of neonatal mortality from the under-five death rose from 37% in 1990 to 44% in 2012 [1]. This clearly one of the reasons why the desired millennium development goal (MDG4) target for the two-thirds reduction of child mortality by 2015 could not be achieved because particular attention was not focused on neonatal mortality.

More than 98% of these deaths occur in developing countries. Sub-Saharan Africa has the highest risk of death in the first month of life and among the regions showing the least progress in reducing the neonatal mortality rate. Most of these deaths are due by infectious diseases, pregnancy-related complications, delivery-related complications, including intra-partum asphyxia, birth trauma and premature birth which can easily be prevented [1,2].

Thus, accelerated reduction in neonatal mortality is increasingly critical for reducing the under-five mortality rate. To do this, identifying the determinants and causes of neonatal mortality at the local context is very crucial. However, many of the neonatal deaths happen at home and unrecorded making it difficult to obtain a sampling-frame and source of data. Moreover, the very few available studies are only facility-based and cross-sectional in design, which are not the preferred designs to establish causal relationships.

Identifying the determinants and causes at different levels by applying multilevel analysis, the findings can be use as inputs for policy makers and program implementers at national as well as regional levels to design evidence-based intervention strategies to tackle the problems of neonatal mortality. (Tura Debelew, Afework, & Yalew, 2014).

Particularly striking was insignificant progress during the last decade in reducing deaths during the first week of life (the early neonatal period) in low-income countries. NMRs (including early neo- natal mortality) have continued to decrease rapidly in high- income countries, resulting in a widening gap in survival chances for infants. Despite increasing attention to neonatal data, child-survival programs and funding continue to focus primarily on important causes of death after the first 4 weeks of life, [9] particularly malaria and vaccine-preventable diseases [10], whereas maternal health programs have focused primarily on the mother [11]. However, newborn deaths can be reduced by strengthening care within existing maternal and child health programs and including evidence based interventions to target the main causes of neonatal deaths [12].

However, improvement on neonatal death data and making better use of existing and future data in selecting and implementing the best practices to curb with the problem. Available information is often not used effectively to strengthen existing programs, especially at district level.

Where do new borns die?

Neonatal deaths are an important proportion of all deaths in children younger than 5 years of age, ranging from 27% to 54% of under-five deaths [3].

NMRs vary widely between regions and more than two-thirds of the world's neonatal deaths occur in sub-Saharan Africa and South Asia [5]. The newborn health gap between rich and poor countries have NMRs of approximately 30 per 1000 live births or less, which is approximately 25% less than the regional average [18]. In contrast, Nigeria, which has a relatively more advanced compared with other African countries but still has a very high NMR of 49 per 1000 live births. Nigeria is 1 of 5 countries that together account for more than 2 million newborn deaths.

More than one-half the total whereas 10 countries account for two-thirds of all deaths. India accounts for approximately 1 million neonatal deaths each year. These same countries also account for a high proportion of the burden of maternal deaths. Many of the countries with the greatest risk of newborn death are countries that have experienced recent wars or other disasters and there is limited information to guide new born survival programs.

Low income countries that have achieved significant reduction in maternal and neonatal mortality have mostly also have attained at least half of the population with skilled attendance during childbirth, although there are some notable exceptions, for example Nepal and Bangladesh [21].Task shifting and innovation in service delivery and technology, as well as major investment in equitably deployed, skilled human resources can make a significant improvement in these countries.

Variation within Countries Within countries and regions are often unacceptably high between rich and poor. Mothers and newborns in poor families have a higher risk of

illness and face more problems in accessing timely, high-quality care compared with wealthier families.

Demographic and Health Surveys (DHS) indicates that the poorest 20% of families experience, on average, 68% higher neonatal mortality than the richest 20% of families [18]. There are also important urban rural disparities. Infants born to families living in rural areas have poorer access to services and are at increased risk of death than babies born to families living in urban areas [5].

More than one-half of the newborns who die in low income countries do so at home, in Bangladesh for example, as few as 15%of infants are born or die in a hospital while in northern Ghana, only 13% of neonatal deaths occur in hospital [24]

For the 60 million women giving birth at home each year, distance to a health facility is often a barrier [25] there are also cultural norms and misconceptions that conspire to keep pregnancy hidden and preclude care seeking outside the home, thus act hindrance to data collection [26].

When Do Newborns Die?

The birth of a neonate should be a time of celebration, however the day of birth is the day of greatest risk of death. The risk of dying during the first day of life is close to 10 per 1000 live births (1%) [5] In fact, this is likely to be an underestimate of the true proportion of deaths in the first 24 hours because of lack of disclosure of very early neonatal deaths, and misclassification as stillbirths or neonatal deaths after the first day as the result of inconsistencies in recording the 24-hour period after birth. More than 2 million deaths (maternal, stillbirths, and neonatal) occur every year during or shortly after childbirth and these deaths are closely linked to lack or inadequate maternal and neonatal care at this critical time. For mothers who die of an intrapartum-related cause, it is rare for the infant

to survive [31]. Maternal morbidity is also closely linked to adverse fetal and neonatal outcomes [32].

Solutions for the Main Causes of Neonatal Death

Three major causes of neonatal deaths in high mortality settings (infections, complications of preterm birth, intrapartum-related neonatal deaths or "birth asphyxia") account for more than 80% of all neonatal deaths globally [3]. The most rapid reductions have been made in reducing neonatal tetanus and there has been apparent progress towards reducing neonatal infections.

Limited, if any, reduction has been made in reducing global deaths from preterm birth and for intrapartum related neonatal deaths.

However, the relative proportions of these 3 causes of death vary between countries as well as within countries. For populations with very high NMR (more than 45 neonatal deaths per 1000 live births), approximately one-half of neonatal deaths are caused by infections, including tetanus [5,37]. In low mortality settings, approximately 15% of deaths are caused by infections and are more likely to take place in hygienic settings with access to antibiotics. Preventing these deaths requires more complex inputs however, the populations with the highest mortality rates have great paucity for reducing neonatal mortality through lower cost and low tech interventions.

Neonatal Infection prevention.

Prevention of infections is mainly dependent on maternal health packages and programs, such as antenatal care, hygienic care during childbirth and the postnatal period, and early and exclusive breastfeeding and use of chlorhexidine cleansing of the umbilical cord.

Treatment of neonatal infections is possible through existing child health programs, such as Integrated Management of Childhood Illness (IMCI) and referral care in hospitals. The scaling-up of infection case management to date has probably contributed to some reduction of deaths from infection in the late neonatal period [24] Adding and upgrading a new algorithm for care of infants in the first week of life from IMCI to integrated management of newborn and childhood illnesses (IMNCI) has provided a further opportunity to reduce neonatal and under-five mortality

Neonatal tetanus

Tetanus was not an important cause of infant mortality in industrialized countries in modern times, even before the tetanus toxoid vaccine was developed. Investment in vaccine coverage has resulted in high coverage of maternal tetanus immunization and 81% of newborns protected at birth from tetanus globally [2].

Birth asphyxia

Infants born in the world's least-developed countries have a very high risk of intrapartum-related injury (birth asphyxia). The most effective interventions for intrapartum- related newborn deaths involve prevention through improved antenatal care, through skilled attendance at childbirth and emergency obstetrical care [8, 46]. Once obstructed labor or hemorrhage has set in, the baby may be stillborn or have a high probability of dying (30%-50%) on the first day of life [30].

National service provision assessments in 6 African countries show that on average, of those births currently in a facility only 1 in 4 infants is delivered by an attendant trained in neonatal resuscitation and who has the simple equipment (bag and mask) required [47].

The only 2 published studies from low-income settings of long-term follow-up of severely asphyxiated babies are from hospital-based cohorts was in South Africa [48] and Nepal

[49]. The limited follow-up data from these studies suggest that initial mortality is very high, and survivors with disability may be fewer than previously estimated, but more data are required on long- term outcomes.

Preterm Birth Complications

Preterm birth complications are a direct cause and accounts for 29% of neonatal deaths globally. Most preterm infants are born between 33 and 37 weeks of gestation [50]. They should survive with careful attention to feeding, warmth and early treatment of conditions, hypoxic ischemic encephalopathy (HIE), infections and jaundice.

Babies born before 33 weeks' gestation or with birth weight under 1500 g are more likely to need advanced care, especially for breathing problems and feeding. If possible, these babies should receive care in a referral hospital. Kangaroo mother care (KMC) involves caring for small, particularly preterm, infants by having them strapped skin-to-skin to the mother's front.

KMC is simple and effective, empowers mothers, and is feasible in most facilities in low-income settings in which care for small infants is provided. Additional home visits for extra care at home with skin-to-skin care and additional support for breastfeeding was proven to be very effective in reducing neonatal mortality [52, 53].

The use of antenatal corticosteroids has the potential to reduce neonatal deaths by up to half a million per year [51].

Preterm birth is a risk factor for mortality as well as a direct cause of death. According to the International Classification of Disease, the direct cause of death is only attributed to preterm birth. If the death results from complications specific to preterm birth or is in a severely preterm baby, For example, if a moderately preterm baby has an infection and

dies, the death is most appropriately attributed to infection but preterm birth is acting as a risk factor. Thus, many infants recorded as dying from infection are also preterm.

Gender and Neonatal Death

In populations in which care is equal for boys and girls, baby girls have a lower mortality rate than baby boys. The ratio of neonatal mortality for boys to girls is usually at least 1.2. There are about 10% more baby boys born than girls, although this ratio has been distorted further in countries with gender specific termination of pregnancy [57].

Analysis of DHS data for African countries does not suggest any loss of the natural survival advantage for girl babies [5]. However, several studies from South Asia have reported reduced care seeking for baby girls and even female infanticide, and after the neonatal period there are more data on the existence of practices that have a significant detrimental effect on the survival of girls [58].

Progress for Coverage of Care

Evidence-based strategies to save the lives of women and children, which are provided through integrated approach.

Reproductive health services to provide contraceptive services;

Antenatal care for pregnant women;

Skilled attendance and emergency obstetrical care during birth;

Postnatal care services, including both preventive and curative interventions.

Global-tracking mechanisms to collect information

One of the most cost-effective interventions for maternal, new born and child health appears to be stagnating, possibly related to lack of global prioritization and funding. The

median use of a modern contraceptive for 68 priority Count down countries is currently only 31%, and nearly one quarter of women express an unmet need for family planning [60].

Antenatal care is one of the success stories in low-income settings, with high coverage and relatively accessible to poor and marginalized populations. Data on trends in service coverage have limitations, but it is clear that antenatal care has increased in all regions and the current global average for at least 1 visit is 78%. Indeed, in sub-Saharan Africa, 71% of women now have at least 1 visit, although fewer have 4 or more visits (44%) [2]. low-resource settings, the current low coverage of key interventions, such as identification and management of pregnancy induced hypertension represents a major missed opportunity.

Antenatal care

Skilled antenatal care accounts for 38% of women in the 50 least developed countries [2]. Except for eastern and southern Africa, all developing regions have increased their coverage of skilled delivery attendance during the past decade, with marked increases in the Middle East and North Africa. However, regional and country averages have large inequities in care, particularly for skilled attendance [17]. For example, 6% of women in Ethiopia have a skilled attendant at birth, 25% of the wealthiest families do in contrast with only 1% of the poorest families. Similarly, rural mothers have much lower access to skilled birth attendance and Cesarean section than mothers in urban areas [60]. The coverage gap of skilled birth attendance is widest in sub-Saharan Africa and South Asia.

The rate of increase of skilled birth attendance in these regions is less than 0.5% per year and, at current rates is 1 in 2 women in sub-Saharan Africa and South Asia [17]. Postnatal care is also a critical yet neglected gap in low- and middle-income countries and with coverage even lower than that for skilled birth attendance.

Postnatal care

Recent data from Bangladesh show that a visit in the first 2 days of life is associated with significantly fewer neonatal deaths compared with those who did not receive a postnatal visit, or received a first visit after 48 hours [34].

In the 68 priority Countdown countries, a median of 38% of mothers received postnatal care within 48 hours of birth [60] For infants and mothers facing complications, such as neonatal sepsis or postpartum hemorrhage, a delay of even a few hours in receiving appropriate care can be fatal or result in long term injuries or disability.

Evidence shows that effective breastfeeding support and counseling for mothers in the first days after birth increases rates of exclusive breastfeeding [61]. Other key behaviors during the neonatal period include hygienic cord care and keeping the baby warm, can save life particularly for babies who are born preterm [62]. In addition, evidence shows that active case finding through routine home visits has a major effect on increasing treatment for neonatal sepsis and reducing mortality [63, 64]. However, in many countries the 6-week postnatal visit is the mother and baby's first interaction with the formal health system after birth [65, 66].

The three delays

The "classic" 3 delays were first described in relation to delay for women with obstetrical emergencies [67].

1. Delay in recognition of the problem and the decision to seek care. Physical distance, financial and cultural barriers to seeking care are compounded when there is a delay in recognizing illness and taking the decision to seek care, particularly in rural settings [68] Such a delay, even if short, can be fatal because neonatal illness generally presents less obviously and progresses more quickly than in older infants [69].

2. Delay to reach a health facility. This covers the time it takes to reach a first-level facility often using public transport on bad roads as well as the time to reach a higher level health facility if referred. In a study in Uganda, fewer than 10% of newborns referred from the first-level facility actually sought care [70].

3. Delay in receiving quality care at the facility. There is often a gap in time between arrival at a facility, timely receipt and effective emergency care. One recent analysis found that addressing missed opportunities in health facilities by ensuring that births already taking place in a health facility receive the necessary obstetrical and neonatal interventions could reduce maternal and newborn deaths by one-quarter without substantial additional cost [71]. Many interventions are feasible with improvement in competency-based training for health workers and logistics management to address key gaps, such as resuscitation equipment.

Vital registration system

Improved health information systems, providing timely data on quality of care and on maternal and newborn outcomes, are essential to track progress effectively and guide program implementation

High coverage with vital registration systems is increasing with 72 countries now having achieved over 80% completeness of death registration almost a doubling since 2000. Neonatal deaths that occur in the first hours after birth or in small babies are less likely than other neonatal deaths to be reported through death certificates and misclassification of neonatal deaths and stillbirths remains a challenge.

Limited use of local data to inform policies and programs and this has prevented advocacy, program prioritization, and rational budget allocation. United Republic of Tanzania link the burden of disease to district level budgeting and in Nigeria uses state

level profiles to address strategies for new born survival. .(Lawn, Kerber, Enweronu-Laryea, & Cousens, n.d.)

CHAPTER THREE

METHOD

3.1 Study Design

An unmatched case control study was conducted in which a total of 226 neonatal deaths of singleton live born babies from June to December 2015 was recorded from 13 hospitals with neonatal intensive care units (NICU) in the region, 12 district and 1 regional hospital. In these hospitals the neonatal dead folders and register were reviewed and the variables extracted were the cause of death, the birth weight, address of the mother or caregiver including any land mark, telephone number of mother, father or landlord.

A **case** is a death less than 28 days of life in a neonatal intensive care unit (NICU) hospital.

A **control** is a live post neonatal (28 days to 11 months) infant in the communities of cases.

The study **participants** were the mothers or caregivers of cases and controls

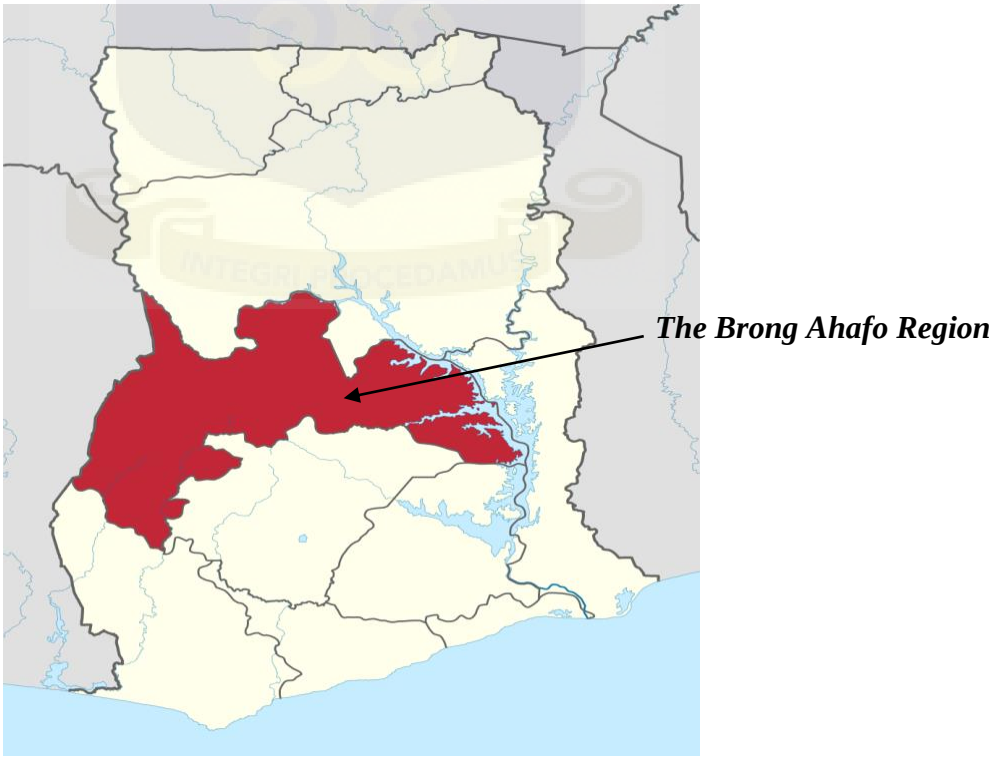
Out of 226, a total of 80 cases were selected based on ease of traceability of mother or caregiver of cases. A total of 80 neonatal deaths (cases) were followed in the community from where they came from with 160 controls (post neonatal) were also selected in the communities where the cases live. The mothers or caregivers of the cases and controls were interviewed using a structure questionnaire.

Univariate analysis was done to determine the frequencies, bivariate to determine the variables that were associated with neonatal mortality and multivariate logistic regression was done to find determinants of neonatal mortality in the region.

3.2 Study Area

The study was conducted in Brong Ahafo Region**.** The Brong Ahafo Region, formerly part of the Ashanti Region, was created in April 1959. It lies within longitude 0° 15'E to 3° W and latitude 8° 45"N to 7° 30'S. It shares boundaries with the Northern Region to the north, the Ashanti and Western Regions to the south, The Volta Region to the east, the Eastern Region to the south east and La Cote D'Ivoire to the west. The region occupies a total land area of 39,554 sq. km, which makes it the second largest Region in the country in terms of land size. It has a population density of 58.44 people per sq. km. The Region is 44.5% urban with an annual urban growth rate of 4.5%. It experiences more inflows of people from other parts of the country than people migrating out the region; this therefore gave the region a net migration value of 117,844 in 2010. With regards to the economy, the labor force participation rate for population aged 15 - 64 is almost 75.4%.

Figure 2: The Map of Brong Ahafo Region of Ghana



The region recorded an Infant Mortality Rate (deaths of infants under age one) of sixty-six (66) infant deaths per 1,000 live births in 2011, this was among the highest rates in the country. Child Mortality Rate (deaths of children between ages one and four) was 41 deaths per 1,000 live births and Under Five Mortality (number of children who die by age five) was reported at 104 deaths per 1,000 live births, the third highest among the regions. It has 27 administrative districts and a population of 2,589,471 (2015 projected population).

The Total Fertility Rate (TFR) of the region is slightly lower (4.0) , that indicates that on the average, women in the Brong Ahafo Region give birth to four children if she were to pass through those years bearing children at the current observed age specific rates.

In 2013, the HIV prevalence rate in the region was 2.1%, which is above the national HIV prevalence of 1.3% (Region, 2013)

3.3 Economic Activities

Agriculture and related work is the major occupation in the region. It is the main occupation for about two-thirds of the economically active group in most districts in the region. Sene, the most rural district, in particular, has 4 out of 5 economically active population in this sector.

Significant proportions of the economically active persons are also engaged as production, transport operations and Laborers, Sales workers, and professional and other related workers. Techiman is the largest market center in the region. In addition, Sunyani Municipal, Berekum and Techiman municipal are urbanized districts, where sales workers are usually predominant.

Professional, Technical and related workers are generally low in most districts but Sunyani Municipal and Berekum have relatively high proportions. These same districts also have appreciable proportions of service workers.

3.4 Target Population for Public Health Activities

The literacy rate among women aged 15 – 49 years in the region has increased to 55.3% in 2008 from 27.4% in 2003 (Survey, 2014). This improvement is very important considering the role women in that age group play in family health and family planning. The target population for Public Health activities was:

Women in fertility age (WIFA)	24.8%
Expected pregnancy	4.0%
Expected delivery	4.0%
Children 0 – 11months	4.0%

3.5 Inclusion Criteria

Mothers or caregivers who had dead singleton live born neonates in the hospital from June to December, 2015; and are easily traced either through telephone, land mark or by the use of community structures example CHPS compound or through community volunteers.

Mothers or caregivers with surviving singleton infants (Post neonatal) beyond neonatal period in community as the cases.

3.6 Exclusion Criteria

Mothers or Caregivers with twins, stillbirths and infants died from 28 days of life and beyond neonates who were not born in the region.

3.7 Variables

The study variables were developed based on the different literatures reviewed from previous studies.

Dependent Variable was neonatal death.

Independent Variables were: Socioeconomic status **(**Maternal marital status, maternal religion, maternal education, ethnicity, paternal education, parental occupation, fuel use for cooking, household income, household composition).

Maternal factors (age at birth, birth interval, medical condition, history of neonatal death, and parity); Neonatal factors (sex, birth weight, and age); Predelivery factors (antenatal visit, and Iron supplementation plan for pregnancy); Delivery factors (place of delivery, mode of delivery and delivery assistance); and Post-delivery factors (postnatal care).

3.8 Sample Size Determination

Sample size of 240 respondents (80 cases and 160 controls), using 1 case to 2 controls criteria. This sample size was determined using the EPI info 7 statistical software. The sample size was calculate sample size for the unmatched case control study with two sided confidence interval of 95%, Power of 80%, Odds ratio 2.25, Percentage of cases with exposure 60% and Percentage of controls exposed 40%. The controls will be all the singleton who survived live births beyond neonatal period in Brong Ahafo region.

3.9 Sampling Method

Purposive sampling method was used.

The study hospitals were selected based on whether the hospital has operational neonatal intensive care unit (NICU), admitting neonates that needs intensive care in the region.

Out of the 27 districts in the region, there were 12 district hospitals and 1 regional hospital that offer neonatal intensive care services and as a results were selected for the study.

3.10 Selection of Participants

Line listing of cases of Neonatal deaths from the hospital folders and Neonatal death registers. A line list of neonatal deaths was obtained from 13 hospitals with Neonatal Intensive Care Unit (NICU) in the entire region. A total of 226 neonatal deaths was line listed, out of which 80 were selected based on the calculated sample size for cases. These cases were selected using availability of telephone number, land mark or whether the individual could be traced with the help of community volunteers.

3.11 Variables of the Line List

1. Hospital registration number
2. House number/address
3. Mother/Caregiver's name
4. Telephone number of mother/caregiver, or landmarks if available.
5. Land lord's name
6. Date of birth of neonate
7. Birth weight
8. Age
9. Cause of death

3.12 Data Collection Technique

A structured questionnaire which contains the study variables was used to conduct the interview in the community for mothers or caregivers of cases and controls.

3.13 Limitation

Respondents were not very keen to mention their monthly household income

3.14 Quality Control

A local female research assistant was recruited to do the interview in the community, supervised by the Principal Investigator. This is because experience has shown that women are more comfortable talking to their female counterparts than men, thus enhancing data quality.

The data was checked for completeness, cleaned for missing values using line list in Microsoft excel.

3.15 Data Management and Analysis

Data was entered in EPI Info version 7.0 and exported to STATA version 13. Descriptive analysis using frequency tabulation was conducted. Crude odds ratios and 95% confidence intervals were calculated to examine the effect of each explanatory variable on the neonatal death.

A univariate analysis was done to identify relationship between neonatal mortality and the potential determinants without adjusting for other independent variables. Determinants identified in the univariate analysis with neonatal mortality was entered into multiple logistic regressions to determine their significant association at 95% confidence level.

3.16 Ethical Consideration

Ethical clearance was sought from the Ghana Health Service ethical committee through Department of Epidemiology and Disease control, School of Public Health, University of Ghana.

An official letter of approval to undertake the research was obtained from the Ghana Health Service Ethics Committee.

An approval letter was also received from the Regional Health Director of Health Services, Brong Ahafo Region to embark on the study.

Informed verbal and written consent was obtained from the study participants prior to interview.

CHAPTER FOUR

RESULTS

Socio-demographic characteristics of the respondents.

Table 1: Community Level Factors

	Case	Control				
Variable	**Died N(%)**	**Alive N(%)**	**Odds ratio**	**[95% conf. interval]**		**P value**
Type of resident						0.78
Urban	9 (11.3)	20 (12.5)	**Ref**	.	.	
Rural	71 (88.8)	140 (87.5)	1.1	0.49	2.61	

A total sample of 240 mothers comprising 80 cases and 160 controls were included in the study. Out of 240 subjects, 87.92 percent were from rural area while 12.08 percent were from urban area.

Out of a total of 80 cases (deaths) recruited in the study, 11.3% occur in the urban and 88.8% in the rural communities.

Living in the rural areas has an odds of 1.1 of having a neonatal death or a 10% increase in the risk of having a neonatal death compared to urban.

Percentage skilled delivery in the region was 92.5% and postnatal care for at least once after discharge from hospital was 72.9% over all.

Mean ANC visit was 5.6 with standard deviation of 1.68.

Table 2: Socioeconomic Status

	Case	Control				
Variable	**Died N(%)**	**Alive N(%)**	**Odds ratio**	**[95% conf. interval]**		**P value**
Ethnicity						0.07
Ga	1 (1.3)	1 (1.3)	1.0	.	.	
Dagomba	5 (6.3)	1 (0.6)	10.0	0.19	516.43	
Akan	47 (58.8)	91 (56.9)	**Ref**	0.09	11.79	
Ewe	3 (3.8)	3 (1.9)	2.0	0.09	44.35	
Others2	24 (30.0)	63 (39.4)	0.8	0.07	8.92	
Religion						0.48
Christian	65 (81.3)	119 (74.4)	1.5	0.77	3.02	
Muslim	14 (17.5)	39 (24.4)	**Ref**	.	.	
Traditional	1 (1.3)	2 (1.3)	1.4	0.11	16.98	
Marital status of mother						0.11
Never married	9 (11.3)	6 (3.8)	3.1	1.03	9.40	
Married	51 (63.8)	106 (66.3)	**Ref**	.	.	
Living together	20 (25.0)	46 (28.8)	0.9	0.48	1.69	
Widowed	0	2 (1.3)	0.0	.	.	
Educational level of mother						0.06
No education	18 (22.5)	26 (16.3)	2.6	0.80	8.62	
Primary	11 (13.8)	28 (17.5)	1.5	0.44	5.06	
Junior secondary	27 (33.8)	68 (42.5)	1.5	0.51	4.48	
Senior secondary	19 (23.8)	19 (11.9)	3.8	1.10	13.08	
Tertiary	5 (6.3)	19 (11.9)	**Ref**	.	.	

Majority of the subjects were Christians 184 (57.5%), the rest were Muslims 53 (22.08%) and African Tradition 3 (1.25%). The main ethnic groups were Akans 138 (57.5%). They contributed 58.75% of the total neonatal mortality whiles Dagomba accounts for the highest neonatal mortality rate (83.33%) in the study

Dagomba tribe have the highest odds of having a neonatal death compare to the other tribes, this was probably because they were among the least educated tribe in the study. None reach tertiary and only one has secondary education in the study.

Over 80% of the deaths were Christians.

Women who have never (3.1) married had a higher odds of having a neonatal mortality compared to the married ones.

Table 2 cont'd

	Case	Control				
Variable	**Died N(%)**	**Alive N(%)**	**Odds ratio**	**[95% conf. interval]**		**P value**
Occupation of mother						**0.02**
Not working	19 (23.8)	37 (23.1)	1.3	0.50	3.64	
Civil servant	8 (10.0)	21 (13.1)	**Ref**	.	.	
Farming	22 (27.5)	18 (11.3)	3.2	1.10	9.39	
Business	22 (27.5)	55 (34.4)	1.1	0.40	2.73	
Others6	9 (11.3)	29 (18.1)	0.8	0.27	2.48	
Educational level of father						0.21
No education	14 (17.5)	13 (8.1)	2.8	1.04	7.81	
Primary	7 (8.8)	15 (9.4)	1.2	0.41	3.69	
Junior secondary	22 (27.7)	54 (33.8)	1.1	0.49	2.38	
Senior secondary	23 (28.8)	41 (25.6)	1.5	0.66	3.32	
Tertiary	14 (17.5)	37 (23.1)	**Ref**	.	.	
Occupation of father						**< 0.001**
Not working	5 (6.3	6 (3.8)	2.8	0.66	11.41	
Civil servant	10 (12.5)	33 (20.6)	**Ref**	.	.	
Farming	31 (38.8)	28 (17.5)	3.7	1.46	9.15	
Business	17 (21.3)	36 (22.5)	1.6	0.62	3.92	
Others8	17 (21.3)	57 (35.6)	1.0	0.40	2.41	
Household size						**< 0.001**
1-3	41 (51.3)	48 (30.0)	**Ref**	.	.	
4-6	27 (33.8)	87 (54.4)	0.4	0.20	0.67	
7+	12 (15.0)	25 (15.6)	0.6	0.25	1.27	

Pv value bold denotes being significant.

The main occupation of women in the region was business 77 (32.08%) compared to 59 (24.58%) of men who were farmers. 56 (23.33%) of women and 11 (4.58%) of men are not working.

157 (65.42%) of the respondents were married as compared to 66 (27.5%) and 15 (6.25%) cohabitation and single women respectively; which has a 60% mortality compared to 32.48% among the married group.

Women and men Farmers have a higher risk of having a neonatal death compare to their counterpart civil servants, (odds of 3.2 and 3.7 respectively).

Table 2 cont'd

	Case	Control				
Variable	**Died N(%)**	**Alive N(%)**	**Odds ratio**	**[95% conf. interval]**		**P value**
Household composition						0.20
At least one adult of each sex	32 (40.0)	45 (28.1)	2.9	1.17	7.38	
One male adult	5 (5.0)	7 (4.4)	2.4	0.53	10.41	
Two or more male adults	8 (10.0)	33 (20.6)	**Ref**	.	.	
One female adult	3 (3.8)	6 (3.8)	2.1	0.41	10.38	
Two or more female adults	33 (41.3)	69 (43.1)	2.0	0.81	4.79	
Household income						0.43
<GH¢350	30 (37.5)	56 (35.0)	2.7	0.70	10.21	
GH¢350-500	32 (40.0)	58 (36.3)	2.8	0.73	10.47	
GH¢500-750	7 (8.8)	20 (12.5)	1.8	0.38	8.13	
GH¢750-900	8 (10.0)	11 (6.9)	3.6	0.72	18.44	
>GH¢900	3 (3.8)	15 (9.4)	**Ref**	.	.	
Fuel use for cooking						0.12
Wood	29 (36.3)	45 (28.1)	2.0	0.99	4.25	
Charcoal	34 (42.5)	61 (38.1)	1.8	0.88	3.55	
Gas	17 (21.3)	54 (33.8)	**Ref**	.	.	

The variable household income was however not well answered by the respondents however, fuel use for cooking could be used to have a fair idea of the income level of the respondents. Those who use wood have twice the risk of having a neonatal death compared to those using gas and those using charcoal have an odds of 1.8 times the risk of registering a neonatal death compared to those using gas.

95 (39.58%) of women and 76 (31.67%) of men have completed junior secondary level whilst only 24 (10%) and 51 (21.25%) have attained Tertiary education.

The mean household size was 4.5 people in the region, however neonatal deaths increase with increasing household size to 7 and above.

Table 3: Pre-delivery Factors

	Case	Control				
Variable	**Died N(%)**	**Alive N(%)**	**Odds ratio**	**[95% conf. interval]**		**P value**
Planned pregnancy						0.72
No	41 (51.3)	78 (48.8)	1.1	0.65	1.89	
Yes	39 (48.8)	82 (51.3)	**Ref**	.	.	
Folic acid taken regularly						0.69
Not regular	5 (6.3)	8 (5.0)	0.8	0.25	2.50	
Regular	75 (93.8)	152 (95.0)	**Ref**	.	.	
Number of ANC visit						0.63
None	1 (1.3)	3 (1.9)	0.7	0.07	6.74	
1-3	7 (8.8)	9 (5.6)	1.6	0.57	4.48	
4+	72 (90.0)	148 (92.5)	**Ref**	.	.	

Over 50% of the women with neonatal death did not plan their pregnancy in the study. Unplanned pregnancy have an odds of 1.1 times the risk of having a neonatal death compared to the planned pregnancy.

Only 220 (91.67%) attended antenatal clinic more than 3 times.

ANC of four and above have a lower risk of having a neonatal mortality compare to 1-3 and none (odds of 1.6 and 0.7 respectively). Mortality reduces as the number of antenatal visit increase. 1-3 visits has 43.75% mortality compared to more than 3 visits 32.73% mortality.

Table 4: Delivery Factors

Variable	Case Died N(%)	Control Alive N(%)	Odds ratio	[95% conf. interval]		P value
Place of delivery						0.60
Home	7 (8.8)	11 (6.9)	0.8	0.29	2.07	
Health facility	73 (91.3)	149 (93.1)	**Ref**	.	.	
Mode of delivery						0.73
SVD	44 (55.0)	96 (60.0)	**Ref**	.	.	
AVD	14 (17.5)	23 (14.4)	1.3	0.62	2.83	
C/S	22 (27.5)	41 (25.6)	1.2	0.62	2.20	
Delivery eventful						0.30
Not eventful	56 (70.0)	122 (76.3)	**Ref**	.	.	
Eventful	24 (30.0)	38 (23.8)	1.4	0.75	2.52	

Most of the deliveries were skilled 222 (92.5%) and 140 (53.33%) were spontaneous vertex delivery compared to 37 (15.42%) and 63 (26.25%) for assisted vaginal delivery and caesarian section respectively.

92.5% of the neonatal deaths were skilled deliveries, however the mortality rate was higher among the unskilled deliveries (35.29%) compared to 33.18% mortality rate of skilled deliveries.

Mortality was higher among neonates born through SVD, however mortality rate was higher among neonates delivered through AVD (37%) compared to 31.43% through SVD.

38.89% of the home deliveries ended as mortality compared to 32.88% of the facility deliveries.

Home deliveries who have reported for postnatal contributed to 12.31% of the total neonatal death in the study, however they have a higher neonatal death rate (44.44%) compared to facility deliveries which was 25.68%

16.67% and 20.42% have previous spontaneous and induced abortion respectively, however, 25.83% have previous neonatal death, and both type of abortion were found to be common among the 25-29 age category. This finding was matched by the fact that the chief reason for an induced abortion was the desire to complete school or training. Neonatal deaths was found to occur mostly at the two extreme ages; 15-19, 35.29% and 40+ age category 42.86% respectively.

Table 5: Post-Delivery Factors

	Case	**Control**				
Variable	**Died N(%)**	**Alive N(%)**	**Odds ratio**	**[95% conf. interval]**		**P value**
Postnatal care						**< 0.001**
No	63 (78.8)	2 (1.3)	292.8	21.11	4060.00	
Yes	17 (21.3)	158 (98.8)	**Ref**	.	.	

Pv value bold denotes being significant.

Most of the mothers with neonatal death (78.8%) did not report back to the hospital for postnatal care and however have the higher risk of having a neonatal death compare with those reported for postnatal care.

Table 6: Neonatal Factors

	Case	**Control**				
Variable	**Died N(%)**	**Alive N(%)**	**Odds ratio**	**[95% conf. interval]**		**P value**
Birth weight (grams)						**< 0.001**
Very low birth weight	13 (16,3)	0	.	.	.	
Low birth weight	28 (35.0)	11 (6.9)	9.7	4.10	23.07	
Normal birth weight	39 (48.8)	149 (93.1)	**Ref**	.	.	
Sex of the infant						0.12
Male	48 (60.0)	79 (49.4)	0.7	0.38	1.12	
Female	32 (40.0)	81 (50.6)	**Ref**	.	.	
Age of the infant in days						**< 0.001**
<1	2 (2.5)	0				
1-7	67 (83.8)	0				
8-27	11 (13.8)	0				
28+	0	160 (100)				

Babies with low birth weight have an increased risk of dying (9.7 times) compared to those with normal weight.

Out of 80 neonatal deaths assessed, 60% of them were males.

188 (78.33%) of the babies had normal birth weight compared to 39 (16.25%) and 13 (5.42%) low and very low birth respectively. Very low and low birth weight together accounts for 51.25% of the total neonatal death in the study compared to the normal weight babies (48.75%).

127 (52.92%) of the respondents had male infants however, 83.5% of the deaths occur in 1-7 days of life (early neonatal death).

Table 7: Maternal Factors

Variable	Case Died N(%)	Control Alive N(%)	Odds ratio	[95% conf. interval]		P value
Age of mother						0.94
15-19	6 (7.5)	11 (6.9)	1.4	0.43	4.36	
20-24	15 (18.8)	29 (18.3)	1.3	0.55	3.05	
25-29	26 (32.5)	52 (32.5)	1.3	0.59	2.65	
30-34	16 (20.0)	40 (25.0)	**Ref**	.	.	
35-39	11 (13.8)	20 (12.5)	1.4	0.53	3.54	
40+	6 (7.5)	8 (5.0)	1.9	0.55	6.38	
Parity						0.18
Primip	21 (26.3)	26 (16.3)	1.9	0.94	3.65	
2-4	47 (58.8)	108 (67.5)	**Ref**	.	.	
5+	12 (15.0)	26 (16.3)	1.1	0.49	2.28	
Birth interval (years)						0.26
1-2	12 (15.0)	15 (9.4)	2.2	0.87	5.72	
3-4	19 (23.8)	53 (33.1)	**Ref**			
5-6	9 (11.3)	23 (14.4)	1.1	0.43	2.78	
7+	40 (50.0)	69 (43.1)	1.6	0.84	3.12	

The mean age of mothers at birth was 28.5 years (standard deviation of 6.22), however, 17 (7.08%) and 14 (5.83%) are at the extreme ages of 15-19 and 40+ respectively.

The mean birth interval was 2.9 years with standard deviation of 1.10.

Of all the respondents 47 (19.58%) were Primiparity and 38 (15.83%) were grand multiparity, and the mean parity was 2.9; however majority of the respondents 155 (64.58%) had 2-4 previous live births**.**

Table 7 cont'd

Variable	Case Died N(%)	Control Alive N(%)	Odds ratio	[95% conf. interval]		P value
Previous abortion						0.64
None	47 (58.8)	104 (65.0)	**Ref**	.	.	
Spontaneous	15 (18.8)	25 (15.6)	1.3	0.64	2.75	
Induced	18 (22.5)	31 (19.4)	1.3	0.65	2.53	
Previous Neonatal death						0.25
No	63 (78.8)	115 (71.9)	**Ref**	.	.	
Yes	17 (21.3)	45 (28.1)	0.7	0.36	1.31	
Chronic medical condition						0.44
No	74 (92.5)	152 (95.0)	**Ref**	.	.	
Yes	6 (7.5)	8 (5.0)	1.5	0.51	4.62	

5.83% of the mothers have chronic medical condition. This group contributed to 7.5% of the neonatal deaths in the study. However mothers with chronic medical conditions have a higher death rate (42.86%) compared to apparently normal mothers (32.74%) in the study

Figure 3: A chart showing causes of neonatal death in Brong Ahafo Region June to December

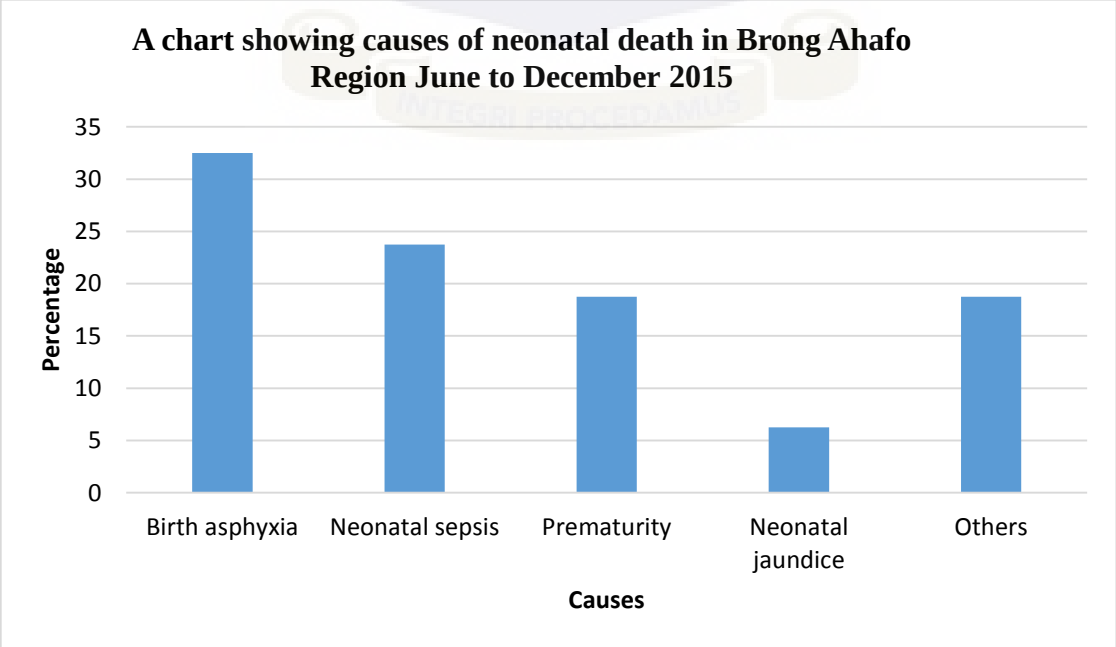


Table 8: Showing Determinants of Neonatal Mortality, Brong Ahafo Region June to December 2015

	Case	Control					
Variable	**Died N(%)**	**AliveN (%)**	**COR**	**AOR**	**[95% [conf.interval]**		**P value**
Birth weight							
Very low	13 (100)	**Ref**	.				
Low	28 (71.79)	11 (28.21)	9.7	18.04	5.03	64.62	< **0.001**
Normal	39 (20.74)	149 (79.26)	**Ref**				
Postnatal care							
No	63 (96.92)	2 (3.08)	292.8	0.00	0.00	0.01	< **0.001**
Yes	17 (9.71)	158 (90.29)	**Ref**				
Household size							
1-3	41 (46.07)	48 (53.93)	**Ref**				
4-6	27 (23.68)	87 (76.32)	0.4	0.56	0.17	1.92	0.358
7+	12 (32.43)	25 (67.57)	0.6	0.06	0.01	0.64	**0.020**

Pv value bold denotes being significant

CHAPTER FIVE

DISCUSSION

Study participants were mothers who had singleton dead neonates (cases) in the neonatal intensive care hospitals and mothers of the live post neonatal infants (controls) in the communities. A total of 240 participants (80 cases and 160 controls) were interviewed. Of the 240 participants 87.9% live in the rural communities.

Overall 92.5% of the participants had skilled delivery, and 72.9% had reported for postnatal care for the (PNC) for cases and controls after delivery however postnatal care among the cases was only 21.3%; and controls 98.8%. Postnatal care was found to be significantly associated with neonatal mortality in the study (adjusted odds of 0.001 at 95% CI 0.0000138-0.011466, p value <0.001).

This high turnout among the controls is because most of them reported after the neonatal period, probably at 6 weeks, which is contrary to the postnatal protocol in Ghana. The protocol dictates 3 postnatal care visits for each new born baby within 48 hours, at 7 days and 6weeks after delivery. This of lack of adherence to the protocol may be attributed to two main reasons, in some cultures is a taboo for babies to be seen outside their home before 6 weeks postnatal (‘locally called 40 day”), reporting for postnatal before this day may not be easy if the baby is not showing any obvious signs of sickness. During this period a lot can happen to the neonate unnoticed, by the time it become obvious until the baby is referred is already late for any positive treatment outcome. This is clearly depicted by the results of this study and is congruent with the results from other studies in Indonesia (C.Titaley, M. Dibley, K. Agho et al 2008).

The mean antenatal care (ANC) visit was 5.6 and with standard deviation of 1.68, which is very encouraging and recommended that each expecting mother should make at least 4 antenatal visits during pregnancy.(Manzi et al., 2014).

Neonatal Factors

Birth weight (BWT) was classified in the study as very low (<1500 grams), low (<2500 grams) and normal (>=2500 grams) birth weight. Very low birth weight accounts for 16.3% in the study with 100% mortality and low birth weight was 35%. The low birth weight babies have 9.7 times the risk of dying during the neonatal period than the normal weight babies. Low birth weight has 71.79 mortality, however, the normal birth weight was found to have 20.74% mortality. Our study showed that low birth weight neonates had a significantly higher risk of dying during the neonatal period compared with normal weight neonates (adjusted odds of 18.03791, 95% CI 5.03475-64.62403, p value < 0.001) however, the very low birth weight neonates (<1500 grams) are unlikely to survive in Brong Ahafo region. This consistent with the study done in Nigeria by O. Ezeh et al, 2014. This is in line with studies done in eastern Nepal by (Bhaskar et al., 2015).

In the study 60% of cases were males with 0.7 times risk of dying compared to their female counterparts. This is congruent with the studies done in Pakistan by Malqvist et al and 2014, Ghana by Kayode et al 2014.

Most of the deaths 86.3% in the study occur during the early neonatal period (0-7 days of life)

Maternal Factors

The mean age of study participants was 28.5 years with standard deviation of 6.22.

One of the maternal factors assessed was maternal age at birth and was found that the risk of neonatal death increases at maternal extreme ages. In this study it was found that risk of

having a neonatal death is 1.4 times greater among women at 15-19 years and 1.9 at 40 years and above compared to women within 30-34 age group. This is consistent with studies done in Ethiopia by (Hibstu et al., 2014).

Mean birth interval 2.93 years for the study participants was 2.93 years with standard deviation of 1.10 which was considered to around 36 months as found by study done in Nigeria by (Ezeh, Agho, Dibley, Hall, & Page, 2014b).

The study highlighted that of the study 41.3% of the study participants have had previous and had 1.3 times the risk of having a neonatal mortality compared to those who did not have abortion.

Parity was also considered in study and found that primiparous women have 1.9 time risk of having a neonatal mortality compared to women between para 2-4, which have 1.1 times lower risk than para 5 and above. This is consistent with study done in Nepal by

(K C et al., 2015).

Previous history of neonatal death accounts for 21.3% in the study participants with 0.7 times the risk of a neonatal mortality compared to those women without previous history of neonatal death.

Socioeconomic Status

Increased household size was also significantly associated with neonatal death in the region. Household size of 7 people and above was found to be statistically significant in the study (adjusted odds of 0.058632, with 95% CI 0.005239-0.642646 and p value of 0.020). Household size in the study was defined as a person or group of persons who lived together in the same house or compound and share the same house keeping arrangements

The study found that women who are never married have 3.1times risk of having a neonatal mortality compared to those married.

Fuel use for cooking was use as a proxy for household income and was found that those using gas has 2 times lower risk than those using wood, however those using charcoal have 1.8 times the risk of having a neonatal death compared to those using gas.

Delivery Factors

The assessment of the mode of delivery showed that study participants who had spontaneous vertex delivery (SVD) have 1.3 times lower risk for neonatal death than those who had assisted vaginal delivery (AVD) and 1.2 times lower risk than those who had a caesarian section (C/S), however, those who delivered at home had 0.8 times risk of neonatal mortality compared to the those who delivered in the health facility. This is in line with study conducted in south western Uganda by (Ronald et al., 2016).

The cause of neonatal death in the Region were birth asphyxia 26 (32.5%), neonatal sepsis 19 (23.75%), prematurity 15 (18.75%), neonatal jaundice 5 (6.25%) and other causes 15 (18.75%). In the multiple logistic regression analysis birth weight, postnatal care, and household size were not identified as determinants of neonatal mortality.

The overall aim of this study was to determine the causes and factors associated with neonatal death in Brong Ahafo Region

.The causes of neonatal mortality in Brong Ahafo region were birth asphyxia, neonatal sepsis, prematurity, neonatal jaundice and other conditions as depicted in the figure above.

At bivariate analysis the study revealed mother's occupation (p value 0.0242), father's occupation (p value 0.003) and household size (p value 0.0036) to be correlated factors of neonatal mortality in the region, however during logistic regression analysis only

household size was found to be statistically significant socioeconomic determinant of neonatal mortality in the region.

The maternal factors assessed were; maternal age at birth, previous abortion, parity, previous neonatal death and maternal medical condition.

The study revealed higher odds ratios compared to others mothers. This is consistent with other studies done in Ethiopia by D. Hibstu et al in 2014. The delivery factors were place of delivery, mode of delivery and postnatal care. Facility and spontaneous vertex delivery have a lower risk of neonatal mortality than home, assisted and caesarian section delivery. This is in line with several studies done in south west Uganda by M. Ronald, M. Sezalio, N. Rachael et al.

Postnatal care was statistically significant in the study.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The main causes of neonatal mortality in the region were birth asphyxia, neonatal sepsis, prematurity, and neonatal jaundice however, and the determinants of neonatal mortality were birth weight, postnatal care and household size.

Birth asphyxia, neonatal sepsis and prematurity are keys to the substantial reduction of neonatal mortality in the region.

6.2 Recommendation

The child survival programmes in the region should focus attention on the main causes and determinants of neonatal death mentioned above and institute the following recommendations.

1. The child survival programmes should focus more attention on the main causes and determinants of neonatal death.
2. Increase trained staff on basic new born care in the peripheral hospitals
3. Provide adequate basic equipment for new born care
4. Training and retraining of staff on appropriate resuscitation and care of the new born baby, such as cleaning the air way, drying and stimulating the baby to cry or by positive pressure ventilation.
5. Intensify early maternal screening and treatment of maternal infections
6. Encourage clean delivery practices with the use of chlorhexidine
7. Intensify hygienic neonatal care practices, in the hospitals.
8. Intensify education of the mothers on the importance of postnatal care to child survival.

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APPENDICES

Appendix A: Hospital line list for neonatal deaths

Hospital…… District…… Date……..……

Hospital no.	Address	Telephone no.	Mother/Caregiver's Name	Date of birth	Birth weight	Date of death	Cause of death

Appendix B: Questionnaire

QUESTIONNAIRE

District……..Completed by……..Mobile No……..

Community ……Date……

Registration No……

Community level factor

1. Type of resident

1 Rural

2 Urban

Socioeconomic status

2. Ethnicity

1 Akan

2 Dagomba

3 Ga

4 Ewe

5 Others specify……

3. Religion

1 Christian

2 Muslim

3 Traditional

4 Others specify……

4. Marital status of Mother

1 Never Married

2 Married

3 Living together

4 Divorce/Separated

5 Widowed

5. Educational level of Mother

1 No education

2 Primary

3 Junior Secondary

4 Senior Secondary

5 Tertiary

6. Occupation of Mother

1 Not working

2 Civil servant

3 Farming

4 Business

5 Others (specify)……

7. Educational level of Father

1 No education

Neonatal factors

13. Birth weight (grams)

14. Sex of the infant

1 Male

2 Female

15. Age of infant (days)

16. Age of previous child (years)

Predelivery factors

17. Was it a planned pregnancy

1 Yes

2 No

18. Total number of pregnancies (No.)

19. Number of Antenatal visits (No.)

20. Was folic acid taken regularly

1 Yes

2 No

3 Don't know

Delivery factors

21. Birth attendant

1 Health worker

2 Traditional birth attendant

3 Others (specify)……

22. Was the delivery eventful

1 Yes

2 No

3 Don't know

23. Mode of delivery

1 SVD

2 Assisted vaginal delivery

3 C/S

24. Place of delivery

2 Home

3 Health facility

Post-delivery factors

25. Postnatal care

1 Yes

2 Primary
3 Junior Secondary
4 Senior Secondary
5 Tertiary

8. Occupation of Father

1 Not working
2 Civil servant
3 Farming
4 Business
5 Others (specify)……

9. Household monthly income

1 Less than Ghc350
2 Ghc350 to 500
3 Ghc500 to750
4 Ghc750 to 900
5 Ghc1000 and over

10. Household size

11. Fuel used for cooking

1 Wood
2 Charcoal
3 Gas
4 Others (specify)……

12. Household composition

1 At least one adult of each sex
2 One male adult
3 Two or more male adults
4 One female adult
5 Two or more female adults

2 No

26. Previous abortion

1 None
2 Spontaneous
3 Induced

27. Previous hx of Neonatal death

1 yes
2 No

Maternal factors

28. Age of Mother at birth

29.Any chronic medical condition

1 yes
2 No

30.If yes which condition

1 hypertension
2 Diabetes
3 Sickle cell disease
4 HIV
5 Others specify……

31. Outcome

1. Alive
2 Dead

32. Cause of dead (from line list)……

Respondent's phone no……

Appendix C: PICTURES

Line list of cases at Kintampo Hospital

Data collection in rural Ghana(Yeji)

Data collection at Kwame Danso

Appendix D: NICU HOSPITAL IN BAR, 2015

No.	DISTRICT	NICU HOSPITALS IN BAR
1	Asutifi south	St Elizabeth hospital, Hwidiem
2	Berekum	holy family hospital, Berekum
3	Jaman north	Sampa government hospital
4	Jaman south	St Mary's hospital
5	Dormaa municipal	Presby hospital, Dormaa
6	Kintampo north	Kintampo municipal hospital
7	Techiman municipal	holy family hospital, Techiman
8	Pru	Matthias hospital
9	Sene west	Kwame Danso hospital
10	Atebubu	Atebubu government hospital
11	Tain	Tain district hospital
12	Wenchi	Methodist hospital, Wenchi
13	Sunyani	regional hospital

Appendix E: CONSENT FORM FOR PARENT OR CAREGIVER

Dear Sir/Madam,

My name is……. I am helping a student from the School of Public to collect data for his academic work; for MPhil degree in Epidemiology and Disease Control.

Several innovative ways have been done by the Ghana Health Service and Partners to increase Neonatal survival in this region. However, Neonatal deaths still continue to be unacceptably high. I would like you to voluntarily answer these questions to help us come up with a better and cost effective approach to combating Neonatal mortality in this Region.

Right to refuse: Your consent to participate is voluntary, meaning you can decided not to participate, however I can assure you of strict confidentiality and anonymity.

If you have any doubt about this research kindly contact Miss Hannah Frimpong on 0507041223, ERB office.

Thank you for your kindness.

Institute of Affiliation: School of Public Health, University of Ghana, Legon.

Participant: I declare that the above is well understood by me and that I was not coerced into giving consent.

Participant No:……

……..

Signed/Thumbprint (Participant)