SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA

LEGON

DETERMINANTS OF NEONATAL MORTALITY IN GHANA: ANALYSIS OF 2017 MATERNAL HEALTH SURVEY DATA

BY

EMMANUEL AYIRE ADONGO

(10702067)

A DISSERTATION SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTERS IN PUBLIC HEALTH DEGREE

JULY 2019

DEDICATION

I am dedicating this thesis first to the Alpha and Omega, Jehovah Jireh, Jehovah El Shaddai, The Omnipotent for His grace, love and guidance and protection. I am also dedicating this work to my mother, the one who educated me, Mary Akolgo Adongo, who died on July 4, 2018 at Ridge Hospital, Accra, when I was about to start this course. I will not forget the support my lovely wife, Mrs. Bridget Ayire gave me. She inspired and encouraged me to undertake this course of study. To all my children, Awsinsognya, Adongo, Adongmah, and Ayire, thank you for being there for me.

ACKNOWLEDGEMENT

I owe gratitude to my supervisor, Dr John Kuumouri Ganle, and my lecturers for being there for me and reposing trust in me throughout the course of my study.

In addition, my gratitude goes to the head and staff of my department, Population, Family and Reproductive Health (PFRH) as well as the head and staff of the department of Biostatics for supporting me in the data extraction, cleaning and analysis.

I am grateful to the director and staff of the Institutional Care Division of the Ghana Health Service who allowed me to do my practicum there.

ABSTRACT

Background: Neonatal mortality contributes about 45% of under-5 mortality globally; 35% in Sub-Saharan Africa; and over 50% of under-5 deaths in Ghana. Though there are existing studies on the determinants of neonatal mortality in Sub-Saharan Africa, not much has been done in Ghana to describe how community level, sociodemographic, health system, maternal and newborn factors individually or in unison interact to influence neonatal mortality.

Objectives: The main objective of the study is to examine the determinants of neonatal mortality in Ghana.

Method: This study is an analysis of secondary data from the 2017 Ghana Maternal Health Survey (GMHS). The data used in the analysis included only responses from women who delivered live babies in the five years preceding the conduct of the 2017 Ghana Maternal Health Survey and the children lived for at least 28 days. A total of 10,624 respondents were included in the study after data cleaning. Descriptive statistical techniques such as frequency and percentage distribution were used to describe important background characteristics of the women included in the study. Pearson's Chi-squares (χ^2) test was used to assess the association between the outcome (neonatal death) and independent variables. Multivariate logistic regression analysis was done to estimate odds ratios and control for potential confounders. Confidence level was held at 95%, and a $p< 0.05$ was considered statistically significant. All the data analysis was done using STATA 15.

Results: The prevalence of neonatal mortality was 2% representing 20 per 1000 live births. Three factors predicted neonatal mortality: ANC attendance, sex of baby, and baby being put on mother's chest immediately after birth. Women with only 1 ANC visit were less likely to experience neonatal mortality as compared to women with no ANC visit prior to delivery (AOR=0.11; CI=0.02-0.56, p=0.01). Baby girls were less likely (COR=0.68; CI=0.48-0.20; p=0.03) to die during the neonatal period as compared to boys and this did not change when potential confounders were controlled for in a multiple logistic regression model (AOR=0.68, CI=0.47-0.98; p=0.04). The odds of a baby dying within the neonatal period when a baby was not put on the mother's chest immediately after birth was 2.5 times (COR=2.46; CI=1.66-3.65, p=0.00).

Conclusion: Community level and sociodemographic factors were not significant determinants of neonatal mortality in Ghana. Rather, neonatal, and maternal characteristics did. It is education to families to seek timely and adequate antenatal care should be intensified. This should be done as a family-centred approach to encourage support from other relevants others from the family. Also, targeted Social and Behaviour Change Communication activities should be intensified on immediate skin-to-skin to prevent neonatal hypothermia and promote successful breastfeeding as well as issues on sex differentiation to improve on neonatal outcome

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF ABBREVIATIONS

ACSD	-	Accelerated Child Survival and Development
ANC+	-	Antenatal care plus
APR	-	A Promise Renewed
BEmONC	-	Basic Emergency Obstetric and Newborn Care
CBA	-	Community-based Agents
CHO	-	Community Health Officer
CHPS	-	Community-based Health Planning and Services
CSOs	-	Civil Society Organizations
DANIDA	-	Danish International Development Agency
DPs	-	Development Partners
ECEB	-	Essential Care for Every Baby
ENC	-	Essential Newborn Care
EmONC	-	Emergency Obstetric and Newborn Care
ENAP	-	Every Newborn Action Plan
EPI+	-	Expanded Programme on Immunization plus
FANC	-	Focused Antenatal Care
GDHS	-	Ghana Demographic and Health Survey
GHS	-	Ghana Health Service
GoG	-	Government of Ghana
GPRS	-	Growth and Poverty Reduction Strategy
GSS	-	Ghana Statistical Service
GNAP	-	Global Newborn Action Plan
HBB	-	Helping Babies Breath
IMF	-	International Monetary Fund
JICA	-	Japan International Corporation Agency
IE&C	-	Information, Education, and Communication
KMC	-	Kangaroo Mother Care
LEAP	-	Livelihood Empowerment Against Poverty
LMICS	-	Low Income and Middle-Income Countries
MAF	-	MDG Acceleration Framework, Ghana Action Plan
MDAs	-	Ministries, Departments, and Agencies
MDGs	-	Millennium Development Goals

MoH	-	Ministry of Health
MICS	-	Multiple Indicator Cluster Survey
NGO	-	Non-Governmental Organization
NMR	-	Neonatal Mortality Rate
NHIS	-	National Health Insurance Scheme
PAS	-	Public Address System
PATH	-	Programme for Appropriate Technology in Health
QoC-MNH	-	Quality of Care for Maternal and Newborn Health
RMNCAH	-	Reproductive, Maternal, Newborn Child and Adolescent Health
SCNC	-	Subcommittee on Newborn Care
SDGs	-	Sustainable Development Goals
SFP	-	School Feeding Programme
UNFPA	-	United Nation's Population Fund
UNICEF	-	United Nation's International Children's Emergency Fund
WHO	-	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1. Background

The first 28 days of life are the most delicate period of life for every child. Globally, neonatal mortality constitutes about 47% of child mortality (World Health Organization, 2017). Whilst global neonatal morality stood at 18 per 1000 live births in 2017, the African Region recorded 26.7 per 1000 live births (World Health Organization, 2017). During the same period, Ghana recorded 25/1000 live births (GSS, 2018). In 2016, close to 3 million newborn deaths occurred, representing about 46% of all under-five deaths (World Health Organization, 2017). This means, every day about 7000 newborns died (WHO, 2017). Most of these deaths occur before end of the first week of life with about 1 million dying within the first 24 hours and close to one million dying within the next six days (WHO, 2017). In Ghana, about 92% of newborns' deaths occur before they reach 7 days (GSS, 2014). It is therefore important to reduce neonatal mortality because it contributes significantly to under-five mortality.

In Sub-Saharan Africa, births are often concealed, unnamed, not counted and unaccounted for until about four years (Kinney et al., 2010). Community beliefs and practices are barriers to early care seeking, and families often resort to traditional medicine if their newborn is sick (Lawn et al, 2014). The lack of recognition of newborn deaths in most African countries contrasts with the assiduous work and reports and paperwork generated in response to the death of one baby in high-income settings and the public outcry if substandard care is suspected.

In response to the global and African regional call to action on Reproductive, Maternal, Newborn and Child Health (RMNCH), Ghana signed and committed to the "Every Woman Every Child" and the Global "Newborn Action Plan" (MoH/GHS, 2019). In 2015, Ghana

launched the Every Woman Every Child and the *''A Promise Renewed''* (APR) as well as a national costed strategy on newborn care to strengthen evidence-based action to accelerate the reduction of neonatal mortality (MoH/GHS, 2019; World Health Organization, 2017). Despite Ghana's commitment, neonatal mortality remains an important public health challenge in the country. It is for this reason that this study aimed to examine the factors influencing neonatal mortality in Ghana as part of efforts to support policies and strategies on accelerating the reduction of neonatal mortality in the country.

1.2.Problem statement

Ghana Health Service has implemented several programmes with support from various Development Partners (DPs) and key stakeholders to support efforts at reducing neonatal mortality over the years. Some of the programmes yielded positive results whilst others did not (MoH, 2014). The plateauing of neonatal mortality calls for increased research on the causes and determinants of neonatal mortality in Ghana.

Though there are existing studies on the determinants of neonatal mortality in Sub-Saharan Africa, very little has been done in Ghana. Examples of studies conducted on neonatal mortality in Ghana include Baiden et al. (2006), which used secondary data from the Navrongo Health and Demographic Surveillance System (NHDSS) with verbal autopsy to describe the trend and causes of neonatal mortality in rural Ghana. Another study is Kayode et al. (2014), a multi-level analytical study, which described individual and community level factors influencing neonatal mortality in Ghana. Kabore et al. (2016) also conducted a matched-case control study in Burkina Faso to examine factors associated with early neonatal mortality. Other studies conducted on the causes of newborn deaths include the Multi-cluster Indicator Survey (Ghana Statistical Service, 2018), the Demographic and Health Survey reports (GSS et al., 2018; GSS et al, 2014) as well as the Lancet series (Lawn et al., 2014; Say et al., 2014). However, not much has been done in Ghana to describe how community

level, sociodemographic, health system, maternal and newborn factors individually or in unison interact to influence neonatal mortality. To address the current knowledge gaps, this study aimed to examine the determinants of neonatal mortality in Ghana.

1.3.Research objectives

1.3.1.General objective

The main objective of this study was to examine the determinants of neonatal mortality in Ghana.

1.3.2.Specific objectives

The specific objectives of the study were to:

1. Determine the prevalence of neonatal mortality in Ghana.
2. Determine community level factors affecting neonatal mortality in Ghana.
3. Examine socioeconomic factors related with neonatal mortality in Ghana.
4. Identify maternal and newborn factors associated with neonatal mortality in Ghana

1.4.Research questions

1. What is the prevalence of neonatal mortality in Ghana?

2. What are the community factors associated with neonatal mortality in Ghana?

3. What are the socioeconomic factors influencing neonatal mortality in Ghana?

4. What maternal and newborn factors are associated with neonatal mortality in Ghana?

1.5. Justification of the study

This study is an analysis of the most recent Ghana Maternal Health Survey (GMHS) following the implementation of the Ghana National Newborn Health Strategy and Action Plan (2014-2018) (MoH, 2014). With empirical evidence on community level, socioeconomic, maternal and neonatal factors of neonatal mortality, it will provide more information on the factors influencing neonatal mortality that could be useful in the

development of policies and strategies to reduce neonatal mortality in Ghana and Sub Saharan Africa. It will provide insight to complement efforts in accelerating the reduction of neonatal mortality in Ghana, thereby enhancing Ghana's efforts at achieving the SDG target of 12/1000 live births by the year 2030 (Owusu, 2017). Finally, this study will serve as a reference material for future researchers on determinants of neonatal mortality in Ghana and in other Lower- and Middle-Income countries (LMICs).

1.6. Chapter Summary and dissertation outline

This chapter introduced the research problem and outlined the research objectives and the justification for the research. The rest of the dissertation is organized as follows. Chapter 2 reviews relevant literature to properly situate the study, whilst chapter 3 discusses the methodology used in the study. Chapter 4 presents the results of the study whilst chapter 5 discusses the results. Chapter 6 concludes the study with relevant recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter reviews empirical literature to properly situate the current study. The review is structured along the specific objectives, and highlights gaps in current literature. The chapter also discusses the conceptual framework developed based on previous literature on the topic.

2.1 Literature search

Various secondary materials including journal articles, reports, and bulletins from different sources related to neonatal mortality were reviewed. Relevant studies were sourced from PubMed, Google, Google scholar, Research Gate, Science Direct, Elsevier and other websites including WHO, UNICEF, MEASURE dhs.com and USAID.

2.2 Neonatal mortality: definition, global burden, and consequences

Neonatal mortality is the probability that a child born in a specific period will die during the first 28 completed days of life if subject to age-specific mortality rates of that period, expressed per 1000 live births (World Health Organization, 2018). Neonatal deaths may be subdivided into early neonatal deaths, occurring during the first 7 days of life; and late neonatal deaths occurring after the 7^{th} day but before the 28^{th} completed day of life (World Health Organization, 2018).

Globally, neonatal mortality accounts for about 47% of under-five deaths, with a rate of 18 deaths per 1,000 live births in 2018. (World Health Organization, 2018). Approximately, 7000 neonates die every day with about three quarters dying on the first day, and close to 1 million dying within the next six days. (World Health Organization, 2018).

In Sub-Saharan Africa, neonatal mortality is among the highest in the region, with 28 per 1,000 live births, followed by Central and South Asia with 25 deaths per 1,000 live births

(WHO, 2018). A child in Sub-Saharan Africa or South Asia is 10 times more likely to die in the first month of life than a child in a high-income country (WHO, 2018).

There are persistent posttraumatic symptoms reported by families after the loss a neonate (Christiansen et al, 2014). The loss of a newborn affects not only the parents but the whole family (Badenhorst & Hughes, 2007). It also affects the quality of parenting (Oglethorpe, 1989). The effects of neonatal mortality on the whole community therefore cannot be overemphasized.

2.3 Global, regional, and national policies and strategies to reduce neonatal mortality

Globally, several strategies and policies have been launched to reduce preventable maternal and child deaths. In September 2010, the WHO launched the Global Strategy for Women and Children's Health, entreating the global community to double efforts on saving the lives of women and children. The 'A Promise Renewed' commitment to child survival and the 'Every Newborn Action Plan (ENAP)' were also launched in 2014 (Lawn & Kerber, 2013). The 'A Promise Renewed' and the ENAP initiatives set specific targets to reduce under-5 and neonatal mortality, and these targets were reflected in the SDG targets, which call an end to preventable deaths of newborn babies and children younger than 5 years by 2030. The SDGs specify that all countries should aim to reduce neonatal mortality rate (NMR) to 12 deaths per 1000 live births or fewer, and under-5 mortality to 25 deaths per 1000 live births or fewer by 2030 (United Nations, 2015).

Other cost-effective interventions implemented worldwide, including in Ghana, are vaccination of pregnant women with tetanus diphtheria, skilled birth attendance, neonatal resuscitation, exclusive breastfeeding, umbilical cord care, and management of infections in the newborn (Khan et al, 2013).

In 2016, the WHO also launched the Quality of Care for Maternal and Newborn Health (QoC-MNH) network to further accelerate the reduction of preventable maternal and newborn deaths. The QoC network involves 10 countries: Bangladesh, Cote d'Ivoire, Ethiopia, Ghana, India, Malawi, Nigeria, Sierra Leone, Tanzania and Uganda (Kinney et al, 2016; MoH, 2016). The QoC-MNH has indeed been promoted globally as a strategy for tackling maternal and newborn deaths (Kinney et al, 2016).

Infection has also been targeted as one of the causes of neonatal mortality. Other programmes developed to reduce neonatal mortality includes the development of Kangaroo Mother Care implementation guidelines in 2014, development of policy statement on the use of chlorhexidine for cord care in 2016, development of implementation guide for perinatal death audit in 2016 and subsequent development of an electronic Maternal and Perinatal Death Surveillance and Response (eMPDSR) in 2018 (Ghana Health Service (GHS), 2017; GHS, 2016).

2.4 Determinants of neonatal mortality

Several studies have been conducted on the determinants of neonatal mortality. In this literature review, the factors have been grouped into community level, socio-demographic, health system, maternal, and neonatal factors.

2.4.1 Community level factors

Neonatal mortality is influenced by geographical location of parents such as provinces, regions, states, and districts (GSS et al., 2018). Other studies in Asia (Wang et al., 2016), Burkina Faso (Kaboré, Meda, Koulidiati, Millogo, & Kouanda, 2016), Ghana (Kikuchi et al., 2015), Tanzania (Msemo et al., 2013) and Ethiopia (Mekonnen, Tensou, Telake, Degefie, & Bekele, 2013) have linked geographical location of parents to neonatal mortality. In a study conducted in Kumasi in the Ashanti Region of Ghana on predictors of neonatal mortality, out

of 222 live births reviewed, 115 babies did not survive representing 53.9% (Annan & Asiedu, 2018).

Type of residence (rural/urban) has also been found to influence neonatal mortality. Neonatal mortality in rural communities in some studies was found to be higher than the national average(Roy & Haque, 2018). For instance, in India, neonatal mortality is almost twice in rural areas compared to urban areas (Upadhyay et al., 2012) whilst dwelling in rural areas where illiteracy, poverty and unemployment are coexistent influenced neonatal mortality in Ghana (Kayode et al., 2014). Neonates born in rural areas of Amhara Region of Ethiopia had higher risk of dying than neonates born in Addis Ababa (Mekonnen et al., 2013). Also, in Burkina Faso, there was more neonatal deaths in rural areas than in urban centres (Kaboré et al., 2016; Kayode et al., 2014). Conversely, in Ghana, risk of dying in rural areas was found to be low though the study admitted having interviewed more rural women than urban women (Kwarteng Acheampong & Eyram Avorgbedor, 2017). In the early 2000, type of residence was a strong predictor of neonatal mortality in Ghana because of maternal education, which was higher in urban areas with better economic conditions and higher incomes. However, with the advent of the free maternal healthcare policy coupled with the introduction of the Community-based Health Planning and Services, this factor gradually became insignificant (Arthur, 2012; Ghana Government, 2016).

In India, villages with population above 6000 had higher risk of neonatal mortality (Singh, Kumar, & Kumar, 2013). Studies in Ghana found that the likelihood of neonatal mortality increased by 58% when a woman moved from a community with low risk to a community with high risk of neonatal mortality (Kayode et al., 2014; Mekonnen et al., 2013). However, this correlation was no longer significant when the researchers adjusted for individual and community level factors.

2.4.2 Socio-demographic factors

Researchers have found that substantial survival remains for babies born into wealthier households with high educational levels in most low- and middle-income countries (McKinnon et al, 2014). Several studies also found that socio-demographic factors were strongly associated with neonatal mortality (Kayode et al., 2014; Sankar et al., 2016; Upadhyay et al., 2012; Victoria et al, 1992). These include maternal education, marital status, place of residence, and wealth quintile. In a population-based cohort study in Brazil (Victoria et al, 1992), and in Ghana (Buor, 2003), maternal education was found to be independently significantly associated with perinatal mortality. In the USA, maternal education was also found to impact positively on child health (Barrera, 1990). In a study conducted in Bangladesh on the association between maternal education and neonatal mortality, higher maternal education showed lower risk for neonatal mortality (Kamal, 2015). A review of literature shows that higher socioeconomic status of better educated women explains about half of the magnitude of the relationship between maternal education and child survival (Upadhyay et al., 2012).

In terms of marital status, some studies suggest that women who were never married had an increased risk of having premature births (Kwarteng Acheampong & Eyram Avorgbedor, 2017).

Religion has also been found to be associated with neonatal mortality. Mothers who are affiliated to religious groups have higher survival probabilities as compared with women without any religious affiliation (Boaventura Cau, Arusyak Sevoyan, 2016). In some studies, the Islamic religion was found to be associated with lower risk of neonatal mortality though not statistically significant (Kanmiki et al, 2014).

In the 2017 Ghana Maternal Health Survey, mothers older than forty years had higher neonatal deaths compared with mothers less than forty years of age (GSS et al., 2018). This is

similar to several studies where women aged above 35 years had higher odds of their newborns dying (Kaboré et al., 2016; Rosenzweig & Schultz, 1982). On the contrary, a study conducted by Kayode et al. (2014) to examine individual and community level factors influencing neonatal mortality found that maternal age was not statistically significant in influencing neonatal mortality (Kayode et al., 2014). The researchers suggested that younger women were rather having higher risk of post-neonatal mortalities and that it was due to socio-economic factors (Kayode et al., 2014).

Wealth index is a composite measure of a household's cumulative living standard calculated using a household's ownership of selected assets, including televisions, bicycles, materials used in construction and types of water access and sanitation facilities (GSS, et al 2018; Pirani, 2014). Children from wealthier families stand a better chance of surviving in their earlier years than children from poorer families (Lawn & Kerber, 2013; Oestergaard et al, 2011). Finally, women in their reproductive age who have HIV/AIDS in Sub-Saharan Africa were found to be associated with high neonatal mortality rate (Kayode et al., 2017).

2.4.3 Health systems factors

According to WHO (2011), the key components of a well-functioning health system are improving the health status of individuals, families and communities, defending the population against what threatens its health, protecting the people against financial consequences of ill-health, providing equitable access to people-centred care and making it possible for people to participate in decisions affecting their health and the health system. Experts have observed that more than eight million deaths per year could be averted in LMICs from conditions that could be treated by the health system, and that poor-quality care is now a bigger barrier to reducing mortality than insufficient access (Kruk et al, 2018). They also posited that about 60% of deaths from conditions amenable to healthcare are due to poor

quality care whereas the remaining deaths results from non-utilization of the health system (Kruk et al, 2018).

Several studies have asserted that qualified personnel providing quality essential newborn care, particularly management of sepsis, neonatal resuscitation and prematurity, could drastically reduce neonatal mortality since they are the major causes of neonatal mortality (Debelew, Afework, & Yalew, 2014). It has been identified that more than three-quarters of newborn deaths occur in high-neonatal mortality settings (NMR more than 15/1000 live births) characterized by struggling health systems with low numbers of health workers and facility births (Dickson et al, 2014).

A well-functioning health information management system is needed for data collection on neonatal mortality rate (Measure Evaluation, 2019). Routine health information management system may collect data for this indicator to obtain estimate for health facilities (Measure Evaluation, 2019). However, health facility data is not recommended for this indicator for the general population because in many settings especially in Sub-Saharan Africa, many neonatal deaths and live births occur outside the health system, which will cause substantial selection bias (Measure Evaluation, 2019).

This further explains why stronger health system, particularly health service delivery, is very relevant as a protective factor against neonatal mortality in any given setting.

Countries in Sub-Saharan Africa with poor governance in health systems have been found to have higher neonatal mortality as compared to countries with better health systems governance (Kayode et al, 2017). A study conducted in the Ashanti Region of Ghana on predictors of neonatal mortality found health system related factors as important predictors of neonatal mortality (Annan & Asiedu, 2018).

2.4.4 Maternal factors

The antenatal period is an opportunity for reaching pregnant women with several cost-effective interventions that may be vital to the health and wellbeing of pregnant women and their unborn babies (Lassi et al, 2015). The benefits of antenatal care include reduced risk of infection and increased survival (Lincetto et al, 2006). In Bangladesh, women who had antenatal care during pregnancy had 18% lower odds of neonatal mortality(Roy & Haque, 2018). For this and many other reasons, the WHO recommended 8 or more visits in 2016 as compared to the previously recommended 4th visits (WHO, 2016). In a systematic review and meta-analysis conducted on the impact of antenatal care on neonatal mortality in Sub Saharan African countries, women who had at least one antenatal care visit had 39% lower risk of neonatal mortality as compared with women with no prior antenatal care visit (Tekelab et al, 2019). Women who had up to 4 ANC visits prior to delivery had 32% lower risk of experiencing neonatal mortality (Tekelab et al, 2019). A study conducted in Ethiopia on predictors of neonatal mortality in intensive care unit also revealed that neonates whose mothers had no antenatal care visits were 6 times more likely to die during the newborn period than neonates whose mothers had 4 times antenatal care (Orsido et al, 2019).

Literature reviewed on association between mode of delivery and neonatal mortality found evidence that suggested significant association between mode of delivery and neonatal mortality (Betran et al., 2016). In a cohort study conducted in Sao Paulo, Brazil, with live births in normal formed foetuses from termed pregnancies in Public Teaching Hospital, there was a significant negative association between elective caesarean section and neonatal mortality. In Ethiopia, a study on the predictors of neonatal mortality in intensive care units revealed that neonates who were delivered via Caesarean Section (C/S) were having 66% protection against neonatal deaths than neonates delivered via spontaneous vaginal delivery (Orsido et al, 2019). (Nisar & Dibley, 2014). C/S, when medically required, is known to

reduce the risk of neonatal mortality especially when performed by experts under aseptic conditions (Betran et al., 2016). Ecologic studies by WHO experts confirmed that C/S was found to be protective only when the rate was between 10-15% (Betran et al, 2016; Chen et al, 2018). In a worldwide population-based ecological study with longitudinal study conducted to find out the association between caesarean section and maternal and newborn mortality it was found that, caesarean section rates were higher than 10% at the population level were not associated with decreases in maternal and neonatal mortality rates (Ye et al., 2016).

Women with multiple deliveries have been found to have higher risk of their newborns dying (Kaboré et al, 2016). In a 7-year study on why babies are dying in the first month after birth in Northern Ghana, multiple births were found to have higher odds of neonatal mortality (Welaga et al., 2013). Similarly, in a multilevel analysis in Ghana on individual and community level determinants of neonatal mortality, women with more than 5 deliveries were more than 2 times likely to experience neonatal mortality even when confounders were controlled (Kayode et al., 2014).

In addition, researchers have found that increasing the availability and quality of skilled care at birth could avert about 800,000 intra-partum related neonatal deaths (Wall et al., 2010). Though not statistically significant, some studies report lower risk of neonatal mortality in children born at home than those born in health facilities(Mekonnen et al., 2013).

In a multicentre study of preterm birth weight and gestational age specific neonatal mortality in the United States of America, women who delivered with gestational age of less than 29 weeks had lower mortality rates (Iams et al., 1993).Women who delivered with gestational age of less than 28 weeks were more likely to experience neonatal mortality (Basiri et al., 2015). In a 7-year study in Northern Ghana on why babies are dying in the first month of

birth, women with gestational age of less than 37 weeks were prone to neonatal mortality (Welaga et al., 2013).

2.4.5 Neonatal factors

Studies have also shown that neonatal mortality is prevalent in males than females (Mekonnen et al., 2013). In a 7-year study in Northern Ghana on why babies are dying in the first month after birth, baby boys were 1.2 times more likely to die than baby girls (Welaga et al., 2013). In Taiwan, female children had a lower age-specific early neonatal mortality as compared to their male counterparts (Hsu et al., 2015). Females had 664.43 per 1000 live births at 23weeks gestation and 473.17 per 1000 live births at 24 weeks gestation (Hsu et al., 2015). In Bangladesh, male babies were 1.4 times more likely to die during the neonatal period as compared to their female counterparts (Muhammed et al., 2018). In Taiwan, sex of baby was found to have greater risk of preterm, macrosomia, operative delivery, neonatal death and congenital anomaly (Weng, Yang, & Chiu, 2015). This is probably due to slow development and maturity of their lungs as compared to female neonates (Hsu et al., 2015).

According to the WHO, the first step in saving the life of a baby immediately after birth is to put the baby to the mother's chest immediately the baby is born with a clean cloth (WHO, 2013). Immediate skin-to-skin is different from early skin-to-skin. Immediate skin-to-skin is putting the baby within the first 10 minutes of birth immediately on the bare chest of the mother whereas early skin-to-skin is putting the baby on the mother's bare chest from 10 minutes of birth to 24 hours post birth (WHO, 2013). As described earlier, neonatal hypothermia, one of the major causes of neonatal mortality, occurs in as much as 50% of infants in low- and middle-income countries (LMICs) and the severity is associated with a higher risk of mortality during the first seven days after birth. In order to reduce the risk associated with hypothermia, the WHO (2013) recommends a set of interlinked procedures

called “the warm chain” to be followed after birth (Almgren, 2018). The interventions include the following:

- Drying and wrapping the baby immediately at birth
- Keeping the baby warm during any procedure, including resuscitation
- Keeping the immediate newborn in skin-to-skin contact with the mother
- Early initiation of breastfeeding within one hour of the birth; the warm milk and contact with the mother’s body helps to keep the newborn warm
- Postponing bathing the newborn for the first 24 hours
- Keeping the baby warm during transportation
- Dressing the baby warm in appropriate clothing and bedding always

The above interventions in addition to Social and Behaviour Change Communication (SBCC) activities and training on the risk of hypothermia will go a long way to reduce neonatal mortality (Singh et al., 2017). In a Lancet publication in 2016 however, only two countries in Sub-Saharan Africa had coverage data on immediate skin-to-skin, namely Kenya, 25.1% (2010-2013), and Zambia (23.4%, 2010-2013) (Miller et al., 2016). In a Cochrane systematic review on early skin-to-skin contact for mothers and their healthy newborn infants involving 46 trials in 21 countries, with 3,850 women and their infants, infants who had early skin-to-skin had an average score (1.24, 95% CI=0.76-1.72) of higher stability of the cardio-respiratory system (SCRIP) during the first six hours post birth, suggestive of better infant stabilisation to extrauterine life, blood glucose levels, and infant thermoregulation(Moore, Bergman, Anderson, & Medley, 2016).

Breastfeeding is one of the single most cost-effective intervention for the reduction of neonatal mortality (Labbok, 2012). In Ghana, not being breastfed was associated with neonatal mortality (Kayode et al, 2014). Early initiation of breastfeeding reduces the risk of neonatal mortality by 2.4 times (Edmond, 2006). This is because of the benefits of early

initiation of breastfeeding to the mother and to the baby, which includes bonding, lactation amenorrhoea, involution, protection against diarrhoea as well as protecting the mother against postpartum haemorrhage (Victora et al, 2016).

Newborns who were delivered with respiratory distress, low Apgar scores, had higher risk of dying during the neonatal period (Basiri et al., 2015). It has also been found that infants with low birth weights had higher likelihood of death during the neonatal period (Basiri et al, 2015; Engmann et al, 2009). In related studies, it was found that in each birth weight group, risk of mortality decreased as gestational age of mother advanced (Copper et al, 1993).

Infants with fifth and higher birth orders in Ghana have higher prevalence of neonatal mortality than infants of lower birth orders (Kayode et al., 2014). In another study in Ethiopia on the determinants of neonatal mortality in Ethiopia, 3rd and 4th (COR=0.67 and 0.76 respectively) birth orders were less likely to die as compared with 1st and 2nd birth orders (Mekonnen et al., 2013).

2.5 Conceptual framework

Figure 1 shows the conceptual framework for this study, which presents factors that may influence newborn mortality in any setting. The conceptual framework presents community level, socio-demographic, health system, maternal and newborn factors as possible determinants of neonatal mortality in Ghana based on both previous literature and the researcher's experience in working in this field over the years.

These factors may act individually or in unison to influence neonatal mortality. For instance, mothers who live in rural areas (community level factor) may have higher risk of experiencing neonatal mortality because rural areas have poor health facilities in terms of infrastructure and competent human resource to manage neonatal complications. Also, women living in rural areas may not be well educated and therefore not well employed

resulting in poverty. This may result in their inability to seek quality healthcare resulting in poor outcomes (Caldwell, 1979).

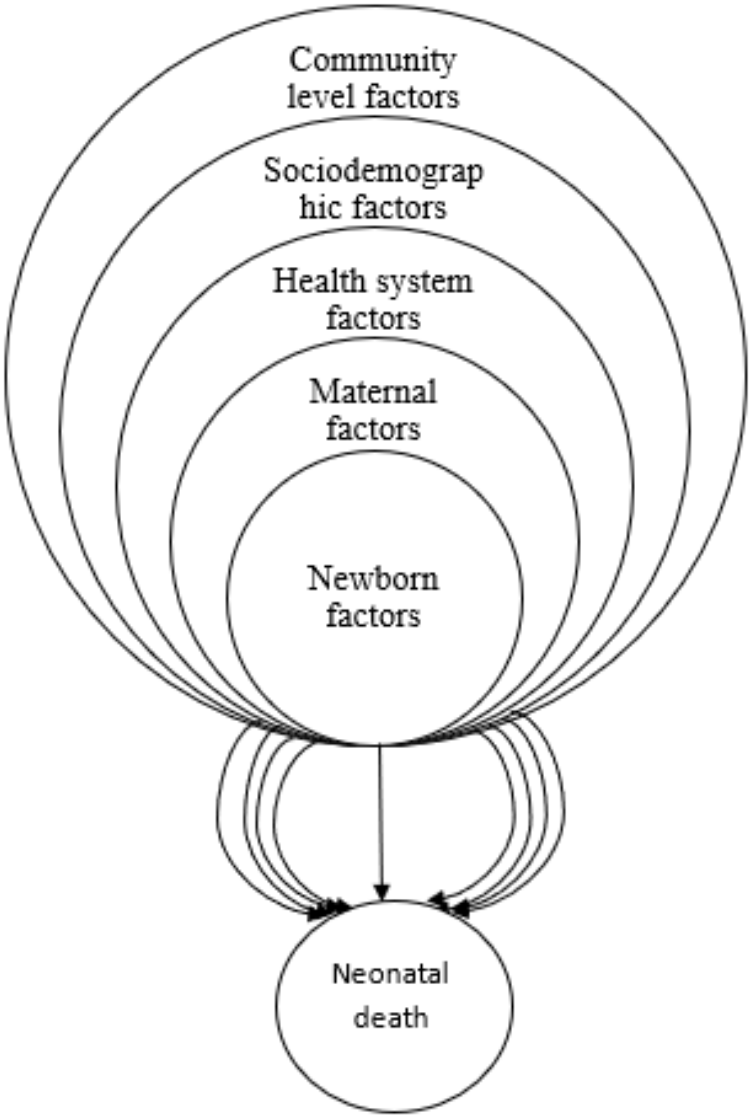

Figure 1: Framework for determinants of neonatal mortality

The framework thus shows how the interrelationship between the different categories of factors may influence neonatal mortality in Ghana. For instance, at the individual level,

household productivity is determined by the skills which are captured by paternal and maternal educational levels. Fathers' education is strongly related to child survival when they are married to less educated mothers (Mosley & Chen, 2003). Conversely, maternal education can influence child survival through their choices and use of skilled birth attendance, use of contraception, improved personal hygiene, nutrition, and treatment of minor ailment (Caldwell, 1979).

Neonatal death is also influenced by the economic situation of the household. For instance, poor family status may result in neglect of a child while wealthy families may hire the services of housemaids to take care of children as well as availability of goods and services including access to basic health services (Filmer & Pritchett, 1999; Rai et al, 2018).

Even though this conceptual framework shows how a broad range of factor interrelate to influence neonatal mortality, this study will be limited to relevant variables measured in the 2017 GMHS. For instance, though health system is very important in the determinants of neonatal mortality, there were no governance and other relevant health system dataset that could be used for this study.

2.6 Chapter Summary and gaps in literature

This chapter provided empirical evidence on the factors influencing neonatal mortality. Some of the literature reviewed in Ghana were contradictory and did not present a clear picture on factors influencing neonatal mortality.

In the literature review, significant literature was not found assessing the effect of immediate skin-to-skin on neonatal mortality. Literature found was on the coverage on the intervention as well as the effect of immediate skin-to-skin to neonatal outcome.

For instance, whilst the 2017 GMHS points to the fact that women with advanced age have higher likelihood of experiencing neonatal, a study in Ghana (Kayode et al., 2014) and another in Ethiopia (Markovitz et al., 2005) found maternal age to be statistically

insignificant as a factor influencing neonatal mortality. Apart from evidence from WHO on the effects of the warm chain, particularly early skin-to-skin, no study was found during literature review assessing the effect of immediate skin-to-skin on neonatal mortality. This study attempts to fill the remaining gaps in literature by examining how community level, sociodemographic, maternal, and newborn factors contribute to neonatal mortality in Ghana using data from the 2017 Ghana Maternal Health Survey.

CHAPTER THREE

METHODS

3.0 Introduction

This chapter discusses the methods used in the study. It presents the study design, the study area, population, inclusion, and exclusion criteria. The chapter also discusses the sample size as well as quality assurance measures, data processing and analysis, and definition and measurement of independent and dependent variables. Ethical issues are also considered.

3.1 Study design

This study is an analysis of secondary data from the 2017 Ghana Maternal Health Survey (GMHS). The GMHS is a retrospective cross-sectional study, conducted by the Ghana Statistical Service (GSS) and partners. This study used data from the 2017 GMHS because it was the most recent study conducted in Ghana that collected data on neonatal mortality.

3.2 Study area

Ghana is in West Africa, just above the Equator with a projected population of 30,955,204 (Ghana Statistical Services, 2019). Whilst the number of people living below the poverty line is declining, people living in rural savannah regions of Ghana are getting worse with over 60% living below the poverty line of GHS 1,314.00 (Ghana Statistical Service, 2017). Data also show that education is positively related to poverty level: people with no formal education are relatively poorer (Ghana Statistical Service, 2017). Whilst all localities

recorded high net attendance rate (at least 33 for girls and 28% for boys in 2016/2017), rural Savannah recorded 14% for boys and 17% for girls in 2016/2017. The report also suggests that girl child education had improved compared with male child education (Ghana Statistical Service, 2017).

Between 2012/2013 and 2016/2017, access to health services worsened with most people not attending health facilities when sick (Ghana Statistical Service, 2017). According to the 2017 GMHS, the total fertility rate in Ghana is 3.9, with variations between women in rural areas (4.7) and urban areas (3.3) declining from 6.8 in 1988 (GSS et al., 2018). Between 2007 and 2017, women who had skilled attendance at antenatal improved from 96% to 98%, with births attended by skilled birth attendants also increasing from 55% to 79% (GSS et al., 2018). Similarly, between 1988 and 2018, neonatal mortality declined from 43 per 100, 000 live births to 25 per 100, 000 live births (GSS et al., 2018).

3.3 Study population

In research, study population is a group of individuals taken from the general population who share a common characteristic such as age, sex or health condition (Kothari, 2004). In this study, the study population was women aged 15-49 years who delivered within 5 years preceding the 2017 GMHS (GSS et al., 2018).

3.3.1 Inclusion criteria

The data used in the analysis included only responses from women who delivered live babies in the five years preceding the conduct of the 2017 Ghana Maternal Health Survey and the children lived for at least 28 days.

3.3.2 Exclusion criteria

The data excluded in this study were women who delivered stillbirths and those who had babies dying after 28 days of live in the last five years preceding the conduct of the 2017 GMHS.

3.4 Sample size determination

In the 2017 GMHS, 25,062 mothers agreed and provided information on the outcome of their births. A total of 15,371 mothers reported having live births in the 5 years preceding the 2017 GMHS. However, a total of 10,624 records were used after cleaning the dataset for this study. The total sample size for this study is thus 10,624.

3.5 Sampling method

The GMHS used a multistage sampling procedure in selecting the study participants. The first stage involved simple random sampling of clusters consisting of enumeration areas (EAs) across the country. Overall, 1,900 enumeration areas (EA) were selected - 466 in urban and 434 in rural areas. The second stage of sampling involved a systematic sampling of households within the clusters. A total of 26,324 households within the selected clusters were sampled out of which 25,062 women aged 15-49 were selected. This was done for the then 10 administrative region of Ghana (i.e. Western, Central, Greater Accra, Volta, Eastern, Ashanti, Brong Ahafo, Northern, Upper East, and Upper West). The sampling frame adopted the 2010 Population and Housing Census (PHC), which contained all enumeration areas (EAs) that covered about 161 households (Nortey, 2015).

3.6 Data collection instrument

The two main data sources used in this study were the Household Questionnaire and the Woman's Questionnaire. The Household and Woman's Questionnaire were adapted from the DHS Programme's Standard Demographic and Health Survey questionnaires used in the 2007 GMHS to reflect the specific interest of the survey (GSS et al., 2018). The Household

Questionnaire was used to list all members and visitors, take basic demographic information including age, sex, marital status, education, and relationship to head of the household. The Woman's Questionnaire was used to collect information from women aged 15-49 years. The information collected included background characteristics, pregnancy history (live births, stillbirths, miscarriage, abortion), family planning, pregnancy and postnatal care, abortion, and miscarriage.

3.7 Data processing and management

The Children's folder (GHCH7IFL) was identified as the primary dataset where most of the variables for this study were found. The individual women folder (GHIQ7IFL) was also identified for variables for maternal education, religion, and wealth quintile. This was merged with the primary dataset (Children's folder).

To ensure representativeness of the sample in the various clusters and regions, analysis were performed by weighting the samples according to the sampling weight in the 2017 GMHS dataset by using the *'svy'* command in Stata.

3.8 Study variables

3.8.1 *Dependent variable*

The dependent variable of interest in this study was "age at death (months)" of the most recent deliveries in the last five years preceding the 2017 GMHS, which was a continuous variable in the dataset from zero to 372. For this study, the variable "age at death (months)" was categorized into two and the outcome dichotomized into: whether death happened in age of month zero or between age in month one to 372. It was recoded as a binary variable as neonatal mortality, and coded as 0=if no, and 1= if yes).

3.8.2 Independent variables

The following variables were identified in the 2017 GMHS dataset as independent variables and included in this study:

3.8.2.1 Community level factors

1. Region of residence was originally recorded in the GMHS as Western, Central, Greater Accra, Volta, Eastern, Ashanti, Brong Ahafo, Northern, Upper East, and Upper West. For the purpose of this study, region of residence was recoded as Western, Central, and Greater Accra as Southern Zone =1, Eastern, Ashanti and Volta as Middle Zone=2 and Upper West, Northern and Upper East as Northern Zone=3).
2. Place of residence was categorized as urban and rural and was recoded as 1=urban, 2=rural.

3.8.2.2 Sociodemographic factors

1. Maternal age in the 2017 GMHS was captured as a continuous variable from 15 to 49 years. For this study, maternal age was recoded as 15-19 years=1, 20-24years=2, 25-29 years=3, 30-34 years=4, 35-39 years=5, 40-44 years=6, 45-49 years=7.
2. Maternal religion was originally recorded as Catholic, Anglican, Methodist, Presbyterian, Pentecostal/charismatic, other Christian, Islam, traditional/spiritualist, no religion, and other. For the purpose of this study, maternal religion was recoded adding all Christian (catholic, Methodist, Presbyterian, Pentecostal/charismatic, other Christian) as Christians=1, Islam=2, Traditional/spiritualist=traditional=3, no religion=Atheist=4.
3. Maternal education was originally recorded in the 2017 GMHS as primary, middle school, JSS/JHS, secondary/tech/voc/comm, SSS/SHS/tech/voc/comm, higher. For this study, maternal education was recoded as 1=no formal education, 2=Primary, 3=JSS/JHS/Middle, 4=SSS/SHS/Voc, 5=Tertiary.

4. Wealth index: The level of household income was defined using wealth quintile as a proxy, which used household ownership of assets and consumer goods. This was derived from the household ownership of assets and goods such as radio sets, television sets and refrigerator, dwelling characteristics, type of source of drinking water, toilet facilities, electricity, wall and floor materials of the house, cooking fuel and means of transport. Each of these assets was assigned a weight generated using principal component analysis (PCA) and the resulting scores standardized in relation to a normal distribution with a mean of zero and standard deviation of one. Each household was then given a score for each asset and these asset scores were then summed up for and divided into quintiles from lowest (1) to highest (5)(GSS, et al, 2018). In this study, these categorizations were maintained. Thus, lowest=1, second=2, middle=3, fourth=4, highest=5.

3.8.2.3 Maternal factors

1. Number of antenatal visits was originally recorded in the 2017 GMHS as continuous, from 1 to 20 visits during pregnancy and "don't know". For this study, number of women who had no ANC visits were recoded as 0=No ANC visit, 1=1-4 ANC visits, 2=>4 ANC visits. The variable "don't know" was dropped for the sake of clarity of analysis and interpretation.
2. Place of delivery was originally recorded as her home, other home, public: government hospital, public: government health post/CHPS, public: mobile clinic/outreach, public: other public sector, private: hospital/clinic, private: FP/PPAG clinic, private: mobile clinic/outreach, private: maternity home, private: other private med centre, other. For the purpose of this study, place of delivery was recoded as her home and other home as Home delivery, public: government hospital, public: government health post/CHPS, public: mobile clinic/outreach, public: other public sector as Public Health Facility, private: hospital/clinic, private: FP/PPAG clinic, private: mobile clinic/outreach, private:

maternity home, private: other private med centre as Private Health Facilities, and other as Others.

3. Mode of Delivery was originally recorded as delivery by Caesarean Section and recoded as Yes and No. For this study, delivery by Caesarean Section was renamed as mode of delivery and recorded as Yes as C/S, No as Spontaneous Vaginal Delivery (SVD).

3.8.2.4 Newborn factors

1. Size of child at birth was recorded in the 2017 GMHS as very large, larger than average, average, smaller than average, very small and don't know. For the sake of this study, size of child at birth was recoded as very large and larger than average as large=1, average as average=2 and smaller than average and very small as small=3. The variable "don't know" was dropped to provide clarity in the data analysis.
2. Sex of baby was recorded in the 2017 GMHS as girl and boy this has not been changed in this study.
3. Child put on mother's chest immediately after birth was recorded in the 2017 GMHS as yes, no and don't know. This was recoded for the purpose of this study as 1=yes, 2=no. The variable "don't know" was dropped to provide clarity in the data analysis.

3.9 Data analysis

Descriptive statistical techniques such as frequency and percentage distribution were used to describe important background characteristics of the women included in the study. In addition, Pearson's Chi-squares (χ^2) test was used to assess the association between the outcome (neonatal death) and the independent variables. Multivariate logistic regression analysis was also done to estimate the odds ratio and control for potential confounders. Confidence level was held at 95%, and a $p< 0.05$ was considered statistically significant. All the data analysis was done using STATA 15.

3.10 Quality assurance measures

Data quality was ensured by using Stata issued-commands to recode variables into new categories appropriate for the study. A ‘Stata Do’ file was used throughout the analysis stages to record all statistical analysis performed. Appropriate changes were made and saved to the Stata Do file when needed after which results are rerun again. This process ensured that inconsistencies were minimized, and data quality ensured.

3.11 Ethics

As the data for this study were secondary and anonymized, there was no need for ethical approval. However, permission was sought from the Demographic and Health Surveys (DHS) programme, and a permission/access was granted (see appendix 1 for authorization letter).

3.12 Chapter Summary

This chapter discussed the methods used in obtaining, processing, and analyzing data for this study. The results of the data analysis are provided in the next chapter (i.e. chapter 4).

CHAPTER FOUR

RESULTS

4.0 **Introduction**

This chapter presents the results of the study. The results are presented according to the objectives and thematic areas described in the conceptual framework. These are the prevalence of neonatal mortality in Ghana, and the community, socio-demographic, maternal and neonatal factors influencing neonatal mortality

4.1 Background characteristics of respondents

Table 1 shows the background characteristics of respondents. Out of the 10,624 respondents included in the analysis, 4,787 (45.1%) were from the southern zone of Ghana whilst 4,098 (38.6%) were from the middle part of the country. The majority (24.6%) of respondents were between the ages 25 – 29 years followed immediately with age 30 – 34 years (23.5%). Respondents aged 15 – 19 years were 5% while those aged 45 – 49 years constituted 2.8%. Also, majority of the respondents (51.7%) resided in rural areas. Over a fifth (24%) of respondents had no formal education, with less than a tenth (6.2%) having tertiary education. Majority (77.2%) of respondents were Christians. Respondents who did not attend antenatal care (ANC) prior to delivery were 2.3% whilst 81.3% attended antenatal care more than 4 times during their most recent pregnancy. As regards place of delivery, 67.2%, 11.4% and 20.3% delivered in public health facilities, private health facilities, and at home, respectively. Also, 15.8% had Caesarean Section (C/S) deliveries out of the facility deliveries.

Table 1: Frequency distribution of women who had newborn babies in the last 5 years preceding the 2017 GMHS (*n*=10,624)

Variable	Number	Percentage
Zone of Residence		
Southern	4787	45.1
Middle	4098	38.6
Northern	1739	16.3
Place of Residence		
Urban	5130	48.3
Rural	5495	51.7
Maternal Age (years)		
15-19	564	5
20-24	1928	18
25-29	2612	24.6
30-34	2498	23.5
35-39	1876	17.7
40-44	849	8
45-49	297	2.8
Maternal Religion		
Christian	8207	77.2
Islam	1851	17.4
Traditional	250	2.3
Atheist	316	3
Maternal Education		
No Formal Education	2552	24
Primary	1875	17.6
JSS/JHS	4209	39.6
SHS/SSS	1330	12.5
Tertiary	658	6.2
Wealth Index		
Lowest	2286	21.5
Second	2304	21.7
Middle	2112	20
Fourth	2097	20
Highest	1825	17.2
Number of ANC visits		
None	241	2.3
1	141	1.3
2-4	1608	15.1
>4	8634	81.3

Table 1 continued

Variable	Number	Percentage
Place of Delivery		
Home	2159	20.3
Public Health Facility	7135	67.2
Private Health Facility	1208	11.4
Others	122	1.1
Mode of Delivery		
Caesarean Section	1277	15.8
Spontaneous Vaginal Delivery	9347	84
Size of Baby at birth		
Large	4437	41.2
Average	4264	40.1
Small	1923	18.1
Sex of baby		
Boy	5375	50.6
Girl	5249	49.4
Child put on mother's chest immediately after birth		
Yes	5254	49.5
No	5370	50.4

4.2 Prevalence of neonatal mortality

Figure 2 shows the proportion of babies who died during the neonatal period. Out of the 10,624 respondents who reported to have delivered livebirths within the 5 years preceding the 2017 GMHS, 190 newborns died within the first 28 days of life. This represents a neonatal mortality prevalence of 2% or approximately Neonatal Mortality Rate (NMR) of 20 per 1000 live births.

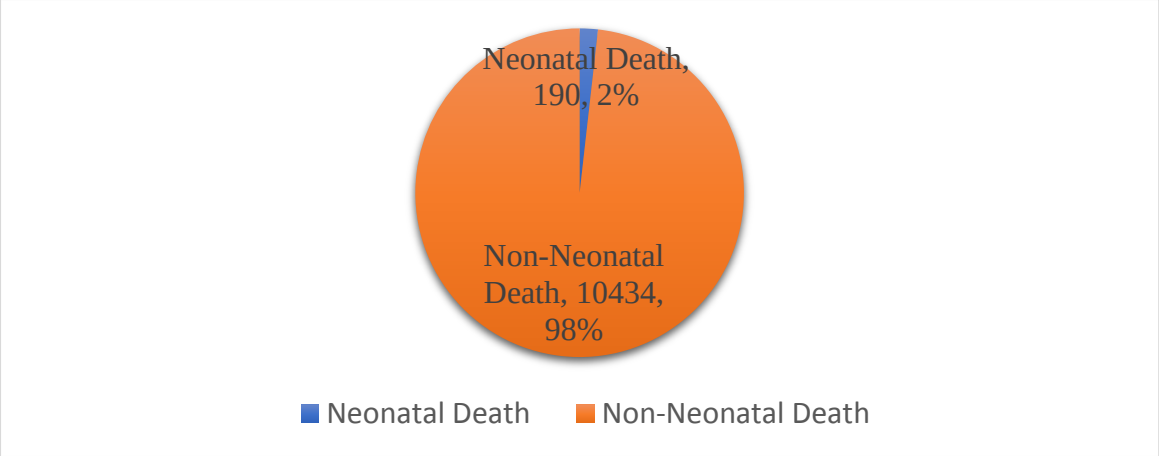

Figure 2: Prevalence of neonatal mortality

4.3 **Determinants of neonatal mortality**

4.3.1 Bivariate analysis

Table 2 presents bivariate analysis examining whether or not there is association between neonatal mortality and community level, socio-demographic, maternal and neonatal factors.

From table 2, none of the community level factors were associated with neonatal mortality: Zone of residence (p=0.26), and place of residence (p=0.51). Similarly, none of the socio-demographic factors examined showed statistical association with neonatal mortality in Ghana: maternal age (p=0.93); maternal religion (p=0.70); maternal education (p=0.34); and wealth index (p=0.81).

Among three maternal factors examined, number of ANC visits was found to be statistically significant (p<0.001) as a determinant of neonatal mortality. However, place of delivery (p=0.80), and mode of delivery (p=0.25) were not statistically significant as determinants of neonatal mortality. Similarly, out of the three neonatal variables examined, two were statistically significantly associated with neonatal mortality. These were sex of the baby (p=0.03) and child put on mother's chest immediately after birth (p=0.00). Though size of the baby was not statistically significant (p=0.07), it was very important as a potential determinant of neonatal mortality.

Table 2*:* Factors associated with neonatal death (bivariate analysis) ***(n=10,624)***

Variable	Neonatal Mortality		P Value
	No, n (%)	**Yes, n (%)**	
Place of Residence			
Urban	5044 (98.3)	86 (1.7)	0.51
Rural	5390 (98.1)	104(1.9)	
Zone of settlement			
Southern	4690(98)	97(2.0)	
Middle	4029(98.3)	69(1.7)	0.26
Northern	1715(98.6)	24(1.4)	
Maternal Age (years)			
15-19	552(97.9)	12(2.1)	
20-24	1898(98.5)	30(1.5)	
25-29	2571(98.4)	41(1.6)	
30-34	2449(98.1)	49(1.9)	0.93
35-39	1840(98.1)	36(2.1)	
40-44	832(98)	17(2)	
45-49	291(98.2)	6(1.8)	
Maternal Religion			
Christian	8060(98.2)	147(1.8)	
Islam	1819(98.3)	32(1.7)	0.70
Traditional	247(98.7)	3(1.2)	
Atheist	307(97.2)	9(2.8)	
Maternal Education			
No Formal Education	2514(98.5)	38(1.5)	
Primary	1836(97.9)	39(2.1)	
JHS/JSS/Middle	4136(98.3)	73(1.7)	0.34
SHS/SSS/Vocational	1295(97.4)	35(2.7)	
Tertiary	651(99.0)	7(1.0)	
Wealth Index			
Lowest	2242(98.1)	44(1.9)	
Second	2263(98.2)	41(1.8)	
Middle	2072(98.1)	40(1.9)	0.81
Fourth	2056(98.0)	41(1.9)	
Highest	1801(98.7)	24(1.3)	
Number of ANC visits			
None	227(94.2)	14(5.8)	
1	140(99.3)	1(0.7)	0.00*
2-4	1579(98.2)	29(1.8)	
>4	8487(98.3)	147(1.7)	

*P<0.05

Table 2 continued

Variable	Neonatal Mortality		P Value
	No, n (%)	Yes, n (%)	
Place of Delivery			
Home	2117(98.1)	42(1.9)	0.80
Public Health	7005(98.2)	130(1.8)	
Private Health	1191(98.6)	17(1.4)	
Other	120(98.6)	2(1.4)	
Mode of Delivery			
Caesarean Section	1247(97.6)	30(2.3)	0.25
Spontaneous Vaginal Delivery	9187(98.3)	160(1.7)	
Sex of baby			
Boy	5261(97.9)	114(2.1)	0.03*
Girl	5173(98.6)	76(1.5)	
Size of baby at birth			
Large	4360(98.3)	78(1.7)	0.07
Average	4192(98.3)	72(1.7)	
Small	1881(97.8)	41(2.2)	
Child put on mother's chest immediately after birth			
Yes	5200(98.9)	54(1.0)	0.00*
No	5234(97.5)	136(2.5)	

*P<0.05

In summary, out of the 12 independent variables examined, only three factors were statistically associated with neonatal mortality, namely number of antenatal visits, sex of baby and child put on mother's chest immediately after birth.

4.3.2 Multivariate logistic regression analysis

From the bivariate analysis in table 2, only three independent variables (i.e. sex of baby, number of antenatal (ANC) attendance and baby put on mother's chest immediately after birth) were statistically associated with neonatal mortality. To further determine the strength of these variables, confounders were controlled for in a multiple regression model and odd ratios were estimated. The results are shown in table 3.

In a binary logistic regression model, the odds of a woman who had only 1 ANC visit prior to delivery experiencing neonatal mortality was significantly lower than those who had no ANC

visit prior to delivery (COR=0.27; CI=0.13-0.68; p=0.00). When potential confounders were controlled for in a multiple regression logistic model, women with only 1 ANC visit prior to delivery were less likely to experience neonatal mortality as compared to women with no ANC visit prior to delivery (AOR=0.11; CI=0.02-0.56, p=0.01). Women with 2-4 ANC visits were also less likely to experience neonatal mortality as compared to women who had no antenatal care (COR=0.27; CI=0.13-0.68, p=0.00). When potential confounders were controlled for in a multiple regression model, the odds of women experiencing neonatal mortality increased (AOR=0.29; CI=0.12-0.68; p=0.01) though still protective as compared to women with no prior antenatal attendance. Also, women with more than 4 antenatal visits were less likely (COR=0.28; CI=0.13-0.60; p=0.00) to experience neonatal mortality as compared to women with no antenatal visits prior to delivery. This however did not change (AOR=0.29; CI=0.13-0.67; p=0.00) when potential confounders were controlled for in a multiple regression model.

In a binary logistic regression, girls were less likely (COR=0.68; CI=0.48-0.20; p=0.03) to die during the neonatal period as compared to boys and this did not change when potential confounders were controlled for in a multiple logistic regression model (AOR=0.68, CI=0.47-0.98; p=0.04).

The odds of a baby dying within the neonatal period when a baby was not put on the mother's chest immediately after birth was 2.5 times (COR=2.46; CI=1.66-3.65, p=0.00). After controlling for potential confounders in the multiple logistic regression model, the odds slightly increased to 2.6 times, and the association remained statistically significant (AOR=2.59; CI=1.75-3.83; p=0.00).

Table 3: Determinants of neonatal mortality (*Binary and Multilevel Regression analysis*), **n=10,624**

Variable	Neonatal Mortality		cOR[95%CI]	P-value	aOR[95%CI]	P-value
	No, n (%)	Yes n (%)				
Number of ANC visits						
None (Ref)				1		1
1	140(99.3)	1(0.7)	0.11(0.02-0.54)	0.01*	0.11(0.02-0.56)	0.01
2-4	1579(98.2)	29(1.8)	0.27(0.13-0.68)	0.00*	0.29(0.12-0.68)	0.01
>4	8487(98.3)	147(1.7)	0.28(0.13-0.60)	0.00*	0.29(0.13-0.67)	0.00
Sex of baby						
Boy (Ref)	5261(97.9)	114(2.1)		1		
Girl	5173(98.6)	76(1.5)	0.68(0.48-0.97)	0.03*	0.68(0.47-0.98)	0.04
Child put on mother's chest immediately after birth						
Yes (Ref)	5200(98.9)	54(1.0)		1		1
No	5234(97.5)	136(2.5)	2.46(1.66-3.65)	0.00*	2.59(1.75-3.83)	0.00

cOR= crude odds ratio; aOR= adjusted odds ratio; CI=confidence interval; ref=reference category; *p<0.05

4.4 Chapter summary

This chapter presented results of the study. The results showed that the prevalence of neonatal mortality among the 10,624 respondents who reported to have delivered a livebirth within the 5 years preceding the 2017 GMHS was 2%. Factors that were statistically significantly associated with neonatal mortality were the number of antenatal visits a woman made prior to delivery, sex of baby, and child put to mother's chest immediately after birth. These factors are maternal and newborn factors. Community and socio-demographic factors were not statistically significant determinants of neonatal mortality in this study. In the next chapter, these results are discussed.

CHAPTER FIVE

DISCUSSION

5.0 **Introduction**

This chapter discusses the results of the study. The discussion in this chapter has been structured as follows: summary of findings, consistency with findings of previous studies, explanation of the findings, and strengths and limitations of the study.

5.1 Summary of findings

This study aimed to determine the prevalence of neonatal mortality as well as examine community, socio-demographic, maternal and neonatal factors associated with neonatal mortality among women who had live births in the last five years preceding the 2017 GMHS. Data from the 2017 GMHS were analysed using descriptive, bivariate and logistic regression statistical methods.

Results showed that 45.1% of women were from the southern zone of Ghana whilst 38.6%, were from the middle part of the country. Also, 24.6% of respondents were between the ages of 25 – 29 years, 23.5% between the ages of 30 – 34 years, 5% between 15-19 years and 2.8% between the ages of 45-49 years old. Majority (51.7%) of respondents resided in rural areas with 24% not formally educated. Also, only 6.2% of respondents had tertiary education with majority (77.2%) of respondents being Christians.

In this study, prevalence of neonatal mortality was found to be 2%. Since neonatal mortality is often reported as a rate per 1000 live births, it can be expressed as approximately 20 per 1000 live births. This means that, in every 1000 live births among the sample of 10,624 respondents who reported to have delivered a livebirth within the 5 years preceding the 2017 GMHS, 20 newborn babies were at risk of dying within the neonatal period.

In terms of determinants of neonatal mortality, findings showed that community level and sociodemographic factors were not significant determinants of neonatal mortality in Ghana. This is in contrast with the hypothesis laid out in the conceptual framework of this study. However, a number of maternal, and neonatal factors were found to be significant determinants of neonatal mortality in Ghana. Specifically, the odds of baby girls dying during the neonatal period were significantly less than baby boys even after potential confounders were controlled for in a multiple logistic regression model. Also, when compared to women who had no antenatal visits prior to delivery, the odds of neonatal death were significantly less for women who had made at least one ANC visit prior to delivery. Finally, this study further revealed that, putting babies on their mother's chest immediately after birth (immediate skin-to-skin) significantly reduced the risk of neonatal mortality. Thus, babies who were not put on their mother's chest immediately after birth were 2.5 times more likely to die during the neonatal period as compared to those who were put on their mother's chest immediately after birth.

5.2 Consistency with previous research

Findings in this study are consistent with some findings in previous research on determinants of neonatal mortality. This study found that the prevalence of neonatal mortality was 2% which is expressed as 20 per 1000 live births. This is different from the findings in the 2017 GMHS which reported 25 per 1000 live births (GSS et al., 2018). This could be due to data cleaning where most variables and data elements were dropped due to the selection criteria. For instance, in the 2017 GMHS, a total of 15,371 mothers reported having live births in the last 5 years preceding the 2017 GMHS but 10,624 (69.1% of sample utilization) records were used in this study due to missing variables. The neonatal mortality rate (NMR) in this study is also lower than the rate in 49 Sub-Saharan African countries, where the mean NMR is 30.1 with a standard deviation (SD) of 9.8 and a range of 8-50 (Kayode et al., 2017).

Generally, the findings of this study showed that antenatal care visits provide protection from neonatal mortality. This is consistent with a study in Bangladesh, where higher number of antenatal visits was found to be closely related with reduced risk of neonatal mortality(Roy & Haque, 2018). The finding on the beneficial effect of ANC attendance on neonatal mortality is also consistent with a study conducted in Ethiopia where they found statistical association between higher number of antenatal visits and reduced risks of neonatal mortality (Orsido et al., 2019). The finding in relation to ANC attendance and neonatal mortality is also similar to results from a systematic review and meta-analysis on the impact of antenatal attendance on neonatal mortality in Sub-Saharan Africa, where women with at least one antenatal visit had 32% lower risk of experiencing neonatal mortality as compared with those with no antenatal attendance (Tekelab et al., 2019).

Sex of baby at birth has been found to be associated with neonatal outcome. The results of this study concurs with a study in Bangladesh where male babies were 1.4 times more likely to die during the neonatal period as compared to their female counterparts (Muhammed et al., 2018). Similarly, another study in Northern Ghana found that baby boys were 1.2 times more likely to die compared to their female counterparts (Welaga et al., 2013).

Putting a baby on mother's bare chest immediately after birth otherwise called immediate skin-to-skin, is one of the cost-effective interventions for improving the survival of newborns especially in LMICs including Ghana. In this study, babies who were not put on their mother's chest immediately after birth were 2.5 times more likely to die during the neonatal period than babies who were put on their mother's chest immediately after birth(Moore et al., 2016). This is consistent previous research which showed that putting babies immediately on their mother's bare chest does improve neonatal outcomes(Moore et al., 2016).

5.3 Explanation of findings and implications

This study found that neonatal mortality was 190 out of the 10,624 live births used in the analysis from the 2017 GMHS. This represents 2% and per the standard reporting, it is expressed as 20 per 1000 live births. Though this is lower than the 2017 GMHS rate of 25 per 1000 live births, it is higher than the SDG target of 12 per 1000 live births by 2030 (United Nations, 2015). It is therefore important to strengthen interventions to accelerate the reduction of neonatal mortality through the use of evidence-based solutions such as essential newborn care (WHO, 2013). There are cost-effective interventions that have been proven to reduce neonatal mortality in LMICs including Essential Newborn Care (ENC), Kangaroo Mother Care(KMC), breastfeeding, Focus Antenatal care and administration of antenatal corticosteroid among others(Zaka et al., 2018). These interventions should be adopted and monitored closely to ensure that they are implemented at all levels.

The results of this study support findings from various research that showed that having antenatal care prior to delivery improves neonatal outcome. It is important to note that the results of this study did not show that having more than one antenatal care visit improves neonatal outcome per se. This could be due to limitations in the data used. While there is a need to carry out further studies to examine the relationship between number of antenatal care visits and the effect on neonatal mortality in Ghana, there are several reasons why ANC attendance may lower the risk of neonatal mortal. For instance, during ANC visits, women are checked (e.g. blood pressure, pulse, foetal pulse, blood chemistry), counselled on maternal and foetal risk factors, diet, exercise, rest, given vitamin supplements, immunized against tetanus diphtheria, given dewormers, as well as having foetal growth and presentation checked (WHO, 2016). Thus while the number of antenatal visits made may not necessarily result in improved maternal and neonatal outcomes because of the quality of the service package(Afulani, 2016), ANC attendance may ensure that risk factors are identified and

resolved early to improve on maternal and foetal outcomes (WHO, 2016). It is for this reason that the WHO recently recommended at least eight antenatal visits for pregnant women - an increase from the previously recommended four visits (WHO, 2016). While increasing the number of antenatal care visits may not be of benefit to women in Ghana because of poor quality of antenatal care(Afulani, 2016), building the capacity of healthcare providers to provide quality antenatal care could be very essential in ensuring that women benefit from services received from the health system. This calls for the government of Ghana and Ghana Health Service to intensify monitoring and coaching visits to ensure that health service providers are providing client-focused quality antenatal care for women. This will go a long way to improve neonatal outcome.

Female were also found to be less likely to die in the neonatal period compared to their male counter parts. This study found females having 32% lower odds of neonatal mortality as compared to their male counterparts. This is less surprising because demographically, females have been found to possess better survival advantages compared to their male counterparts (Khoury et al, 1985). This has given rise to a better sex ratio in their favour globally. It is therefore not surprising to find similar characteristics in the findings of this study. In Bangladesh, males infants were 1.4 times more likely to die as compared to their female counterpart during the neonatal period (Muhammed et al., 2018) and in Northern Ghana, the odds was 1.2 times in males as compared with their female counterpart (Welaga et al., 2013).

The sex differences in risk of neonatal mortality has been linked to genetic and developmental disadvantage of male babies, which is more pronounced following birth (Naeye, Burt, Wright, Blanc, & Tatter, 1971).These biological factors are particularly associated with the slow development and maturity of male infant lungs compared to their female counterparts (Khoury et al, 1985; Hsu et al., 2015). The relevance of this finding is to

inform healthcare providers to prepare expectant families of the need to provide gender-based care to ensure that male infants receive the needed care to help them thrive and survive. Also, it is important to create community awareness on sex differentiation in survival rates to improve on their knowledge and practices related to neonatal care.

Findings also revealed that babies who did not benefit from immediate skin-to-skin care were 2.6 times more likely to die when compared to those who benefited. Indeed, the current study is one of the few studies that assessed the effect of immediate skin-to-skin on neonatal mortality in Sub-Saharan Africa and will thus support the "warm chain" protocols recommended by WHO as part of basic neonatal resuscitation in LMICs particularly in Ghana (WHO, 2013). Immediate skin-to-skin care, otherwise known as putting baby on mother's chest immediately after birth, is part of the components of immediate essential newborn care (ENC). The components of immediate ENC are thermal care, hygienic cord care and early and exclusive initiation of breastfeeding(WHO, 2015). Thermal care, a component of ENC includes immediate drying and immediate skin-to-skin contact with the bare chest of the mother (De Graft-Johnson et al., 2017).

The importance of immediate skin-to-skin care cannot be overemphasized. It provides the infant warmth, thereby preventing neonatal hypothermia, which is one of the 3 major causes of neonatal mortality (Liu et al., 2015). The findings of this study thus provide an even stronger effect and adds empirical evidence to support this cost-effective intervention: that putting babies on their mother's chest provide extra-uterine support to newborns by improving their score on Stability of Cardio-Respiratory system (SCRIP) during the first six hours post birth suggestive of better infant stabilisation to extrauterine life, blood glucose levels, and infant thermoregulation(Moore et al., 2016). Despite the benefits of this ENC intervention, studies reveal that in LMICs, the practice is poor and most healthcare professionals lack the competence to provide quality ENC services in the midst of inadequate

equipment to provide ENC services including inadequate bag and mask (De Graft-Johnson et al., 2017). It is therefore important from the foregoing for policy makers, particularly, Ghana's Ministry of Health and Ghana Health Service to strengthen the health system to ensure availability, knowledge and skills on policies on ENC, availability and functional equipment including bag and mask, proficiency of healthcare providers, documentation and improve monitoring and supervision to ensure that quality and client-centred care is provided to improve neonatal outcomes. Community members, family members and opinion leaders should be sensitised on the relevance of immediate skin-to-skin to prepare themselves before they go into labour.

It is important to note that, some of the factors in the conceptual framework were not significantly associated with neonatal mortality. These include community level and, sociodemographic factors. This may be due to the overall improvement in poverty level nationally in Ghana (Cooke et al, 2016). Between 1992 and 2013, poverty level reduced by more than half (from 56.5% to 24.2%) thereby achieving the MDG1 target ahead of schedule (Cooke et al, 2016).

5.4 Strengths and limitations of the study

The strength of this include the fact that it had a national character and as a result, the findings could be generalized to the wider population. The study also established a relationship between immediate skin-to-skin and neonatal mortality, which has not been given the needed attention in the provision of empirical evidence to back intervention on ENC. This study has thus added more empirical evidence to the determinants of neonatal mortality in Ghana, and these findings have implications for interventions in neonatal health.

However, there are several limitations in this study. For instance, while several more variables could potential affect neonatal mortality, reliance on the number of variables available in the 2017 GMHS meant that the analysis was only limited to only 12 independent

variables that were measured and fully captured in 2017 GMHS. Also, the design of the study and the reliance on secondary data did not offer an opportunity for exploring reasons that could help understand some of the findings better. Future research could be prospective and use mixed methods to identify reasons for the findings to gain better understanding. It is important to acknowledge the fact that errors such as recall bias and social desirability responses could not have been corrected in this study. Therefore, though the results could be important in planning, their application in the general population should be done with caution, taking into consideration, the limitations enumerated.

5.5 Chapter summary

This chapter discussed the results of the study and provided areas of consistency or otherwise and the study strengths and limitation thereon. The discussions showed that antenatal care attendance, sex of baby and immediate skin-to-skin care were significant determinants of neonatal mortality in Ghana. The discussion also offered suggestions on interventions that could help improve neonatal outcomes in Ghana which could help accelerate the reduction of neonatal mortality rate thereby helping achieve the SDG 3 target of reducing neonatal mortality rate to as low as 12 per 1000 live births by 2030 (UN, 2019). The next chapter presents specific recommendations in this regard.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6 Introduction

This chapter presents the conclusion and recommendations of the study. The chapter first provides key conclusions from the study, followed by recommendations for policy, practice and research.

6.1 Conclusion

This study was aimed at determining the prevalence of neonatal mortality and the community, socio-demographic, maternal and neonatal determinants of neonatal mortality in Ghana among women who had live births in the last five years preceding the 2017 GMHS.

The study revealed that neonatal mortality was 2% and this is equivalent to 20 per 1000 live births. This means that, in every 1000 live births among the sample of 10,624 respondents who reported to have delivered a livebirth within the 5 years preceding the 2017 GMHS, 20 newborn babies were at risk of dying within the neonatal period.

The results revealed that community level and sociodemographic factors were not significant determinants of neonatal mortality. Rather, maternal, and neonatal factors were significant determinants of neonatal mortality in Ghana. Specifically, sex of baby and number of antenatal visits prior to delivery, and baby put on mother's chest immediately after birth (immediate skin-to-skin) were associated with neonatal mortality in Ghana.

In conclusion, sex of the baby, number of antenatal visits and baby put on mother's chest immediately after birth were statistically associated with neonatal mortality in Ghana.

6.2 Recommendations

Based on the findings reported and discussed in the previous chapters, the following recommendations are made.

a. ANC attendance was shown to reduce the risk of neonatal mortality. It is therefore recommended that the Ministry of Health and Ghana Health Service implement interventions to sensitise women to understand the importance of ANC attendance and the need to start ANC early. In this regard, there is a need to identify and use appropriate Social and Behaviour Change Communication (SBCC) strategies through various channels including radios, television, social media and community Public Address System (PAS), community meetings, sensitization and activities of Community Health Nurses during scheduled and routine home visits to improve the number of antenatal visits. There is also a need to build the capacity of healthcare providers on quality of antenatal care to ensure that women benefit from quality and quantity of antenatal care. Also, ensuring that supervisors at all levels improve on the frequency and quality of supportive visits at all levels could help ensure that quality antenatal care is provided.
b. It is also recommended that healthcare providers and women should be trained and/ or sensitized to recognize sex differentiation in the risk of neonatal death and how to support male infants thrive and survive. This would involve building the capacity of healthcare providers and educating communities to ensure that they are aware of the different risks that sex differentiation confers on neonates and the need to provide extra care for male neonates to improve their survival.
c. It is essential to improve on community knowledge, attitudes, and practices on the importance of immediate skin-to-skin care through SBCC using various channels of communication including social media, mass media, community PAS and compound visits. Healthcare workers should also be trained to improve on their knowledge, attitude, and practice. Though this is already ongoing, there is need to intensify efforts through continued capacity building and improved monitoring and supportive supervision.

REFERENCES

Afulani, P. A. (2016). Determinants of stillbirths in Ghana: Does quality of antenatal care matter? *BMC Pregnancy and Childbirth*, *16*(1), 132. https://doi.org/10.1186/s12884-016-0925-9

Almgren, M. (2018, March 1). Benefits of skin-to-skin contact during the neonatal period: Governed by epigenetic mechanisms? *Genes and Diseases*, *5*, 24–26. https://doi.org/10.1016/j.gendis.2018.01.004

Annan, G. N., & Asiedu, Y. (2018). Predictors of Neonatal Deaths in Ashanti Region of Ghana: A Cross-Sectional Study. *Advances in Public Health*, *2018*, 1–11. https://doi.org/10.1155/2018/9020914

Arthur, E. (2012). Wealth and antenatal care use: Implications for maternal health care utilisation in Ghana. *Health Economics Review*, *2*, 1–8. https://doi.org/10.1186/2191-1991-2-14

Badenhorst, W., & Hughes, P. (2007, April). Psychological aspects of perinatal loss. *Best Practice and Research: Clinical Obstetrics and Gynaecology*, *21*, 249–259. https://doi.org/10.1016/j.bpobgyn.2006.11.004

Barrera, A. (1990). The role of maternal schooling and its interaction with public health programs in child health production. *Journal of Development Economics*, *32*(1), 69–91. https://doi.org/10.1016/0304-3878(90)90052-D

Basiri, B., Esna Ashari, F., Shokouhi, M., & Sabzehei, M. K. (2015). Neonatal Mortality and its Main Determinants in Premature Infants Hospitalized in Neonatal Intensive Care Unit in Fatemieh Hospital, Hamadan, Iran. *Journal of Comprehensive Pediatrics*, *6*(3). https://doi.org/10.17795/ijcp-26965

Betran, A. P., Torloni, M. R., Zhang, J. J., & Gülmezoglu, A. M. (2016). WHO statement on caesarean section rates. *BJOG: An International Journal of Obstetrics and Gynaecology*, *123*, 667–670. https://doi.org/10.1111/1471-0528.13526

Boaventura M. Cau, & Arusyak Sevoyan, V. A. (2016). Religious affiliation and under-five mortlaity in Mozambique. *Biosocial Science*, *25*(3), 289–313. https://doi.org/110.1016/j.bbi.2017.04.008

Buor, D. (2003). Mothers' education and childhood mortality in Ghana. *Health Policy*, *64*(3), 297–309. https://doi.org/10.1016/S0168-8510(02)00178-1

Caldwell, J. C. (1979). Education as a Factor in Mortality Decline An Examination of

Nigerian Data. *Population Studies*, *33*(3), 395. https://doi.org/10.2307/2173888

Chen, I., Opiyo, N., Tavender, E., Mortazhejri, S., Rader, T., Petkovic, J., … Betran, A. P. (2018). Non-clinical interventions for reducing unnecessary caesarean section. *The Cochrane Database of Systematic Reviews*, *9*, CD005528. https://doi.org/10.1002/14651858.CD005528.pub3

Christiansen, D. M., Olff, M., & Elklit, A. (2014). Parents bereaved by infant death: Sex differences and moderation in PTSD, attachment, coping and social support. *General Hospital Psychiatry*, *36*(6), 655–661. https://doi.org/10.1016/j.genhosppsych.2014.07.012

Cooke, E., Hague, S., & McKay, A. (2016). The Ghana Poverty and Inequality Report. In *Unicef*. Retrieved from https://www.unicef.org/ghana/Ghana_Poverty_and_Inequality_Analysis_FINAL_Match_2016(1).pdf

Copper, R. L., Goldenberg, R. L., Creasy, R. K., DuBard, M. B., Davis, R. O., Entman, S. S., … Cliver, S. P. (1993). A multicenter study of preterm birth weight and gestational age-specific neonatal mortality. *American Journal of Obstetrics and Gynecology*, *168*(1 Pt 1), 78–84. https://doi.org/8420354

De Graft-Johnson, J., Vesel, L., Rosen, H. E., Rawlins, B., Abwao, S., Mazia, G., … Tekleberhan, A. (2017). Cross-sectional observational assessment of quality of newborn care immediately after birth in health facilities across six sub-Saharan African countries. *BMJ Open*, *7*(3). https://doi.org/10.1136/bmjopen-2016-014680

Debelew, G. T., Afework, M. F., & Yalew, A. W. (2014). Determinants and causes of neonatal mortality in jimma Zone, Southwest Ethiopia: A multilevel analysis of prospective follow up study. *PLoS ONE*, *9*(9). https://doi.org/10.1371/journal.pone.0107184

Dickson, K. E., Simen-Kapeu, A., Kinney, M. V, Huicho, L., Vesel, L., Lackritz, E., … Lawn, J. E. (2014, August 2). Every Newborn: Health-systems bottlenecks and strategies to accelerate scale-up in countries. *The Lancet*, *384*, 438–454. https://doi.org/10.1016/S0140-6736(14)60582-1

Edmond, K. M. (2006). Delayed Breastfeeding Initiation Increases Risk of Neonatal Mortality. *PEDIATRICS*, *117*(3), e380–e386. https://doi.org/10.1542/peds.2005-1496

Engmann, C., Matendo, R., Kinoshita, R., Ditekemena, J., Moore, J., Goldenberg, R. L., … Wright, L. L. (2009). Stillbirth and early neonatal mortality in rural Central Africa. *Int J*

Gynaecol Obstet, *105*(2), 112–117. https://doi.org/10.1016/j.ijgo.2008.12.012

Filmer, D., & Pritchett, L. (1999). The impact of public spending on health: Does money matter? *Social Science and Medicine*, *49*(10), 1309–1323. https://doi.org/10.1016/S0277-9536(99)00150-1

Ghana Government. (2016). *National Community-based Health Planing and Services (CHPS) Policy*. Retrieved from http://www.ghanahealthservice.org/downloads/MOH_CHPS_Policy_Final.pdf

Ghana Health Service (GHS). (2017). *Ghana Health Service 2016 Annual Report*. Accra.

Ghana Statistical Service. (2017). Ghana living standards Survey. *Ma Theory and the Creative Management of Innovation*, v–vii. https://doi.org/10.1057/978-1-137-59194-4

Ghana Statistical Service. (2018). *Ghana Multiple Indicator Cluster Survey (MICS 2017/18), Survey Findings Report.* 1–76.

Ghana Statistical Services. (2019). Ghana Statistical Services. Retrieved July 19, 2020, from Population by Regions website: https://www.statsghana.gov.gh/

GHS. (2016). Family Health Division Annual Report. In *Ghana health service*.

GSS, GHS, I. (2018). *Ghana Maternal Health Survey 2017 Key Indicators*. 17. Retrieved from www.DHSprogram.com.

GSS;GHS;ICF, I. (2014). *Ghana Demographic and Health Survey 2014*. https://doi.org/10.15171/ijhpm.2016.42

GSS, G. (2014). Ghana - Emergency Obstetric And Newborn Care,2011, Second Round. Retrieved October 11, 2018, from http://www.statsghana.gov.gh/nada/index.php/catalog/73

Hsu, S. T., Hsieh, C. J., Chen, H. W., Jeng, S. F., Wu, H. C., Chen, M. H., … Hsieh, W. S. (2015). Nationwide Birth Weight and Gestational Age-specific Neonatal Mortality Rate in Taiwan. *Pediatrics and Neonatology*, *56*(3), 149–158. https://doi.org/10.1016/j.pedneo.2014.07.006

Kaboré, R., Meda, I. B., Koulidiati, J. L. E., Millogo, T., & Kouanda, S. (2016). Factors associated with very early neonatal mortality in Burkina Faso: A matched case–control study. *International Journal of Gynecology and Obstetrics*, *135*, S93–S97. https://doi.org/10.1016/j.ijgo.2016.08.017

Kamal, S. M. M. (2015). What is the association between maternal age and neonatal mortality? An analysis of the 2007 Bangladesh demographic and health survey. *Asia-Pacific Journal of Public Health*. https://doi.org/10.1177/1010539511428949

Kanmiki, E.W., Bawah, A.A., Agorinya, I., Achana, F.S., Awoonor-Williams, J.K., O. A. et al. (2014). Socio-economic and demographic determinants of under-five mortality in rural northern Ghana. *BMC International Health and Human Rights*, 2–4.

Kayode, G. A., Ansah, E., Agyepong, I. A., Amoakoh-Coleman, M., Grobbee, D. E., & Klipstein-Grobusch, K. (2014). Individual and community determinants of neonatal mortality in Ghana: A multilevel analysis. *BMC Pregnancy and Childbirth*, *14*(1), 165. https://doi.org/10.1186/1471-2393-14-165

Kayode, G., Grobbee, D., Amoakoh-Coleman, M., Ansah, E., Uthman, O., & Klipstein-Grobusch, K. (2017). Variation In Neonatal Mortality And Its Relation To Country Characteristics In Sub-Saharan Africa. *BMJ Global Health*, *2*(Suppl 2), A49.1-A49. https://doi.org/10.1136/bmjgh-2016-000260.130

Khan, A. A., Zahidie, A., & Rabbani, F. (2013). Interventions to reduce neonatal mortality from neonatal tetanus in low and middle income countries - A systematic review. *BMC Public Health*, *13*(1), 1–7. https://doi.org/10.1186/1471-2458-13-322

Khoury, M. J., Marks, J. S., McCarthy, B. J., & Zaro, S. M. (1985). Factors affecting the sex differential in neonatal mortality: The role of respiratory distress syndrome. *American Journal of Obstetrics and Gynecology*, *151*(6), 777–782. https://doi.org/10.1016/0002-9378(85)90518-6

Kikuchi, K., Okawa, S., Yasuoka, J., Nanishi, K., Shibanuma, A., Jimba, M., … Kamiya, Y. (2015). Effective linkages of continuum of care for improving neonatal, perinatal, and maternal mortality: A systematic review and meta-analysis. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0139288

Kinney, M. V, Boldosser-Boesch, A., & McCallon, B. (2016). Quality, equity, and dignity for women and babies. *The Lancet*, *388*, 2066–2068. https://doi.org/10.1016/S0140-6736(16)31525-2

Kinney, M. V, Kerber, K. J., Black, R. E., Cohen, B., Nkrumah, F., Coovadia, H., … Lawn, J. E. (2010). Sub-Saharan Africa's mothers, newborns, and children: Where and why do they die? *PLoS Medicine*, *7*(6). https://doi.org/10.1371/journal.pmed.1000294

Kothari, C. R. (2004). *Research methodology : methods & techniques*. Retrieved from https://books.google.com.gh/books/about/Research_Methodology.html?id=8c6gkbKi-F4C&redir_esc=y

Kruk, M. E., Gage, A. D., Arsenault, C., Jordan, K., Leslie, H. H., Roder-DeWan, S., … Pate, M. (2018). High-quality health systems in the Sustainable Development Goals era: time for a revolution. *The Lancet Global Health*, *6*(11), e1196–e1252.

https://doi.org/10.1016/S2214-109X(18)30386-3

Kwarteng Acheampong, G., & Avorgbedor, Y. E. (2017). Determinants of under Five Mortality in Ghana; A Logistic Regression Analysis Using Evidence from the Demographic and Health Survey (1988-2014). *American Journal of Public Health Research*, *5*(3), 70–78. https://doi.org/10.12691/ajphr-5-3-4

Labbok, M. H. (2012). Global Baby-Friendly Hospital Initiative Monitoring Data: Update and Discussion. *Breastfeeding Medicine*, *7*(4), 210–222. https://doi.org/10.1089/bfm.2012.0066

Lassi, Z. S., Middleton, P. F., Crowther, C., & Bhutta, Z. A. (2015). Interventions to Improve Neonatal Health and Later Survival: An Overview of Systematic Reviews. *EBioMedicine*, *2*(8), 985–1000. https://doi.org/10.1016/j.ebiom.2015.05.023

Lawn J, Kerber K, E. (2013). *Committing to Child Survival: A Promise Renewed: UNICEF Progress Report 2013*. https://doi.org/978-92-806-4706-8

Lawn, J., Blencowe, H., Oza, S., You, D., Lee, A., & Waiswa, P. (2014). Every Newborn: progress, priorities, and potential beyond survival. *The Lancet*, *384*(9938).

Lawn, J. E., Cousens, S., & Zupan, J. (2005). 4 million neonatal deaths: When? Where? Why? *The Lancet*, *365*(9462), 891–900. https://doi.org/10.1016/S0140-6736(05)71048-5

Lincetto, O., Mothebesoane-Anoh, S., Gomez, P., & Munjanja, S. (2006). *Antenatal Care III*. Retrieved from https://www.who.int/pmnch/media/publications/oanfullreport.pdf

Liu, L., Oza, S., Hogan, D., Perin, J., Rudan, I., Lawn, J. E., … Black, R. E. (2015). Global, regional, and national causes of child mortality in 2000-13, with projections to inform post-2015 priorities: An updated systematic analysis. *The Lancet*, *385*(9966), 430–440. https://doi.org/10.1016/S0140-6736(14)61698-6

Markovitz, B. P., Cook, R., Flick, L. H., & Leet, T. L. (2005). Socioeconomic factors and adolescent pregnancy outcomes: Distinctions between neonatal and post-neonatal deaths? *BMC Public Health*, *5*(1), 79. https://doi.org/10.1186/1471-2458-5-79

Mckinnon, B., Harper, S., Kaufman, J.S., & B. Y. (2014). *Socioeconomic inequality in neonatal mortality in countries of low and middle income:a multicountry analysis*.

Measure Evaluation. (2019). Neonatal mortality rate (NMR) — MEASURE Evaluation. *Family Planning and Reproductive Health*. Retrieved from https://www.measureevaluation.org/prh/rh_indicators/womens-health/nb/neonatal-mortality-rate-nmr

Mekonnen, Y., Tensou, B., Telake, D. S., Degefie, T., & Bekele, A. (2013). Neonatal mortality in Ethiopia: Trends and determinants. *BMC Public Health*, *13*(1). https://doi.org/10.1186/1471-2458-13-483

Miller, S., Abalos, E., Chamillard, M., Ciapponi, A., Colaci, D., Comandé, D., … Althabe, F. (2016). Beyond too little, too late and too much, too soon: a pathway towards evidence-based, respectful maternity care worldwide. *The Lancet*, *388*(10056), 2176–2192. https://doi.org/10.1016/S0140-6736(16)31472-6

MoH/GHS. (2019). *Ghana National Newborn Health Strategy And Action Plan, 2019-2023*.

MoH. (2016). *Ghana National Healthcare Quality Strategy-2017-2021*. Retrieved from http://www.moh.gov.gh/nationalqualitystrategyghana

MoH, G. (2014). Ghana National Newborn Health Strategy and Action Plan. In *Ministry of Health*. https://doi.org/10.1017/CBO9781107415324.004

Moore, E. R., Bergman, N., Anderson, G. C., & Medley, N. (2016). Early skin-to-skin contact for mothers and their healthy newborn infants. *Cochrane Database of Systematic Reviews*. https://doi.org/10.1002/14651858.CD003519.pub4

Mosley, H. W., & Chen, L. C. (2003). An analytical framework for the study of child survival in developing countries. (Public Health Classics). *Bulletin of the World Health Organization*, *81*(2), 140.

Msemo, G., Massawe, A., Mmbando, D., Rusibamayila, N., Manji, K., Kidanto, H. L., … Perlman, J. (2013). Newborn Mortality and Fresh Stillbirth Rates in Tanzania After Helping Babies Breathe Training. *PEDIATRICS*, *131*(2), e353–e360. https://doi.org/10.1542/peds.2012-1795

Muhammed, G., Kibriaid, A., Khanam, R., Mitra, K., Mahmud, A., Begum, N., … Baqui, A. (2018). *Rates and determinants of neonatal mortality in two rural sub-districts of Sylhet, Bangladesh*. https://doi.org/10.1371/journal.pone.0206795

Naeye, R. L., Burt, L. S., Wright, D. L., Blanc, W. A., & Tatter, D. (1971). Neonatal mortality, the male disadvantage. *Pediatrics*, *48*(6), 902–906.

Nisar, Y. Bin, & Dibley, M. J. (2014). *Determinants of neonatal mortality in Pakistan: secondary analysis of Pakistan Demographic and Health Survey 2006-07*. https://doi.org/10.1186/1471-2458-14-663

Nortey, E. (2015). *National Analytical Report: 2010 Population and Housing Census*. (July).

Oestergaard, M. Z., Inoue, M., Yoshida, S., Mahanani, W. R., Gore, F. M., Cousens, S., … Mathers, C. D. (2011, August 30). Neonatal mortality levels for 193 countries in 2009 with trends since 1990: A systematic analysis of progress, projections, and priorities (P.

Byass, Ed.). *PLoS Medicine*, *8*, e1001080. https://doi.org/10.1371/journal.pmed.1001080

Oglethorpe, R. J. L. (1989). Parenting After Perinatal Bereavement - A Review of The Literature. *Journal of Reproductive and Infant Psychology*, *7*(4), 227–244. https://doi.org/10.1080/02646838908403597

Orsido, T. T., Asseffa, N. A., & Berheto, T. M. (2019). Predictors of Neonatal mortality in Neonatal intensive care unit at referral Hospital in Southern Ethiopia: A retrospective cohort study. *BMC Pregnancy and Childbirth*, *19*(1). https://doi.org/10.1186/s12884-019-2227-5

Owusu, B. (2017). *The Sustainable Development Goals (SDGs) in Ghana*. 27,30,32. Retrieved from http://gh.one.un.org/content/dam/unct/ghana/docs/SDGs/UNCT-GH-SDGs-in-Ghana-Avocacy-Messages-2017.pdf

Parveen Tariq, Z. K. (2006). *Determinants of neonatal mortality*. Retrieved from https://pdfs.semanticscholar.org/c797/6074bd26c2772d33e01aacb52c4d095ab630.pdf

Pirani, E. (2014). Wealth Index. In *Encyclopedia of Quality of Life and Well-Being Research* (pp. 7017–7018). https://doi.org/10.1007/978-94-007-0753-5_3202

Rai, C., Kharka, L. V., Dutta, S., & Kumar, N. (2018). A retrospective analysis of the risk factors leading to perinatal mortality at a tertiary care hospital of Sikkim, India. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, *7*(6), 2295. https://doi.org/10.18203/2320-1770.ijrcog20182338

Rosenzweig, M. R., & Schultz, T. P. (1982). Child mortality and fertility in Colombia: Individual and community effects. *Health Policy and Education*, *2*(3–4), 305–348. https://doi.org/10.1016/0165-2281(82)90015-7.

Roy, S., & Haque, M. A. (2018). Effect of antenatal care and social well-being on early neonatal mortality in Bangladesh. *BMC Pregnancy and Childbirth*, *18*(1), 4–9. https://doi.org/10.1186/s12884-018-2129-y

Sankar, M. J., Neogi, S. B., Sharma, J., Chauhan, M., Srivastava, R., Prabhakar, P. K., … Paul, V. K. (2016). State of newborn health in India. *Journal of Perinatology*, *36*(s3), S3–S8. https://doi.org/10.1038/jp.2016.183

Say, L., Chou, D., Gemmill, A., Tunçalp, Ö., Moller, A.-B., Daniels, J., … Alkema, L. (2014). Global causes of maternal death: a WHO systematic analysis. *The Lancet Global Health*, *2*(6), e323–e333. https://doi.org/10.1016/S2214-109X(14)70227-X

Singh, A., Kumar, A., & Kumar, A. (2013). Determinants of neonatal mortality in rural India,

2007–2008. *PeerJ*, *1*, e75. https://doi.org/10.7717/peerj.75

Singh, K., Khan, S. M., Carvajal-Aguirre, L., Brodish, P., Amouzou, A., & Moran, A. (2017). The importance of skin-to-skin contact for early initiation of breastfeeding in Nigeria and Bangladesh. *Journal of Global Health*, *7*(2), 20505. https://doi.org/10.7189/jogh.07.020505

Sutan, R., & Berkat, S. (2014). Does cultural practice affects neonatal survival- a case control study among low birth weight babies in Aceh Province, Indonesia. *BMC Pregnancy and Childbirth*, *14*(1). https://doi.org/10.1186/1471-2393-14-342

Tekelab, T., Chojenta, C., Smith, R., & Loxton, D. (2019). The impact of antenatal care on neonatal mortality in sub-Saharan Africa: A systematic review and meta-analysis. *PLOS ONE*, *14*(9), e0222566. https://doi.org/10.1371/journal.pone.0222566

UN. (2019). The sustainable development goals report 2017. In *The sustainable development goals report 2016*. https://doi.org/10.29171/azu_acku_pamphlet_k3240_s878_2016

United Nations. (2015). Sustainable Development Goal 2015. Retrieved April 28, 2019, from United Nation website: https://www.undp.org/content/dam/undp/library/corporate/brochure/SDGs_Booklet_Web_En.pdf

Upadhyay, R. P., Dwivedi, P. R., Rai, S. K., Misra, P., Kalaivani, M., & Krishnan, A. (2012). Determinants of neonatal mortality in rural Haryana: A retrospective population based study. *Indian Pediatrics*, *49*(4), 291–294. https://doi.org/10.1007/s13312-012-0044-2

Victora, C. G., Bahl, R., Barros, A. J. D., França, G. V. A., Horton, S., Krasevec, J., … Richter, L. (2016). Breastfeeding in the 21st century: Epidemiology, mechanisms, and lifelong effect. *The Lancet*, *387*. https://doi.org/10.1016/S0140-6736(15)01024-7

Victoria, C. G., Huttly, S. R. A., Barros, F. C., Lombardi, C., & Vaughan, J. P. (1992). Maternal education in relation to early and late child health outcomes: Findings from a Brazilian cohort study. *Social Science & Medicine*, *34*(8), 899–905. https://doi.org/10.1016/0277-9536(92)90258-R

Wall, S. N., Lee, A. C. C., Carlo, W., Goldenberg, R., Niermeyer, S., Darmstadt, G. L., … Lawn, J. E. (2010). Reducing Intrapartum-Related Neonatal Deaths in Low- and Middle-Income Countries—What Works? *Seminars in Perinatology*, *34*(6), 395–407. https://doi.org/10.1053/j.semperi.2010.09.009.

Wang, H., Bhutta, Z. A., Coates, M. M., Coggeshall, M., Dandona, L., Diallo, K., … Murray, C. J. L. (2016). Global, regional, national, and selected subnational levels of stillbirths, neonatal, infant, and under-5 mortality, 1980–2015: a systematic analysis for the Global

Burden of Disease Study 2015. *The Lancet*, *388*(10053), 1725–1774. https://doi.org/10.1016/S0140-6736(16)31575-6.

Welaga, P., Moyer, C. A., Aborigo, R., Adongo, P., Williams, J., Hodgson, A., … Engmann, C. (2013). Why Are Babies Dying in the First Month after Birth? A 7-Year Study of Neonatal Mortality in Northern Ghana. *PLoS ONE*, *8*(3). https://doi.org/10.1371/journal.pone.0058924

Weng, Y. H., Yang, C. Y., & Chiu, Y. W. (2015, December 9). Neonatal outcomes in relation to sex differences: A national cohort survey in Taiwan. *Biology of Sex Differences*, *6*. https://doi.org/10.1186/s13293-015-0052-8

WHO. (2013). Pocket Book of Hospital care for children: Guidelines for the Management of common childhood illnesses. In *Pocket Book of Hospital Care for Children: Guidelines for the Management of Common Childhood Illnesses*.

WHO. (2015). *Pregnancy, Childbirth, Postpartum and Newborn Care: A guide for essential practice Third Edition*. Retrieved from www.who.int

WHO. (2016). WHO Recommendations on antenatal care for a positive pregnancy experience. *Journal of Experimental Psychology: General*, *136*(1), 23–42.

WHO. (2017). WHO | Neonatal mortality. Retrieved October 11, 2018, from WHO website: http://www.who.int/gho/child_health/mortality/neonatal/en/

WHO. (2018). Newborns: reducing mortality. *World Health Organization*, 2017–2020. https://doi.org/28, September 2018

World Health Organization. (2017). WHO _ Neonatal mortality. Retrieved March 1, 2020, from Global Health Observatory (GHO) data website: https://www.who.int/gho/child_health/mortality/neonatal_text/en/%0Ahttp://www.who.int/gho/child_health/mortality/neonatal_text/en/

World Health Organization. (2018). WHO | Causes of child mortality. Retrieved August 22, 2019, from Who website: http://www.who.int/gho/child_health/mortality/causes/en/

Ye, J., Zhang, J., Mikolajczyk, R., Torloni, M. R., Gülmezoglu, A. M., & Betran, A. P. (2016). Association between rates of caesarean section and maternal and neonatal mortality in the 21st century: A worldwide population-based ecological study with longitudinal data. *BJOG: An International Journal of Obstetrics and Gynaecology*, *123*(5), 745–753. https://doi.org/10.1111/1471-0528.13592.

Zaka, N., Alexander, E. C., Manikam, L., Norman, I. C. F., Akhbari, M., Moxon, S., … Pearson, L. (2018). Quality improvement initiatives for hospitalised small and sick newborns in low- and middle-income countries: A systematic review. *Implementation*

Science, *13*. https://doi.org/10.1186/s13012-018-0712-2.

APPENDIX: APPROVAL FOR USE OF DATA

Oct 08, 2018

Emmanuel Ayire Adongo
Ghana Health Service
Ghana
Phone: +233 244727223
Email: apogbayire@gmail.com
Request Date: 10/06/2018

Dear Emmanuel Ayire Adongo:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Determinants of neonatal mortality in Ghana; Review of 2017 Maternal Health Survey Report".

Ghana

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. Users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: archive@dhsprogram.com.

Sincerely,

Bridgette Wellington

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program

530 Gaither Road, Suite 500, Rockville, MD 20850 USA +1.301.407.6500 +1.301.407.6501 fax icf.com