

UNIVERSITY OF GHANA
COLLEGE OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH



PREDICTORS OF NEONATAL MORTALITY IN TEMA GENERAL HOSPITAL,
GREATER ACCRA REGION OF GHANA.

SUBMITTED BY:

WISDOM ADEAPENA

(ID: 11006426)

**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN
PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MPhil
IN APPLIED EPIDEMIOLOGY AND DISEASE CONTROL DEGREE**



NOVEMBER 2024

DECLARATION

I, Wisdom Adeapena, affirm that this research is entirely my original work, except where references to other authors have been appropriately cited. Furthermore, it has not been submitted to any university with the intention of acquiring a degree.

Signature: 

November 10, 2024

Wisdom Adeapena

Date

(Student)

Signature: 

Nov.26.2024

Prof. Alexander Manu

Date

(Supervisor)

Signature: 

NOV. 27.2024

Dr. Adolphina Addo-Lartey

Date

(Co-Supervisor)



DEDICATION

I dedicate this research, first and foremost, to God Almighty and to all mothers who have endured the loss of a newborn. It is also dedicated to my family, particularly my uncle, Dr. Rudolf Kumapley, my mother, and my brother. I extend my heartfelt gratitude to my mentors, Dr. Yeetey Kwesi Enuameh and Professor Kwaku-Poku Asante, for their unwavering support and guidance throughout my academic journey.



ACKNOWLEDGEMENT

I am deeply grateful to my academic supervisors, Professor Alexander Manu and Dr. Adolphina Addo Larney, for their exceptional guidance and unwavering support throughout my time at the school and during my research.

I wish to express my deepest appreciation to Miss Jessica Asante, Dr. Samuel O. Sackey, Dr. Charles Lwanga Noora, and Dr. Donne Ameme from the Department of Epidemiology and Disease Control, University of Ghana, for their insightful guidance and encouragement, which greatly contributed to the completion of this program and my research. May God richly bless you all.

I extend my heartfelt appreciation to Dr. Sally Quartey, Ms. Linda Agyapong, and the team at the Tema Metropolitan Health Directorate. My gratitude also goes to Dr. Richard Anthony, Tema General Hospitals' Medical Director, as well as the Departmental heads and staff of the Obs and Gynae unit, Paediatrics, NICU (special recognition to Madam Paulina and Madam Florence), and Public Health (Mr. Divine Doe and Mrs. Cynthia Asante) for their invaluable support during the data collection process.

Lastly, I would like to express my gratitude to my colleagues in Cohort XVI of GFELTP and everyone who contributed in diverse ways to help make this endeavor possible. May God bless you all.



Contents	
DECLARATION.....	i
DEDICATION	ii
ACKNOWLEDGEMENT	iii
LIST OF FIGURES	vi
LIST OF TABLES	vi
LIST OF ABBREVIATIONS	viii
ABSTRACT.....	ix
CHAPTER ONE	1
1.0 INTRODUCTION	1
1.1 Background.....	1
1.2 Problem statement.....	3
1.3 Justification.....	4
1.4 Conceptual framework.....	6
1.5.1 General objective	9
1.5.2 Specific objectives	9
CHAPTER TWO	10
2.0 LITERATURE REVIEW.....	10
2.1 Neonatal Mortality	10
2.2 Socio-demographic factors influencing Neonatal Mortality	10
2.3 Maternal factors influencing Neonatal Mortality.....	11
2.4 Delivery Factors influencing Neonatal Mortality.....	14
2.5 Fetal Factors influencing Neonatal Mortality.....	16
CHAPTER THREE	18
3.0 METHOD	18
3.1 Study Design.....	18
3.2 Study Area.....	18
3.3 Variables.....	21
Independent variables	21
3.4 Sampling.....	22
3.5.1 Cases	22
3.5.2 Control	22
3.5.3 Exclusion criteria	22
3.5.3 Sample size	22
3.6 Data collection	22
3.6.1 Selection of cases	23

3.6.2 Selection of controls.....	23
3.7 Data processing and analysis.....	24
3.8 Ethical considerations	25
4.0 RESULTS.....	27
4.1 Birth outcomes.....	27
4.2. Socio-Demographic Characteristics of Mothers of Cases and Controls	27
4.3 Association between Maternal factors and neonatal mortality	31
4.4 Association between neonatal factors and neonatal mortality	34
4.5 Association between Delivery factors and neonatal mortality	36
CHAPTER FIVE	38
5.1 DISCUSSION.....	38
5.2 Socio-demographic factors associated with neonatal mortality	38
5.3 Maternal factors associated with neonatal mortality	40
5.4 Neonatal/foetal factors associated with neonatal mortality	43
5.5 Association between delivery factors and neonatal mortality.....	45
5.6 Study strengths.....	46
5.7 Study Limitations.....	46
CHAPTER SIX.....	47
6.0 Conclusion and Recommendations.....	47
6.1 Recommendations.....	47
6.1.1 Ghana Health Service – Greater Accra Regional Health Directorate.....	47
6.1.2 Tema Metropolitan Health Directorate.....	47
6.1.3 Tema General Hospital.....	48
6.2 Further Research	48
REFERENCES	49
APPENDICES	64
Appendix A: Consent Information for Participants	64
Participant Consent Form.....	66
Variable tables.....	68
Appendix B: QUESTIONNAIRE.....	73
Investigators CV's.....	76

LIST OF FIGURES

Fig 1: Conceptual framework for the predictors of neonatal mortality in the Tema Metropolis in the Greater Accra Region of Ghana.

Fig 2: Map of Tema Metropolis, 2023. Source: Author generated.

LIST OF TABLES

Table 1: Association between Socio-Demographic characteristics and Neonatal mortalities, Tema General Hospital, 2024.

Table 2: Association between Socio-Demographic characteristics and Neonatal mortality, Tema General Hospital, 2024. Adjusted and Unadjusted odds Ratio

Table 3: Association between Maternal Factors against neonatal death outcomes, Tema General Hospital, 2024

Table 4: Association between Maternal Factors against neonatal death outcomes, Tema General Hospital, 2024.

Table 5: The association between Neonatal Factors and neonatal death outcomes, Tema General Hospital, 2024: Adjusted and Unadjusted odds ratio.

Table 6: The association between Neonatal Factors and neonatal death outcomes, Tema General Hospital, 2024: Adjusted and Unadjusted odds ratio.

Table 7: The association between Delivery Factors and neonatal death outcomes, Tema General Hospital, 2024.

Table 8: The association between Delivery Factors and neonatal death outcomes, Tema General Hospital, 2024: Adjusted and Unadjusted odds ratio.

Table 9: Independent variables of neonatal mortality

Table 10: The operational definitions, data source and measurement scales for socio-demographic variables.

Table 11: Operational definitions, measurement scales and data sources for the maternal independent variables.

Table 12: The operational definitions, measurement scales and data sources for the maternal independent variables.

Table 13: The operational definitions, measurement scales and data sources for the neonatal independent variables.

Table 14: The operational definitions, measurement scales and data sources for the delivery related independent variables.



LIST OF ABBREVIATIONS

<i>Abbreviation</i>	<i>Meaning</i>
ANC	Ante natal care
CS	Caesarean Section
CHPs	Community-based Health Planning and Services
DHS	Demographic and Health Survey
DM	Diabetes Mellitus
END	Early Neonatal Death
EO	Emergency Obstetric
GAR	Greater Accra Region
GHS	Ghana Health Service
ITNs	Insecticide Treated Nets
LMICs	Low Middle-Income Country
LBW	Low Birth Weight
MHMT	Metropolitan Health Management Team
NHIS	National Health Insurance Scheme
NICU	Neonatal Intensive Care Unit
NMR	Neonatal Mortality Rate
NNM	Neonatal Mortality
PI	Principal Investigator
RHD	Regional Health Directorate
SDGs	Sustainable Development Goals
SSA	Sub-Saharan Africa
TGH	Tema General Hospital
TMHD	Tema Metropolitan Health Directorate
TMA	Tema Metropolitan Assembly
TPPHA	Tema Public and Private Health Workers Association
WHO	World Health Organization
UNICEF	United Nations Children's Fund

ABSTRACT

Background: Neonatal mortality (NNM), the death of a newborn within the first 28 days of life, accounts for 60% of infant deaths in middle- and low-income countries, with over two million deaths globally in 2021. In Ghana, maternal, delivery, foetal, and socio-economic factors are key contributors. This study examines the determinants of neonatal mortality at Tema General Hospital in the Greater Accra region.

Methods: A 1:2 unmatched case-control study with 180 participants (60 cases and 120 controls) was conducted at Tema General Hospital from January to August 2024. Cases were neonatal deaths within 28 days of delivery, and controls were newborns who survived the neonatal period. Data analysis utilized univariate and multivariate logistic regression in Stata version 17, reporting odds ratios (OR) and adjusted odds ratios (aOR) with 95% confidence intervals (CI). A p-value <0.05 indicated statistical significance.

Results: Of the sixty (60) cases, 49 (81.7%) were early neonatal deaths and 11 (18.3%) were late neonatal deaths. Factors substantially related with reduced odds of newborn mortality were mothers' education (OR = 0.1, 95%, C.I: 0.0 - 0.5), fathers' occupation (OR = 0.9, 95%, C.I: 0.3 - 2.8), birthweight above 2.5 (OR=0.3, 95% C.I: 0.1 - 0.5) and ANC attendance (OR = 0.2, 95% C.I: 0.1 - 0.7). Whereas those associated with increased odds were Obstetric complications (OR = 6.0, 95%, C.I: 2.4 - 15.0), History of abortion or miscarriage (OR = 3.4, 95%, C.I: 1.8 - 6.4), Physical/Sexual assault (OR = 8.9, 95% C.I: 3.2 - 23.8), Congenital malformation (OR = 4.4 95%, C.I: 1.6 - 11.8), aggressively resuscitation (OR = 9.6, 95% C.I: 4.7 - 18.6), delivery by induction is (OR = 5.9, 95%, C.I: 1.2-28.4) and gestational age below 37 weeks (OR = 6.2, 95%, C.I: 0.1 - 0.3)

Conclusion: Parental factors such as mother's secondary education and an employed father combine with other factors such as, a higher number of ANC visits, and a gestational age of 37 weeks or more may protect against neonatal mortality, whereas obstetric complications, a history of abortion(s), physical or sexual abuse, a low birthweight of less than 2.5kg, the presence of congenital malformations, and aggressively resuscitating a baby may increase the odds of neonatal mortality. Targeted campaigns and health education in the communities must be implemented to create awareness and increase ANC attendance. Refresher skill-based training for midwives and provision of logistics for NICU should be prioritised to mitigate the effects of these factors.

Key words: Determinants, Neonates, Mortality, Hospital, Tema, Ghana

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Neonatal mortality is defined as the death of a newborn within the first 28 days of life, and this is further categorized as death by the 7th day (early neonatal) and from the 8th to the 28th day (late neonatal) (WHO, 2022c). This period is the riskiest for the child's survival, with over 2.3 million newborns dying around the globe in 2021 (UN-IGME report, 2022). Neonatal mortality remains a significant public health problem worldwide and accounts for 60% of infant deaths in middle- and Lower-Income Countries (LMICs) (Imbo et al., 2021).

Globally, 2.3 million children lost their lives within the first month of life in 2021 (UNICEF, 2023a). While the neonatal mortality rate (NMR) declined globally and across all regions, it declined more slowly than mortality among children aged 1–11 months or 1–4 years (UNICEF, 2023a). Across all regions, the annual rate of reduction from 1990 to 2021 was larger for children aged 1–59 months than for newborns. The share of neonatal deaths among all under-five deaths increased from 40 percent in 1990 to 47 percent in 2021 (UNICEF, 2023a).

Newborn mortality rates vary significantly across the globe, with Sub-Saharan Africa (SSA) and South Asia (SA) bearing a disproportionate share of the burden (UNICEF, 2023a). Sub-Saharan Africa holds the highest neonatal mortality rate worldwide, with 27 deaths per 1,000 live births. Within this region, the risk of neonatal death in the country with the highest mortality rate is about 56 times greater than in the country with the lowest rate (WHO, 2022c). Reducing newborn deaths must be a top priority for countries, particularly those in Sub-Saharan Africa (SSA), to stay on track toward achieving the Sustainable Development Goal (SDG). Specifically, SDG 3.2 seeks to reduce neonatal mortality to 12 deaths per 1,000 live

births by 2030 (UN report, 2022). Finding solutions to these neonatal fatalities is a top priority on the international public health agenda (Mitiku, 2021; Sahile et al., 2022).

As at 2022, the NMR in Ghana was 23 per 1000 live births, a 4% reduction from 25/1000 live births in 2017 (WHO, 2023). This, however, is higher than the global rate of 18 per 1000 live births. Although Ghana has made progress in overall childhood indicators, it continues to lag in neonatal mortality indicators, which have only seen marginal changes (Azaare et al., 2022). Several policy interventions such as the free maternal care under the National Health Insurance (NHIS) that were implemented to reduce both neonatal and under-5 mortality remain significant and relevant to achieving the SDG targets on child mortality (Abredu et al., 2023).

Newborn deaths can be directly caused by factors such as premature birth, complications during delivery (including birth asphyxia or difficulty breathing at birth), infections, and congenital abnormalities (WHO, 2022b). There are also several factors that may influence neonatal deaths. These may generally include maternal factors such as age and level of education, parity, history of abortion, hypertension, diabetes, etc, delivery factors such as mode of delivery and onset of labor, fetal/neonatal factors such as sex, birth weight, gestational age, multiple or singleton etc and socio-demographic factors such as age, occupation, marital status etc.

Additionally, maternal health is closely linked to newborn survival, as inadequate maternal nutrition and overall poor health have been associated with adverse newborn outcomes (Imbo et al., 2021; Sacks et al., 2022). Other factors such as antenatal care (ANC), access to emergency obstetric care, skilled attendance at birth, postnatal care, neonatal care, and early breastfeeding initiation are also associated with neonatal deaths.

In Ghana, neonatal mortality is a significant public health concern, accounting for 61% of infant deaths and 43% of deaths among children under five years old (GSS, 2023). Addressing

these determinants in high-burden facilities such as the Tema General Hospital will yield lessons that may be applicable to other high burden facility settings in the country and will have more significant impact on the national overall NMR. It is for this reason that this study seeks to investigate the determinants of neonatal deaths in the Tema Metropolis.

1.2 Problem statement

Despite global progress, neonatal mortality reduction has lagged post-neonatal mortality. In Ghana, NMR stands at 23/1000 live births, with Tema General Hospital recording 35/1000 in 2021, higher than national and regional averages. Causes include prematurity, obstetric complications, birth asphyxia etc. Consequences include increased under-5 mortality and failure to achieve SDG 3.2. This study seeks to identify maternal, socio-demographic, delivery, and foetal predictors of neonatal mortality at Tema General Hospital to inform interventions.

Significant advancements in child survival have been achieved globally since 1990. Neonatal deaths worldwide decreased from 5 million in 1990 to 2.4 million in 2021. However, the reduction in neonatal mortality during this period has been slower compared to the decline in post-neonatal under-5 mortality (WHO - UNICEF, 2022).

In Ghana, approximately 50% of under-five deaths occur within the first 24 hours of life, with the remaining happening as late neonatal mortality (Adongo & Ganle, 2023; Helegbe et al., 2023). Majority of neonatal deaths occur within the first week of life (1 to 7 days after birth) in Ghana. The neonatal death rate for the Greater Accra region in 2021 was 24 per 1000 live births, slightly higher than the national average of 23 per 1000 live births (GSS, 2023). Tema General Hospital's infant death rate for 2021 was as high as 35 per 1000 births. As a major referral facility, the rate is higher than that for Ghana and the Greater Accra Region in 2021.

Premature delivery, complications during pregnancy, and birth asphyxia are recognized as major factors contributing to neonatal mortality in Ghana (Adjei et al., 2021; Adongo & Ganle, 2023; Dare, 2018; Kolekang et al., 2022). Child survival initiatives have traditionally concentrated on addressing illnesses that affect children over one month old, including pneumonia, malaria, diarrhea, and vaccine-preventable diseases. Conversely, efforts specifically targeting neonatal mortality have received relatively less attention. In terms of national public health strategy and programs, newborn deaths have received insufficient attention commensurate with the burden (Azaare et al., 2022).

A dedicated focus on neonatal mortality is essential, as its underlying causes and required health interventions differ significantly from those affecting older children. Under-five mortality cannot see a substantial reduction if nothing is done about neonatal mortality (WHO, 2020). A reduction in NMR at such a high-volume facility will result in a substantial gain in the overall regional NMR. Key determinants, when identified, may also apply to similar high-volume settings in the country and therefore strategies could be implemented to impact on the national NMR to keep the country on track towards meeting the SDG NMR targets. Evaluating the factors contributing to neonatal mortality is crucial for identifying and implementing evidence-based interventions in the Tema Metropolis and similar healthcare settings across Ghana.

1.3 Justification

Neonatal mortality remains a pressing concern within the Tema Metropolis. The findings from this study have the potential to provide valuable insights to mothers, healthcare professionals, authorities, and policymakers by shedding light on the fetal/neonatal, and delivery-related factors contributing to neonatal deaths in TGH. The aim is to harness these insights to inform the development of effective policies aimed at mitigating neonatal mortality.

The process of reducing neonatal mortality invariably involves a fusion of established interventions adapted to the local setting. By focusing interventions on key determinants that may be found from research such as this study, a substantial reduction in NMR within the Tema Metropolis can be achieved. The combination of efforts to analyze the determinants of both early and late neonatal deaths may also pave the way for the formulation of neonatal policies and programs and interventions to enhance child survival in the region.



1.4 Conceptual framework

Numerous factors, either directly or indirectly, affect neonatal mortality. This conceptual framework tries to clarify or emphasize the impact of different factors on neonatal mortality. These variables have been categorized as maternal, fetal/new-born, sociodemographic, and delivery variables.

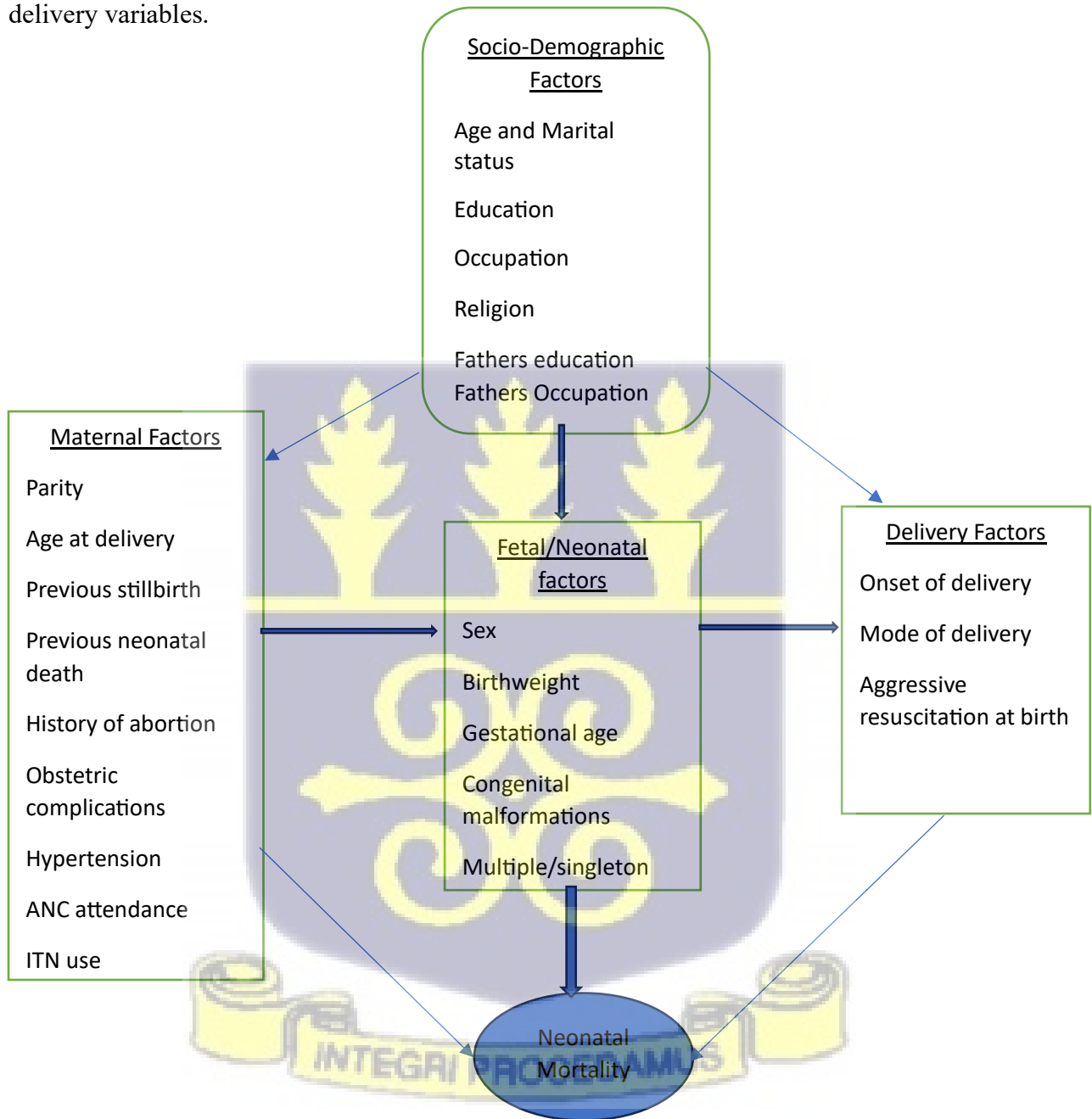


Fig 1: Conceptual framework for the predictors of neonatal mortality in the Tema General Hospital in the Greater Accra Region of Ghana.

Socio-demographic factors significantly influence neonatal mortality across both developed and developing nations. Age, for example, is strongly associated with neonatal death. Very young teenage mothers, whose reproductive systems are not fully developed, are at higher risk of complications such as obstructed labor. Likewise, older mothers, particularly those over 40 years, may face an increased likelihood of giving birth to babies with congenital abnormalities, a leading cause of neonatal mortality.

A mother's level of education also plays a critical role in neonatal survival. Women with higher education are more likely to access and act on new information, increasing their likelihood of attending antenatal care (ANC) compared to those with limited educational opportunities. Additionally, employed mothers often achieve financial independence, enabling them to seek ANC services without relying on their partners' support. These socio-demographic factors influence maternal behaviors and choices, which in turn impact neonatal outcomes, as outlined in the conceptual framework.

Maternal factors exert a direct and indirect effect on neonatal mortality. For example, frequent antenatal visits, often shaped by socio-demographic variables, provide opportunities for educating mothers on healthy pregnancy practices. These visits also facilitate early detection and management of pregnancy-related complications and medical conditions.

Maternal complications, such as obstetric emergencies, can significantly affect neonatal outcomes. For instance, healthcare providers may opt for early delivery to protect the mother's life during complications, which may result in preterm births or low birth weight, both of which are associated with increased neonatal mortality. Conditions like infections and hypertension, including pregnancy-induced hypertension, pre-eclampsia, and eclampsia, may require urgent intervention, such as labor induction or surgical delivery, even if the pregnancy has not reached full term.

First-time mothers (nulliparous women) face a higher likelihood of obstructed labor, which increases the risk of neonatal mortality and may necessitate Caesarean section delivery.

Fetal and neonatal factors also play a vital role. Male newborns and those with low birth weights have higher odds of neonatal mortality. Similarly, congenital abnormalities further increase the risk of neonatal death. Low Apgar scores within the first minute after birth, often caused by asphyxia, are also well-documented contributors to neonatal mortality. These interconnected factors highlight the complex relationship between socio-demographic, maternal, and neonatal variables in influencing neonatal survival.

Maternal factors such as age, parity, antenatal care attendance, pregnancy complications, and maternal health status directly influence fetal development and neonatal outcomes. For instance, inadequate antenatal care or untreated maternal conditions such as hypertensive disorders, infections, or anemia increase the risk of preterm delivery, intrauterine growth restriction, and low birth weight, which are major neonatal risk factors for mortality. Similarly, maternal age at the extremes (adolescents and advanced maternal age) is associated with higher risks of obstetric complications, congenital anomalies, and adverse neonatal conditions. Thus, maternal health behaviors and conditions during pregnancy set the foundation for the neonate's survival.

Also, maternal complications during labor and delivery often translate into neonatal conditions like asphyxia, sepsis, or respiratory distress, which drive mortality. In addition, maternal nutrition and access to quality obstetric care strongly influence gestational age, birth weight, and the newborn's ability to survive early life stresses, underscoring the indirect yet powerful link between maternal and neonatal factors in determining survival outcomes.

1.5 Study objectives

This research sought to achieve the following objectives

1.5.1 General objective

To assess the determinants of neonatal mortality among facility attendants at the Tema General Hospital in the Tema Metropolis, Greater Accra Region of Ghana.

1.5.2 Specific objectives

1. To Identify Socio-demographic factors associated with neonatal mortality at the Tema General Hospital.
2. To assess the Maternal factors associated with neonatal mortality at the Tema General Hospital.
3. To determine the Neonatal factors associated with neonatal mortality at the Tema General Hospital.
4. To assess delivery-related factors associated with neonatal mortality at the Tema General Hospital.

1.6 Research Questions:

1. What socio-demographic factors are associated with neonatal mortality at TGH?
2. What maternal factors are predictors of neonatal mortality?
3. What neonatal factors influence mortality risk?
4. What delivery-related factors are associated with neonatal mortality?

1.7 Hypotheses:

- H1: Low maternal education is associated with increased neonatal mortality.
- H2: Obstetric complications increase the odds of neonatal death.
- H3: Frequent ANC attendance reduces the odds of neonatal death.
- H4: Neonates with low birthweight and prematurity have increased odds of mortality.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Neonatal Mortality

Worldwide, a considerable number of infants are either stillborn or pass away within their first week of life, making a significant contribution to under-five child mortality rates. This critical window presents a crucial opportunity for intervention, as significant progress in later months hinges on successfully navigating the first few days. While overall neonatal mortality has seen declines, the early days after birth remain a critical period where the majority of deaths occur. A 2022 analysis by UNICEF identified prematurity, birth complications, and infections as leading causes of mortality, highlighting the need for targeted interventions during this vulnerable stage (UNICEF, 2023). This issue is especially severe in low- and middle-income countries (LMICs), where restricted access to skilled birth attendants, adequate healthcare services, and essential newborn care significantly affects early survival rates. A study published by Abebe in 2021, reported that sub-Saharan Africa bears the brunt of this burden, accounting for around 40% of global neonatal deaths (Abebe et al., 2021).

Neonatal mortality can arise from several factors, such as compromised maternal health, limited prenatal care, ineffective management of pregnancy and childbirth complications, unsanitary conditions during delivery and the critical postnatal period, and insufficient newborn care (Egesa et al., 2020).

2.2 Socio-demographic factors influencing Neonatal Mortality

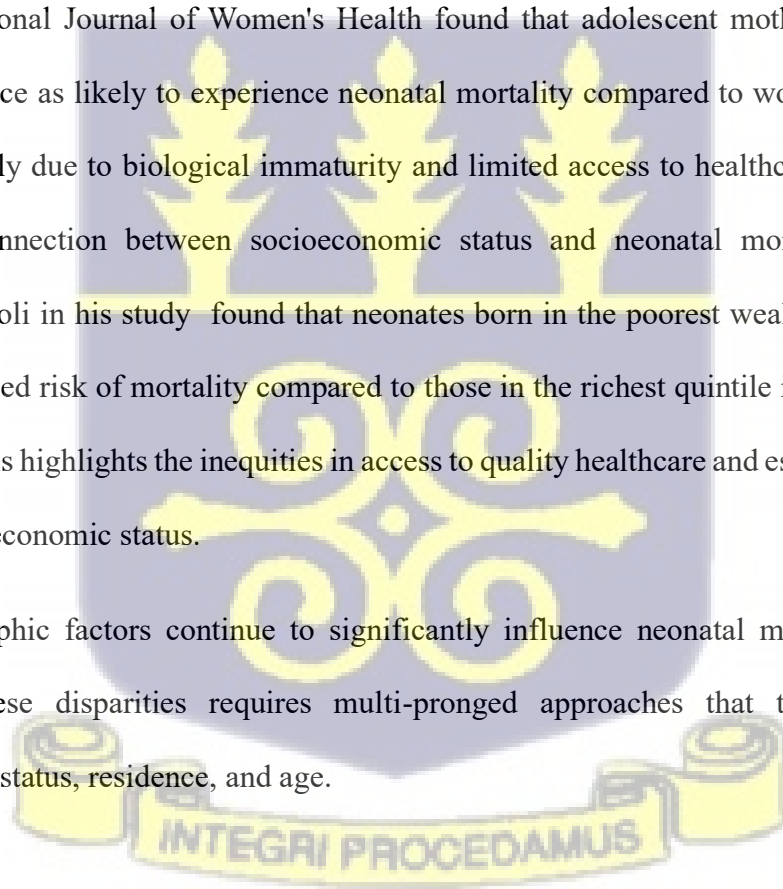
Multiple studies highlight the significant influence of social factors on birth outcomes. This was further demonstrated in a 2022 study conducted in rural Burkina Faso by Saya and team. Utilizing verbal autopsy to investigate stillbirths and neonatal deaths, the research identified social, cultural, economic, and environmental factors as key contributors to neonatal mortality. This aligns with growing recognition of the complex interplay between individual health and

broader societal influences (Saya et al., 2022). Studies highlight the significant impact of maternal education on neonatal mortality (Doku, 2022). A 2022 study published in BMC Public Health found that mothers with no education had a 2.3-fold increased risk of neonatal death compared to those with secondary education in Ethiopia (Asratie et al., 2023).

Newborns' chances of survival during the first 28 days of life are reduced by factors such as low household income, maternal illiteracy, and being born in a rural setting. (Fasina et al., 2020).

This disparity highlights the critical role of education in empowering mothers with knowledge about essential healthcare practices and accessing quality prenatal care. Similarly, a 2021 study in the International Journal of Women's Health found that adolescent mothers (aged 10-19 years) were twice as likely to experience neonatal mortality compared to women aged 20-34 years, potentially due to biological immaturity and limited access to healthcare (Izulla et al., 2023). The connection between socioeconomic status and neonatal mortality is widely recognized. Okoli in his study found that neonates born in the poorest wealth quintile had a 3.1-fold increased risk of mortality compared to those in the richest quintile in Nigeria (Okoli et al., 2022). This highlights the inequities in access to quality healthcare and essential resources based on socioeconomic status.

Socio-demographic factors continue to significantly influence neonatal mortality globally. Addressing these disparities requires multi-pronged approaches that target education, socioeconomic status, residence, and age.



2.3 Maternal factors influencing Neonatal Mortality.

Literature has indicated that primigravidae (women pregnant for the first time) and those with null parity (no previous pregnancies) are associated with increased risk of neonatal death in

Africa (Houweling et al., 2019). This heightened risk has been attributed, in part, to the increased likelihood of obstructed and complicated labor. A study conducted in Sweden aimed to explore the relationship between parity and neonatal mortality, revealing a U-shaped pattern where both first-time pregnancies and pregnancies of third, fourth, and higher order showed elevated risk compared to second pregnancies (Lemonde, 2022). Contrastingly, a study uncovered that infants born to multiparous mothers exhibited greater survival rates during the neonatal period compared to firstborns. Additionally, another investigation indicated that null parity is linked to an increased likelihood of preterm delivery, which subsequently leads to unfavorable neonatal outcomes (Kassie et al., 2023). Moreover, research suggests a correlation between the frequency of antenatal visits and neonatal mortality, with evidence supporting the notion that regular antenatal check-ups for expectant mothers contribute to a reduction in perinatal mortality rates (Adongo & Ganle, 2023; Tekelab et al., 2019).

A short birth interval, defined as delivering within two years of a previous delivery, significantly raises the risk of neonatal death (Takramah & Aheto, 2023). According to research by Doku et al. (2022), children born less than two years after a previous birth were 2.2 times more likely to die compared to those born following an interval of two or more years. This increased risk is attributed to maternal depletion syndrome caused by inadequate recovery time and resource competition among closely spaced siblings (Doku, 2022). This increased risk may be attributed to maternal depletion syndrome, caused by the shorter birth interval, and competition among siblings for limited resources.

A study in Indonesia suggests that a previous stillbirth experience can impact subsequent pregnancies, but not always in the expected way (Dev, 2022). Behboudi et al.'s study found that women who had a prior stillbirth with their first pregnancy actually experienced lower rates of stillbirth in subsequent pregnancies compared to those whose first infant was born alive. The researchers suggest that this unexpected outcome might be attributed to heightened

medical attention and closer monitoring for women with a history of stillbirth (Behboudi-Gandevani et al., 2022).

Research indicates that having a history of previous abortions can contribute to higher perinatal mortality rates (Kapoor et al., 2020). This link is established due to the observed association between prior abortions and increased risk factors like preterm birth and low birth weight. Evidence suggests that this risk may compound with an increasing number of previous abortions. Additionally, studies have demonstrated a correlation between a greater number of prior abortions and higher rates of preterm births, prematurity, and perinatal and neonatal mortality (Ahinkorah et al., 2021; Baruwā et al., 2021; Polis et al., 2020).

Pre-existing hypertension before pregnancy has been linked to an increased incidence of neonatal mortality (Doku, 2022). Currently, around 4% of pregnancies are complicated by pre-gestational diabetes, while approximately 8% are affected by gestational diabetes. The primary contributors to elevated perinatal mortality rates among women with pre-existing diabetes mellitus are congenital abnormalities and preterm labor. Several studies have indicated that pregnant women with diabetes experience poorer pregnancy outcomes (Afagbedzi et al., 2023; Boadu et al., 2022) compared to those without diabetes, with pre-gestational diabetes leading to more frequent complications than gestational diabetes (Ghosh & Wojtowycz, 2021).

Hypertensive disorders during pregnancy are on the rise, yet their underlying causes and mechanisms are not fully comprehended. Hypertensive conditions in pregnancy affect approximately 7% to 10% of pregnancies and are significant contributors to neonatal morbidity and mortality (McKenzie & Trotman, 2022). Research examining the prevalence and effects of hypertensive disorders on neonatal outcomes revealed that both mild and severe hypertension substantially elevate the risks of stillbirth, preterm birth, and infants being small for their gestational age. These conditions are key contributors to neonatal mortality. (Prüst et al., 2021).

Early initiation of antenatal care is widely recognized as a critical factor in improving maternal and fetal health outcomes (Ambaye et al., 2023). Women who delay initiating antenatal care are at a higher likelihood of undergoing cesarean section deliveries, encountering delivery complications, and delivering infants with low birth weights compared to those who begin antenatal care early (Alem et al., 2022). However, the timing of gestational age at which antenatal care is initiated did not show a significant correlation with perinatal outcomes; outcomes were comparable between mothers who commenced antenatal care early and those who initiated it later (Amponsah-Tabi et al., 2022).

In regions with increased malaria transmission, the safety and effectiveness of intermittent preventive treatment (IPT) using sulfadoxine-pyrimethamine (SP) is regarded as an effective approach to controlling malaria during pregnancy. This strategy can significantly reduce the incidence of low birth weight and contribute to lowering neonatal mortality rates (Kolekang et al., 2022; Sacks et al., 2022).

2.4 Delivery Factors influencing Neonatal Mortality.

The health sector has a role towards humanity from conception to death. In doing that, a specific effort such as regular check-ups, ultrasound monitoring, and other diagnostic tests must be performed throughout a woman's pregnancy and birth to help prevent neonatal mortality. According to the World Bank (2017), Ghana reports over 30000 neonatal deaths annually, and four (4) neonates die every hour (UN IGME, 2017). The numbers are shocking compared to other West African countries, such as Liberia and deserve attention as a country (Brobbe et al., 2023). Mortality can arise during the intra-partum or delivery phase. Globally, an estimated 2.6 million stillbirths occur annually, with over 40% linked to intra-partum factors (Tadesse et al., 2021). Research conducted in rural Central Africa reveals a fresh to macerated stillbirth ratio approximately ten times higher than anticipated (Akombi et al., 2019; Workineh et al., 2020).

Extensive research has shed light on the impact of delivery method on neonatal outcomes. Studies consistently show that neonatal mortality rates tend to be higher in vaginal deliveries compared to caesarean deliveries (Döblin et al., 2023). This finding underscores the potential benefits of opting for a caesarean section, particularly in cases where there may be concerns about fetal distress or complications during labor. While the decision to perform a caesarean section involves careful consideration of potential risks, it is recognized that this surgical procedure carries certain inherent risks for the unborn fetus, particularly in cases where it is conducted as an emergency measure or to safeguard the well-being of the mother (Roeckner et al., 2022). However, it is important to note that many of the common causes of neonatal mortality associated with caesarean sections are preventable with appropriate medical interventions and attentive care (Abdul-Mumin et al., 2021).

Caesarean sections (C-sections) can be lifesaving in certain situations, but unnecessary interventions can also increase risks. A 2022 study in BMJ Open found a U-shaped association between C-section rates and neonatal mortality globally, with both low and high rates associated with increased risk (Alipour et al., 2022). This highlights the need for judicious use of C-sections based on clear medical indications, particularly in resource-limited settings like SSA (Dickson et al., 2022).

Administering labor induction for indications not officially recognized at term is linked to heightened risks of adverse outcomes. Therefore, a cautious approach is warranted regarding a liberal stance on labor induction at term in pregnancies that are otherwise uncomplicated. Studies suggest that infants delivered through elective induction tend to have better outcomes compared to those born through spontaneous labor (Vecchioli et al., 2020). Nevertheless, elective induction might elevate the risk of hysterectomy. While the judicious use of labor-inducing medications is generally safe and can enhance outcomes in complicated pregnancies (Bengtsson et al., 2023).

Roughly 10% of newborn infants need help with their transition to independent breathing and may require immediate resuscitation interventions (Madar et al., 2021). Less than 1% of these cases typically require full, extensive resuscitation. Research links an increased need for resuscitation with several factors that elevate the risk of neonatal mortality. Importantly, one study emphasized that failing to provide resuscitation when necessary carries a significant risk of newborn death (Shukla et al., 2022). Although newborn resuscitation is extremely common in neonatal care, established guidelines often prioritize expert clinical judgment over strictly evidence-based practices. However, emerging scientific research supports the use of room-air as a preferred method for resuscitating both term and preterm newborns, as opposed to the traditional use of 100% oxygen (Robbins & Saugstad, 2023). Difficulty establishing breathing at birth is another major contributor to neonatal mortality (WHO, 2022a).

2.5 Fetal Factors influencing Neonatal Mortality

Although strides have been made in improving neonatal survival, fetal factors continue to play a crucial role in determining a newborn's health and chances of survival.

Certain genetic conditions can predispose babies to complications that contribute to neonatal mortality (Owen et al., 2023). A 2022 study in *Nature Reviews Genetics* highlighted the complex interplay of genetics and environmental factors in congenital anomalies, which account for an estimated 3-5% of neonatal deaths globally (Cooper et al., 2022). In SSA, a 2021 study in the *Journal of Global Health* reported that congenital anomalies were responsible for 12% of neonatal deaths, with limited access to diagnostic tools and specialized care posing additional challenges (Mgusha et al., 2021). Restricted fetal growth can significantly impact newborn health and survival. Liu et al., reported that IUGR was associated with a 5.7-fold increased risk of neonatal mortality globally, with the highest burden observed in low-resource settings like SSA (Liu et al., 2021).

While uncommon, the risk of neonatal mortality is higher for multiples compared to singletons. A multicenter study in 2021 found a 2.3-fold increased risk of neonatal death among twins compared to singletons globally (Thekkevedu et al., 2021). In SSA, limited access to specialized antenatal care and neonatal intensive care units further amplifies the risks associated with multiple births (Trust, 2023).

Preterm birth (before 37 weeks of gestation) and low birth weight (less than 2500 grams) are key factors that contribute to neonatal mortality (Darmstadt et al., 2023). Studies have reported a 35-fold increased risk of death among extremely preterm babies (born before 28 weeks) compared to term infants globally (Jana et al., 2023; Pusdekar et al., 2020). A 2022 study reported that preterm birth accounted for 36% of neonatal deaths (Abebaw et al., 2021). Interventions to reduce preterm birth, such as improved antenatal care and addressing risk factors like maternal infections, are critical.



CHAPTER THREE

3.0 METHOD

3.1 Study Design

An unmatched 1:2 case-control study design was employed. Cases were neonates who died within 28 days at TGH (Jan–Aug 2024), while controls were neonates surviving beyond 28 days. This design was selected to compare exposures across groups and estimate predictors of mortality.

This design was deemed most appropriate because neonatal mortality is a relatively uncommon outcome, and a case–control approach allows efficient comparison between neonates who died (cases) and those who survived (controls) with respect to multiple maternal, delivery, and neonatal exposures. A 1:2 case–control ratio was selected to improve statistical power and precision of estimates while remaining feasible given available resources and the expected number of neonatal deaths during the study period. Thus, a 1:2 ratio was considered optimal, balancing statistical power, resource constraints, and data availability within the hospital setting.

3.2 Study Area

The Tema Metropolis, located in the southeastern part of Ghana, is one of the 26 administrative districts in the Greater Accra Region. It shares borders with the Ashaiman Municipality to the north-east, Adentan Municipality to the north-west, Ledzokuku-Krowor Municipality to the west, the Gulf of Guinea to the south, and Kpone Katamanso District to the east. The Metropolis spans from latitude 5°37'N on the southern coastline to latitude 5°41'N at its northernmost point. The Greenwich Meridian, which represents the zero longitude, runs through the Tema Metropolis. Situated about 50 kilometers from the Equator, Tema is uniquely positioned at the "heart of the world." (TMA, 2023).

At the center of Tema's coastline is a major harbor extending nearly 2 kilometers, alongside a military naval base, as well as a mix of large and small-scale industries. These features highlight Tema's crucial role in Ghana's economic development and security. The Tema Metropolis is comprised of distinct communities, each designated with an official numerical identifier, with the highest being 26. According to the Ghana Statistical Service, the estimated population in 2021 stood at 177,924 individuals, with 87,529 males and 90,395 females (GSS, 2021; TMA, 2023). The population density is 5,169.7 persons per square . kilometre, with a total of 55,037 households and an average household size of 3.2. This demographic composition positions the Tema Metropolis as the second most populous district among the 26 districts within the Greater Accra Region, trailing only the Accra Metropolis (GSS, 2021).

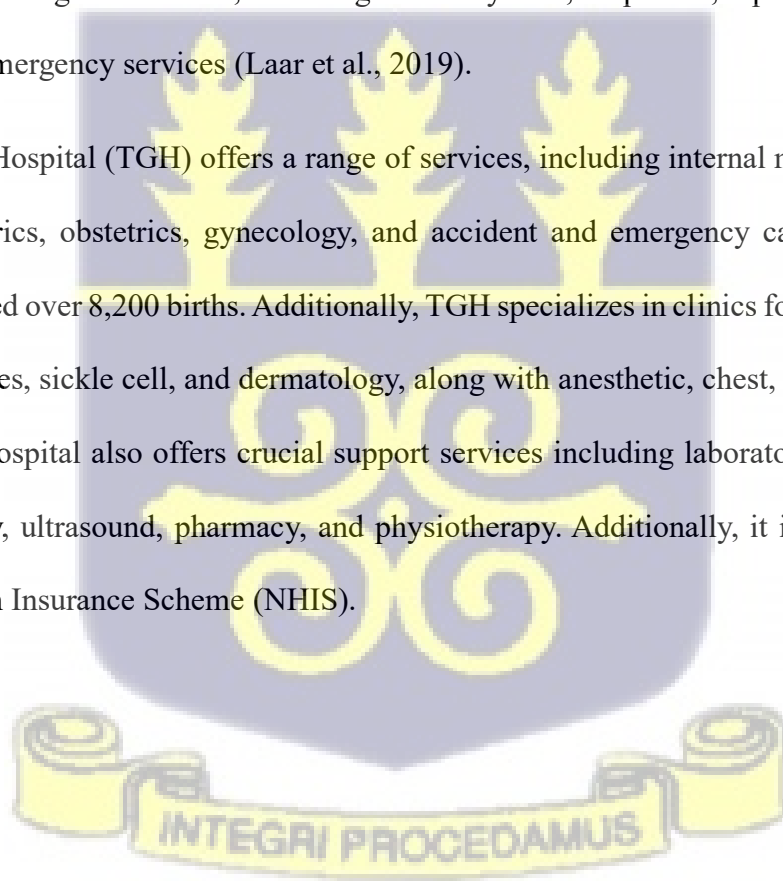
Within the stretch of the Tema Metropolis, there are different dispersed health facilities encompassing both the public and private sectors. The classification of these facilities hinges on their functional capacities and the types of services they provide. Owing to the rapid increase in population, the imperative of expanding both public and private health facilities has seen several health facilities sprout up. The health facilities within the metropolis are manned by both public and private sector healthcare service providers. Notable among them are the Tema General Hospital (a pivotal referral hub), which was established in 1954, one (1) polyclinic (Tema Polyclinic), and 10 other major private hospitals. In addition to these, there are over twenty-one (21) Community-based Health Planning and Services (CHPs) facilities, three (3) maternity clinics, and one (1) health center (Manhean Health Center). The doctor-to-patient ratio is 1:6365, and the nurse-to-patient ratio is 1:409 (Over et al., 2019). Complementing this, the Metropolis has numerous private health facilities catering to both individual and corporate clientele.

The Tema Public and Private Health Providers Association (TPPHA) is a collective entity that was created by the Metropolitan Health Management Team (MHMT) to facilitate joint

initiatives. The MHMT operates synergistically with this association, a cooperative structure that unites more than several recognized private facilities. A wide range of allied healthcare providers are also accommodated in the city, including those found in most cities' pharmacies, chemical stores, and private laboratories. Additionally, the Metropolis is home to a variety of complementary medical practitioners, including homeopathic clinics, traditional midwives, herbalists, bone setters, and spiritual retreats.

The Health Insurance Scheme, which came into effect in March 2004, is seen as a crucial intervention in the health sector for improving access to healthcare. The program, which was primarily designed to reduce the financial difficulties associated with healthcare access, provides a wide range of services, including maternity care, outpatient, inpatient, oral health, eye care, and emergency services (Laar et al., 2019).

Tema General Hospital (TGH) offers a range of services, including internal medicine, general surgery, pediatrics, obstetrics, gynecology, and accident and emergency care. In 2022, the hospital recorded over 8,200 births. Additionally, TGH specializes in clinics for eye care, dental services, diabetes, sickle cell, and dermatology, along with anesthetic, chest, and hypertensive services. The hospital also offers crucial support services including laboratory testing, blood bank, radiology, ultrasound, pharmacy, and physiotherapy. Additionally, it is enrolled in the National Health Insurance Scheme (NHIS).



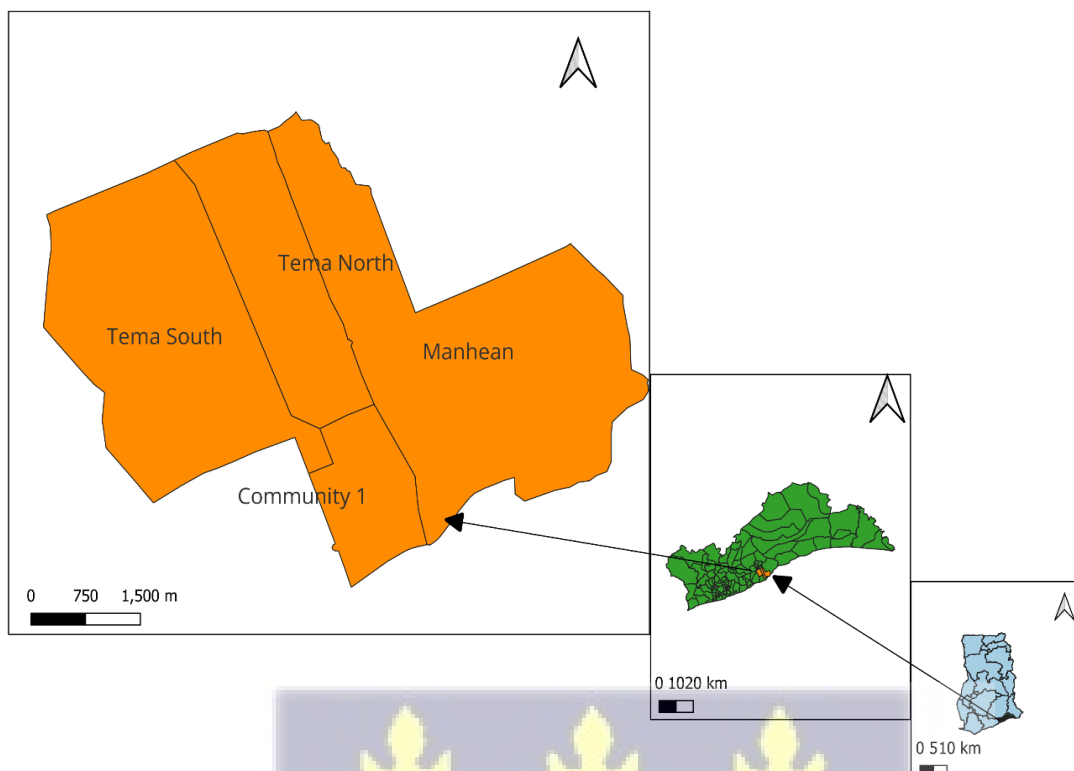


Fig 2: Map of Tema Metropolis (study area), 2023. Source: *Author generated*.

3.3 Variables

Outcome/ dependent variable

Neonatal mortality: defined as the death of a newborn within the first 28 days of life. This is further categorized as death by the 7th day (early neonatal) and from the 8th to the 28th day (late neonatal). For this analysis, the outcome was categorized as neonatal mortality or not.

Independent variables

The independent variables were exposures of interest collected from both the cases and controls, classified into socio-demographic, maternal, fetal, and delivery-related factors, as depicted in the conceptual framework.

3.4 Sampling

3.5.1 Cases

Cases and controls were identified from the records of all deliveries at Tema General Hospital between January 2024 and June 2024. Cases were defined as neonatal deaths occurring within the first 28 days of life and were further classified into early neonatal deaths (occurring within the first week of life) and late neonatal deaths (occurring between the 8th and 28th day of life).

3.5.2 Control

The control group comprised newborns born at Tema General Hospital during the same timeframe who survived the neonatal phase.

3.5.3 Exclusion criteria

1. Neonates who were not born in the region or were referred from outside the region.
2. Records of patients that had information on the outcome of the baby as at the 29th day after birth or beyond.

3.5.3 Sample size

Total sample size for the study was 180, consisting 60 cases and 120 controls. The sample size was calculated using a 1:2 case-control ratio, applying a 5% level of significance. Using Epi Info 7's Unmatched Case Control Stat-Calculator package with a 95% confidence interval (CI) and 80% power, the calculated sample size was 174 (58 cases and 116 controls). However, the figure was rounded up resulting in a final sample size of 180 to make room for nonresponse. We considered only a small proportion of the data will be unusable and therefore the sample size above the 174 minimum to 180 participants- 60 cases and 120 controls.

3.6 Data collection

The Tema General Hospital was specifically chosen for this study due to its status as the primary metropolitan hospital and the main referral health facility in the metropolis.

3.6.1 Selection of cases

Data for the cases were obtained from the NICU records and the labor ward. Since the outcome variable is uncommon and the data collection period was limited, each neonatal death that occurred during this time was included as a case until the required sample size was achieved.

3.6.2 Selection of controls

Two (2) controls were selected per every neonatal death. ANC and PNC attendance records were retrieved taking into consideration the date of delivery and matched against the respective cases. A call was placed to mothers who were discharged immediately after delivery to solicit information on their babies.

A structured questionnaire was utilized to gather information from the mothers of both cases and controls. Some of the details provided by the mothers were cross-checked using delivery registers, maternal health records, death notification forms, and neonatal cards. The interviews with the mothers were conducted either in person or over the phone. For all telephone interviews, oral consent was sought and documented accordingly. In certain instances, interviews took place before the mothers left the hospital or during postnatal reviews or weighing. Each interview lasted approximately 10 minutes. Any refusals were replaced with other eligible participants.

The data collectors, mainly midwives and pediatric nursing staff, were selected from their respective departments at Tema General Hospital and underwent training before the data collection process. To assess the effectiveness of the data collection tools, they were pre-tested at the Tema Polyclinic, a facility with similar characteristics to the general hospital. This pre-test helped evaluate the field competence of the tools, allowing for necessary adjustments to ensure they were culturally appropriate and clear for the respondents. Additionally, the pre-test ensured that the tools were well-structured and understandable

3.7 Data processing and analysis

Data collected through structured questionnaires were transferred from Google Forms into Microsoft Excel (xlsx format), and then imported into Stata v17 for analysis. Descriptive statistics were utilized to summarize the data, showcasing it through frequencies, proportions, and percentages. Univariate logistic regression was employed to examine the association between neonatal mortality and the selected independent variables. The outcomes were presented as odds ratios (OR) with 95% confidence intervals (CI), with statistical significance determined by a p-value less than 0.05. Furthermore, multivariate logistic regression analysis was conducted, with results expressed as adjusted odds ratios (AOR) and corresponding 95% CIs. As with the univariate analysis, significance was identified by p-values below 0.05. The findings were primarily displayed in text format and tables.

The primary outcome was neonatal mortality, defined as death within 0–28 completed days of life as recorded in hospital records (in-hospital or by documented follow-up where available). Because the endpoint is binary and the objective was to quantify independent associations between hypothesised predictors and mortality, we used multivariable logistic regression to estimate adjusted odds ratios (aORs) with 95% confidence intervals (CIs). This approach provided interpretable measures of association and is appropriate given the case-outcome structure of the dataset at discharge. Guided by the conceptual framework, variables were organised into hierarchical blocks expected to influence outcome in a distal → proximal sequence:

1. Socio-demographic factors: Age, Marital status, Education, Occupation, Religion, Fathers education and Fathers Occupation

2. Maternal/socio-demographic: Parity, Age at delivery, Previous stillbirth, Previous neonatal death, History of abortion, Obstetric complications, Hypertension, ANC attendance and ITN use
3. Intrapartum/delivery: Mode of delivery, Onset of delivery and Aggressive resuscitation at birth
4. Neonatal/clinical: Gestational age (GA), Birthweight (BW), Sex, APGAR, Congenital anomalies and Multiple/singleton

Screening was done for each predictor in bivariable models ($p < 0.20$) for entry, a forced a priori confounders (maternal age, parity, ANC attendance, GA/BW and sex) into the multivariable model regardless of p-value. A backward elimination method was applied ($p < 0.10$) while retaining any covariate that altered one or more exposure effect estimates by $\geq 10\%$ (change-in-estimate criterion), even if not statistically significant. This ensured confounding control aligned to our framework and objectives rather than purely data-driven selection.

3.8 Ethical considerations

Informed consent was obtained from the mothers, either through their signature or thumbprint, and they were reassured of confidentiality throughout the study. They were provided with comprehensive information regarding the study's objectives, procedures, potential risks, and benefits. For mothers who could not read, the consent form was read aloud and thoroughly explained to them in the presence of an impartial witness, who was a member of the healthcare staff. An assent was sought from mothers who were below 18 years together with consent from their guardians.

All information gathered in the study was kept confidential and used exclusively for research purposes. Data were securely stored without any identifiers to protect participants' identities and were accessible only to the principal investigator. The results of the study were reported in

aggregate form, ensuring no individual participant's identity could be traced. The principal investigator, with the support of trained health professionals, extracted data from the mothers' records. Mothers who experienced a neonatal death were provided with counselling, and the contact details of the principal investigator and relevant unit heads were shared for any further questions or education.



CHAPTER FOUR

4.0 RESULTS

4.1 Birth outcomes

Cumulatively, a total of 180 cases and controls (neonates) together with their mothers were recruited. The study included a total of 60 cases (neonatal mortality) and 120 controls (no neonatal mortality). Among the 60 cases, 49 (81.7%) were classified as early neonatal deaths, which refers to the death of live newborns within the first 7 days of life, while 11 (18.3%) were late neonatal deaths, occurring from the 8th to the 28th day of life.

4.2. Socio-Demographic Characteristics of Mothers of Cases and Controls

The majority of the mothers, 133 (73.9%), were between the ages of 18 and 34 years, while 33 (18.3%) were 35 years or older. Teenage mothers, aged 17 and below, comprised 14 (7.8%) of the total. Regarding educational attainment, 70 (38.9%) of the mothers had reached tertiary or training college education, while 15 (8.3%) had no formal schooling. In terms of marital status, 106 (58.9%) were married, and 48 (26.7%) were single. Over half of the mothers, 96 (53.3%), were engaged in trading or business, while 37 (20.6%) were civil servants, and 23 (12.8%) were unemployed. Among the 180 mothers, 11 (5.8%) had partners with no formal education, while the majority, 104 (57.8%), had partners with tertiary or training college education. Only 9 (4.7%) of the mothers had partners who were unemployed.

Table 1 and Table 2 shows the association and adjusted odds of sociodemographic characteristics on childbirth outcome. Results from univariate analysis in table 1 shows that mother's highest level of education and fathers' occupational status are significantly associated with neonatal birth outcome with ($p=0.01$) and ($p=0.002$) respectively.

After haven adjusted for these variables in the multivariate analysis as presented in Table 2, there was still a significant ($p=0.003$) association of mother's level of education on neonatal mortality (either early or late). Mother's age did not a have significant association with neonatal mortality ($p = 0.345$). Also in the multivariate regression, the occupation of the baby's father, maintained a significant ($p\leq 0.00$) influence on neonatal mortality. A mother with JHS/Primary education has ($OR = 0.1$, 95%, C.I: 0.0 - 0.5) less odds of having a neonatal death compared to persons with no education level. Also, mothers with secondary education level have ($OR = 0.8$, 95%, C.I: 0.3 - 2.6) less odds of experiencing a neonatal death compared to persons with no education level. Furthermore, persons with tertiary education level are ($OR = 0.5$, 95%, C.I: 0.2 - 1.6) odds less likely to cause neonatal death compared to persons with no education level. Findings also suggest that Government workers have ($OR = 0.9$, 95%, C.I: 0.3 - 2.8) less odds have a neonatal death compared to artisans while traders are ($OR = 3.3$, 95%, C.I: 1.2 - 9.7) odds more likely to have a neonatal death compared to artisans. Also, unemployed persons are ($OR = 1.1$, 95%, C.I: 0.2 - 7.2) odds more likely to experience neonatal death compared to artisans.

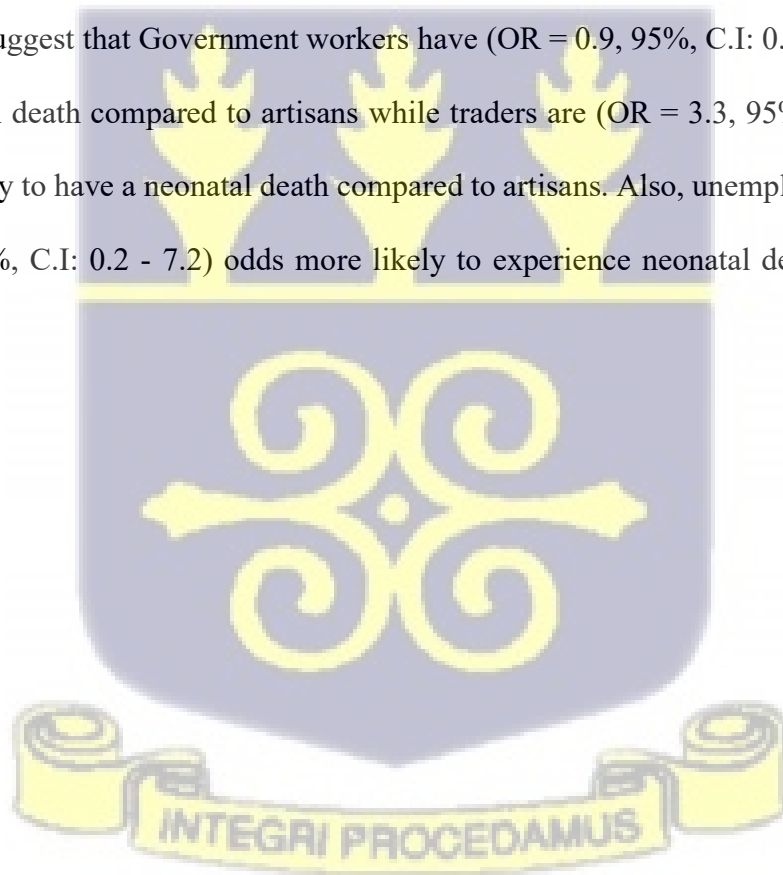


Table 1: Association between Socio-Demographic characteristics and Neonatal mortalities, Tema General Hospital, 2024.

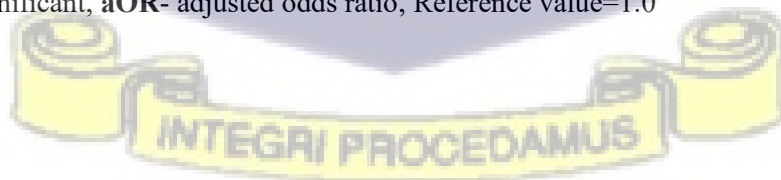
Variable	Total N=180	Controls N=120	Cases N=60	p-value
	<u>n (%)</u>	<u>n (%)</u>	<u>n (%)</u>	
Mothers Age				0.33
<18	14 (7.78)	10 (8.3)	4 (6.7)	
18 to 34	133 (73.9)	88 (73.3)	45 (75.0)	
35+	33 (18.3)	22 (18.3)	11 (18.3)	
Mothers highest educational level				0.003*
No schooling	15 (8.3)	8 (6.7)	7 (11.7)	
Primary/JHS	36 (20.0)	33 (27.5)	3 (5.0)	
Secondary	59 (32.8)	34 (28.3)	25 (41.7)	
Tertiary/ Training college	70 (38.9)	45 (37.5)	25 (41.7)	
Mothers Religion				0.44
Christian	133 (73.9)	90 (75.0)	43 (71.7)	
Non-Christian	47 (26.1)	30 (25.0)	17 (28.3)	
Mother's occupation				0.13
Artisan	10 (5.5)	8 (6.7)	2 (3.3)	
Civil servant	37 (20.6)	28 (23.3)	9 (15.0)	
Housewife	14 (7.8)	6 (5.0)	8 (13.3)	
Trader/Businesswoman	96 (53.3)	60 (50.0)	36 (60.0)	
Unemployed	23 (12.8)	18 (15.0)	5 (8.3)	
Fathers highest educational level				0.57
No schooling	11 (6.1)	9 (7.5)	2 (3.3)	
Primary/JHS	18 (10.0)	14 (11.7)	4 (6.7)	
Secondary	56 (31.1)	38 (31.7)	18 (30.0)	
Tertiary/ Training college	95 (52.8)	59 (49.2)	36 (60.0)	
Father's occupation				0.001*
Artisan	25 (13.8)	20 (16.7)	5 (8.3)	
Government/ Civil servant	66 (36.7)	54 (45.0)	12 (20.0)	
Trader/Businessman	80 (44.4)	39 (32.5)	41 (68.3)	
Unemployed	9 (5.0)	7 (5.8)	2 (3.3)	
Mother's marital status				0.071
Married	106 (58.9)	75 (62.5)	31 (51.7)	
Not Married	74 (26.1)	45 (37.5)	29 (48.3)	
Number of children delivered prior to current delivery				0.36
None	24 (13.3)	17 (14.2)	7 (11.7)	
1-3	79 (43.9)	48 (40.0)	21 (35.0)	
Above three kids	77 (42.8)	55 (45.8)	32 (53.3)	

*-statistically significant

Table 2: Association between Socio-Demographic characteristics and Neonatal mortality, Tema General Hospital, 2024. Adjusted and Unadjusted odds Ratio

Neonatal mortality	OR (95% C.I)	p-values	aOR (95% C.I)	p-values
Education of mother		0.01*		0.0156
No schooling	1.0		1.0	
Primary/JHS	0.1 (0.0 - 0.5)		0.1(0-0.8)	
Secondary	0.8 (0.3 - 2.6)		1.7(0.4-7.2)	
Tertiary/ Training college	0.5 (0.2 - 1.6)		0.9(0.2-3.7)	
Religion		0.436		0.8926
Christian	1.0		1.0	
Non-Christian	1.3 (0.7 - 2.6)		0.9(0.4-2.3)	
Occupation of mother		0.157		0.354
Artisan	1.0		1.0	
Civil servant	1.3 (0.2 - 7.2)		1.7(0.2-15.6)	
Housewife	5.3 (0.8 - 34.8)		6.5(0.6-66.8)	
Trader/Business woman	2.1 (0.4 - 10.2)		2.8(0.4-19.8)	
Unemployed	1.1 (0.2 - 7.0)		1.7(0.2-17.4)	
Education of father		0.583		0.4435
No schooling	1.0		1.0	
Primary/JHS	1.2 (0.2 - 8.5)		0.8(0.1-7.7)	
Secondary	2.1 (0.4 - 10.9)		0.7(0.1-4.7)	
Tertiary/ Training college	2.3 (0.5 - 11.4)		1.5(0.2-11.1)	
Occupation of father		0.002*		0.0002*
Artisan	1.0		1.0	
Government/ Civil servant	0.9 (0.3 - 2.8)		0.6(0.1-2.4)	
Trader/Businessman	3.3 (1.2 - 9.7)		4.6(1.3-16.3)	
Unemployed	1.1 (0.2 - 7.2)		0.6(0.1-5.1)	
Marital Status		0.073		0.0524
Married	1.0		1.0	
Not Married	1.8 (0.9 - 3.3)		2.2(1-5)	
Number of Children delivered prior		0.358		0.9817
None	1.0		1.0	
1 to 3	0.9 (0.3 - 2.4)		0.9(0.3-3.3)	
Above three kids	1.4 (0.5 - 3.8)		1(0.3-3.7)	

*-statistically significant, aOR- adjusted odds ratio, Reference value=1.0



4.3 Association between Maternal factors and neonatal mortality

Table 3 and Table 4 shows the association between maternal factors and neonatal death. Results in table 3 shows that Number of ANC attendance is significantly associated with neonatal death ($p=0.003$). Additionally, complications during pregnancy is also found to be associated significantly ($p\leq 0.001$) with a neonatal death outcome. History of abortion or miscarriage is found to be significantly ($p=0.001$) associated with neonatal death same as being physically or sexually abused during the pregnancy ($p\leq 0.001$). In table 4, the univariate level analysis shows that number of ANC attended ($p=0.004$), Obstetric complications ($p\leq 0.001$), History of abortions ($p\leq 0.001$), Physical and sexual assault ($p\leq 0.001$) all significantly impact neonatal death outcomes. In addition to that, result from the multivariable level analysis in table 4 also shows that, Obstetric complications ($p\leq 0.001$), History of abortions ($p\leq 0.001$), Physical and sexual assault ($p\leq 0.002$) are significant predictors of neonatal death outcomes. Mothers with about 10 or more ANC attendance are (OR = 0.2, 95% C.I: 0.1 - 0.7) less likely to have neonatal deaths compared to mothers with ANC attendance of 1 to 3. Also, persons with ANC attendance of 4-9 are (OR = 0.3, 95%, C.I: 0.2 - 0.7) less likely to experience neonatal death compared to persons with ANC attendance of 1 to 3. Additionally, persons with obstetric complications are (OR = 6.0, 95%, C.I: 2.4 - 15.0) more likely to have a neonatal death compared to people with no obstetric complications. Also, persons with history of abortion or miscarriage are (OR = 3.4, 95%, C.I: 1.8 - 6.4) more likely to experience neonatal death compared to no history of abortion. Persons with Physical/Sexual Assault are (OR = 8.9, 95% C.I: 3.2 - 23.8) more likely to cause neonatal death compared to persons with no physical or sexual assault.

Table 3: Association between Maternal Factors against neonatal death outcomes, Tema General Hospital, 2024

	Total	Controls	Cases	p-value
	N=180	N=120	N=60	
Number of babies delivered	n (%)	n (%)	n (%)	0.46
1	165 (91.6)	111 (92.5)	54 (90.0)	
2-3	15 (8.3)	9 (7.5)	6 (10.0)	
History of previous still birth				0.075
No history of previous stillbirth	149 (82.7)	103 (85.8)	46 (76.7)	
Had history of previous stillbirth	31 (17.2)	17 (14.2)	14 (23.3)	
History of previous neonatal death				0.12
No previous neonatal death	153 (85.0)	105 (87.5)	48 (80.0)	
Had previous neonatal death	27 (15.0)	15 (12.5)	12 (20.0)	
Diagnosed of Hypertension during or before this pregnancy				0.053
No diagnoses of hypertension	150 (83.3)	104 (86.7)	46 (76.7)	
Diagnosed of hypertension	30 (16.6)	16 (13.3)	14 (23.3)	
Number of ANC attendance				0.003*
1 to 3	47 (26.2)	23 (19.2)	24 (40.0)	
10+	26 (14.4)	21 (17.5)	5 (8.3)	
4 to 9	107 (59.4)	76 (63.3)	31 (51.7)	
Slept under ITN during this pregnancy				0.69
Did not sleep under ITN	69 (38.3)	46 (38.3)	23 (38.3)	
Slept under ITN	111 (61.7)	74 (61.7)	37 (61.7)	
Complications during this pregnancy				<0.001*
No Obstetric Complications	155 (86.1)	112 (93.3)	43 (71.7)	
Had Obstetric Complications	25 (13.8)	8 (6.7)	17 (28.3)	
History of abortion or miscarriage				<0.001*
No History of abortion	107 (59.4)	82 (68.3)	25 (41.7)	
Had history of abortion	73 (40.6)	38 (31.7)	35 (58.3)	
Physically or sexually abused during this pregnancy				<0.001*
No Physical/Sexual Assault	156 (86.7)	114 (95.0)	42 (70.0)	
Physical/Sexual Assault	24 (13.3)	6 (5.0)	18 (30.0)	
Age at delivery				0.95
18 to 34	133 (73.9)	88 (73.3)	45 (75.0)	
<18	14 (7.8)	10 (8.3)	4 (6.7)	
35+	33 (18.3)	22 (18.3)	11 (18.3)	

*-statistically significant

Table 4: Association between Maternal Factors against neonatal death outcomes, Tema General Hospital, 2024: Adjusted and Unadjusted odds ratio

Neonatal mortality	OR (95% C.I)	p-values	aOR (95% C.I)	p-values
Number of babies delivered		0.467		0.548
1	1		1	
2 to 3	1.5 (0.5 - 4.4)		1.5(0.4-5.1)	
History of previous stillbirth		0.079		0.313
No history of previous stillbirth	1		1	
Had history of previous stillbirth	2.0 (0.9 - 4.4)		0.5(0.2-1.8)	
Previous neonatal death		0.125		0.612
No previous neonatal death	1		1	
Had previous neonatal death	1.9 (0.8 - 4.4)		1.3(0.4-4.1)	
Diagnose of hypertension		0.056		0.848
No diagnoses of hypertension	1		1	
Diagnosed of hypertension	2.2 (1.0 - 4.8)		1.1(0.4-3.1)	
Number of ANC attended		0.004*		0.133
1 to 3	1		1	
10+	0.2 (0.1 - 0.7)		0.3(0.1-1.1)	
4 to 9	0.3 (0.2 - 0.7)		0.5(0.2-1.1)	
Slept under ITN		0.695		0.921
Did not sleep under ITN	1		1	
Slept under ITN	0.9 (0.5 - 1.7)		1.0 (0.4-2.1)	
Obstetric Complications		<0.001*		<0.001*
No Obstetric Complications	1		1	
Had Obstetric Complications	6.0 (2.4 - 15.0)		7.1(2.5-20.5)	
History of abortion		<0.001*		0.047*
No History of abortion	1		1	
Has history of abortion	3.4 (1.8 - 6.4)		2.2(1.0-4.6)	
Physical/Sexual Assault		<0.001*		0.002*
No Physical/Sexual Assault	1		1	
Physical/Sexual Assault	8.9 (3.2 - 23.8)		7.7 (2.2-27.4)	
Age at delivery		0.948		0.82
18-34	1		1	
35+	1.1 (0.5 - 2.4)		1.4 (0.5 - 3.5)	
<18	0.9 (0.3 - 2.9)		1.1 (0.3 - 4.1)	

*-statistically significant, **aOR**- adjusted odds ratio, Reference value=1.0

4.4 Association between neonatal factors and neonatal mortality

Tables 5 and 6 present the relationship between neonatal factors and neonatal mortality outcomes. Table 5 highlights significant associations with neonatal mortality, including birth weight ($p < 0.001$), the presence of birth defects ($p = 0.002$), and gestational age ($p < 0.001$). Similarly, the univariate analysis in Table 6 indicates that neonatal mortality was significantly influenced by birth weight ($p < 0.001$), birth defects ($p = 0.003$), and gestational age ($p < 0.001$).

Furthermore, a birth weight of 3.9 and above is (OR=0.3, 95% C.I: 0.1 - 0.5) less likely to influence neonatal death compared to birth weight within the range of 2.5 – 3.9. Also, neonates born with congenital malformation are (OR = 4.4 95%, C.I: 1.6 - 11.8) more likely to experience neonatal death compared to persons with no congenital malfunction. Gestational ages at 37-38 are (OR = 0.2, 95%, C.I: 0.1 - 0.3) less likely to neonatal death compared to gestational age below 37. Also, gestational age of 39 and above are (OR = 0.1, 95%, C.I: 0.0 - 0.3) less likely to influence neonatal death compared to a gestational age below 37.

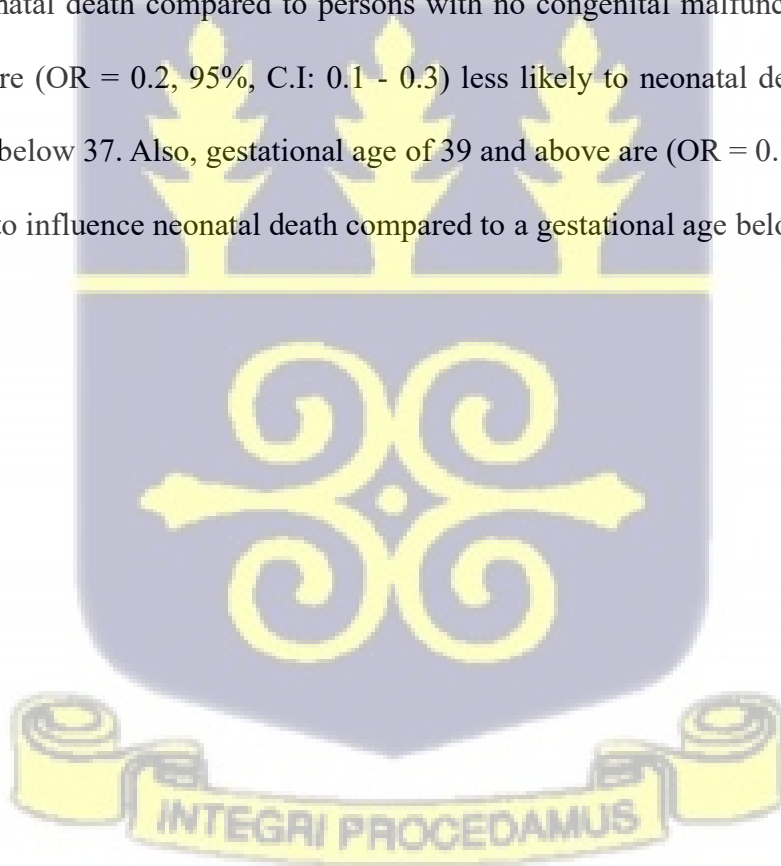


Table 5: Association between Neonatal Factors and neonatal death outcomes, Tema General Hospital,2024.

	Total	Controls	Cases	p-value
	N=180	N=120	N=60	
Sex of the baby	n (%)	n (%)	n (%)	0.26
Female	97 (53.9)	70 (58.3)	27 (45.0)	
Male	83 (46.1)	50 (41.6)	33 (55.0)	
Birth weight in kg of the baby				<0.001*
2.5-3.9	113 (62.7)	63 (52.5)	50 (83.3)	
3.9+	67 (37.3)	57 (47.5)	10 (16.7)	
Congenital malformation				0.002*
No Congenital malformation	161 (89.4)	113 (94.2)	48 (80.0)	
Congenital malformation	19 (10.5)	7 (5.8)	12 (20.0)	
Number of babies delivered				0.46
One	165 (91.7)	111 (92.5)	54 (90.0)	
2-3	15 (8.3)	9 (7.5)	6 (10.0)	
Gestational age (weeks) at delivery				<0.001*
<37	61 (33.9)	24 (20.0)	37 (61.7)	
37-38	71 (39.4)	57 (47.5)	14 (23.3)	
39+	48 (26.7)	39 (32.5)	9 (15.0)	

*-statistically significant

Table 6: Association between Neonatal Factors and neonatal death outcomes, Tema General Hospital,2024: Adjusted and Unadjusted odds ratio.

Neonatal mortality	OR (95% C.I)	p-values	aOR (95% C.I)	p-values
Sex of Baby		0.258		0.387
Female	1.0		1.0	
Male	1.4 (0.8 - 2.6)		1.4(0.7-2.7)	
Birth weight (kg)		<0.001		0.285
2.5-3.9	1.0		1.0	
3.9+	0.3 (0.1 - 0.5)		0.6(0.2-1.5)	
Congenital Malformation		0.003		0.038
No Congenital malformation	1.0		1.0	
Congenital malformation	4.4 (1.6 - 11.8)		3.2(1.1-9.7)	
Multiple/Singleton		0.467		0.403
One	1.0		1.0	
two – three	1.5 (0.5 - 4.4)		1.7(0.5-5.8)	
Gestational Age		<0.001		<0.001
<37	1.0		1.0	
37-38	0.2 (0.1 - 0.3)		0.2(0.1-0.5)	
39+	0.1 (0.0 - 0.3)		0.2(0.1-0.4)	

*-statistically significant, **aOR**- Adjusted odds ratio, Reference value=1.0

4.5 Association between Delivery factors and neonatal mortality

Tables 7 and 8 show the association between delivery factors and neonatal deaths. Table 7 shows that aggressively resuscitating babies after delivery ($p \leq 0.001$) is significantly associated with neonatal death. In table 8, we see that Baby aggressively resuscitated ($p \leq 0.001$) and onset of delivery ($p = 0.015$) are significant influencers of neonatal mortality at the multivariate level. Also, the aggressive resuscitation of a baby ($p \leq 0.001$) influences neonatal death in the univariate analysis. Babies that are aggressively resuscitated (OR = 9.2 95% C.I: 4.7 - 18.6) are more likely to experience neonatal death compared to babies that do not aggressively resuscitate at the univariate level. Also, babies that are aggressively resuscitated' are (OR = 9.6, 95%, C.I: 4.5-20.3) more likely to die compared to babies that do not aggressively resuscitate at the multivariate level. Multivariate analysis indicates that delivery by induction is (OR = 5.9, 95%, C.I: 1.2-28.4) more likely to influence neonatal death compared to caesarean section. Moreover, spontaneous delivery (OR = 6.1, 95%, C.I: 1.6-22.5) is more likely to influence neonatal death compared to caesarean section.

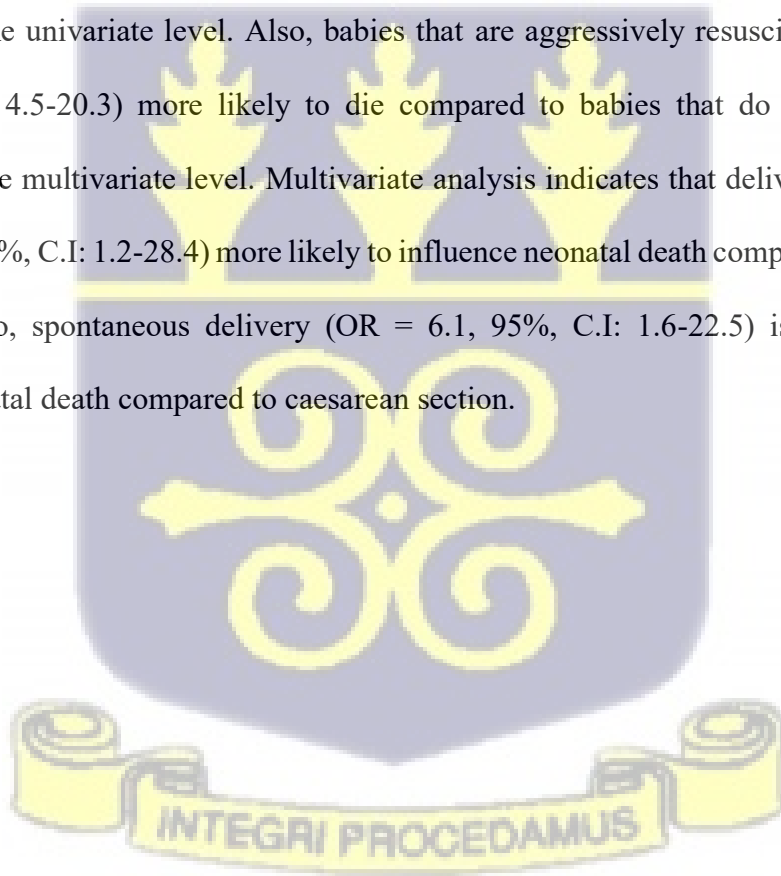


Table 7: Association between Delivery Factors and neonatal death outcomes, Tema General Hospital, 2024.

	Total N=180	Controls N=120	Cases N=60	p-value
Baby aggressively resuscitated after delivery	n (%)	n (%)	n (%)	<0.001*
Not aggressively resuscitated	109 (60.6)	92 (76.7)	17 (28.3)	
Aggressively resuscitated	71 (39.4)	28 (23.3)	43 (71.7)	
Mode of delivery				0.079
Non-VG	83 (46.1)	58 (48.3)	35 (58.3)	
Vaginal	97 (53.9)	62 (51.7)	25 (41.7)	
How did labor start				0.76
Caesarean section	72 (40.0)	51 (42.5)	21 (35.0)	
Induction	10 (5.6)	6 (5.0)	4 (6.7)	
Spontaneous	98 (54.4)	63 (52.5)	35 (58.3)	

*-statistically significant

Table 8: Association between Delivery Factors and neonatal death outcomes, Tema General Hospital, 2024: Adjusted and Unadjusted odds ratio.

Neonatal mortality	OR (95% C.I)	p-values	aOR (95% C.I)	p-values
Baby aggressively resuscitated		<0.001*		<0.001*
Not aggressively resuscitated	1.0		1.0	
Aggressively resuscitated	9.2 (4.7 - 18.6)		9.6(4.5-20.3)	
Mode of delivery		0.08		0.019*
Non-Vaginal	1.0		1.0	
Vaginal	0.6 (0.3 - 1.1)		0.2(0.1-0.8)	
Onset of delivery		0.759		0.015*
Caesarean section	1.0		1.0	
Induction	1.6 (0.4 - 6.3)		5.9(1.2-28.4)	
Spontaneous	1.2 (0.6 - 2.2)		6.1(1.6-22.5)	

*-statistically significant, aOR- Adjusted odds ratio, Reference value=1.0

CHAPTER FIVE

5.1 DISCUSSION

This study examined the factors associated with neonatal mortality. Results from the multivariate analysis indicate that neonatal mortality is significantly associated with, the education background of the mother, fathers' occupation, number of ANC attendance, complications, history of abortion, physical or sexual abuse, gestational age, congenital malformation, birthweight, aggressive resuscitation, mode of delivery.

5.2 Socio-demographic factors associated with neonatal mortality

It is an established fact that, socio-demographic factors can greatly impact neonatal mortality (Dare et al., 2021; Fasina et al., 2020; Tembo et al., 2024). Results from this study however indicate that, except for mother's education and occupation of the father, other factors such as age of mother at delivery, occupation, religion etc had no significant association with neonatal mortality. This finding could be attributed to the fact that most of the study participants, including both cases and controls, were within the age range typically associated with childbirth. Additionally, most participants identified as Christians, a group whose religious beliefs generally support child immunization and other child survival programs. This is in synch with Fasina et al., who found that neonatal mortality decreases linearly with an increase in mothers' educational level and a significant increase in neonatal mortality for those non christians.

A mothers' education is crucial for understanding healthcare recommendations, following ANC guidelines, and recognizing warning signs during pregnancy and neonatal periods. Mothers with higher levels of education are more inclined to utilize skilled healthcare services, seek prompt medical attention when needed, and maintain better nutrition, all of which play a crucial role in significantly reducing the risk of neonatal mortality. Educated mothers are also more

likely to adopt preventive measures, including vaccination, that protect infants from infections (Ahinkorah et al., 2022). Phung et al., found that a one-year reduction in educational level of a mother leads to an increase in odds of neonatal mortality by 2.4 folds (Nguyen-Phung, 2023).

The employment status of a father plays a significant role in neonatal survival. This correlates to earning income which directly affects the survival of the neonate. An employed father has access to quality healthcare for both mother and baby during pregnancy and eventual delivery. As evident from our study, a fathers' employment status is significantly associated with neonatal mortality and this is in line with a study in Bangladesh which found a fathers' employment status and age difference to be potential risk factors for neonatal mortality (Rahman et al., 2021). Similarly another study, found that, fathers' unemployment status had an increased odds of neonatal mortality (Asif et al., 2022).

There was no indication of a significant association between marital status and neonatal mortality. Regardless, Oduro et al., found in 2023 that, marital status of mothers significantly impacts neonatal mortality as Mothers who were married had less odds of neonatal mortality as compared to single mothers (Oduro et al., 2023). The marital status of a mother may influence her decision making in attending ANC and PNC. It could also stem from the moral and financial support provided by her partner in getting access to these neonatal care services (Kortsmit et al., 2020). Though this study did not find any significant association between mothers age at delivery and neonatal mortality, a study cross sectional study by Tamir et al., in low and middle income countries found that neonatal mortality rate among neonates born to mothers at extreme ages of reproductive life to be 28.96 neonatal deaths per 1000 live births (Tamir, 2024).

5.3 Maternal factors associated with neonatal mortality

In this study, maternal variables that were substantially linked with neonatal outcomes included the number of ANC visits, pregnancy difficulties, a history of abortions, and physical or sexual abuse during pregnancy. While parity, history of past newborn mortality/stillbirth, hypertension, sleeping under ITN, and mother's age at delivery were all linked, they were not statistically significant.

The findings show that a higher number of antenatal visits (ten or more) is related with a lower risk of newborn mortality than fewer visits of one to three. However, the modified model revealed no statistically significant relationship between ANC attendance and newborn mortality. This result is consistent with a study by Lansdale in 2024, which reported an odds ratio of 0.89 for number of ANC attendance (Lansdale et al., 2024). Regular ANC visits offer a critical opportunity or window for screening, early diagnosis of complications, identification of coexisting medical conditions and chance for health education (Meitei & Singh, 2024). ANC allows the healthcare provider to monitor fetal growth, advise on nutrition, and administer tetanus immunizations. Inadequate or irregular ANC attendance might lead to undetected problems that threaten infant survival (Uwimana et al., 2023).

An obstetric complication during pregnancy has an increased odds of neonatal mortality compared to a pregnancy without complications (WHO, 2024). The normal gestational process is disrupted by conditions such as pre-eclampsia, infections, and other pregnancy-related complications, increasing the likelihood of adverse neonatal outcomes. These complications pose significant risks to both maternal and neonatal health, directly affecting fetal development, birth processes, and immediate postnatal survival (Annan & Asiedu, 2018). A multivariate analysis by Thomas et al., revealed that neonatal mortality was about 4.79 times more likely in mothers who had a complication during their last pregnancy compared with mothers who had no pregnancy complication (Thomas et al., 2022). Other obstetric complications, such as

prolonged labor, placental abruption, and uterine rupture, further elevate the risk of neonatal mortality. Prolonged labor can result in foetal distress, hypoxia, and increased risk of infection due to prolonged exposure to the birth canal. Placental abruption, where the placenta detaches prematurely, can lead to severe foetal hypoxia, preterm birth, or stillbirth. Similarly, uterine rupture is a life-threatening emergency for both mother and baby, often necessitating immediate surgical intervention to save the neonate's life (Timofeev et al., 2023).

Maternal infections during pregnancy, including urinary tract infections and sexually transmitted infections, are significant contributors to neonatal mortality. These infections can result in preterm labor, placental inflammation, and low birth weight, all of which heighten neonatal vulnerability (Goldenberg et al., 2022). This study found an increased odds obstetric complications (maternal infections) and neonatal mortality. This corroborates with many other studies across the globe which found that infections such as syphilis, Urinary tract infections, Human Immunodeficiency virus (HIV) infection, Tuberculosis and malaria had an increased risk of neonatal mortality (Bhattacharya et al., 2024; Edelson et al., 2023; Gad et al., 2024; Oranuka et al., 2024; Satapathy et al., 2024; Shen et al., 2023).

This study reports that, having a history of maternal abortion or miscarriage has an increased odds of neonatal mortality by three folds compared to no history of abortion or miscarriage. This finding is supported by Yang et al., who found in their cohort study that, there are higher odds of neonatal mortality among mothers who had experienced one or more abortions (Yanga et al., 2020). A history of adverse pregnancy outcomes such as stillbirth or abortion is said to often be a sign of underlying health conditions or pregnancy-related complications that can increase the risk of neonatal mortality. Recurrent pregnancy loss may be due to chronic health issues, immune conditions, or previous infections, each of which can affect the health and survival of a subsequent neonate.

Physical or sexual abuse during pregnancy significantly impacts maternal and neonatal health, increasing the risk of neonatal mortality. Abuse often creates a cascade of adverse effects, both directly through physical harm and indirectly by disrupting maternal health-seeking behaviors and physiological well-being. As evident in this study, there was an increased odds of neonatal mortality among mothers who had experienced a form of physical or sexual abuse as compared to mothers who did not experience any of such. Comparatively, a study in Northern Ghana reported that women who had suffered partner violence during their last pregnancy were three times more likely to deliver babies who may not survive the neonatal stage due to low birthweight (Boah et al., 2023).

Physical abuse can result in direct trauma to the abdomen, leading to placental abruption, uterine rupture, or preterm labor. Traumatic injuries may compromise the fetus by interrupting blood supply, causing fetal distress or even stillbirth (Afaya et al., 2021). In severe cases, repeated trauma can result in low birth weight, which is strongly associated with increased neonatal mortality due to underdeveloped organs and susceptibility to infections (Finnbogadóttir et al., 2020).

Sexual abuse may also have direct physiological effects, such as the transmission of sexually transmitted infections (STIs) like syphilis or HIV, which can increase the risk of congenital anomalies, preterm birth, and neonatal sepsis (Memiah et al., 2020). Additionally, abused women may avoid antenatal care due to fear of further victimization, stigma, or lack of autonomy. Substance use, which is sometimes a coping mechanism among abuse victims, can also exacerbate neonatal risks through poor intrauterine growth, preterm labor, or congenital defects (Achana et al., 2023; Kallah-Dagadu et al., 2024).

5.4 Foetal factors associated with neonatal mortality

From indications, birthweight, congenital malformation and the gestational age of the baby were some factors that were significantly associated with neonatal mortality whereas sex and number of babies delivered did not show any statistical significance.

Low birth weight (LBW) is a major health concern for newborns and a contributing cause of death in 40–60% of newborns globally (Dare et al., 2021). Studies have consistently shown a direct correlation between low birthweight and a higher risk of neonatal mortality (Afagbedzi et al., 2023; Afaya et al., 2021; Kargbo et al., 2021; Pellegrino et al., 2022). As evident in this study, a birth weight of 3.9kg and above has less odds of neonatal mortality compared to a birth weight within the range of 2.5 – 3.9kg. This finding is in synch with Dagadu et al., who found in a multinomial logistic model that a child's age, birth type, and weight at birth were significant factors influencing child mortality (Kallah-Dagadu et al., 2024).

According to a systematic review by Cutland and Lawn et al. (2022), neonates with LBW are 20 times more likely to die within the first 28 days of life compared to those with normal birth weight (Cutland et al., 2022). In Ghana, research by Apanga et al. (2024) identified LBW as a primary contributor to neonatal mortality, accounting for nearly 50% of all neonatal deaths in the Eastern Regional hospital (Apanga et al., 2024). LBW infants often have underdeveloped organs, particularly the lungs, heart, and immune system. Immature lungs can lead to respiratory distress syndrome (RDS), a leading cause of death in neonates. Similarly, an underdeveloped immune system increases vulnerability to infections such as sepsis and pneumonia, which are common in the neonatal period (Wondie et al., 2023). In line with a study in Uganda, a predictor of mortality in neonates were babies who were discharged with weight less than 1,200g (Wondie et al., 2023). Low birth weight can be caused by premature delivery, poor maternal nutrition, insufficient rest, maternal stress, anxiety, and use of dangerous medicines during pregnancy.

Congenital malformations can severely disrupt the normal functioning of vital organs and systems, leading to early neonatal death. For example, cardiac anomalies such as congenital heart defects (CHDs) can cause circulatory failure, while neural tube defects may result in severe neurological complications incompatible with life. As indicated in this study, neonates born with congenital malformation have an increased odds (four-folds) of neonatal mortality compared to neonates with no congenital malfunction. This finding corresponds with a 10 year retrospective study which found mortality occurring in 33.2% of neonates with congenital abnormalities (Anane-Fenin et al., 2023). Nevertheless, this is in contrast with a study in Nigeria which reported congenital abnormalities to have a reduced risk of neonatal mortality compared to other acute conditions (Anane-Fenin et al., 2023).

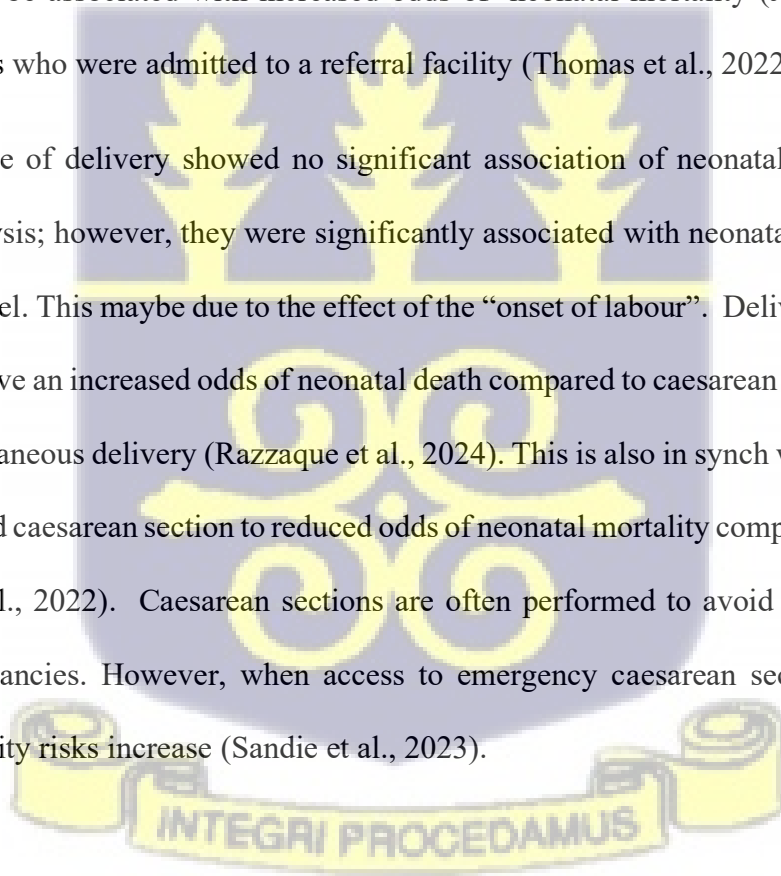
Infants born prematurely, especially before 37 weeks, face high neonatal mortality risks due to the immaturity of their organs and physiological systems (Helegbe et al., 2023). This study found gestational ages at 37-38 or more have reduced odds of neonatal mortality compared to gestational age below 37. Preterm birth often leads to low birth weight and an underdeveloped immune system, putting neonates at risk of infections and respiratory issues. In an observational cohort study, Yan found gestational age to be strongly associated with increased neonatal mortality which was evident in this study (Yan et al., 2023).

There was no significant association between the sex of a baby or the number of babies delivered and neonatal mortality. This finding is contrary to other studies which found a statistically significant association between the sex of a baby and neonatal mortality (Adongo & Ganle, 2023). Male born babies had an increased odds of neonatal mortality compared to female neonates (Abebe et al., 2021; Tamir, 2024; Tembo et al., 2024; Woday Tadesse et al., 2021). The number of multiple births recorded in this study was low, this may have been a limitation in determining the level of association.

5.5 Association between delivery factors and neonatal mortality.

Aggressively resuscitating babies after delivery is significantly associated with neonatal death. Immediate resuscitation for neonates experiencing birth asphyxia is essential (Wayessa et al., 2024). However, delays in resuscitation or inadequate resuscitation efforts are associated with higher neonatal mortality rates (Yoon et al., 2021). Trained personnel and resources are crucial to perform timely and effective neonatal resuscitation, especially in low-resource settings where asphyxia-related neonatal deaths are common (Brathwaite et al., 2020). Resuscitation protocols and timely intervention have been shown to significantly reduce neonatal mortality (Rosa-Mangeret et al., 2022). Comparatively studies in Tanzania and Ethiopia found resuscitation to be associated with increased odds of neonatal mortality (Joho et al., 2020) among neonates who were admitted to a referral facility (Thomas et al., 2022).

Onset and mode of delivery showed no significant association of neonatal mortality at the univariate analysis; however, they were significantly associated with neonatal mortality at the multivariate level. This maybe due to the effect of the “onset of labour”. Delivery by induction was found to have an increased odds of neonatal death compared to caesarean section and same applies to spontaneous delivery (Razzaque et al., 2024). This is also in synch with Mohammed et al., who found caesarean section to reduced odds of neonatal mortality compared to induction (Mohamed et al., 2022). Caesarean sections are often performed to avoid complications in high-risk pregnancies. However, when access to emergency caesarean sections is limited, neonatal mortality risks increase (Sandie et al., 2023).



5.6 Study strengths

The study had some strengths. The design allowed for the simultaneous evaluation of multiple determinants, such as maternal, neonatal, socio-economic, and delivery factors, that may contribute to neonatal mortality.

5.7 Study Limitations

There might be potential recall bias as mothers or caregivers of cases may recall events differently compared to controls, especially for cases that were characterized with emotions during data collection. This may have potentially skewed the data.

The findings from the study cannot be generalized to the whole of Ghana because the sample size was inadequate. Cases may not be representative of all neonatal deaths, as facility-based these exclude neonates who die at home or were brought in dead to the facility.

Moreso, though there were some independent factors that were significantly associated to the outcome, we could not establish causality. Regardless, it gave vital insight into the factors influencing neonatal mortality in the main health referral facility within the Tema Metropolis and the Greater Accra Region at large.

Another limitation relates to the pre-testing of the data collection tools at the Tema Polyclinic rather than at a hospital with similar characteristics to the Tema General Hospital. This decision was based on feasibility, as access and logistical considerations made the polyclinic the most practical choice at the time. This limitation was mitigated by refining the questionnaire based on feedback from both pre-test respondents and expert supervisors before implementation at the study site.

There were pockets of missing data though these were adequately handled during data management.

CHAPTER SIX

6.0 Conclusion and Recommendations

The result of this study shows that, a mothers' education of at least secondary level, an employed father, a higher number of ANC and PNC visits and a gestational age of 37 weeks or more may protect against neonatal mortality whereas the experience of obstetric complications, a history of abortion(s), physical or sexual abuse, a low birthweight of less than 2.5kg, the presence congenital malformation and aggressively resuscitating a baby may increase the odds of neonatal mortality. It is therefore a necessity to devise and formulate policies to guard against the impact of these factors on neonatal mortality.

6.1 Recommendations

6.1.1 Ghana Health Service – Greater Accra Regional Health Directorate.

There is the need for the GHS to provide women attending ANC clinics to have the privacy to disclose the experience of violence. Such women should also be tracked as they are likely to have neonatal deaths, further complicating their plight at home and reduce sexual and physical assault of these pregnant women and lactating mothers.

6.1.2 Tema Metropolitan Health Directorate

The TMHD should train and improve data collection and analysis systems to identify high-risk areas or trends in neonatal mortality within the metropolis, enabling targeted interventions. Beyond facility-based strategies, community interventions such as health education campaigns, male partner involvement in ANC, and community surveillance of neonatal deaths should be implemented to address socio-cultural barriers.

6.1.3 Tema General Hospital

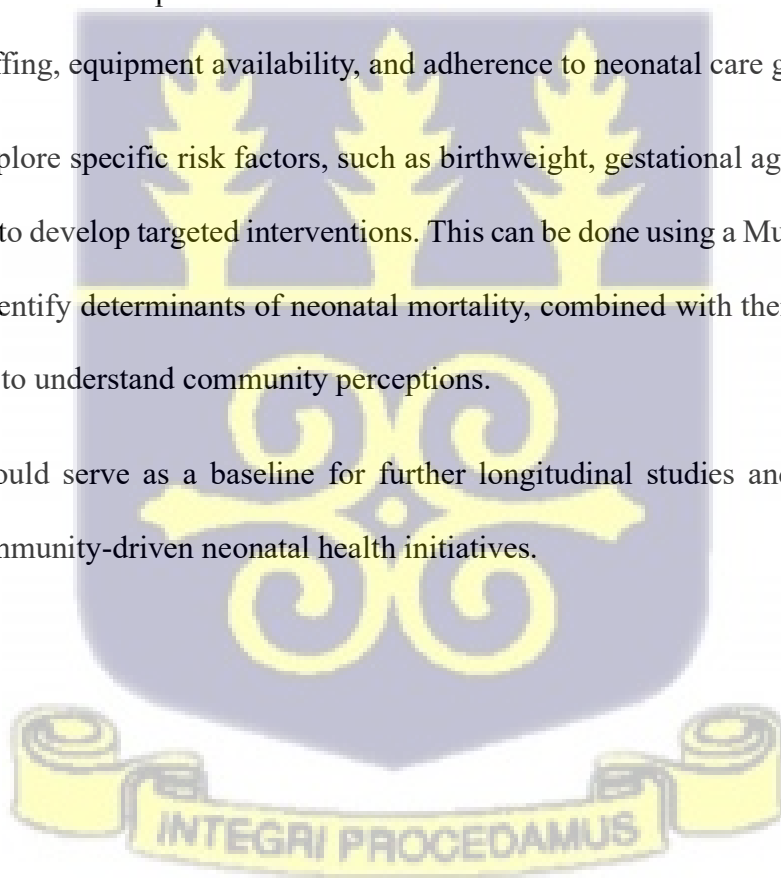
1. To upgrade and expand the NICU to accommodate more neonates, ensuring adequate care for preterm and low birthweight babies and prevent deaths among these vulnerable babies.
2. They should conduct continuous professional development (CPD) programs to enhance skills in neonatal resuscitation and infection control as vigorous resuscitation was associated with higher neonatal deaths.

6.2 Further Research

By adopting a mixed-methods approach within a larger sample size, future research can assess the quality of neonatal care provided at the various healthcare facilities within the metropolis, focusing on staffing, equipment availability, and adherence to neonatal care guidelines.

It could also explore specific risk factors, such as birthweight, gestational age, and congenital malformations, to develop targeted interventions. This can be done using a Multivariate logistic regression to identify determinants of neonatal mortality, combined with thematic analysis of qualitative data to understand community perceptions.

The findings could serve as a baseline for further longitudinal studies and pilot programs focusing on community-driven neonatal health initiatives.



REFERENCES

- Abdul-Mumin, A., Cotache-Condor, C., Owusu, S. A., Mahama, H., & Smith, E. R. (2021). Timing and causes of neonatal mortality in Tamale Teaching Hospital, Ghana: A retrospective study. *PLoS ONE*, *16*(1 January), 1–12. <https://doi.org/10.1371/journal.pone.0245065>
- Abebaw, E., Reta, A., Kibret, G. D., & Wagnew, F. (2021). Incidence and Predictors of Mortality among Preterm Neonates Admitted to the Neonatal Intensive Care Unit at Debre Markos Referral Hospital, Northwest Ethiopia. *Ethiopian Journal of Health Sciences*, *31*(5), 937–946. <https://doi.org/10.4314/ejhs.v31i5.4>
- Abebe, H., Wasie, A., Yeshaneh, A., Shitu, S., Mose, A., Adane, D., Workye, H., & Gashu, M. (2021). Determinant Factors of Neonatal Near Miss Among Neonates in Gurage Zone Hospitals, Ethiopia: A Case-Control Study. *Pediatric Health, Medicine and Therapeutics, Volume 12*, 129–139. <https://doi.org/10.2147/phmt.s302363>
- Abredu, J., Alipitio, B., Dwumfour, C. K., Witter, S., & Dzomeku, V. M. (2023). Factors influencing the free maternal health care policy under the national health insurance scheme's provision for skilled delivery services in Ghana: a narrative literature review. *BMC Pregnancy and Childbirth*, *23*(1), 1–9. <https://doi.org/10.1186/s12884-023-05730-2>
- Achana, F. S., Tanle, A., & Doku, D. T. (2023). *Women's autonomy, neonatal, infant and under-five mortality in the Upper East Region of Ghana*. 1–25. <https://doi.org/10.1371/journal.pgph.0002776>
- Adjei, G., Darteh, E. K. M., & Doku, D. T. (2021). Neonatal mortality clustering in the central districts of Ghana. *PLoS ONE*, *16*(6 June), 1–15. <https://doi.org/10.1371/journal.pone.0253573>
- Adongo, E. A., & Ganle, J. K. (2023). *Predictors of neonatal mortality in Ghana: evidence from 2017 Ghana Maternal Health Survey*. 1–15.
- Afagbedzi, S. K., Alhassan, Y., Alangea, D. O., & Taylor, H. (2023). Maternal factors and child health conditions at birth associated with preterm deaths in a tertiary health facility in Ghana: A retrospective analysis. *Frontiers in Public Health*, *11*. <https://doi.org/10.3389/fpubh.2023.1108744>

- Afaya, A., Afaya, R. A., Azongo, T. B., Yakong, V. N., Konlan, K. D., Agbinku, E., Agyabeng-Fandoh, E., Akokre, R., Karim, J. F., Salia, S. M., Kaba, R. A., & Ayanore, M. A. (2021). Maternal risk factors and neonatal outcomes associated with low birth weight in a secondary referral hospital in Ghana. *Heliyon*, 7(5), e06962. <https://doi.org/10.1016/j.heliyon.2021.e06962>
- Ahinkorah, B. O., Budu, E., Seidu, A. A., Agbaglo, E., Adu, C., Osei, D., Banke-Thomas, A., & Yaya, S. (2022). Socio-economic and proximate determinants of under-five mortality in Guinea. *PLoS ONE*, 17(5 May), 1–13. <https://doi.org/10.1371/journal.pone.0267700>
- Ahinkorah, B. O., Seidu, A. A., Hagan, J. E., Archer, A. G., Budu, E., Adoboi, F., & Schack, T. (2021). Predictors of pregnancy termination among young women in Ghana: Empirical evidence from the 2014 demographic and health survey data. *Healthcare (Switzerland)*, 9(6), 1–14. <https://doi.org/10.3390/healthcare9060705>
- Akombi, B. J., Ghimire, P. R., & Renzaho, A. M. (2019). Factors associated with neonatal mortality in the African Great Lakes region: A pooled analysis of national surveys. *Journal of Global Health Reports*, 3. <https://doi.org/10.29392/joghr.3.e2019043>
- Alem, A. Z., Yeshaw, Y., Liyew, A. M., Tesema, G. A., Alamneh, T. S., Worku, M. G., Teshale, A. B., & Tessema, Z. T. (2022). Timely initiation of antenatal care and its associated factors among pregnant women in sub-Saharan Africa: A multicountry analysis of Demographic and Health Surveys. *PLoS ONE*, 17(1 January), 1–17. <https://doi.org/10.1371/journal.pone.0262411>
- Alipour, A., Hantoushzadeh, S., Hessami, K., Saleh, M., Shariat, M., Yazdizadeh, B., Babaniamansour, S., Ghamari, A., Aghajanian, S., Moradi, K., Abdolmaleki, A. S., & Emami, Z. (2022). A global study of the association of cesarean rate and the role of socioeconomic status in neonatal mortality rate in the current century. *BMC Pregnancy and Childbirth*, 22(1), 1–9. <https://doi.org/10.1186/s12884-022-05133-9>
- Ambaye, E., Regasa, Z. W., & Hailiye, G. (2023). Early initiation of antenatal care and its associated factors among pregnant women attending antenatal care at public health centres in Bahir Dar Zuria zone, Northwest Ethiopia, 2021: a cross-sectional study. *BMJ Open*, 13(1), 1–7. <https://doi.org/10.1136/bmjopen-2022-065169>
- Amponsah-Tabi, S., Dassah, E. T., Asubonteng, G. O., Ankobea, F., Annan, J. J. K., Senu, E., Opoku, S., Opoku, E., & Opare-Addo, H. S. (2022). An assessment of the quality of

- antenatal care and pregnancy outcomes in a tertiary hospital in Ghana. *PLoS ONE*, 17(10 October), 1–13. <https://doi.org/10.1371/journal.pone.0275933>
- Anane-Fenin, B., Opoku, D. A., & Chauke, L. (2023). Prevalence, Pattern, and Outcome of Congenital Anomalies Admitted to a Neonatal Unit in a Low-Income Country—a Ten-Year Retrospective Study. *Maternal and Child Health Journal*, 27(5), 837–849. <https://doi.org/10.1007/s10995-023-03591-x>
- 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>
- Apanga, D. A., Kumbeni, M. T., Salifu, A. M., Mireku-Gyimah, N., & Apanga, P. A. (2024). Predictors of neonatal mortality in the Eastern Regional Hospital in Ghana: A retrospective cohort study. *PLOS Global Public Health*, 4(6), 1–13. <https://doi.org/10.1371/journal.pgph.0003295>
- Asif, M. F., Ali, S., Ali, M., Abid, G., & Lassi, Z. S. (2022). The Moderating Role of Maternal Education and Employment on Child Health in Pakistan. *Children*, 9(10). <https://doi.org/10.3390/children9101559>
- Asratie, M. H., Tesema, G. A., Chilot, D., Aragaw, F. M., Merid, M. W., & Belay, D. G. (2023). Socio-demographic and antenatal care-related factors associated with early post-partum family planning use in Ethiopia: evidence from Ethiopian Demographic and Health Survey 2016 data. *Frontiers in Global Women's Health*, 4(September), 1–12. <https://doi.org/10.3389/fgwh.2023.1131143>
- Azaare, J., Akweongo, P., Aryeteey, G. C., & Dwomoh, D. (2022). Evaluating the impact of maternal health care policy on stillbirth and perinatal mortality in Ghana; a mixed method approach using two rounds of Ghana demographic and health survey data sets and qualitative design technique. *PLoS ONE*, 17(9 September), 1–24. <https://doi.org/10.1371/journal.pone.0274573>
- Baruwa, O. J., Amoateng, A. Y., & Biney, E. (2021). Induced abortion in Ghana: Prevalence and associated factors. *Journal of Biosocial Science*, 257–268. <https://doi.org/10.1017/S0021932020000772>
- Behboudi-Gandevani, S., Bidhendi-Yarandi, R., Panahi, M. H., Mardani, A., Gåre Kymre, I.,

- Paal, P., & Vaismoradi, M. (2022). A Systematic Review and Meta-Analysis of the Risk of Stillbirth, Perinatal and Neonatal Mortality in Immigrant Women. *International Journal of Public Health*, 67(May), 1–13. <https://doi.org/10.3389/ijph.2022.1604479>
- Bengtsson, F., Ekéus, C., Hagelroth, A., & Ahlsson, F. (2023). Neonatal outcomes of elective labor induction in low-risk term pregnancies. *Scientific Reports*, 13(1), 1–9. <https://doi.org/10.1038/s41598-023-42413-6>
- Bhattacharya, Debika MD, MSc*; Guo, Rong MS*; Tseng, Chi-Hong PhD, MS*; Emel, Lynda PhD†; Sun, Ren PhD*; Chiu, Shih-Hsin PhD*; Stranix-Chibanda, Lynda MMED‡; Chipato, Tsungai MBChB‡; Mohtashemi, Neaka Z. BS*; Kintu, Kenneth BS§; Manji, Karim P. MMED, MPH¶, Ms. (2024). Maternal HBV Viremia and Association With Adverse Infant Outcomes in Women Living With HIV and HBV. *The Pediatric Infectious Disease Journal*, 40(2)(p e56-e61). doi: 10.1097/INF.0000000000002980
- Boadu, W. I. O., Kugblenu, P., Senu, E., Opoku, S., & Anto, E. O. (2022). Prevalence and Risk Factors Associated With Gestational Diabetes Mellitus Among Pregnant Women: A Cross-Sectional Study in Ghana. *Frontiers in Clinical Diabetes and Healthcare*, 3(March), 1–8. <https://doi.org/10.3389/fcdhc.2022.854332>
- Boah, M., Abdulai, N., Issah, A. N., Yeboah, D., Kpordoxah, M. R., Aballo, J., & Adokiya, M. N. (2023). Risk of adverse newborn outcomes among women who experienced physical and psychological intimate partner abuse during pregnancy in Ghana's northern region. *Heliyon*, 9(4), e15391. <https://doi.org/10.1016/j.heliyon.2023.e15391>
- Brathwaite, K. P., Bryce, F., Moyer, L. B., Engmann, C., Twum-Danso, N. A. Y., Kamath-Rayne, B. D., Srofenyoh, E. K., Ucer, S., Boadu, R. O., & Owen, M. D. (2020). Evaluation of two newborn resuscitation training strategies in regional hospitals in Ghana. *Resuscitation Plus*, 1–2(March), 100001. <https://doi.org/10.1016/j.resplu.2020.100001>
- Cooper, P. A., Rudan, I., & Baird, P. A. (2022). The rising tide of genetic risk factors for child health outcomes. *Nature Reviews Genetics*, 23(1), 35-48.
- Cutland, C. L., Lackritz, E. M., Mallett-Moore, T., Bardají, A., Chandrasekaran, R., Lahariya, C., Nisar, M. I., Tapia, M. D., Pathirana, J., Kochhar, S., & Muñoz, F. M. (2017). Low birth weight: Case definition & guidelines for data collection, analysis, and presentation

- of maternal immunization safety data. *Vaccine*, 35(48), 6492–6500.
<https://doi.org/10.1016/j.vaccine.2017.01.049>
- Dare, S. (2018). *A multilevel mixed methods study of neonatal mortality in Ghana*. October, 1–419. <http://theses.gla.ac.uk/30943/1/2018Darephd.pdf>
- Dare, S., Oduro, A. R., Owusu-Agyei, S., Mackay, D. F., Gruer, L., Manyeh, A. K., Nettey, E., Phillips, J. F., Asante, K. P., Welaga, P., & Pell, J. P. (2021). Neonatal mortality rates, characteristics, and risk factors for neonatal deaths in Ghana: analyses of data from two health and demographic surveillance systems. *Global Health Action*, 14(1), 1–13. <https://doi.org/10.1080/16549716.2021.1938871>
- Darmstadt, G. L., Al Jaifi, N. H., Arif, S., Bahl, R., Blennow, M., Cavallera, V., Chou, D., Chou, R., Comrie-Thomson, L., Edmond, K., Feng, Q., Riera, P. F., Grummer-Strawn, L., Gupta, S., Hill, Z., Idowu, A. A., Kenner, C., Kirabira, V. N., Klinkott, R., ... Yunis, K. (2023). New World Health Organization recommendations for care of preterm or low birth weight infants: health policy. *EClinicalMedicine*, 63, 1–13.
<https://doi.org/10.1016/j.eclinm.2023.102155>
- Dev, A. (2022). Risk of recurrent stillbirth and neonatal mortality: mother-specific random effects analysis using longitudinal panel data from Indonesia (2000 – 2014). *BMC Pregnancy and Childbirth*, 22(1), 1–10. <https://doi.org/10.1186/s12884-022-04819-4>
- Developed, E., Group, U. N. I., & Estimation, C. M. (2017). *Global levels and trends in mortality*. 5–28. <https://doi.org/10.18356/6351dbde-en>
- Dickson, K. S., Okyere, J., Ahinkorah, B. O., Seidu, A. A., Salihu, T., Bediako, V., Owusu, B. A., Budu, E., Agbemavi, W., Edjah, J. O., Kofuor, E., & Darteh, M. (2022). Skilled antenatal care services utilisation in sub - Saharan Africa : a pooled analysis of demographic and health surveys from 32 countries. *BMC Pregnancy and Childbirth*, 5, 1–10. <https://doi.org/10.1186/s12884-022-05137-5>
- Döblin, S., Seefeld, L., Weise, V., Kopp, M., Knappe, S., Asselmann, E., Martini, J., & Garthus-Niegel, S. (2023). The impact of mode of delivery on parent-infant-bonding and the mediating role of birth experience: a comparison of mothers and fathers within the longitudinal cohort study DREAM. *BMC Pregnancy and Childbirth*, 23(1), 1–26.
<https://doi.org/10.1186/s12884-023-05611-8>

- Doku, D. T. (2022). Survival analysis of neonatal mortality in Ghana using three population-based surveys. *Archives of Public Health*, 80(1), 1–8. <https://doi.org/10.1186/s13690-021-00773-3>
- Edelson, P. K., Cao, D., James, K. E., Ngonzi, J., Roberts, D. J., Bebell, L. M., & Boatin, A. A. (2023). Maternal anemia is associated with adverse maternal and neonatal outcomes in Mbarara, Uganda. *Journal of Maternal-Fetal and Neonatal Medicine*, 36(1). <https://doi.org/10.1080/14767058.2023.2190834>
- Egesa, W. I., Odong, R. J., Kalubi, P., Ortiz Yamile, E. A., Atwine, D., Turyasiima, M., Kiconco, G., Maren, M. B., Nduwimana, M., & Ssebuufu, R. (2020). <p>Preterm Neonatal Mortality and Its Determinants at a Tertiary Hospital in Western Uganda: A Prospective Cohort Study</p>. *Pediatric Health, Medicine and Therapeutics, Volume 11*, 409–420. <https://doi.org/10.2147/phmt.s266675>
- Fasina, F., Oni, G., Azuh, D., & Oduaran, A. (2020). Impact of mothers' socio-demographic factors and antenatal clinic attendance on neonatal mortality in Nigeria. *Cogent Social Sciences*, 6(1). <https://doi.org/10.1080/23311886.2020.1747328>
- Finnbogadóttir, H., Baird, K., & Thies-Lagergren, L. (2020). Birth outcomes in a Swedish population of women reporting a history of violence including domestic violence during pregnancy: A longitudinal cohort study. *BMC Pregnancy and Childbirth*, 20(1), 1–10. <https://doi.org/10.1186/s12884-020-02864-5>
- Gad, A., Alkhdr, M., Terkawi, R., Alsharif, H., Ibrahim, M., Amin, R., Algibali, E., Chandra, P., Hamed, M., Petkar, H. M., & Bayoumi, M. A. A. (2024). Associations between maternal bacteremia during the peripartum period and early-onset neonatal sepsis: a retrospective cohort study. *BMC Pediatrics*, 24(1). <https://doi.org/10.1186/s12887-024-04980-z>
- Ghosh, C., & Wojtowycz, M. (2021). Effect of gestational disorders on preterm birth, low birthweight, and NICU admission. *Archives of Gynecology and Obstetrics*, 303(2), 419–426. <https://doi.org/10.1007/s00404-020-05760-7>
- Goldenberg, R. L., Culhane, J. F., & Johnson, D. C. (2005). Maternal infection and adverse fetal and neonatal outcomes. *Clinics in Perinatology*, 32(3), 523–559. <https://doi.org/10.1016/j.clp.2005.04.006>

- GSS. (2023). Ghana Demographic and Health Survey. Key indicators Report 2022. *Journal of Chemical Information and Modeling*, 15(2), 65.
- Helegbe, G. K., Aryee, P., & Mohammed, B. S. (2023). Preterm Delivery and Neonatal Deaths among Anaemic Pregnant Women in the Bolgatanga Metropolis of Ghana. *Anemia*, 2023, 1–7. <https://doi.org/10.1155/2023/9865224>
- Houweling, T. A. J., Van Klaveren, D., Das, S., Azad, K., Tripathy, P., Manandhar, D., Neuman, M., De Jonge, E., Been, J. V., Steyerberg, E., & Costello, A. (2019). A prediction model for neonatal mortality in low- and middle-income countries: An analysis of data from population surveillance sites in India, Nepal and Bangladesh. *International Journal of Epidemiology*, 48(1), 186–198. <https://doi.org/10.1093/ije/dyy194>
- Imbo, A., Mbuthia, E., & Ngotho, D. (2021). Determinants of Neonatal Mortality in Kenya: Evidence from the Kenya Demographic and Health Survey 2014. *International Journal of Maternal and Child Health and AIDS (IJMA)*, 10(2), 287–295. <https://doi.org/10.21106/ijma.508>
- Izulla, P., Muriuki, A., Kiragu, M., Yahner, M., Fonner, V., Nitu, S. N. A., Osir, B., Bello, F., & De Graft-Johnson, J. (2023). Proximate and distant determinants of maternal and neonatal mortality in the postnatal period: A scoping review of data from low- and middle-income countries. *PLoS ONE*, 18(11 November), 1–20. <https://doi.org/10.1371/journal.pone.0293479>
- Jana, A., Saha, U. R., Reshmi, R. S., & Muhammad, T. (2023). Relationship between low birth weight and infant mortality: evidence from National Family Health Survey 2019–21, India. *Archives of Public Health*, 81(1), 1–14. <https://doi.org/10.1186/s13690-023-01037-y>
- Joho, A. A., Kibusi, S. M., & Mwampagatwa, I. (2020). Predictors of Helping Babies Breathe knowledge and skills among nurses in primary health settings in Dodoma region, Tanzania. *BMC Pregnancy and Childbirth*, 20(1), 1–7. <https://doi.org/10.1186/s12884-020-2782-9>
- Kalikkot Thekkeveedu, R., Dankhara, N., Desai, J., Klar, A. L., & Patel, J. (2021). Outcomes of multiple gestation births compared to singleton: analysis of multicenter KID database. *Maternal Health, Neonatology and Perinatology*, 7(1), 1–11.

<https://doi.org/10.1186/s40748-021-00135-5>

Kallah-Dagadu, G., Donkor, F., Duah, M., Yeboah, H., Arku, D., & Lotsi, A. (2024).

Investigation of Factors Influencing Infant Mortality at Greater Accra Regional Hospital, Ghana. *BioMed Research International*, 2024.

<https://doi.org/10.1155/2024/6610617>

Kapoor, M., Kim, R., Sahoo, T., Roy, A., Ravi, S., Kumar, A. K. S., Agarwal, R., &

Subramanian, S. V. (2020). Association of Maternal History of Neonatal Death With Subsequent Neonatal Death in India. *JAMA Network Open*, 3(4), e202887.

<https://doi.org/10.1001/jamanetworkopen.2020.2887>

Kargbo, D. K., Nyarko, K., Sackey, S., Addo-Lartey, A., Kenu, E., & Anto, F. (2021).

Determinants of low birth weight deliveries at five referral hospitals in Western Area Urban district, Sierra Leone. *Italian Journal of Pediatrics*, 47(1), 1–11.

<https://doi.org/10.1186/s13052-021-01160-y>

Kassie, A., Kassie, M., Bantie, B., Worku, T., & Aynalem, Z. B. (2023). *Neonatal Mortality at Felege Hiwot Comprehensive Specialized Hospital in Ethiopia Over 5 years : Trends and Associated Factors*. <https://doi.org/10.1177/11795565231187500>

Kolekang, A., Sarfo, B., Danso-Appiah, A., Dwomoh, D., & Akweongo, P. (2022).

Contribution of child health interventions to under-five mortality decline in Ghana: A modeling study using lives saved and missed opportunity tools. *PLoS ONE*, 17(8 August), 1–15. <https://doi.org/10.1371/journal.pone.0267776>

Kortsmit, K., Garfield, C., Smith, R. A., Boulet, S., Simon, C., Pazol, K., Kapaya, M., Harrison, L., Barfield, W., & Warner, L. (2020). Paternal Involvement and Maternal Perinatal Behaviors: Pregnancy Risk Assessment Monitoring System, 2012-2015. *Public Health Reports*, 135(2), 253–261. <https://doi.org/10.1177/0033354920904066>

Laar, A. K., Adler, A. J., Kotoh, A. M., Legido-Quigley, H., Lange, I. L., Perel, P., & Lamptey, P. (2019). Health system challenges to hypertension and related non-communicable diseases prevention and treatment: Perspectives from Ghanaian stakeholders. *BMC Health Services Research*, 19(1), 1–13.

<https://doi.org/10.1186/s12913-019-4571-6>

Lansdale, A. J., Bountogo, M., Sie, A., Zakane, A., Compaore, G., Ouedraogo, T., Lebas, E.,

- Lietman, T., & Oldenburg, C. E. (2024). Associations between Antenatal Care Visit Attendance and Infant Mortality and Growth. *American Journal of Tropical Medicine and Hygiene*, 110(6), 1270–1275. <https://doi.org/10.4269/ajtmh.23-0659>
- Le monde. (2022). *Infant mortality drops in Sweden, where pregnant women and newborns are closely monitored*.
https://www.lemonde.fr/en/environment/article/2022/05/03/infant-mortality-drops-in-sweden-where-pregnant-babies-and-newborns-are-closely-monitored_5982332_114.html#
- Liu, L., Johnson, H. L., Cousens, S., Lawn, J. E., Blencowe, H., Zhu, J., ... & The Lancet Global Health Collaborators. (2021). Global, regional, and national estimates of neonatal mortality in 192 countries in 2000-2017: a systematic analysis. *The Lancet Global Health*, 9(e456-e480.), (4).
- Madar, J., Roehr, C. C., Ainsworth, S., Ersdal, H., Morley, C., Rüdiger, M., Skåre, C., Szczapa, T., te Pas, A., Trevisanuto, D., Urlesberger, B., Wilkinson, D., & Wyllie, J. P. (2021). European Resuscitation Council Guidelines 2021: Newborn resuscitation and support of transition of infants at birth. *Resuscitation*, 161, 291–326.
<https://doi.org/10.1016/j.resuscitation.2021.02.014>
- McKenzie, K. A., & Trotman, H. (2019). A Retrospective Study of Neonatal Outcome in Preeclampsia at the University Hospital of the West Indies: A Resource-limited Setting. *Journal of Tropical Pediatrics*, 65(1), 78–83. <https://doi.org/10.1093/tropej/fmy014>
- Meitei, W. B., & Singh, A. (2024). The nexus between maternal antenatal care attendance, newborn postnatal care and neonatal mortality in India: a matched case-control study. *BMC Pregnancy and Childbirth*, 24(1), 691. <https://doi.org/10.1186/s12884-024-06881-6>
- Memiah, P., Bond, T., Opanga, Y., Kingori, C., Cook, C., Mwangi, M., Gitahi-Kamau, N., Mubangizi, D., & Owuor, K. (2020). Neonatal, infant, and child mortality among women exposed to intimate partner violence in East Africa: A multi-country analysis. *BMC Women's Health*, 20(1), 1–16. <https://doi.org/10.1186/s12905-019-0867-2>
- Mgusha, Y., Nkhoma, D. B., Chiume, M., Gundo, B., Gundo, R., Shair, F., Hull-Bailey, T., Lakhanpaul, M., Lorencatto, F., Heys, M., & Crehan, C. (2021). Admissions to a Low-Resource Neonatal Unit in Malawi Using a Mobile App and Dashboard: A 1-Year

- Digital Perinatal Outcome Audit. *Frontiers in Digital Health*, 3(December), 1–22.
<https://doi.org/10.3389/fdgth.2021.761128>
- Mohamed, H. A., Shiferaw, Z., Roble, A. K., & Kure, M. A. (2022). Neonatal mortality and associated factors among neonates admitted to neonatal intensive care unit at public hospitals of Somali Regional State, Eastern Ethiopia: A multicenter retrospective analysis. *PLoS ONE*, 17(5 5), 1–16. <https://doi.org/10.1371/journal.pone.0268648>
- Nguyen-Phung, H. T. (2023). The impact of maternal education on child mortality: Evidence from an increase tuition fee policy in Vietnam. *International Journal of Educational Development*, Volume 96(ISSN 0738-0593).
<https://doi.org/https://doi.org/10.1016/j.ijedudev.2022.102704>.
- Oduro, A. R., Anyorikyea, M., Ansah, P., Oladokun, S., Tei, E. M., Oduro-Ayeh, R., Welaga, P., & Deh, S. (2023). Birth preparedness and complications readiness among women in disadvantaged rural districts of Ghana. *BMC Pregnancy and Childbirth*, 23(1), 1–12.
<https://doi.org/10.1186/s12884-023-06041-2>
- Okoli, C. I., Hajizadeh, M., Rahman, M. M., & Khanam, R. (2022). Geographic and socioeconomic inequalities in the survival of children under-five in Nigeria. *Scientific Reports*, 12(1), 1–12. <https://doi.org/10.1038/s41598-022-12621-7>
- Oranuka, K. R., Chama, C., Adogu, I. O., Okafor, C. G., Eleje, G. U., Ugwu, E. O., Adeleke, O. P., Obakpororo, P. H., Nnabuchi, K. O., Yusuf, A., Ugwu, N. P., Akabuikie, J. C., & Eke, A. C. (2024). Placental Malaria and Its Relationship with Neonatal Birth Weight among Primigravidae: An Analytical Cross-sectional Study. *Exploratory Research and Hypothesis in Medicine*, 000(000), 000–000. <https://doi.org/10.14218/erhm.2023.00015>
- Owen, M. J., Wright, M. S., Batalov, S., Kwon, Y., Ding, Y., Chau, K. K., Chowdhury, S., Sweeney, N. M., Kiernan, E., Richardson, A., Batton, E., Baer, R. J., Bandoli, G., Gleeson, J. G., Bainbridge, M., Chambers, C. D., & Kingsmore, S. F. (2023). Reclassification of the Etiology of Infant Mortality With Whole-Genome Sequencing. *JAMA Network Open*, 6(2), E2254069.
<https://doi.org/10.1001/jamanetworkopen.2022.54069>
- Pellegrino, J., Kanyangarara, M., Agbinko-Djobalar, B., Owusu, P. G., Sakyi, K. S., Baffoe, P., Sackey, A., Sagoe-Moses, I., & Dail, R. B. (2022). Occurrence of neonatal hypothermia and associated risk factors among low birth weight (LBW) infants in accra,

- Ghana. *Journal of Global Health Reports*, 6, 1–8. <https://doi.org/10.29392/001c.55766>
- Polis, C. B., Castillo, P. W., Otupiri, E., Keogh, S. C., Hussain, R., Nakua, E. K., Larsen-Reindorf, R., & Bell, S. O. (2020). Estimating the incidence of abortion: Using the Abortion Incidence Complications Methodology in Ghana, 2017. *BMJ Global Health*, 5(4). <https://doi.org/10.1136/bmjgh-2019-002130>
- Prüst, Z. D., Kodan, L. R., van den Akker, T., Bloemenkamp, K. W. M., Rijken, M. J., & Verschuere, K. J. C. (2021). The burden of severe hypertensive disorders of pregnancy on perinatal outcomes: a nationwide case-control study in Suriname. *AJOG Global Reports*, 1(4). <https://doi.org/10.1016/j.xagr.2021.100027>
- Pusdekar, Y. V., Patel, A. B., Kurhe, K. G., Bhargav, S. R., Thorsten, V., Garces, A., Goldenberg, R. L., Goudar, S. S., Saleem, S., Esamai, F., Chomba, E., Bauserman, M., Bose, C. L., Liechty, E. A., Krebs, N. F., Derman, R. J., Carlo, W. A., Koso-Thomas, M., Nolen, T. L., ... Hibberd, P. L. (2020). Rates and risk factors for preterm birth and low birthweight in the global network sites in six low- and low middle-income countries. *Reproductive Health*, 17(3), 1–17. <https://doi.org/10.1186/s12978-020-01029-z>
- Rahman, M. M., Ara, T., Mahmud, S., & Samad, N. (2021). Revisit the correlates of infant mortality in Bangladesh: Findings from two nationwide cross-sectional studies. *BMJ Open*, 11(8), 1–12. <https://doi.org/10.1136/bmjopen-2020-045506>
- Razzaque, A., Chowdhury, R., Mustafa, A. G., Billah, M. A., Naima, S., Shafique, S., Sarker, B. K., Islam, M. Z., Kim, M., Jahangir, M. A., Matin, Z., Ferdous, J., Vandenberg, M., & Rahman, A. (2024). Caesarean delivery and neonatal mortality: evidence from selected slums in and around Dhaka city, Bangladesh- A prospective cohort study. *Journal of Health, Population and Nutrition*, 43(1), 1–11. <https://doi.org/10.1186/s41043-024-00563-x>
- Regina Appiaa Brobbey, Mawumenyo Aku Kwawukume, Peter Twum, Peter Agyei-Baffour, Daniel Opoku, Nana Kwasi Bredu Antwi-Berko, Oscar Vetsi, Jacob Aparah, & Kofi Akohene Mensah. (2023). Health service delivery factors influencing neonatal mortality in health facilities in the bono region of Ghana. *World Journal of Advanced Research and Reviews*, 17(3), 157–176. <https://doi.org/10.30574/wjarr.2023.17.3.0368>
- Robbins, M. E., & Saugstad, O. D. (2023). Oxygen for newborn resuscitation: a narrative review. *Pediatric Medicine*, 6, 1–12. <https://doi.org/10.21037/pm-21-110>

- Roeckner, J. T., Rizzo, J., Peterson, E., Flores-torres, J., & Duncan, J. (2022). Poster Session IV. *The American Journal of Obstetrics & Gynecology*, 226(1), S695.
<https://doi.org/10.1016/j.ajog.2021.11.1146>
- Rosa-Mangeret, F., Benski, A. C., Golaz, A., Zala, P. Z., Kyokan, M., Wagner, N., Muhe, L. M., & Pfister, R. E. (2022). 2.5 Million Annual Deaths—Are Neonates in Low-and Middle-Income Countries Too Small to Be Seen? A Bottom-Up Overview on Neonatal Morbi-Mortality. *Tropical Medicine and Infectious Disease*, 7(5), 1–21.
<https://doi.org/10.3390/tropicalmed7050064>
- Sacks, E., Sakyi, K., Owusu, P. G., Ohrt, C., Ademuwagun, L., Watkoske, K., Zabel, C., Laar, A., & Kanyangarara, M. (2022). Factors contributing to neonatal mortality reduction in three regions in Ghana: a mixed-methods study using the Lives Saved (LiST) modelling tool. *Journal of Global Health Reports*, 5, 1–12.
<https://doi.org/10.29392/001c.30750>
- Sandie, A. B., Mutua, M. K., Sidze, E., Nyakangi, V., Sylla, E. H. M., Wanjoya, A., Njom Nlend, A. E., & Faye, C. (2023). Epidemiology of emergency and elective caesarean section and its association with early neonatal mortality in sub-Saharan African countries. *BMJ Open*, 13(10). <https://doi.org/10.1136/bmjopen-2023-074995>
- Satapathy, P., Khatib, M. N., Gaidhane, S., Zahiruddin, Q. S., Sharma, R. K., Rustagi, S., Al-Jishi, J. M., Albayat, H., Al Fares, M. A., Garout, M., Alrasheed, H. A., Al-Subaie, M. F., Rabaan, A. A., & Sah, R. (2024). Adverse pregnancy outcomes in maternal malarial infection: A systematic review and meta-analysis. *New Microbes and New Infections*, 62(July), 101474. <https://doi.org/10.1016/j.nmni.2024.101474>
- Saya, A. R., Katz, J., Khatry, S. K., Tielsch, J. M., LeClerq, S. C., & Mullany, L. C. (2022). Causes of neonatal mortality using verbal autopsies in rural Southern Nepal, 2010–2017. *PLOS Global Public Health*, 2(9), e0001072.
<https://doi.org/10.1371/journal.pgph.0001072>
- Shen, G. F., Ge, C. H., Shen, W., Liu, Y. H., & Huang, X. Y. (2023). Association between hepatitis C infection during pregnancy with maternal and neonatal outcomes: a systematic review and meta-analysis. *European Review for Medical and Pharmacological Sciences*, 27(8), 3475–3488.
https://doi.org/10.26355/eurrev_202304_32120

- Shukla, V. V., Carlo, W. A., Niermeyer, S., & Guinsburg, R. (2022). Neonatal resuscitation from a global perspective. *Seminars in Perinatology*, 46(6), 151630. <https://doi.org/10.1016/j.semperi.2022.151630>
- Takramah, W. K., & Aheto, J. M. K. (2023). Multilevel modelling of neonatal mortality in Ghana: Does household and community levels matter? *Heliyon*, 9(8), e18961. <https://doi.org/10.1016/j.heliyon.2023.e18961>
- Tamir, T. T. (2024). Neonatal mortality rate and determinants among births of mothers at extreme ages of reproductive life in low and middle income countries. *Scientific Reports*, 14(1), 1–10. <https://doi.org/10.1038/s41598-024-61867-w>
- 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), 1–15. <https://doi.org/10.1371/journal.pone.0222566>
- Tembo, D., Abobo, F. D. N., Kaonga, P., Jacobs, C., & Bessing, B. (2024). Risk factors associated with neonatal mortality among neonates admitted to neonatal intensive care unit of the University Teaching Hospital in Lusaka. *Scientific Reports*, 14(1), 1–12. <https://doi.org/10.1038/s41598-024-56020-6>
- Thomas, G., Demena, M., Hawulte, B., Eyeberu, A., Heluf, H., & Tamiru, D. (2022). Neonatal Mortality and Associated Factors Among Neonates Admitted to the Neonatal Intensive Care Unit of Dil Chora Referral Hospital, Dire Dawa City, Ethiopia, 2021: A Facility-Based Study. *Frontiers in Pediatrics*, 9(February), 1–7. <https://doi.org/10.3389/fped.2021.793160>
- Timofeev, Julia MD; Reddy, Uma M. MD, MPH; Huang, Chun-Chih PhD; Driggers, Rita W. MD; Landy, Helain J. MD; Laughon, S. Katherine MD, M. (2023). Obstetric Complications, Neonatal Morbidity, and Indications for Cesarean Delivery by Maternal Age. *Obstetrics & Gynecology*, 122(6), 1184–1195. doi: 10.1097/AOG.0000000000000017
- Twins Trust. (2023). *New statistics show neonatal death risk five times greater for twin or triplet pregnancies compared to carrying one baby*. <https://twinstrust.org/resource/new-statistics-show-neonatal-death-risk-five-times-greater-for-twin-or-triplet-pregnancies-compared-to-carrying-one-baby.html>

- UNICEF. (2023). *The neonatal period is the most vulnerable time for a child*.
<https://data.unicef.org/topic/child-survival/neonatal-mortality/>
- Uwimana, G., Elhoumed, M., Gebremedhin, M. A., Qi, Q., Azalati, M. M., Wang, L., & Zeng, L. (2023). Association between adequacy of antenatal care and neonatal outcomes in Rwanda: a cross-sectional study design using the Rwanda demographic and health surveys. *BMC Health Services Research*, 23(1), 1–11. <https://doi.org/10.1186/s12913-023-10345-6>
- Vecchioli, E., Cordier, A. G., Chantry, A., Benachi, A., & Monier, I. (2020). Maternal and neonatal outcomes associated with induction of labor after one previous cesarean delivery: A French retrospective study. *PLoS ONE*, 15(8 August), 1–12.
<https://doi.org/10.1371/journal.pone.0237132>
- Wayessa, Z. J., Safayi, B. L., Demisie, F., Melese, G. T., Bonkiye, A. J., & Beyene, B. N. (2024). Neonatal Resuscitation Practice and Associated Factors among Health Care Workers in Public Health Facilities in West Guji Zone, Southern Ethiopia. *Iranian Journal of Neonatology*, 15(1), 9–20. <https://doi.org/10.22038/IJN.2023.72547.2405>
- WHO. (2020). Neonatal and Perinatal Mortality. *Psychiatric Clinics of North America*, 5(2), 75. [https://doi.org/10.1016/s0193-953x\(18\)30879-7](https://doi.org/10.1016/s0193-953x(18)30879-7)
- WHO. (2022a). *Birth asphyxia*. <https://www.who.int/teams/maternal-newborn-child-adolescent-health-and-ageing/newborn-health/perinatal-asphyxia>
- WHO. (2022b). *Key facts: Newborn Mortality*. <https://www.who.int/news-room/fact-sheets/detail/levels-and-trends-in-child-mortality-report-2021#:~:text=Preterm birth%2C intrapartum-related complications,causes of most neonatal deaths.>
- WHO. (2024). *Newborn mortality*. <https://www.who.int/news-room/fact-sheets/detail/newborn-mortality>
- WHO - UNICEF. (2020). *Ending preventable newborn deaths and stillbirths. Moving faster towards high-quality universal in 2020-2025. July*.
<https://www.unicef.org/media/77166/file/Ending-preventable-newborn-deaths-and-stillbirths-by-2030-universal-health-coverage-in-2020-2025.pdf>
- Woday Tadesse, A., Mekuria Negussie, Y., & Aychiluhm, S. B. (2021). Neonatal mortality and its associated factors among neonates admitted at public hospitals, pastoral region,

Ethiopia: A health facility based study. *PloS One*, 16(3), e0242481.

<https://doi.org/10.1371/journal.pone.0242481>

Wondie, W. T., Zeleke, K. A., & Wubneh, C. A. (2023). Incidence and predictors of mortality among low birth weight neonates in the first week of life admitted to the neonatal intensive care unit in Northwestern Ethiopia comprehensive specialized hospitals, 2022. Multi-center institution-based retrospective follow-up study. *BMC Pediatrics*, 23(1), 1–13. <https://doi.org/10.1186/s12887-023-04319-0>

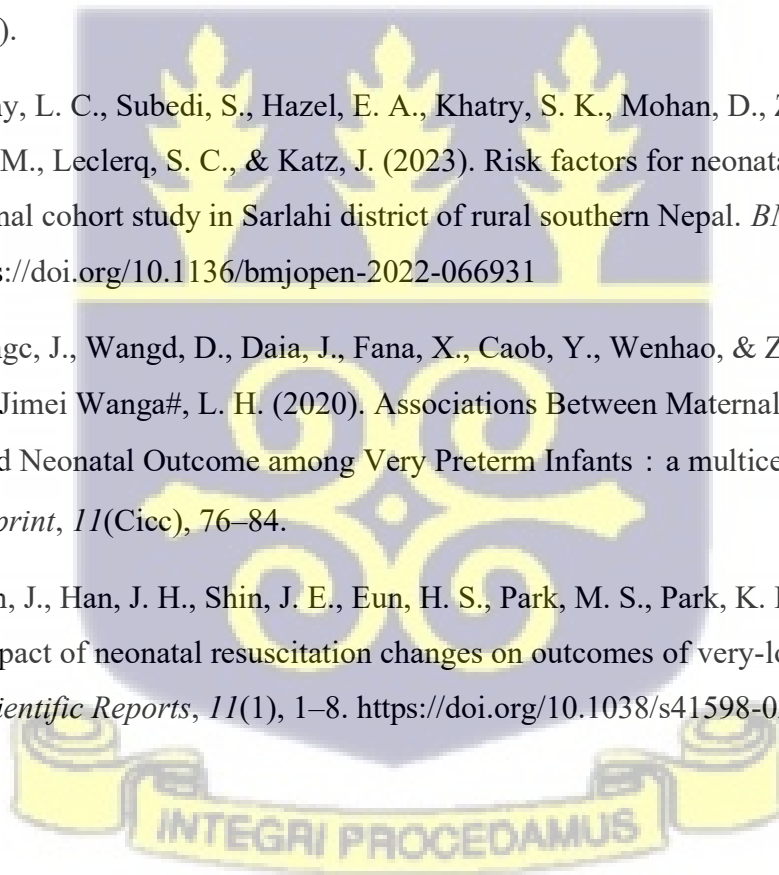
Workineh, Y., Semachew, A., Ayalew, E., Animaw, W., Tirfie, M., & Birhanu, M. (2020). Prevalence of perinatal asphyxia in East and Central Africa: systematic review and meta-analysis. *Heliyon*, 6(4). <https://doi.org/10.1016/j.heliyon.2020.e03793>

World Health Organization. (2023). World Health Statistics:Monitoring Health for the Sustainable Development Goals(SDGs). In *The Milbank Memorial Fund quarterly* (Vol. 27, Issue 2).

Yan, T., Mullany, L. C., Subedi, S., Hazel, E. A., Khatry, S. K., Mohan, D., Zeger, S., Tielsch, J. M., Leclercq, S. C., & Katz, J. (2023). Risk factors for neonatal mortality: An observational cohort study in Sarlahi district of rural southern Nepal. *BMJ Open*, 13(9), 1–15. <https://doi.org/10.1136/bmjopen-2022-066931>

Yanga, M., Yangc, J., Wangd, D., Daia, J., Fana, X., Caob, Y., Wenhao, & Zhou, c, Shoo K Lee, f, g, Jimei Wanga#, L. H. (2020). Associations Between Maternal Abortion History and Neonatal Outcome among Very Preterm Infants : a multicenter cohort study. *Preprint*, 11(Cicc), 76–84.

Yoon, S. J., Lim, J., Han, J. H., Shin, J. E., Eun, H. S., Park, M. S., Park, K. I., & Lee, S. M. (2021). Impact of neonatal resuscitation changes on outcomes of very-low-birth-weight infants. *Scientific Reports*, 11(1), 1–8. <https://doi.org/10.1038/s41598-021-88561-5>



APPENDICES

Appendix A: Consent Information for Participants

PARTICIPANT INFORMATION SHEET

Study Title: Predictors of neonatal mortality in the Tema Metropolis in the Greater Accra Region, Ghana, 2024.

INTRODUCTION: My name is Wisdom Adeapena, a Master of Philosophy in Applied Epidemiology and Disease Control student at the School of Public Health, University of Ghana. My background is in public health and I am currently resident in Tema. My email is adeapenadalmeida@gmail.com and Mobile number is 0240713888.

Background and purpose: A neonatal death is the death of a live newborn in the first 28 days of life (including perinatal). Over 80% of these deaths occur in developing countries like Ghana. Neonatal mortality in Ghana remains high but majority of these deaths remain unexplained. Although some studies have been done in the developed world in relation to neonatal mortality, limited studies have been done in the Ghanaian context. This study may help us to know the determinants of neonatal deaths and make recommendations to improve the data and use the data for policy formulation.

Nature of research: You are being invited to participate in the study together with 158 other people, some will be selected as cases and others as controls. You are being requested to participate because you delivered your last pregnancy at the Tema General Hospital and your baby meets our selection criteria. If you agree to participate in this study, I will ask you a few questions centered on your last pregnancy and childbirth.

Participants involvement: Participating in this study is entirely voluntary. You have the right to refuse to participate and this will not affect your rights in any way, especially to your healthcare. You are also at liberty to withdraw from this study at any stage of your participation. I would like to see you participate to the end. This will take about 20 to 30 minutes of your time.

Potential risks and Benefits: There are no direct benefits or risks in participating. You will not be paid or compensated for your participation. However, the info that the study will come out with, will help us to understand the factors associated with neonatal mortality in Tema General Hospital and the entire Greater Accra Region. The questions are not very sensitive. However,

whenever you feel uncomfortable answering some of them, you may choose not to answer them.

Confidentiality: All the info collected from you will be treated strictly confidential and will be used for the intended purpose only. You will not be identified by name in any dissemination reports or publications resulting from this study.

Voluntary participation: Participation is voluntary, and you have the right to decline to participate and withdraw from the study at any time without penalty and without having to give any reasons.

Feedback to participant: Feedback in a form of a short summary report, and an article will be shared with the management of the hospital.

Funding information: This is a self funded study. All cost will be borne by the principal investigator.

A copy of the Information sheet and Consent form will be given to you after it has been signed or thumb-printed to keep.

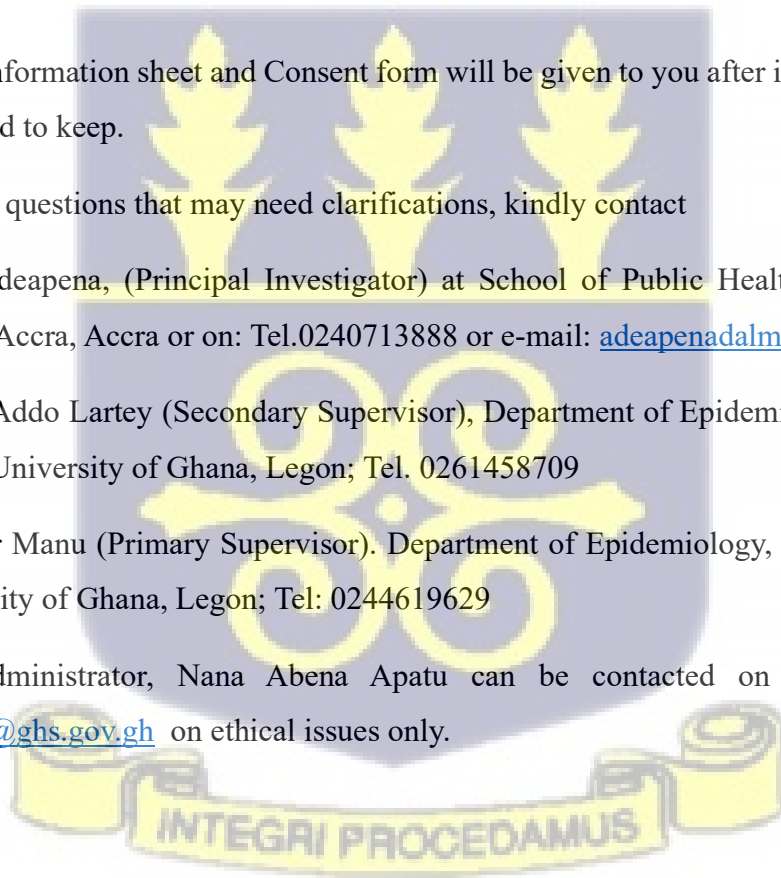
If you have any questions that may need clarifications, kindly contact

Mr. Wisdom Adeapena, (Principal Investigator) at School of Public Health, University of Ghana, Legon, Accra, Accra or on: Tel.0240713888 or e-mail: adeapenadalmeida@gmail.com

Dr. Adolphina Addo Larney (Secondary Supervisor), Department of Epidemiology, School of Public Health, University of Ghana, Legon; Tel. 0261458709

Prof. Alexander Manu (Primary Supervisor). Department of Epidemiology, School of Public Health, University of Ghana, Legon; Tel: 0244619629

GHS ERC Administrator, Nana Abena Apatu can be contacted on 0503539896 at ethics.research@ghs.gov.gh on ethical issues only.



Participant Consent Form

STUDY TITLE: Predictors of Neonatal Mortality in the Tema General Hospital.

PARTICIPANTS' STATEMENT

I acknowledge that I have read or have had the purpose and contents of the participants' Information Sheet read and all questions satisfactorily explained to me in a language I understand. I fully understand the contents and any potential implications as well as my right to change my mind (i.e. withdraw from the research) even after I have signed this form.

I voluntarily agree to be part of this research.

Name of Participant.....

Participants' SignatureOR Thumb Print.....

Date:

INTERPRETERS' STATEMENT

I interpreted the purpose and contents of the Participants' Information Sheet to the afore named participant to the best of my ability in the language to her proper understanding.

All questions, appropriate clarifications sort by the participant and answers were also duly interpreted to his/her satisfaction.

Name of Interpreter.....

Signature of Interpreter..... OR Thumb Print

Date:



STATEMENT OF WITNESS

I was present when the purpose and contents of the Participant Information Sheet was read and explained satisfactorily to the participant in the language she understood. I confirm that she was given the opportunity to ask questions/seek clarifications and same were duly answered to his/her satisfaction before voluntarily agreeing to be part of the research.

Name:

Signature..... OR Thumb Print

Date:

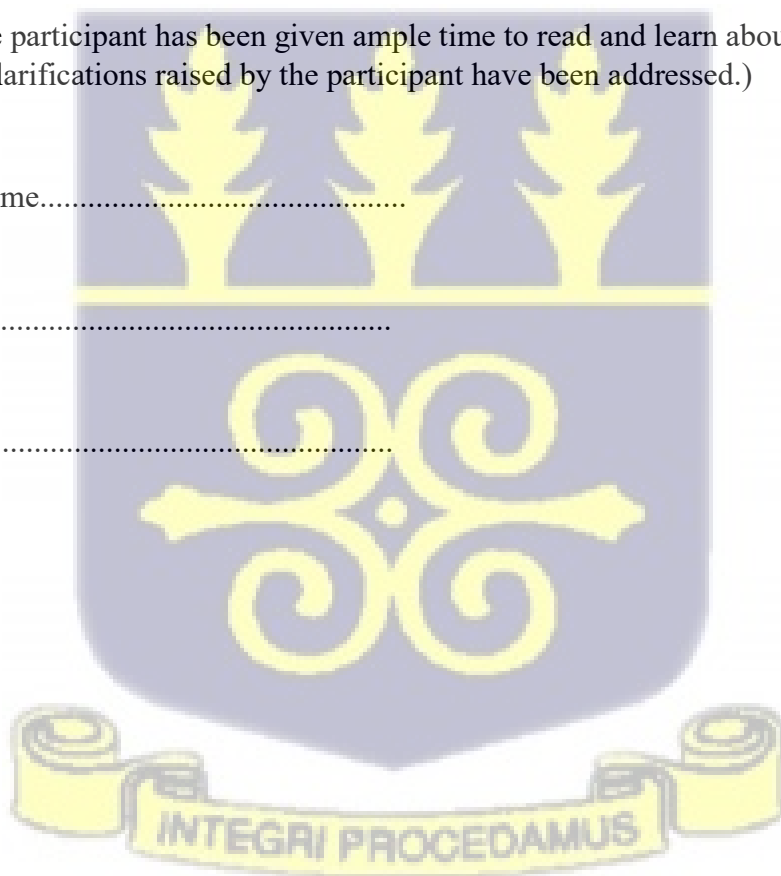
INVESTIGATOR STATEMENT AND SIGNATURE

I certify that the participant has been given ample time to read and learn about the study. All questions and clarifications raised by the participant have been addressed.)

Researcher's name.....

Signature

Date.....



Variable tables

Table 9: The independent variables of neonatal mortality

Socio-demographic factors	Maternal Factors	Fetal/Neonatal Factors	Delivery related Factors
*Mother's age	*Parity	* Number of babies delivered	* Onset of labour
* Mother's educational status	* Birth interval	* Birth defect or birth injury	* Mode of delivery
* Mother's Marital status	* History of still births	* Sex of the baby	* Aggressive resuscitation of baby
* Mother's Occupation	* History of early neonatal/Late death	* Birth weight	
* Father's educational status		* Gestational age at birth	
* Father's Occupation	* History of abortions		
* Religion	*Obstetric complications		
	* Maternal infections		
	*Hypertension		
	*Physical or sexual Assault		
	*Number of ANC visits		
	*Use of Herbal medicine		
	*ITN use		



Table 10: Operational definitions, data source and measurement scales for socio-demographic variables.

Variable	Definition	scale	Data source
Mothers' Age	Mother's age at childbirth -the age (in years) of a mother as at last birthday: <20,20-34,35+	Nominal	ANC/NICU book interview
Mother's educational status	Mother's highest of education or school completed: No Schooling, Primary/JHS, Secondary/SHS, Tertiary	Ordinal	Interview
Marital status	Mother's legal marital status: Single, Married, Separated	Nominal	Interview
Occupation	Mother's principal work or business, especially as a means of earning a living: Farming, Trader/businesswoman, Artisan, Gov. work/private formal job, housewife, unemployed	Nominal	Interview
Father's educational status	Father's highest of education or school completed: No Schooling, Primary/JHS, Secondary/SHS, Tertiary	Ordinal Interview	Interview
Father's occupation	Father's principal work or business, especially as a means of earning a living: Farming/fishing, Trader/businessman, Artisan, Gov. work/private formal job, unemployed	Nominal	Interview
Religion	Christian Muslim Traditionalist Atheist	Nominal	Interview



Table 11: The operational definitions, measurement scales and data sources for the maternal independent variables.

Variable	Definition	scale	Data source
Parity	The number of pregnancies carried to viable gestational age (>27 completed weeks and delivered dead or alive before index pregnancy: 0, 1 – 3, 4+	Nominal	ANC/NICU book Interview
Birth interval	The period, in years, between the delivery/birth from the index pregnancy and that from the preceding pregnancy: < 2, 2+, N/A	Binary	Interview
History of still birth	Any previous fetal death at 28 weeks gestation or more with no signs of life at birth: Yes, No, N/A	Binary	Interview
History of neonatal death	Any previous death of a live newborn at or before 28 days of life: Yes, No, N/A	Binary	Interview
History of abortions	Any previous spontaneous or induced termination of pregnancy before viable gestational age (before 28 weeks): Yes, No	Binary	ANC book Interview
Obstetric complications	The complications that directly arise from the pregnancy: Yes, No	Binary	ANC/NICU book Interview
Infection	Any infection presents during the index pregnancy: Yes, No	Binary	ANC book Interview



Table 12: The operational definitions, measurement scales and data sources for the maternal independent variables.

Variable	Definition	Scale	Data source
Hypertension	A mother suffering from Hypertension during pregnancy: Yes, No	Binary	ANC book Interview
Gestational age at booking	The age of a pregnancy, in weeks, at the first antenatal visit, where the origin is from woman's last normal menstrual period (LMP):	Ordinal	ANC book
Number of antenatal visits	The number routine visits to the antenatal clinic: 0, 1 – 3, 4 – 7, 8+	Ordinal	ANC book
Bed net usage	A mother usually sleeping under long lasting insecticide treated bed net during the period of the index pregnancy: Yes, No	Binary	ANC book Interview

Table 13: The operational definitions, measurement scales and data sources for the neonatal independent variables.

Variable	Definition	scale	Data source
Sex of baby	Sex of the baby at birth: Male, Female	Nominal	ANC/NICU card Interview
Gestational age	The age of a pregnancy, in weeks, at birth, where the origin is from woman's last normal menstrual period (LMP): 40	Ordinal	ANC/NICU book
Number of babies delivered (singleton or Multiple)	Whether baby is a singleton or are twins, triplets or more: Multiple, Singleton	Binary	ANC.NICU book Interview
Birth weight	The weight of the baby at birth in kilograms as determined using a measuring scale:	Ordinal	ANC/NICU book
Birth defect	A physical defect present in a baby at birth or an injury sustained during delivery: Yes, No	Binary	ANC/NICU book

Table 14: The operational definitions, measurement scales and data sources for the delivery related independent variables.

Variable	Definition	scale	Data source
Mode of delivery	How baby was delivered or the type of delivery process: Vaginal delivery, Caesarean section	Nominal	AND book
Aggressive resuscitation	Whether or not baby required aggressive suctioning and ventilation with or without chest compression.: Yes, No	Binary	AND book
Onset of labour	How labour started: Spontaneous, Induction, Caesarean section	Nominal	Interview/ AND book



Appendix B: QUESTIONNAIRE

STUDY TITLE: PREDICTORS OF NEO-NATAL MORTALITY IN THE
TEMA METROPOLIS IN THE GREATER ACCRA REGION OF GHANA, 2024.

Participant ID:

Interviewer ID:

Date of Completion of form:

Please record the data as per questions in the spaces provided or choose from the options.
provided.

1. Date of delivery:

2. What is the outcome of delivery

a. Early neonatal death b. Late neonatal c. No neonatal death

A. SOCIO-DEMOGRAPHIC FACTORS

3. What was your age at delivery?

a. < 20 b. 20 – 34 c. 35+

4. What is mother's highest educational level?

a. No schooling b. Primary/JHS c. Secondary d. Tertiary

5. What is mother's marital status? a. Single b. Married c. Separated

6. What is mother's occupation?

a. Farming b. Trader/businesswoman c. Artisan d. Gov. work/private formal job
e. housewife f. unemployed

7. What is Father's highest educational level? a. No schooling b. Primary/JHS c. Secondary d. Tertiary

8. What is father's occupation? a. Farming/ fishing b. Trader/businessman c. Artisan d. Gov.work/private formal job e. Unemployed

9. What is mother's religion? A. Christian b. Muslim c. Traditionalist d. Atheist

B. MATERNAL FACTORS

10. How many children have you delivered (dead or alive) prior to this delivery?
a. 0 b. 1 – 3 c. 4+
11. How long (in years.) is your previous delivery (if the index is not the first)?
a. < 2 b. 2+ c. N/A
12. Have you had a previous still birth? a. Yes b. No c. N/A
13. Have you had a previous early neonatal death? a. Yes b. No c. N/A
14. Have you ever had an abortion or miscarriage? a. Yes b. No
15. Did you have any complications (obstetric – give examples) during pregnancy?
a. Yes b. No
16. Did you have any infection/illness during pregnancy? a. Yes b. No
17. Did you have Hypertension during pregnancy? a. Yes b. No
18. Were you physically or sexually abused during pregnancy? a. Yes b. No
19. How many weeks pregnant were you at the 1st ANC visit (please confirm)?
a. < 16 b. 17 – 27 c. 28+
20. How many times did you attend ANC (please confirm)?
a. 0 b. 1 – 3 c. 4 – 7 d. 8+
21. Were you sleeping under ITN during pregnancy? a. Yes b. No

C. FETAL/NEONATAL FACTORS

22. How many babies were delivered (index pregnancy)?
a. Singleton b. Multiple (if multiple state the number)
23. What is the sex of the baby? (*write sexes if multiple*)
a. Male b. Female
24. What was the gestational age (weeks) at delivery (explain)?
a. < 37 b. 37 – 38 c. 39 – 40 d. 40+
25. What was the birth weight (kilograms) of the baby?
a. < 2.5 b. 2.5 – 2.9 c. 3.0 – 3.9 d. 4.0+ e. Not weighed
26. Any birth defect present? a. Yes b. No

D. DELIVERY RELATED FACTORS

27. How did labour start? a. Spontaneous b. Induction c. Caesarean section

28. What was the mode of delivery? a. Spontaneous vaginal b. Instrumental c. Caesarean section

29. Was the baby aggressively resuscitated after delivery? a. Yes b. No



Investigators CV's

MR. WISDOM ADEAPENA			
Contact details:			
Kintampo Health Research Centre		Telephone: +233 24713888	
Ghana Health Service			
P. O. Box 200, Kintampo, Bono East Region, Ghana		Email: adeapenadalmeida@gmail.com	
Languages: English-professional working proficiency, French-Basic, Ewe & Twi proficiency			
Academic Qualifications:			
Year	Institution	Discipline	Degree
2022-2024	University of Ghana (Ongoing)	Applied Epidemiology and disease and control	MPHIL
2022-2024	GFELT (Ongoing)	Field Epidemiology and Laboratory Training Program	Competency Certificate.
2021	University of Washington, DC	Epidemiology in Global Health	Cert.
2017	Catholic University of Ghana.	Public Health	BSc.
2013	St. Peter's Senior High School	General Science	WASSC
Skills			
Survey solutions, Openhds, QGIS, STATA, Microsoft Office Suite: Excel, PowerPoint, Word, Operational Research, EPI Info, EPI data, Proposal, and manuscript writing, surveillance system evaluation.			
Areas of research:			
Epidemiology of Infectious diseases – Malaria, NTDs, Antimicrobial resistance, Population health, Maternal and Child health, Coronavirus, Implementation research.			
Academic & professional posts:			
Period	Position		
2021 till Date	Secretary, Scientific Technical Meetings, Kintampo Health Research Centre.		
2018 till Date	Research Officer, Kintampo Health Research Centre		
2017 - 2018	National Service Personnel- Kintampo Health Research Centre.		
2016 - 2017	Public Relations Officer, Faculty of Public Health, and Allied Sciences, CUCG.		
2015 - 2017	Chairman- Electoral Commission, Catholic University College of Ghana-SRC		
Research experience			

Date	Role	Name of	
2019 to 2021	Principal Investigator	A descriptive study to assess the use of antibiotics in rural veterinary service (ABVET).	
2017 till date	Project Coordinator	Health and Demographic Surveillance System.	
2020	Research officer	Covid -19 Community-based Health Planning and Services	
April to May 2018	Research Officer	National CHPs' Verification Survey	
2017 to 2018	Research Officer	Antibiotic Access and use at the community level (ABACUS).	
2017 to 2018	Project Coordinator	Every Newborn Action Plan (ENAP)- EN-INDEPTH study	
Selected research grants:			
Title	Period	Role	Name of funder
Assessing antibiotic use in a municipal Veterinary clinic in rural Ghana.	2019 – 2021	Principal Investigator	WHO TDR Structured Operational Research Training Program (SORT-IT).
Selected publications			
2024	Edward Anane Apraku, Sulemana Watara Abubakari, Richard Joshua Tetteh, Samuel Afari-Asiedu, Ekow Samuel Harrison, Francis Agbokey, Solomon Nyame, Mieks Frenken Twumasi, Wisdom Adeapena , Charles Zandoh, Livesy Naafoe Abokyi, Lawrence Gyabaa Febir, Kwaku Poku Asante. Impact of the COVID-19 pandemic on handwashing practices among community members in the middle belt of Ghana: evidence from a cross-sectional study. Volume 47, Article 122, 19 Mar 2024. 10.11604/pamj.2024.47.122.37914. https://www.panafrican-med-journal.com/content/article/47/122/full/#		
2023	Kubasari, C.; Adeapena, W. ; Najjemba, R.; Hedidor, G.K.; Adjei, R.L.; Manu, G.; Timire, C.; Afari-Asiedu, S.; Asante, K.P. Quality of Data Recording and Antimicrobial Use in a Municipal Veterinary Clinic in Ghana. <i>Trop. Med. Infect. Dis.</i> 2023 , 8, 485. https://doi.org/10.3390/tropicalmed8110485		
2022	Ohene Larbi R, Wisdom Adeapena , Ayim-Akonor M, Ansa E.D.O, Tweya H, Terry R.F, Labi A.-K, Harries A.D. Antimicrobial, Multi-Drug and Colistin Resistance in Enterobacteriaceae in Healthy Pigs in the Greater Accra Region of Ghana, 2022: A Cross-Sectional Study. <i>Int. J. Environ. Res. Public Health</i> 2022 , 19, 10449. https://doi.org/10.3390/ijerph191610449		

2022	Hawa Ahmed, Maria Zolfo, Anita Williams, Jacklyne Ashubwe-Jalemba, Hannock Tweya, Wisdom Adeapena , Appiah-Korang Labi, Lady A. B. Adomako, Gloria N. D. Addico, Regina A. Banu, Mark O. Akrong, Gerard Quarcoo, Selorm Borbor and Mike Y. Osei-Atweneboana. Antibiotic-Resistant Bacteria in Drinking Water from the Greater Accra Region, Ghana: A Cross- Sectional Study, December 2021–March 2022. Int. J. Environ. Res. Public Health 2022 , 19.
2021	Wisdom Adeapena , Samuel Afari-Asiedu, Robinah Najjemba, Johan van Griensven, Alexandre Delamou, Kwame Ohene Buabeng and Kwaku Poku Asante. Antibiotic use in a municipal veterinary clinic in Ghana. Trop. Med. Infect. Dis. 2021, 6(3), 138; https://doi.org/10.3390/tropicalmed6030138
2020	Yeetey Akpe Kwesi Enuameh, Francis Dzabeng, Hannah Blencowe, Sanne M. Thysen, Solomon Mekonnen Abebe, Kwaku Poku Asante, Charlotte Tawiah, Vladimir Sergeevich Gordeev, Wisdom Adeapena , Doris Kwesiga, Simon Kasasa, Charles Zandoh, Md. Ali Imam, Seeba Amenga-Etego, Sam K. Newton, Seth Owusu-Agyei, Joy E. Lawn, Peter Waiswa, Jenny A. Cresswell & the Every Newborn-INDEPTH Study Collaborative Group, Termination of pregnancy data completeness and feasibility in population-based surveys: EN-
2020	Understanding the context of death of under-five mortalities in rural Ghana using verbal postmortem (in press).
Conferences, Workshops and Short courses	
June 2023	WHO TDR/ Structured Operational Research Training on antimicrobial resistance, Kathmandu, Nepal.
March 2023	Infodemic management, WHO- Health Emergency Programme
May 2022	Implementation Research, WHO/TDR. Sierra Leone
January, 2021	Epidemiology for Global Health, University of Washington
November, 2021	Research dissemination, WHO
January, 2020	Capacity building by Axis Human Capital led by Dr. Esi Ansah.
Sept., 2019	WHO TDR/ Structured Operational Research Training on antimicrobial resistance, Entebbe Uganda.
June, 2019	Training on QGIS and R software packages, Kintampo Health Research Centre
December, 2018	Proposal and Manuscript Writing, Kintampo Health Research Centre
October 2016.	Planned Parenthood Association of Ghana (Youth Action Movement) Training workshop in Life Planning Skills (LPS) and Sexual Reproductive Health and Rights.
March, 2016	NIH (National Institutes of Health, Extramural research) Web-based training course “Protecting Human Research Participants”.

February, 2016	Malnutrition e-learning Certificate (University of Southampton). Online course.
Sept. 2018	Ethical Principles in Health Research, Kintampo Institutional Ethics Committee
Membership	
2018 till Date	Member, Scientific Review Committee, Kintampo Health Research Centre
2019 till Date	Fellow, OR Network under the Global WHO SORT/IT partnership
2019 till Date	Member, Allied Health Professional Council of Ghana.
2020 till Date	Member, International Society for Infectious Diseases (ISID)
2021	Member, American Society of Tropical Medicine, and Hygiene (ASTMH)
2016 till Date	Member, Planned Parenthood Association of Ghana, Youth Action Movement.
2013 till Date	Member, PERSCOB
Awards	
2021	Meritorious Award: Best Research Officer, Kintampo Health Research Centre.
2018	Meritorious Award: Best Research Officer, Kintampo Health Research Centre.
Referee	
Dr. Kwaku Poku Asante, Director, Kintampo Health Research Centre, Bono East Region, Ghana. Tel: +233 208956598, E-mail: kwakupoku.asante@kintampo-hrc.org Dr. Yeetey Enuameh, Head of Department, Department of Epidemiology and Biostatistics, School of Public Health, Kwame Nkrumah University of Science and Technology, Ghana. Tel: +233 208113713/+24 4366662, E-mail: yeetey@gmail.com	



BIOGRAPHICAL SKETCH

NAME: Adolphina Addoley Addo-Lartey

eRA COMMONS USER NAME (credential, e.g., agency login): AADDO-LARTEY

POSITION TITLE: Senior Lecturer, Dept. of Epidemiology & Disease Control, Univ. of Ghana, Legon

EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
University of Massachusetts, Amherst, MA, USA	PhD	09/2014	Public Health
Iowa State University, Ames, IA, USA	MS	05/2006	Human Nutrition
University of Ghana, Legon, Ghana	BSc	05/2003	Biochemistry & Nutrition

A. Personal Statement

I am Public Health Epidemiologist whose research primarily focuses on epidemiological studies in women's health. I have done extensive research in the area of maternal and child health, nutritional factors associated with disease outcome (HIV infection), healthcare accessibility and the social support aspect of healthcare delivery, as well as gender and health issues in Ghana. I have expertise in research methods including research design, data collection and management, and statistical analysis for epidemiological studies.

Currently, I am a senior lecturer at the University of Ghana's School of Public Health, where I teach and mentor undergraduate and postgraduate students in the Department of Epidemiology and Disease Control. I am also an adjunct faculty at the NYU College of Global Public Health where I mentor graduate students on their thesis and also teach courses on Assessment of Community Health Needs and Resources, Research Methods in Public Health, and Advanced Epidemiology.

B. Positions and Honors

Positions/Employment

- New York University, NY, USA 2016 – now

Adjunct faculty at College of Global Public Health (NYU, New York)

- Department of Epidemiology and Disease Control, University of Ghana, Legon 2015 – now

Position: Senior Lecturer

Course: EPDC 662, Design and Analysis of Epidemiological Studies

Course: EPDC 653, Basic Statistics for Clinical Trials

Course: EPDC 601, Epidemiological Research Methods

Course: EPDC 602, Advanced Epidemiology

Course: BSTT 603, Research Methods in Public Health

Course: GSPH 214, Writing for Public Health

Course: GSPH 203, Epidemiology Principles and Methods

*SPH Course: Introduction to Stata (graduate students' workshop - taught each semester)

- Department of Nutrition, University of Massachusetts, Amherst, MA, U.S.A. 2010 - 2014

Project Assistant (Supervisor: Lisa Sullivan-Werner, Director)

UMass Extension Nutrition Education Program

- Department of Nutrition, University of Massachusetts, Amherst, 2010 - 2012

Guest Lectures (Undergrad & Graduate level)

- Department of Nutrition, University of Massachusetts, Amherst, MA, U.S.A 2009 - 2010

Research Assistant (Supervisor: Dr. Loraine Cordeiro)

- Department of Nutrition, University of Massachusetts, Amherst, MA, U.S.A 2008 - 2010

Teaching Assistant

- Department of Nutrition and Food Science, University of Ghana, Legon 2006 - 2008

Assistant Data Analyst / Manager, Research to Improve Infant Nutrition and Growth (RIING) Project

Principal Investigators: Professors Grace Marquis, Rafael Perez-Escamilla, Anna Lartey, Robert Mazur

- Department of Nutrition and Food Science, University of Ghana, Legon 2007– 2008

Part-time Lecturer

- Department of Food Science and Human Nutrition, Iowa State University, IA, U.S.A 2004 - 2006

Research Assistant (Supervisor: Prof. Grace Marquis)

- Department of Nutrition and Food Science, University of Ghana, Legon 2003 - 2004

Teaching Assistant (National Service Fulfilment)

- Department of Nutrition and Food Science, University of Ghana, Legon 2002 - 2003

Research Assistant (Supervisor: Prof. Grace Marquis)

- Department of Nutrition and Food Science, University of Ghana, Legon 2002 - 2003

Research Assistant (Supervisor: Prof. Anna Larrey)

Honors

FELLOWSHIPS, SCHOLARSHIPS & AWARDS

Graduate / Post Graduate Academic Excellence

- Virginia Beal Fellowship 2010 – 2011

(Department of Nutrition, University of Massachusetts, Amherst, MA, U.S.A.)

- Virginia Beal Scholarship 2009 - 2010

(Department of Nutrition, University of Massachusetts, Amherst, MA, U.S.A.)

- International Doctoral Fellowship 2008 -2009

(Funds provided by American Association of University Women, Washington, DC, U.S.A.)

- Masters Fellowship 2004 - 2006

(Funds provided by National Institute of Child Health and Development (NICHD)

and the National Institutes of Health (NIH). Oversight provided by: Research to Improve Infant

Nutrition and Growth, Dept. of Food Science & Human Nutrition, Iowa State University, Ames, IA, U.S.A.)

- 3rd place, Norman Borlaug graduate level poster competition 2005

(Iowa State University, Ames, IA, U.S.A.)

Undergraduate Academic Excellence, University of Ghana, Legon

- Akuaba Prize, best graduating student in Public Health 2003
- Volta Hall Award, best graduating science student 2003
- Coca-Cola Student Representative Council Excellence Award, 2002

Best science student (Level 200)

Other Experience/Professional Memberships

LEADERSHIP & SERVICE

University of Ghana, Legon

- External Examiner Ensign Global College - Public Health 2023 - now
- Examination Officer Dept of Epidemiology and Disease Control 2019 - now
- Coordinator MSc Clinical Trials/ MPhil Applied Epidemiology and Disease Control 2016 - now

- Committee Member Graduate admissions committee (Dept EPDC, SPH) 2016 - now
- Coordinator MSc Clinical Trials & MPhil Applied Epidemiology and Disease Control 2016 - now
- Committee Member Teaching Assessment Committee (Dept EPDC & Biostatistics, SPH) 2016 – 2022
- Fellow of Volta Hall, University of Ghana, Legon - 2015 – now

PEER REVIEWER (Scientific Journals)

- Journal of Human Nutrition and Dietetics 2013 - now
- BMC Nutrition 2017 - now
- BMC Public Health 2017 – now
- Global Health Action 2018 – now
- Journal of Advanced Nursing 2022 - now

PROFESSIONAL AFFILIATIONS

- Ghana Nutrition Association (GNuTA)
- American Society for Nutrition (ASN)
- Society for Epidemiologic Research (SER)
- National Scholars Honor Society, USA

C. Contribution to Science

Published Journal Articles

1. Addo-Lartey AA, Bonful HA, Sefenu RS, Awua AK, Bando DA, Asamoah A, Adu-Aryee NA, Dedey F, Adanu RMK, Okuyemi

KS. Effectiveness of a culturally tailored text messaging program for promoting cervical cancer screening in accra, Ghana: a

quasi-experimental trial. Health BMC Women's Health 24 (1), 1-15

2. Longla TA, Ogum-Alangea D, Addo-Lartey A, Manu AA, Adanu RMK. Male characteristics and contraception in four districts

of the central region, Ghana. Contracept Reprod Med. 2023 Aug 25;8(1):45. doi: 10.1186/s40834-023-00245-9. PMID:

37620867.

3. Ramsoomar L, Gibbs A, Chirwa ED, Machisa MT, Alangea DO, Addo-Lartey AA, Dunkle K, Jewkes R. Pooled analysis of the

association between mental health and violence against women: evidence from five settings in the Global South. BMJ Open.

2023 Mar 15;13(3):e063730. doi: 10.1136/bmjopen-2022-063730. PMID: 36921941; PMCID: PMC10030569.

4. Jewkes R, Chirwa E, Alangea DO, Addo-Lartey A, Christofides N, Dunkle K, Ramsommar L, Gibbs A. Pooled analysis of the

association between food insecurity and violence against women: Evidence from low- and middle-income settings. *J Glob*

Health. 2023 Mar 10;13:04021. doi: 10.7189/jogh.13.04021. PMID: 36896806; PMCID: PMC9999307.

5. Agbemaflle EE, Addo-Lartey A, Odikro MA, Frimpong JA, Kubio C, Ameme DK, Sackey SO, Bonful HA. Adherence to the test,

treat and track strategy for malaria control among prescribers, Mfantseman Municipality, Central Region, Ghana. *PLoS One*.

2023 Feb 21;18(2):e0279712. doi: 10.1371/journal.pone.0279712. eCollection 2023.

6. Noora CL, Manu A, Addo-Lartey A, Mohammed AG, Ameme DK, Kenu E, Torpey K, Adanu R. Incidence and determinants of

maternal sepsis in Ghana in the midst of a pandemic. *BMC Pregnancy Childbirth*. 2022 Nov 23;22(1):864. doi: 10.1186/s12884-

022-05182-0.

7. Bansah EC, Adanu KK, Adedia D, Addo-Lartey AA*. Surgical provider-reported reasons for utilization of the World Health

Organization's Surgical Safety Checklist at a tertiary hospital in Ghana. *PLOS Glob Public Health* 3(1): e0001143.

<https://doi.org/10.1371/journal.pgph.0001143>

8. Claude Romaric Pingdwindé Ouédraogo JCRP, Anto F, Addo-Lartey AA*. Factors determining preventive chemotherapy

uptake against soil-transmitted helminthiasis among school-age children in Ghana. *Parasitology Research* 2022.

<https://doi.org/10.1007/s00436-022-07691-5>

9. Nuvey FS, Nortey PA, Addo KK, Addo-Lartey A, Kreppel K, Hounghbedji CA, Dzansi G and Bonfoh B (2022) Farm-related

determinants of food insecurity among livestock dependent households in two agrarian districts with varying rainfall patterns in

Ghana.*Front. Sustain. Food Syst*.6:743600. <https://doi.org/10.3389/fsufs.2022.743600>

10. Anaba EA, Alangea DO, Addo-Lartey A, Modey EJ, Manu A, Alor SK, Torpey K. Determinants of health facility delivery among

young mothers in Ghana; insights from the 2014 Ghana Demographic and Health Survey. *BMC Pregnancy Childbirth* 22, 656

(2022). <https://doi.org/10.1186/s12884-022-04985-5>

11. Abagre TA, Bando DA, Addo-Lartey AA*. Determinants of metabolic syndrome among patients attending diabetes clinics in

two sub-urban hospitals: Bono Region, Ghana. *BMC Cardiovasc Disord.* 2022 Aug 10;22(1):366. doi: 10.1186/s12872-022-

02805-4.

12. Bonful HA, Addo-Lartey AA*, Sefenu RS, Nwameme A, Abagre TA, Awua AK, Adu-Aryee NA, Dedey F, Adanu RMK, Okuyemi

KS. Developing a culturally tailored short message service (SMS) intervention for improving the uptake of cervical cancer

screening among Ghanaian women in urban communities. *BMC Women's Health* (2022) 22:154

<https://doi.org/10.1186/s12905-022-01719-9>

13. Aflakpui PE, Bando DA, Kploatanyi EE, Kenu E, Addo-Lartey AA*. Prevalence and factors associated with low medication

adherence among Type 2 Diabetic patients attending diabetic clinic at the Tema general hospital, Ghana. *Journal of Interventional Epidemiology and Public Health.* 2022; 5:4. Available online at: <https://www.afenetjournal.net/content/article/5/4/full>

14. Afari BA, Enos JY, Alangea DO, Addo-Lartey A, Manu A. Predictors of HIV testing among women experiencing intimate partner violence in the Central Region of Ghana. *PLOS Glob Public Health* 2022;2(5): e0000376. <https://doi.org/10.1371/journal.pgph.0000376>

15. Hornuvo R, Addo-Lartey A, Alangea DO, Dako-Gyeke P. Using the Theoretical Framework of Acceptability for qualitative assessment of the "COMBAT" VAW intervention in Ghana. *PLOS Glob Public Health* 2022;2(5): e0000269. <https://doi.org/10.1371/journal.pgph.0000269>

16. Sikweyiya Y, Stern E, Hanass-Hancock J, van der Heijden I, Myrtilinen H, Addo-Lartey AA, Dunkle K. Intersections between disability, masculinities, and violence: experiences and insights from men with physical disabilities from three African countries. *BMC Public Health* 22, 705 (2022). <https://doi.org/10.1186/s12889-022-13137-5>

17. Kangbai DM, Bando DA, Manu A, Kangbai JY, Kenu E, Addo-Lartey A*. Socio-economic determinants of maternal health care utilization in Kailahun District, Sierra Leone, 2020. *BMC Pregnancy Childbirth* 22, 276 (2022). <https://doi.org/10.1186/s12884-022-04597-z>

18. Kargbo DK, Nyarko K, Sackey S, Addo-Lartey A, Kenu E, Anto F. Determinants of low birth weight deliveries at five referral hospitals in Western Area Urban district, Sierra Leone.

Ital J Pediatr. 2021 Oct 28;47(1):212. doi: 10.1186/s13052-021-01160-y. PMID: 34711248; PMCID: PMC8554995.

19. Nuvey FS, Addo-Lartey A, Nortey PA, Addo KK, Bonfoh B. Coping with Adversity: Resilience Dynamics of Livestock Farmers in Two Agroecological Zones of Ghana. *Int. J. Environ. Res. Public Health* 2021, 18, 9008. <https://doi.org/10.3390/ijerph18179008>

20. Anaba EA, Manu A, Ogum-Alangea D, Modey EJ, Addo-Lartey A, Torpey K. Young people's attitudes towards wife-beating: Analysis of the Ghana demographic and health survey 2014. *PLoS One*. 2021 Feb 2;16(2): e0245881. doi: 10.1371/journal.pone.0245881. PMID: 33529235; PMCID: PMC7853453.

21. Lartey M, Frimpong-Manso S, Banahene PS, Addo-Lartey A, Okine NNA, Boamah D, Mohammed AAR. Heavy metal constituent of medicinal plants: a case study of *Moringa oleifera* Lam. from selected areas in Accra, Ghana. *HSI Journal* (2021) Volume 2 (Issue 1): <https://doi.org/10.46829/hsijournal.2021.6.2.1.181-188>

22. Osei JY, Nortey PA, Bandoh DA, Kenu E, Addo-Lartey AA*. Adverse drug reaction reporting by community pharmacists in the Greater Accra Region of Ghana, 2016. *Ghana Med J* 2020; 55(1): 9-17 doi: <http://dx.doi.org/10.4314/gmj.v55i1.3>

23. Nuoh RD, Nyarko KM, Noora CL, Addo-Lartey A*, Nortey P, Nuolabong C, Lartey M, Kenu E. Barriers to early infant diagnosis of HIV in the Wa Municipality and Lawra District of Upper West Region, Ghana. *Ghana Med J* 2020; 54(2) supplement: 83-90 DOI: <http://dx.doi.org/10.4314/gmj.v54i2s.13>

24. Abdulai M, Kenu E, Ameme DK, Bandoh DA, Tabong PT, Addo Lartey A, Noora CL, Adjei EY, Nyarko KM. Demographic and socio-cultural factors influencing contraceptive uptake among women of reproductive age in Tamale Metropolis, Northern Region, Ghana. *Ghana Med J* 2020; 54(2) supplement: 64-72 DOI: <http://dx.doi.org/10.4314/gmj.v54i2s.11>

25. Dadzie D, Addo-Lartey AA*, Peprah NY, Kenu E. Evaluation of surveillance system for pneumonia in children below five years, Tema Metropolis, Ghana, 2012 – 2016. *Ghana Med J* 2020; 54(2) supplement: 11-17 DOI: <http://dx.doi.org/10.4314/gmj.v54i2s.3>

26. Bonful HA, Addo-Lartey A, Aheto JMK, Ganle JK, Sarfo B, Aryeetey R. Limiting spread of COVID-19 in Ghana: Compliance audit of selected transportation stations in the Greater Accra region of Ghana. *PLoS One*. 2020 Sep 11;15(9): e0238971. doi:10.1371/journal.pone.0238971. eCollection 2020.

27. Stern E, Willan S, Gibbs A, Myrntinen H, Washington L, Sikweyiya Y, Addo-Lartey A, Mastonshoeva S, Jewkes R. Pathways of change: qualitative evaluations of intimate partner violence prevention programmes in Ghana, Rwanda, South Africa and Tajikistan. *Cult Health Sex.* 2021 Dec;23(12):1700-1716. doi: 10.1080/13691058.2020.1801843. Epub 2020 Sep 8.

28. Poku SA, Bandoh DA, Kenu E, Kploanyi EE, Addo-Lartey AA*. Factors contributing to road crashes among commercial vehicle drivers in the Kintampo North Municipality, Ghana in 2017. *Ghana Med J* 2020; 54(3): 132-139 doi: <http://dx.doi.org/10.4314/gmj.v54i3.2>

29. Nuvey FS, Kreppel K, Nortey PA, Addo-Lartey A, Sarfo B, Fokou G, Ameme DK, Kenu E, Sackey S, Addo KK, Afari E, Chibanda D, Bonfoh B. Poor mental health of livestock

farmers in Africa: a mixed methods case study from Ghana. BMC Public Health. 2020 Jun 1;20(1):825. doi: 10.1186/s12889-020-08949-2.

30. Sikweyiya Y, Addo-Lartey AA, Ogum Alangea D, Dako-Gyeke Phyllis, Chirwa ED, Coker-Appiah D, Adanu RMK, Jewkes R. Patriarchy and gender-inequitable attitudes as drivers of intimate partner violence against women in the Central Region of Ghana. BMC Public Health. 2020 May 13;20(1):682. doi: 10.1186/s12889-020-08825-z.

31. Ogum Alangea D, Addo-Lartey AA*, Chirwa ED, Sikweyiya Y, Coker-Appiah D, Jewkes R, Adanu RMK. Evaluation of the rural response system intervention to prevent violence against women: findings from a community-randomised controlled trial in the Central Region of Ghana. Glob Health Action. 2020; 13(1):1711336. doi: 10.1080/16549716.2019.1711336.

32. Kaburi BB, Ameme DK, Adu-Asumah G, Dadzie D, Tender EK, Addeh SV, Aryee T, Addo-Lartey A, Sackey SO, Wurapa F, Afari EA, Kenu E. Outbreak of scabies among preschool children, Accra, Ghana, 2017. BMC Public Health. 2019 Jun 13; 19(1):746. doi: 10.1186/s12889-019-7085-6.

33. Addo-Lartey AA, Ogum Alangea D, Sikweyiya Y, Chirwa ED, Coker-Appiah D, Jewkes R, Adanu RMK. Rural Response System to Prevent Violence Against Women: Methodology for a Community Randomised Controlled Trial in Ghana. Glob Health Action. 2019; 12(1):1612604. doi: 10.1080/16549716.2019.1612604.

34. Dako-Gyeke P, Addo-Lartey AA*, Ogum Alangea D, Sikweyiya Y, Chirwa ED, Coker-Appiah D, Jewkes R, Adanu RMK. 'Small small quarrels bring about happiness or love in the relationships': Exploring community perceptions and gendered norms contributing to male perpetrated intimate partner violence in the Central Region of Ghana. PLoS ONE 2019 Nov 21; 14(11): e0225296. <https://doi.org/10.1371/journal.pone.0225296>.

35. Ogum Alangea D, Addo-Lartey AA*, Sikweyiya Y, Chirwa ED, Coker-Appiah D, Jewkes R, Adanu RMK. Prevalence and Risk Factors of Intimate Partner Violence among Women in Four Districts of the Central Region of Ghana: Baseline findings from a Cluster Randomised Controlled Trial PLoS One. 2018 Jul 19; 13(7):e0200874. doi: 10.1371/journal.pone.0200874.

36. Chirwa ED, Sikweyiya Y, Addo-Lartey AA, Ogum Alangea D, Coker-Appiah D, Adanu RMK, Jewkes R. (2018) Prevalence and risk factors of physical or sexual intimate violence perpetration amongst men in four districts in the central region of Ghana: Baseline findings from a cluster randomized controlled trial. PLoS One. 2018 Mar 9; 13(3):e0191663. doi: 10.1371/journal.pone.0191663.

37. Senya KY, Ibrahim A, Lindong I, Addo-Lartey A. Use of Smartphone applications for clinical decision-making in a poor country: an exploratory study of Smartphone use among medical practitioners in Ghana. Glob Soc Welf. 2016. DOI 10.1007/s40609-016-0078-9. Glob Soc Welf. 2017, March 4(1):1–10

38. Addo AA; Marquis GS; Lartey AA; Pérez-Escamilla R; Mazur RE; Harding KB. Food insecurity and perceived stress but not HIV infection are independently associated with lower energy intakes among lactating Ghanaian women. Matern Child Nutr. 2011 Jan; 7(1): 80-91.

Book Chapter

o State of the Nation's Health Report. December 2018. University of Ghana, School of Public Health. Sub-Saharan Publishers. Chapter 4, Human Resources for Health. Pp 76-94. Available at <http://ugspace.ug.edu.gh/handle/123456789/30195>

Technical Reports

o Report on the burden of obstetric fistula in Ghana. Ghana Health Service. June 2015. Available at <http://ghana.unfpa.org/en/publications/report-burden-obstetric-fistula-ghana>

o Evaluation of the Rural Response System Intervention to Reduce Intimate Partner Violence in the Central Region of Ghana. April 2019. Available at <https://whatworks.co.za/resources/item/686-evaluation-of-the-rural-response-system-intervention-to-prevent-violence-against-women>

Ongoing and Completed projects:

- UNICEF, \$ 50, 000 2019 - 2022

Using Trials of Improved Practices to Strengthen Infant and Young Child Feeding Programming in Ghana. PI – Prof. Richmond Ayeetery, Amber Hromi-Fiedler.

o This is a 3-year research grant from UNICEF to strengthen infant and young child feeding practices in Ghana through the application of the trials of improved practices (TIPS) methodology to identify and counsel on best practices related to exclusive breastfeeding, meal frequency, and diet diversity. Counseling will utilize and strengthen IYCF and responsive feeding packages that are already in place emphasizing hands-on complementary feeding preparation, demonstrations, cultural beliefs surrounding infant feeding practices, and family and health system support, including fathers and other caregivers at home.

Role: Co-Investigator

- DFID UK & SAMRC , £ 604, 000, 2015 - 2019

Impact assessment of the rural response system to reduce violence against women in Ghana. Also known as the 'Ghana COMBAT Health Promotion Study' (Ghana CHiPS). PI – Prof. Richard Adanu

o This is a 3-year research grant funded by the UK Department for International Development (DFID) through the What Works to prevent violence against women program which is overseen by the South African Medical Research Council (SAMRC). The objective is to carry out an impact assessment of the rural response system to reduce violence against women in Ghana. Role:

Co-Principal Investigator

- Masonic Cancer Center (MCC), University of Minnesota (UMN), \$ 13, 000. 2016 - 2018

Effectiveness of a Culturally Tailored Text Messaging Program for Promoting Breast and Cervical Cancer Screening in Accra, Ghana: Randomized Controlled Trial. PI – Prof. Richard Adanu & Prof. Kolawole Okuyemi

o The goal of this project was to develop and assess the effectiveness of a culturally tailored mobile phone text messaging intervention on Papanicolaou (Pap) smear test and Mammogram uptake among women in Accra, Ghana. Role: Co-Principal Investigator

• Institute of Tropical Medicine (ITM), Belgium, £ 10, 000. 2015 - 2017

Exclusive breastfeeding duration and child feeding behaviours. PI – Dr Esi Colecraft & Prof. Richmond Aryeetey

o Infant feeding methods are a major determinant of their nutritional status in terms of growth and development. Among infants feeding methods, breastfeeding is of particular importance because the practice of it is fundamental for the survival, growth and development of infants. This review is meant to investigate the relationship between the duration of exclusive breastfeeding (6 months versus < 6 months), and how these impacts on child eating behaviors in low and middle income countries. Role: CoInvestigator

• Ghana Health Services and UNFPA, \$ 50,000 2014 - 2015

Assessing the incidence and determinants of obstetric fistula in Ghana.

o This was a research project commissioned by the Ghana Health Service and UNFPA to aid the advocacy and development of interventions to eliminate obstetric fistula in Ghana. Role: Co-Principal Investigator.



DTD AN 16

Tema community 5

Tema, Greater Accra Region

4th March 2024

The Chairperson
Ethics Review Committee
Ghana Health Service
Accra.

Dear Sir/Madam,

APPLICATION FOR ETHICAL CLEARANCE

My name is Wisdom Adeapena, a student in the University of Ghana, School of Public Health offering M. PHIL in Applied Field Epidemiology and Disease Control in the department of Applied Field Epidemiology and Disease Control. As part of the requirements for the award of a master's degree, I am conducting research titled "Predictors of neonatal mortality in Tema Metropolis, Greater Accra region of Ghana.". My thesis is supervised by Prof. Alexander Manu and Dr. Adolphina Addo Larney.

I am writing this letter to apply for ethical clearance and permission to conduct my study in the Tema General Hospital.

Kindly find attached a copy of my research protocol and other relevant documents.

Counting on your usual cooperation and consideration.

Thank You.

Yours Faithfully,

The image shows the official crest of the University of Ghana, which is a shield with a yellow border and a blue background. Inside the shield are three yellow symbols: a cross at the top, a star in the middle, and a crescent at the bottom. Below the shield is a yellow banner with the Latin motto "INTEGRI PROCEDAMUS" in blue capital letters. To the right of the banner is a handwritten signature in blue ink.

Wisdom Adeapena

0240713888

DTD AN 16

Tema Community 5

Tema, Greater Accra Region

4th March 2024.

The Medical Superintendent

Tema General Hospital

P. O. Box CO 14

Hospital Rd., Comm. 9.

Greater Accra Region

Dear Sir/Madam,

PERMISSION TO CONDUCT A RESEARCH IN THE TEMA GENERAL HOSPITAL
GREATER ACCRA REGION

I am a student in the University of Ghana, School of Public Health offering MPhil. Applied Epidemiology and Disease Control in the Department of Epidemiology and Disease Control, (EPDC). As part of the requirements for the award of master's degree, I am conducting research titled "Predictors of Neonatal Mortality in the Tema General Hospital. The factors that may influence neonatal mortality could be socio demographic, maternal, fetal or delivery factors amongst others. It is therefore critical to understand how these factors could possibly lead to different neonatal outcomes.

However, little is known about how these factors influence neonatal outcomes within the greater Accra region and specifically the Tema Metropolis which has the Tema General Hospital serving as its remain referral hub. This study seeks to fill a knowledge gap by investigating the predictors of neonatal mortality in the Tema General Hospital and suggest possible ways to improve on neonatal outcomes.

The findings will also contribute to reducing the neonatal mortality burden within the metropolis and region at large.

Research would only be conducted once ethical clearance from the Ghana Health Service Ethics Review Committee (GHS-ERC) is received. Permission is therefore being sought to enable me collect data from the Tema General Hospital.

Counting on your consideration and approval.

Thank You.

Yours faithfully



Wisdom Adeapena

STATEMENT TO COMPLY WITH ETHICAL PRINCIPLES

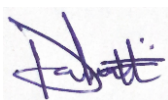
I, Wisdom Adeapena, the Principal Investigator of this study, write to state that I will comply with all ethical principles and guidelines throughout the study.

I shall carry out in accordance with approved protocol.

Name of primary Investigator: Wisdom Adeapena

ID: 11006426

Signature:



.....

Date: ...March 19, 2024.....





UNIVERSITY OF GHANA
DEPARTMENT OF EPIDEMIOLOGY AND DISEASE CONTROL
SCHOOL OF PUBLIC HEALTH

12th February, 2024

The Chairperson
Ethics Review Committee
Ghana Health Service
Accra

Dear Sir/Madam,

SUPPORT OF APPLICATION FOR ETHICAL CLEARANCE:
WISDOM ADEAPENA

I write to support the request for ethical clearance for the research proposal of **WISDOM ADEAPENA** an **MPHIL** student in the Department of Epidemiology and Disease Control, School of Public Health, College of Health Sciences, University of Ghana, Legon.

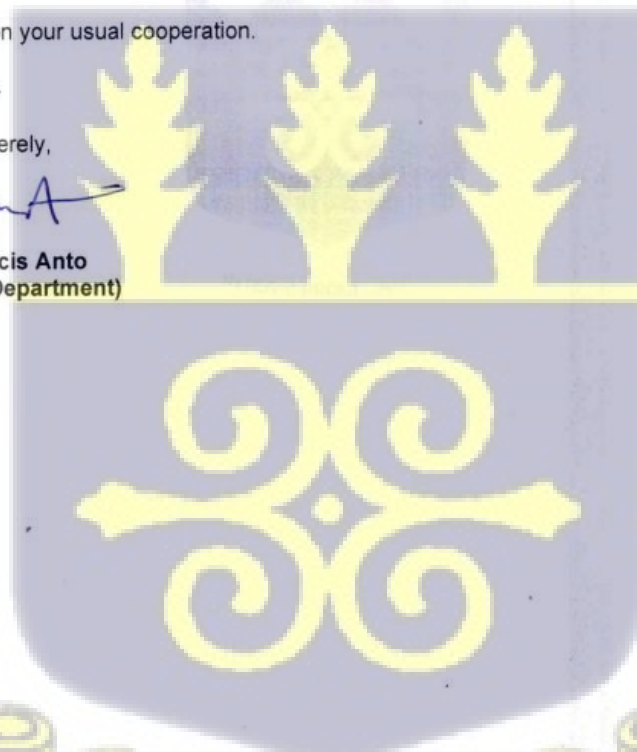
The research proposal is entitled: **PREDICTORS OF NEONATAL MORTALITY IN THE TEMA GENERAL HOSPITAL: A CASE-CONTROL STUDY.**

Counting on your usual cooperation.

Thank you.

Yours sincerely,

Prof. Francis Anto
(Head of Department)



COLLEGE OF HEALTH SCIENCES
P.O. Box LG 13, Legon, Accra, Ghana

• Telephone: +233 (0)28 910 9006

• Email: sph-epdc@ug.edu.gh

• Website: www.publichealth.ug.edu.gh

INTEGRITY PROCEDARIUS



UNIVERSITY OF GHANA
DEPARTMENT OF EPIDEMIOLOGY AND DISEASE CONTROL
SCHOOL OF PUBLIC HEALTH

12th February, 2024

The Metropolitan Director
Tema Metropolitan health Directorate
PMB, Tema

Dear Sir/Madam,

INTRODUCTORY LETTER

I write to introduce to you **WISDOM ADEAPENA** an **MPHIL** student in the Department of Epidemiology and Disease Control, School of Public Health, College of Health Sciences, University of Ghana, Legon.

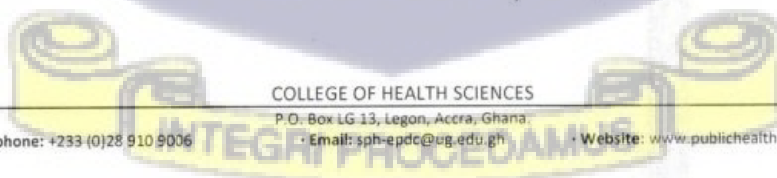
He is conducting research on the topic: **PREDICTORS OF NEONATAL MORTALITY IN THE TEMA GENERAL HOSPITAL: A CASE-CONTROL STUDY**. I will be grateful if you can give him the necessary support to undertake his research work in your institution.

Counting on your cooperation.

Thank you.

Yours sincerely,

Prof. Francis Anto
(Head of Department)



COLLEGE OF HEALTH SCIENCES

P.O. Box LG 13, Legon, Accra, Ghana

• Telephone: +233 (0)28 910 9006

• Email: sph-epdc@ug.edu.gh

• Website: www.publichealth.ug.edu.gh



UNIVERSITY OF GHANA
DEPARTMENT OF EPIDEMIOLOGY AND DISEASE CONTROL
SCHOOL OF PUBLIC HEALTH

2nd April, 2024

The Chairperson
Ghana Health Service
Ethics Review Committee
Accra

Dear Sir/Madam,

SUPPORT OF APPLICATION FOR ETHICAL CLEARANCE:
WISDOM ADEAPENA

I write to support the request for ethical clearance for the research proposal of **WISDOM ADEAPENA** an **M.PHIL** student in the Department of Epidemiology and Disease Control, School of Public Health, College of Health Sciences, University of Ghana, Legon.

The research proposal is entitled: **PREDICTORS OF NEONATAL MORTALITY IN THE TEMA GENERAL HOSPITAL: A CASE-CONTROL STUDY.**

Counting on your usual cooperation.

Thank you.

Yours sincerely,

Dr. Adolphina Addo Larney
(Supervisor)



COLLEGE OF HEALTH SCIENCES

P.O. Box LG 13, Legon, Accra, Ghana.

• Telephone: +233 (0)28 910 9006

• Email: sph-epdc@ug.edu.gh

• Website: www.publichealth.ug.edu.gh

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

*In case of reply the
number and date of this
Letter should be quoted.*



My Ref: GHS/RDD/ERC/Admin/App 124/239
Your Ref. No.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Digital Address: GA-050-3303
Mob: +233-50-3539896
Tel: +233-302-960628
Email: ethics.research@ghs.gov.gh
29th May 2024

Wisdom Adeapena
P.O. Box 16
Tema-Accra

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	GHS-ERC: 086/04/24
Study Title	Predictors of Neonatal Mortality in the Tema General Hospital, Greater Accra Region, 2024.
Approval Date	29 th May, 2024
Expiry Date	28 th May, 2025
GHS-ERC Decision	Approved

This approval requires the following from the Principal Investigator

- Submission of a yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months.
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report after completion of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.

You are kindly advised to adhere to the national guidelines or protocols on the prevention of COVID-19

Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....

Mr. Kofi Wellington
(GHS ERC Chairperson)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra

In case of reply the number and the date of this letter should be quoted.

My Ref No. GHS/MHD-
Your Ref. No.

GHS Core Values

- PEOPLE-CENTRED
- PROFESSIONALISM
- INTEGRITY
- TRANSPARENCY
- ACCOUNTABILITY
- TEAMWORK
- INNOVATION



METRO HEALTH DIRECTORATE
GHANA HEALTH SERVICE
PRIVATE MAIL BAG
TEMA

Tel 0537566777

18th June, 2024

**THE MEDICAL DIRECTOR
TEMA GENERAL HOSPITAL
TEMA**

INTRODUCTORY LETTER
MR. WISDOM ADEAPENA – MPHIL STUDENT

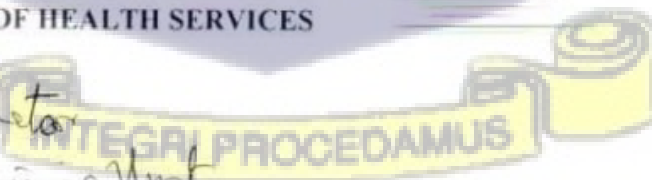
This is to introduce to you Mr. Wisdom Adeapena an MPHIL student in the Department of Epidemiology and Disease Control, School of Public Health, College of Health Science, University of Ghana, Legon.

He is conducting research on the topic: **PREDICTORS OF NEONATAL MORTALITY IN THE TEMA GENERAL HOSPITAL: A CASE – CONTROL STUDY** effective 18th June, 2024 to 30th November, 2024.

Kindly accord him the necessary assistance to enable him carry out his research work successfully.

**DR. SALLY D. QUARTEY
METRO DIRECTOR OF HEALTH SERVICES
TEMA**

Chinweh Okechukwu
Head of Training Unit
Kindly facilitate
the
21/06/24



GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

*In case of reply the
number and date of this
Letter should be quoted.*



My Ref: GHS/RDD/ERC/Admin/App 124/239
Your Ref. No.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Digital Address: GA-050-3303
Mob: +233-50-3539896
Tel: +233-302-960628
Email: ethics.research@ghs.gov.gh
29th May 2024

Wisdom Adeapena
P.O. Box 16
Tema-Accra

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	GHS-ERC: 086/04/24
Study Title	Predictors of Neonatal Mortality in the Tema General Hospital, Greater Accra Region, 2024.
Approval Date	29 th May, 2024
Expiry Date	28 th May, 2025
GHS-ERC Decision	Approved

This approval requires the following from the Principal Investigator

- Submission of a yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months.
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report after completion of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.

You are kindly advised to adhere to the national guidelines or protocols on the prevention of COVID-19

Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....

Mr. Kofi Wellington
(GHS ERC Chairperson)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra