ENSIGN GLOBAL UNIVERSITY

DEPARTMENT OF COMMUNITY HEALTH

A RESEARCH PROPOSAL FOR A DISSERTATION

ON

RATES AND RISK FACTORS OF INFANT MORTALITY IN GHANA: AN ANALYSIS OF THE 2022 GHANA DEMOGRAPHIC HEALTH SURVEY

BY

JESSICA XORSE ABLA SEDODE

247100275

DECLARATION

I, Jessica Xorse Abla Sedode hereby declare that "Rates and Risk Factors of Infant Mortality in Ghana: An Analysis of the 2022 Ghana Demographic Health Survey*"* is my work as a student of the School of Public Health, Ensign Global College. All sources and information used have been acknowledged.

Jessica Xorse Abla Sedode (247100275)	…….	24th April 2025
(Student's Name &ID)	Signature	Date

Certified by:

Dr Sandra Boatemaa Kushitor	……	…….…….
(Supervisor's Name)	Signature	Date

Certified by:

Dr Stephen Manortey	…….	…….
(Head of Academics Program)	Signature	Date

DEDICATION

I would like to express my heartfelt dedication with gratitude and sincere recognition to the Almighty God, ‘the one whose cattle is upon the thousand hills’. This work is dedicated to my parents Mr. and Mrs. Sedode, and my siblings whose resilience, charisma, abundant prayers, and encouragement led me throughout my study. No amount of words can express how valuable you are to me. I am very much grateful for your support and sacrifices towards my academic development.

ACKNOWLEDGEMENT

My sincere appreciation goes to my supervisor, Dr. Sandra Boatemaa Kushitor of the Department of Community Health, Ensign Global College for her guidance through all the stages of the proposal to the thesis writing for without her, this study would not have materialized.

ABBREVIATIONS/ ACRONYMS

ANC	Antenatal Care
CHPS	Community-based Health Planning and Services
COVID-19	Coronavirus Disease of 2019
DALY	Disability-Adjusted Life Years
GDHS	Ghana Demographic Health Survey
GEHIP	Ghana Essential Health Intervention Project
IMR	Infant Mortality Rate
NHIS	National Health Insurance Scheme
PNC	Postnatal Care
SDGs	Sustainable Developmental Goals
SIDS	Sudden Infant Death Syndrome
SSA	Sub-Saharan Africa
UN IGME	United Nations Inter-Agency Group for Child Mortality Estimation
WHO	World Health Organization

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS

ABSTRACT

Background

Infant mortality continues to be a significant public health challenge worldwide. Although there has been a notable reduction in the global infant mortality rate over the years, the decrease in many African nations, including Ghana, is considerably slower than what is needed to achieve the targets set by the Sustainable Development Goals (SDGs).

Goal

This study, therefore, utilized data from the 2022 Ghana Demographic and Health Survey (GDHS) to investigate the infant mortality rate (IMR) and the associated risk factors of infant deaths in Ghana.

Methodology

Data from the 2022 Ghana Demographic and Health survey, a cross-sectional survey, was used for the purpose of this study. A total of 2,151 infants aged 0–12 months were included in this study. The study employed descriptive statistics, chi-square tests, and logistic regression to examine associations between infant mortality and variables such as maternal age, occupation, place of delivery, duration of pregnancy, region, and household wealth. STATA 17.0 was used for the data analysis, with statistical significance set at $p<0.05$.

Results

The infant mortality rate was 2.2%. Infant deaths were slightly higher among mothers living in urban areas (2.5%), mothers aged 15–19 (3.7%), mothers with no formal education (2.7%), preterm births (66.7%), women self-employed in agriculture (11.1%), those in sales (4.3%), women in the "Poorer" group (3.6%), and births observed in polyclinics (4.0%) and home deliveries (2.5%). Regionally, infant mortality ranged from 0.0% in Volta and Western North to 5.1% in Eastern and 4.4% in Central. Ethnic disparities were also observed, with the Mole-Dagbani group recording the highest number of infant deaths (10 deaths per 1,000 live births). Duration of pregnancy, maternal occupation in sales, regional location, and household wealth index were the predictors of infant survival in this study.

Conclusion

To reduce infant mortality rates in Ghana, current treatments should be evaluated in light of the identified predictors. Based on the study's findings, the Ministry of Gender, Children, and Social Protection should provide more economic support to vulnerable women. This can be accomplished by increasing access to the Livelihood Empowerment Against Poverty (LEAP) program and social health insurance coverage. Furthermore, the Ghana Health Service should expand its antenatal care outreach, focusing on early detection and management of pregnancy complications. Training community health workers in preterm birth risk identification and neonatal intensive care should be prioritized, particularly in rural areas. To address healthcare disparities, the Ministry of Health should implement region-specific interventions such as strengthening referral systems, improving healthcare infrastructure, and increasing funding to these regions. Various stakeholders, including government and non-governmental organizations, should take into account the predictors of child survival identified in the design of interventions to effectively reduce morbidity and mortality among infants.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

According to the World Health Organisation [WHO], (2024), Infant Mortality Rate (IMR) is the likelihood that, out of 1,000 live births, a child born in a given year or time period will pass away before becoming one year old. It is among the most significant markers of population health and has a significant impact on a nation's social progress, economic growth, and access to healthcare (Tesema *et al.*, 2022), as well as the effectiveness of a country's health systems (Ali *et al.*, 2024). From 64 deaths per 1,000 live births in 1990 to 28 deaths per 1,000 live births in 2022, the infant mortality rate (IMR) has dramatically declined globally (United Nations Inter-agency Group for Child Mortality Estimation (UN IGME), 2024).

Despite the fact that newborn mortality has significantly decreased worldwide, 4.1 million children continue to die annually before they reach one-year-old, accounting for 73% of deaths among those under five (Tesema *et al.*, 2022). The majority of the deaths occur in Sub-Saharan Africa (SSA), which has the highest infant mortality rate (49 deaths per 1000 live births) (United Nations Inter-agency Group for Child Mortality Estimation (UN IGME), 2024). The Sustainable Development Goal (SDG-3) of the World, which aims to "guarantee healthy lifestyles and promote the well-being of people at all ages" by 2030, is much lower than the IMR in SSA. This objective includes lowering the high incidence of under-five mortality to at least 25 per 1,000 live births and the high rate of newborn deaths to no more than 12 per 1,000 live births (Mfateneza *et al.*, 2022).

In 126 countries, the goal of bringing the newborn mortality rate down to 12 or fewer deaths per 1,000 live births has already been accomplished, however, if the current patterns persist, 63 nations

will likely fall short of this objective (Poulin *et al.*, 2024). Many nations that are currently falling short of the goal will have to accelerate their rate of advancement to reach it. Similarly, 54 countries are not on track to reach the under-5 mortality target, whereas 133 countries have accomplished it (Poulin *et al.*, 2024).

Ghana is one of the nations that must accelerate efforts to meet the targets for under-five and neonatal mortality rates (United Nations, 2024). Ghana has an infant mortality rate of 31.6 deaths for every 1,000 live births, and its stillbirth rate is 21.4 deaths per 1,000 live births (UN Inter-agency Group for Child Mortality Estimation, 2024). Nigeria has rates of 34.9 and 110.8 deaths per 1000 live births, respectively, and Cote d'Ivoire has rates of 55.9 and 74.9 deaths per 1000 live births, despite Ghana's neonatal and under-5 mortality rates being better than those of many other nations in the region (UN Inter-agency Group for Child Mortality Estimation, 2024). Ghana's progress continues to lag behind the goals set by the Sustainable Development Goals (SDGs) (United Nations, 2024).

Although Ghana has made significant strides in child health thanks to a number of national policies and initiatives, including the Child Health Policy, the Community-based Health Planning and Services (CHPS) policy, and the free maternal delivery services provided by the National Health Insurance program, infant mortality does not disappear (Aheto, 2019). Between 1990 and 2017, Ghana reduced infant mortality from 79 to 36 per thousand live births (United Nations Inter-agency Group for Child Mortality Estimation (UNIGME), 2018). However, recent data from the 2022 Ghana Demographic and Health Survey shows that while the infant mortality rate has further decreased to 28 per 1,000 live births, the rate of decline is slowing in comparison to previous decades (Ghana Statistical Service (GSS) and ICF., 2024).

Researching infant mortality is beneficial to improving child and maternal health. Various studies have been conducted around the world to identify factors that affect infant mortality (Baraki *et al.*, 2020)**.** For instance, a study by Ratnasiri *et al.*, (2020) argued in their investigation that certain maternal and infant characteristics have important associations with IMR. Among these, there were those who did not attend prenatal care (Leal *et al.*, 2017), had metabolic disorders (de Bitencourt, Schwartz and Vianna, 2019), lived in rural areas and were highly impoverished (Mohamoud, Kirby and Ehrenthal, 2019), and delayed seeking medical attention (Koffi *et al.*, 2017). According to Irana et al. (2023), social welfare, environmental quality, economic advancement, general living conditions, and preventable bio-demographic characteristics are all directly linked to infant mortality.

Previous studies identified different determinants of infant mortality like maternal education level (Abate, Angaw and Shaweno, 2020; Shibre, 2020), maternal age (Kim *et al.*, 2021), maternal age at first birth (Ahinkorah, 2021; Neal, Channon and Chintsanya, 2018), maternal anemia (Argawu *et al.*, 2021; Tesema *et al.*, 2021), sex of the child (Tiruneh *et al.*, 2022). Recent research conducted in Ethiopia and various African nations indicates that factors such as a child's nutritional status, birth asphyxia, the distance to healthcare facilities, the infant's age, maternal health issues during pregnancy, preterm birth, maternal mortality at childbirth, the mother's level of education, maternal age, type of delivery, and the child's gender impact infant mortality rates (Kebede L. Adebe *et al.*, 2023; Ahmed *et al.*, 2023; Deressa and Desta, 2023; Gudayu, 2023; Kibret, Demant and Hayen, 2023; Osei-Poku *et al.*, 2023).

Numerous studies have been conducted on infant mortality in Ghana's jurisdiction. For instance, infant mortality has been investigated by Aheto, (2019); Takramah and Aheto, (2021). Though both the studies used population-based data (2014 GDHS datasets), they are quite out of date due

to Ghana's different economic situations, the COVID-19 healthcare crisis, which has reduced access to biomedical care, and the increased global food insecurity, which can affect prenatal, natal and postnatal care. As a result, knowledge gaps exist regarding the country's infant mortality rates and risk factors.

For strategists creating successful interventions to lower infant mortality, it is essential to recognize and identify the risk factors linked to infant mortality, which can help achieve the sustainable development goal by 2030. Given the SDG 3 target, there is not only a need to step up efforts to lower the number of newborn deaths, but also to conduct more study employing population-based data to completely comprehend Ghana's infant mortality causes and predictions, as well as the tactics needed to hasten improvement. Ghana needs sufficient empirical data to support a paradigm change toward a more rapid decline in infant mortality. This study, thus, investigated the factors influencing infant mortality in Ghana, considering various demographic and socioeconomic elements based on the 2022 Ghana Demographic and Health Survey (2022 GDHS) data, as a component of efforts to supply empirical data to support plans and policies aimed at accelerating the nation's infant mortality reduction.

1.2 Problem Statement

The Sustainable Development Goals (SDGs), especially Goal 3, which aims to lower infant mortality rates, remain extremely difficult for Ghana to achieve (United Nations, 2024). However, the 2022 GDHS shows that the country is still far from meeting these targets (NMR - 17 deaths per 1000 live births, and U5MR- 40 deaths per 1000 live births) ((GSS) and ICF., 2024). Several barriers, including limited healthcare access and resource disparities, hinder progress in reducing

infant deaths. Despite some improvements in healthcare infrastructure, the current infant mortality rate remains a major concern.

The loss of a child has a significant impact on maternal health, frequently resulting in depression and other mental health issues. Over the past two decades (2003–2023), Ghana has consistently reported a high prevalence of perinatal depression up to 50.1%, with suicidal ideation rates of 13–17 percent (WHO, 2024a). This emotional toll can affect their overall well-being and capacity to care for other children (Goeglein and Yatchmink, 2020). Addressing maternal mental health is essential in mitigating the long-term effects of infant mortality on families and communities.

Mothers' physical health is also jeopardized following the death of an infant, as complications during pregnancy and childbirth can have long-term consequences. Prolonged labor, infections, and inadequate postnatal care can expose mothers to additional health risks. Furthermore, the emotional and physical toll of infant loss may increase the likelihood of maternal mortality in subsequent pregnancies (WHO, 2021). These results highlight how crucial it is to treat maternal and newborn health concurrently in order to enhance overall health outcomes.

1.3 Rationale of The Study

Understanding the specific factors contributing to infant mortality in Ghana is critical for several reasons. First, it allows for the identification of vulnerable populations and key determinants of infant survival, which is critical for developing targeted and effective interventions. Second, it provides empirical evidence that can help policymakers allocate resources and develop health policies to reduce infant mortality. Finally, reducing infant mortality is an important step toward achieving SDG 3, which focuses on ensuring healthy lives and promoting well-being for all.

This study, which uses the most recent and comprehensive data from the 2022 GDHS, offers a significant chance to assess Ghana's current infant mortality rate. This study will help us better understand the causes of infant mortality by looking at a variety of socioeconomic, demographic, health-related, and environmental factors. The study's findings are expected to provide actionable insights that will help to improve the effectiveness of public health strategies and contribute to Ghana's ongoing efforts to improve child survival. Furthermore, the study will provide insights that are not only relevant to the country, but also applicable to other developing nations with comparable healthcare and socioeconomic conditions.

1.4 Conceptual Framework

The study adopted an adjusted conceptual framework of IM derived from the analytical framework reported in the study of Abate et al., (2020); and Mosley and Chen, (1984). The model examines the interaction of various factors contributing to infant mortality in Ghana. It categorizes the influencing variables into two main domains: maternal, and reproductive variables; and sociodemographic variables. Each of these factors has an independent and coexisting influence on infant mortality. These factors are defined as background variables influencing infant mortality directly, immediately, and remotely, respectively.

Maternal, and reproductive variables pertain to the duration of pregnancy. A mother's age, occupation, educational attainment, wealth index, place of birth, ethnicity, and type of residence are examples of sociodemographic characteristics. The model puts all factors (Maternal and reproductive variables; and sociodemographic) as the main predictors and infant mortality as the major outcome variable of the study.

The diagram below (figure 1) is a framework that represents the pathway by which the predictors can influence infant mortality. The framework hypothesizes that the interplay between these domains contributes to infant mortality rates in Ghana. Sociodemographic factors provide the contextual backdrop, determining the accessibility of resources and healthcare services. By categorizing these variables, this framework allows for a comprehensive understanding of the multifaceted determinants of infant mortality in Ghana.

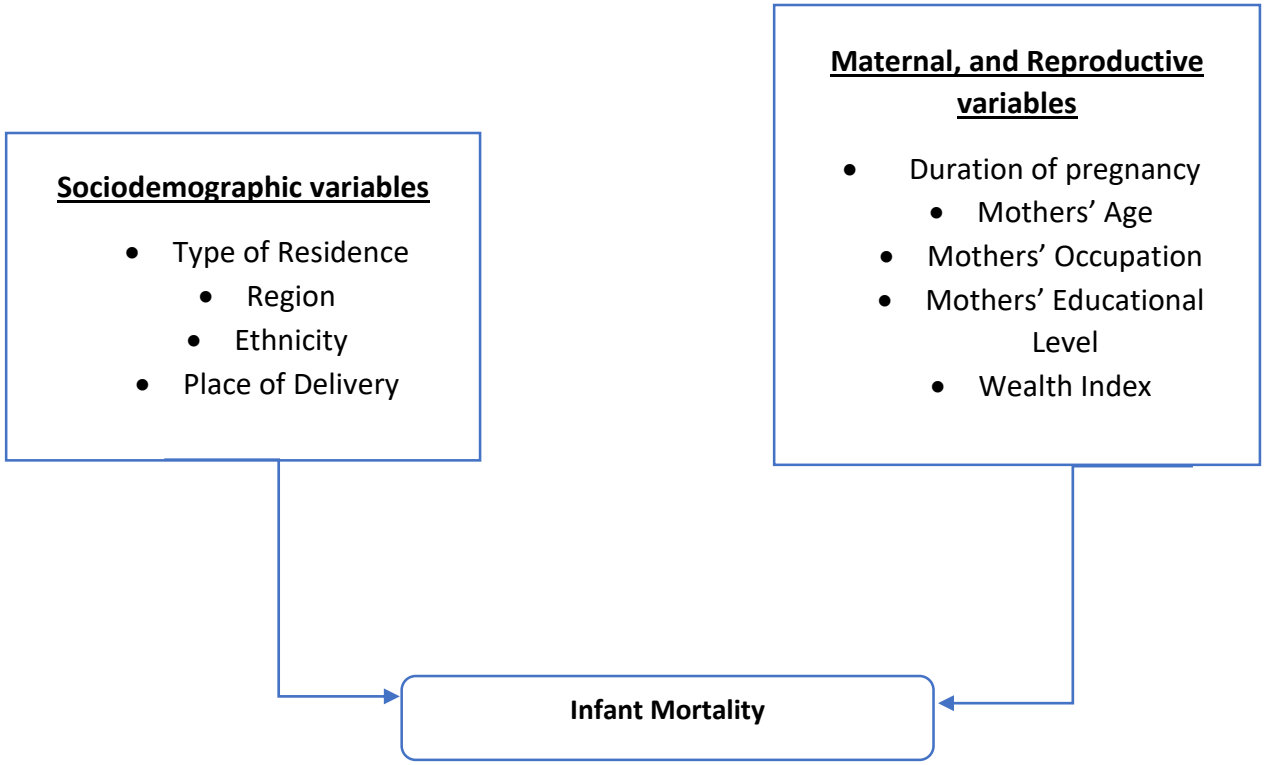

Figure 1: Conceptual framework of infant mortality in Ghana adapted from Abate et al., (2020); Mosley and Chen, (1984)

Source: Abate et al., (2020)

1.5 Research Questions

1. What is the current rate of infant mortality in Ghana?
2. What are the risk factors of infant mortality in Ghana?
3. How do rates of infant mortality differ across various demographic groups (e.g., socioeconomic status, ethnicity, geographic location) in Ghana?

1.6 General Objective

This study investigated the infant mortality rate (IMR) and the associated risk factors in Ghana.

1.7 Specific Objectives

Specifically, this study sought to;

1. Describe the current rate of infant mortality in Ghana.
2. Assess the risk factors of infant mortality in Ghana.
3. Determine variations in infant mortality rates across different demographic groups, within Ghana such as socioeconomic status, ethnicity and geographic location.

1.8 Profile of Study Area

The Republic of Ghana is the study area for the study. Ghana is well situated on the coast of West Africa. It is surrounded by three French-speaking nations and has a total land area of 238,537 square kilometers. Ghana's population is predicted to be 30,832,019 based on the 2021 Population and Housing Census (Ghana Statistical Service, 2021). Out of this, 56.7 percent are living in urban areas with the remaining 43.3 percent in rural areas. Children under five years constitute 24.5% of the entire population of Ghana.

Over the past two decades, Ghana has launched some programs that have helped to reduce newborn and maternal mortality (Poulin *et al.*, 2024). Launched in 2008 as a component of the National Health Insurance Scheme (NHIS), the free maternal health care plan mandates that women registered in the insurance program receive free medical services including prenatal appointments, childbirth, and postoperative and neonatal care (Lambon-Quayefio and Owoo, 2017; Dwomoh *et al.*, 2020). The initiative was attributed to an increase in registration of more than 300,000 moms between 2008 and 2012 (Johnson *et al.*, 2015).

A research study examining two nations that adopted a program of free maternal health care in Burkina Faso and Ghana, alongside two neighboring countries without such a policy, Nigeria and Zambia, showed that between 2008 and 2014, the strategy was associated with a 45 percent reduction in the risk of newborn mortality and a 54 percent reduction in the risk of infant mortality (Dwomoh *et al.*, 2020).

The goals of the Ghana Child Health Policy and the Child Health Strategy were to prevent and treat childhood illnesses while also improving the standard and accessibility of healthcare (Adua *et al.*, 2017). As a result, standards for diarrhea management improved, along with the accessibility of immunization programs, which led to a rise in baby vaccination rates (Adua *et al.*, 2017).

Community leaders, community health nurses, and traditional birth attendants are among the various stakeholders involved in Ghana's CHPS, which mobilizes community resources to give community-based help and a basic facility to remote communities (Johnson *et al.*, 2015). The CPHS has facilitated better access to qualified medical facilities for childbirth in nearby locations, enhanced the use of contraception, and has contributed to reducing Ghana's infant mortality rate by serving as gatekeepers (Dalinjong, Wang and Homer, 2018).

1.9 Organization of the Study

This research was divided into six main chapters. The backdrop, problem statement, study justification, conceptual framework, research questions, study objectives, study area profile, and study organization were all included in the first chapter's introduction. The rate and burden of infant death, the causes of infant mortality, sociodemographic factors, maternal and reproductive factors, newborn characteristics, disparities in infant mortality among various demographic categories, and a chapter summary were all covered in detail in the second chapter. Research technique, comprising study setting, data source, study variables, outcome and explanatory, data analysis, ethical issues, and study limits, was covered in the third chapter. The data collected for the study was analyzed in the fourth chapter. An analytical summary of the gathered data was given using descriptive statistics. This is shown as percentages and frequencies in charts, graphs, and tables. While chapter six concentrated on the overall overview of findings that led to a conclusion, suitable recommendations, and ideas for additional research, chapter five covered the investigation.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter offers evidence on the rate and causes of infant mortality in Ghana. The rate of infant mortality, the burden of infant mortality, the causes of infant mortality, as well as the variations in infant mortality rates between various demographic groups, within Ghana such as socioeconomic status, ethnicity, and geographic location.

2.2 The rate of infant mortality

One of the main causes of death is infant mortality, which is especially concerning in developing nations. IMR is essential for social and economic growth and is a crucial measure of a society's general health (Shobiye *et al.*, 2022). According to Okwuwa and Adejo, (2020), IMR is a gauge of a nation's general growth as well as its health policies, institutions, and practices. A lack of social integration between women and children is indicated by high rates of maternal and newborn mortality. Lack of access to healthcare before, during, and after birth has led to a rise in infant mortality. Both in emerging and poor nations, this leads to high IMR (Jim and Friday, 2023).

According to a study by Mathews and Driscoll, (2017) to examine the trends in infant mortality in the United States observed that the country's overall infant mortality rate has improved, falling by 15% from a recent high of 6.86 newborn deaths per 1,000 live births in 2005 to 5.82 in 2014. The Sample Registration System of India also showed a decrease in IMR, which went from 72/1000 live births in 1998 to 57/1000 live births in 2006 and then to 39/1000 live births in 2014. (Rai *et al.*, 2017).

A cross-sectional analysis of the Indian National Family Health Survey (NFHS-1 to NFHS-4) data from 1992 to 2016 witnessed that IMR in India has declined from 41 deaths per 1,000 live births to 35 deaths per 1,000 live births in the last five years, which translates to over 50 percent reduction in both infant and under-5 mortality rates (Bhatia *et al.*, 2019). Also, a retrospective analysis of routinely collected data from July 2012 to December 2012 using verbal and social autopsy tools by Rai *et al.*, (2017) noted that the infant mortality rate during the study period was 46.5/1000 live births.

Existing data show that, despite improvements in overall health indicators over the past two decades, IMR remains disproportionately high, particularly in rural areas. For example, in rural Ethiopia, Weldearegawi *et al.*, (2015) reported a study with an IMR of 47 per 1000 live births (95% CI: 41-54) over the four years of follow-up on infants.

Patel and their team conducted a study to evaluate the variations in infant mortality rates in Nigeria from 1990 to 2018. Using data from the Nigerian Demographic and Health Survey (NDHS), they observed that infant deaths decreased by nearly 25 percent, 8 percent, and 2.9 percent over the 5-year periods 2003-2008, 2008-2013, and 2013-2018, respectively (Patel, Prasad and Biradar, 2021) .

Ghana made significant progress in reducing infant mortality from 79 to 36 per 1,000 live births between 1990 and 2017 (United Nations Inter-agency Group for Child Mortality Estimation (UNIGME), 2018). Recent Demographic and Health Surveys (DHS) in Ghana show that infant mortality rates are slowing down. According to the 2022 Ghana Demographic Health Survey report, the infant mortality rate in Ghana is 28 per 1,000 live births, down from 64 per 1,000 in 2003, five years prior to the survey (Ghana Statistical Service (GSS) and ICF., 2024).

Infant mortality has far-reaching social, economic, and emotional consequences for families, communities, and nations. High infant mortality rates put a strain on healthcare systems while also perpetuating cycles of poverty and underdevelopment, particularly in vulnerable communities. The global estimated number of deaths from sudden infant death syndrome (SIDS) was 27,685. SIDS caused 2,448,496 DALYs per 100,000 person-years worldwide in 2019. While the crude DALY rate was 1855.13 per 100,000 newborns, the crude SIDS fatality rate was 20.98 per 100,000 infants. (Park *et al.*, 2022).

Furthermore, the consequences of high infant mortality go beyond health, affecting socioeconomic development and family stability. Adolescents who may face unintended pregnancies are also at heightened risk, emphasizing the importance of sexual health education and accessible reproductive health services (Amponsah, 2023).

2.3 The causes of infant mortality

2.3.1 Sociodemographic Factors

Sociodemographic determinants of infant mortality are particularly related to region and residence, including geographic location within a country and whether a person lives in an urban or rural setting. Previous research investigated the relationship between region and residence as a predictor of infant mortality. For instance, according to Baraki et al., (2020) that evaluated the factors influencing infant mortality using EDHS data indicated that one's place of residence was significantly linked to infant mortality, and the likelihood of infant mortality exhibited considerable variation across various regions.

Similarly, a recent study by Kebede Lulu Adebe *et al.*, (2023) found that infants living in rural residences were at higher risk of dying before first birthday whereas infants living in urban residences were at lower risk of dying before first birthday.

Furthermore, Tamir et al., (2023) noted that infant mortality rates in Ethiopia showed significant spatial disparities, with the highest rates occurring in the Eastern, Northwestern, and Southwestern regions, while Addis Ababa and Gambela had lower rates. Furthermore, the Somali region (AOR = 2.78, 95 percent CI: 1.05, 7.36) demonstrated a significant correlation with infant mortality in Ethiopia.

Using data from the 2018 Nigeria Demographic Health Survey (NDHS), a population-level analysis revealed that infant mortality rates were lowest in the South-West, South-East, and South-South areas, and highest in the North-West and North-East regions (Shobiye et al., 2022).

Furthermore, Nwanze, Siuliman and Ibrahim's, (2023) scoping review, which aimed to identify and summarize the extent of evidence regarding factors linked to infant mortality in Nigeria, discovered that the majority of the reviewed research articles concerning socioeconomic elements at the interpersonal level related household income/wealth index to infant mortality. Other factors identified included the father's job, paternal educational level, maternal employment, social support from family members, and the role of the household head.

Infants whose mothers are married or in cohabiting relationships showed a lower risk of mortality than those whose mothers had been married previously (divorced, widowed, or separated). Furthermore, it was discovered that children born into polygynous unions (where a man has more than one wife) had a higher risk of infant mortality (Nwanze, Siuliman and Ibrahim, 2023).

Similarly, Nwanze, Siuliman and Ibrahim, (2023) showed that working women were more likely than stay-at-home mothers to experience baby fatalities. In contrast, A Japanese study concluded that a mother's employment level only influences the health of her unborn child during pregnancy and did not correlate with the likelihood of newborn death (Suzuki, Senda and Honjo, 2021).

As mentioned by Bango and Ghosh, (2023), a significant portion of the differences in infant and child mortality rates among castes and tribes can be linked to factors such as location, the educational background of the mother, financial standing, and the size of the family.

2.3.2 Maternal and Reproductive Factors of the Mother

Several studies have been conducted around the world to investigate risk factors for infant death. A recent retrospective study by Ratnasiri *et al.*, (2020) found that compared to all women in the research, babies born to pregnant mothers who were overweight or obese accounted for 55% of the IMR. This study was carried out in California.

A study by Schellekens, (2021) combined information from every stage of the Indonesian DHS to provide a more precise picture of how maternal education has contributed to the 36-year drop in infant mortality. It was discovered that 30% of the decrease in infant mortality between 1980 and 2015 can be attributed to improved maternal education.

From a global perspective, Islam, Tabassum and Moni, (2022) examined the rates of infant mortality and the various factors that influence them in 24 developing countries using the most recent DHS data. According to Islam and associates, the most critical factors influencing infant mortality in these countries include antenatal and postnatal care (ANC) received by mothers, as well as the educational levels of both mothers and fathers.

Another study by Shobiye *et al.*, (2022), conducted on a population-based analysis using the 2018 Nigeria Demographic Health Survey (NDHS), revealed that women who gave birth at 18 years old or younger, those who had no antenatal care (ANC) visits, those who had more than four ANC visits, and mothers of first children were associated with an increased infant mortality rate. According to Khadka *et al.*, (2015), infant mortality was higher in the poor and middle classes than

in the upper classes. Residential status, mother's age at first birth, mother's educational attainment, wealth index, religion, and birth order were additional important predictors of infant mortality (Baruah *et al.*, 2023).

Mothers' health-seeking behaviors have a significant impact on Ghana's infant mortality rates. A significant proportion of women (32%, 44.8%, and 47 %) defer antenatal care (ANC) visits, with many starting care after the first trimester (Anaba and Afaya, 2022; Oduro *et al.*, 2022; Nsiah *et al.*, 2024). This delay in seeking care reduces the opportunity for early detection and treatment of complications. Additionally, home births without trained birth attendants are still frequent, especially in rural areas with limited access to medical facilities (WHO, 2024b), increasing the risk of complications during childbirth (Madewell *et al.*, 2022), and leading to higher infant mortality rates. The 2022 GDHS data indicates that only a fraction of births are attended by skilled health personnel, particularly in rural regions (GSS, 2023). Cultural beliefs and financial constraints frequently force mothers to rely on traditional birth attendants, who may lack the necessary skills to handle emergencies (Bango and Ghosh, 2023). Improving maternal education and access to healthcare services is crucial in promoting better health-seeking behaviors and reducing IMR.

2.3.3 Newborn Characteristics of the child

In Ethiopia, Baraki *et al.*, (2020) found a significant association between infant mortality and being male (AOR = 1.51; 1.25, 1.82). Calais-Ferreira *et al.*, (2022) discovered that male twins were 100 g heavier and had a higher risk of infant death compared to female counterparts. Another study by Bugelli *et al.*, (2021) made the case that, in contrast to the nation's less developed regions, more developed regions showed lower IMR and higher LBW.

Also, Khadka *et al.*, (2015) observed that infant mortality was found to be higher for those born with very small sizes, as reported by their mothers, as well as a higher birth order and shorter intervals between births, when compared to infants with average birth sizes. Similarly, infants with a short prior birth interval (two years or less) and a birth rank of fourth or above were at a higher risk of dying than infants born in the second or third place with longer intervals between births. .

According to Taskaya and Demirkiran, (2016), birth weight is one of the most important predictors of infant mortality. A significant finding revealed that the mother's job influences infant mortality rates (IMR) through breastfeeding, implying that the frequency of breastfeeding is more important than the amount of time spent breastfeeding. This suggests that the more breastfeeding an infant receives, the less likely they are to die (Nwanze, Siuliman and Ibrahim, 2023).

2.4 The variations in infant mortality rates across different demographic groups

Infant mortality rates vary significantly across different demographic groups, with disparities observed based on socioeconomic status, ethnicity, and geographic location. For instance, compared to White British newborns, South Asian and Black infants had higher infant mortality rates, which cannot be attributed to maternal factors, migration status, or deprivation (Li, Quigley and Hollowell, 2017).

Also, a study by Tamir *et al.*, (2023) noted that the rates of infant mortality in Ethiopia displayed considerable spatial differences throughout the country. The greatest infant mortality rates were recorded in the Eastern, Northwestern, and Southwestern regions of Ethiopia. Additionally, they found that maternal ages of 15 to 19 and 45 to 49, lack of antenatal care follow-up, and residing in the Somali region were significantly linked to infant mortality in Ethiopia.

Similarly, Infant and maternal mortality rates vary by region, emphasizing the importance of focusing on districts in Madhya Pradesh, India, where these rates are higher. These disparities point to deeper inequities in healthcare access, maternal education, financial challenges, low literacy levels, distance to medical facilities, cultural influences, quality of care, and overall living conditions (Singh and John, 2017).

2.5 Chapter Summary

In summary, the research utilized an analytical framework outlined in the studies by Abate et al., (2020); and Mosley and Chen, (1984) to aid in achieving the goals of the investigation. Furthermore, the study included an empirical review of previous studies on the risk factors associated with infant mortality, demonstrating that the causes of infant mortality are complex and diverse. These factors include the mother's age, health condition, living environment, employment status, marital situation, educational level, and the age at which she first becomes a mother. Other important factors include the child's gender. A comparative analysis is used to highlight discrepancies in findings across contexts. The examined literature's relevance to the current study is articulated, demonstrating how earlier research provides insights and rationale for the investigation.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

The research methods are explained in this chapter. The study site description, data source, study variables, data, data analysis, ethical issues, and study limitations are all included.

3.2 Study setting

Ghana is located in West Africa and has an estimated population of around 31 million individuals, with women comprising approximately 50.7% of that number (Ghana Statistical Service, 2021). Out of this, 56.7 percent are living in urban areas with the remaining 43.3 percent in rural areas. Children under five years constitute 24.5% of the entire population of Ghana. Currently, Ghana has 16 administrative regions and they include; Oti, Bono, Bono East, Ahafo, North East, Savannah, Western North, Western, Greater Accra, Central Region, Eastern, Upper East, Upper West, Volta, Northern, and Ashanti. Through various programs, Ghana has made significant progress in reducing infant and maternal mortality over the past two decades. One noteworthy program is the National Health Insurance Scheme's (NHIS) 2008 maternal health care policy, which provides enrolled women with free prenatal, postnatal, and delivery care. Improving the standard and availability of healthcare for newborns is another goal of the Ghana Child Health Policy and Strategy. The Ghana Essential Health Intervention Project (GEHIP) and the Community-based Health Planning and Services (CHPS) have also helped expand health services to rural areas (Poulin *et al.*, 2024).

3.3 Source of Data

Data from the 2022 GDHS, the seventh edition of the series and a nationally representative cross-sectional research, was used in this investigation (Ghana Statistical Service (GSS) and ICF., 2024). The data was been obtained (Appendix I) from the DHS MEASURE Program (https://dhsprogram.com/). The data, which is available online, covers a range of population, health, and nutrition indicators, including rates of childhood mortality, maternal and child health, the use of family planning methods, the nutritional status of women and children, and socioeconomic characteristics of the household. In order to produce representative findings at the national level for both urban and rural regions, as well as for each of the 16 regions within the country, the GDHS used a two-stage sampling procedure to choose research participants.

Comprehensive survey techniques can be found in other publications (Ghana Statistical Service (GSS) and ICF., 2024). A nationally representative sample was composed of 18,450 households drawn from 618 clusters, which included 304 urban and 314 rural centers. In total, 17,933 eligible households participated in interviews, yielding responses from 15,014 women aged 15 to 49 and 7,044 men aged 15 to 59. Comprehensive birth histories were gathered, detailing the month and year of birth and death for each biological child. This information was utilized to determine the number of children born in the previous five years and the age at which each child died. The analysis focused exclusively on the most recent **child death** (thus women whose last born **died**), with the data adjusted for weighting purposes. The study specifically targeted women who had children within the age range of 0 to 1 year (classified as infants). The sample size was determined based on participants who shared information regarding the age at which their children passed away before the survey. A weighted sample of 2,151 was obtained for use in our research.

3.4 Study Variables

Information from the past five years was collected regarding children who passed away, using data on all births to a mother within the five years leading up to the survey. The study categorized the parameters it measured into dependent and independent variables. Table 1 outlines the variables employed in the study, including both outcome and explanatory variables (i.e. risk factors associated with infant mortality), as well as their definitions and categories.

3.4.1 Outcome Variable

The outcome variable for this study was infant survival status, which is the probability of survival of a live-born infant between birth and exactly one year of age. From the DHS, mothers' verbal answers to the questions were used to gather data on child mortality about the total number of children who live with the mother, the date of birth of each of their children, whether the child is still alive, and if not, the child's age at death. Only women who gave specific answers regarding the age of the child at death in relation to their most recent births were included in the study's final analysis. As a result, all the response options with regards to the child's age at death were recoded into a binary form (0= "Yes" and 1= "No"). Infant survival status was created as an index variable where those who died at ages less than or equal to 1 year (<= 12 months) was termed "Dead- infant not surviving (No)" whilst the remaining was termed "Alive-infants surviving (Yes)".

Similarly, Infant Mortality Rate (IMR) was calculated as a key indicator to assess the frequency of infant deaths within the first year of life per 1,000 live births. The IMR provides a critical measure of child health and survival, and is often used as a proxy for the overall health and development status of a population. The formula used to compute the Infant Mortality Rate is as follows:

Infant Mortality Rate (IMR) = $\frac{(\text{Number of infant deaths (under 1 year)})}{(\text{Total number of live births})} \times 1{,}000$

3.4.2 Explanatory variables

A total of nine (9) explanatory variables were analyzed in this research. The selection of these variables were guided by their conceptual relevance and significant relationship with the outcome variable, as indicated by findings from prior studies (Aheto, 2019; Fenta *et al.*, 2022; Mfateneza *et al.*, 2022; Ali *et al.*, 2024). Sociodemographic variables include mother's age, mother's occupation, mother's educational attainment, wealth index, type of residence, place of delivery, ethnicity, and region (current 16 regions of Ghana). Maternal and reproductive characteristics consists of duration of pregnancy.

Table 1: A table on the study variables.

Variables	Coding/ Categories	Description
Outcome		
Infant survival status	0 = Yes (greater than 12 months), 1 = No (<= 12 months)	Whether the infant survived or died
Infant Mortality Rate (IMR)	(Number of infant deaths (under 1 year)) / Total number of live births) * 1,000	Key indicator to assess the frequency of infant deaths within the first year of life per 1,000 live births
Explanatory		
Sociodemographic Factors		
Region	All 16 regions	Geographic location of the respondent (16 regions)

Rural/Urban Residence	0=Rural, 1= Urban	Type of residence (Urban/Rural)
Wealth Index	Wealth quintile (1=Poorest, 5=Richest)	For socio-economic status analysis
Mother's Education	(1=None,2= Primary, 3= Secondary, 0=Higher)	Mother's education level
Mother's Employment	(1=Employed, 0=Not employed)	Employment status of mother
Mother's Age	(1=15-19, 2=20-24, 3=25-29 etc.)	Age of mother
Mother's Occupation	(Not working, Professional/technical/managerial etc.)	Occupation of mother
Ethnicity	1=Akan, 2=Ewe, 3=Ga/Dangme	Mother's ethnic group
Place of Delivery	1=Home, 2=Government Hosp. etc.	Place of delivery
Maternal, and Reproductive Factors		
Duration of pregnancy	1=1, 2=2, 3=3	Duration of Pregnancy

3.5 Data Analysis

All statistical analyses were performed using STATA (version 17.0). Descriptive statistics were used to summarize the distribution of selected maternal background characteristics. Categorical variables were summarized based on their frequencies and associated percentages. The rate of infant mortality was calculated using frequencies and percentages. Following that, cross-tabulation was used to investigate the differences in infant mortality associated with explanatory factors. The variables for the multilevel regression model were selected using a binary logistic regression analysis. The findings, together with their 95 percent CIs, were displayed as crude odds ratios (OR)

and adjusted odds ratios (AOR). Every variable that had a p-value of less than 0.05 was deemed statistically significant and added to the multilevel regression model. The GDHS parameters were used to weight the data before analysis. As a result, the survey set statement employed a stratum of v022, a primary sampling unit of v021, and a survey design weight of v005. To generate objective means and precise variance estimates at every step of the data analysis process, a STATA survey set statement (svy prefix command) was utilized.

3.6 Ethical issues

Human subjects participated in this investigation. The Ghana Health Service's Ethical Review Committee and ICF International's Institutional Review Board reviewed and approved the survey protocol, which included gathering biomarkers, according to the 2022 GDHS final report (Ghana Statistical Service (GSS) and ICF., 2024). The GDHS data were gathered using pre-translated questionnaires in cases where communication was impeded by English in order to reduce bias. Furthermore, during interviews, participants' anonymity and privacy were safeguarded. The GSS received verbal or written consent from each research participant. Furthermore, ethical approval was requested from Ensign Global University's ethical council.

3.7 Limitations of Study

The cross-sectional form of the Demographic and Health Survey restricts the study's capacity to draw conclusions on causality. Adolescent girls' and young women's self-reports were used to evaluate the study's variables, which raised the risk of recall bias and other social desirability biases. Secondary data was used in this study, and the variables in the dataset were the only ones analyzed. Consequently, the study's interpretations and findings ought to be restricted to the variables that were employed.

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

This chapter presents the results of the data collected based on the research objectives. These include: the sociodemographic characteristics of the study population, rate of infant survival status, predictors of infant survival status, and graphical variations of infant survival status by geographical location, wealth index, and ethnicity.

4.2 Socio-demographic characteristics of the respondents

Table 2 presents the sociodemographic and reproductive characteristics of the 2,151 women surveyed. The majority of respondents were between the ages of 25–29 (26.5%), followed by those aged 20–24 (22.3%), 30–34 (22.0%), and 35-49 (20.4%). In terms of educational attainment, nearly half had completed secondary education (48.3%), while 27.9% had no formal education. Regional representation was highest in the Northern Region (10.9%), followed by Savannah (9.8%) and Bono East (7.3%). Regarding socioeconomic status, 33.3% of respondents were classified in the poorest wealth quintile, with only 10.1% in the richest group. Regarding the distribution of women's occupations, two-fifth respondents (43.9%) were employed in services, and 24.2% reported not working. Most pregnancies lasted the full term of nine months (93.5%). A greater proportion of respondents resided in rural areas (60.9%) compared to urban areas (39.1%). Place of delivery varied, with 42.5% in government hospitals, 21.6% in health centers, and 14.9% at home. Ethnically, the sample was predominantly Mole-Dagbani (54.2%), followed by Akan (32.8%) and Ewe (8.1%).

Table 2: Socio-demographic characteristics of the respondents.

Variables	Frequency (N=2,151)	Percentage (%)
Ages in 5-year groups		
15-19	190	8.8
20-24	480	22.3
25-29	569	26.5
30-34	473	22.0
35-49	439	20.4
Educational Attainment		
No education	600	27.9
Primary	341	15.9
Secondary	1039	48.3
Higher	171	7.9
Region		
Western	88	4.1
Central	114	5.3
Greater Accra	99	4.6
Volta	75	3.5
Eastern	98	4.6
Ashanti	130	6.0
Western North	107	4.9
Ahafo	129	6.0
Bono	86	4.0
Bono East	143	6.7
Oti	156	7.3
Northern	235	10.9
Savannah	182	8.5
North East	210	9.8
Upper East	169	7.8
Upper West	129	6.0
Wealth Index Combined		
Poorest	717	33.3
Poorer	535	24.8
Middle	371	17.3
Richer	311	14.5
Richest	217	10.1
Occupation		
Not working	520	24.2
Professional/technical/managerial	116	5.4
Clerical	19	0.9
Sales	141	6.6
Agricultural- self-employed	9	0.4
Agricultural- employed	120	5.6
Services	946	43.9
Skilled manual	265	12.3
Unskilled manual	8	0.4

Other	7	0.3
Duration of Pregnancy (in months)		
6	3	0.1
7	31	1.5
8	25	1.2
9	2012	93.5
10	80	3.7
Type of residence		
Urban	841	39.1
Rural	1310	60.9
Place of delivery		
Home	320	14.9
Government hospital	914	42.5
Polyclinic	50	2.3
Health center	465	21.6
CHPS	194	9.0
Private hospital	208	9.7
Ethnicity		
Akan	706	32.8
Ga/Dangme	79	3.7
Ewe	174	8.1
Mole-Dagbani	1166	54.2
Others	26	1.2

4.3 Infant survival status by socio-demographic characteristics

The overall infant mortality rate was low, with 2.2% of children reported as deceased (Table 2). The majority of infant deaths were slightly higher in urban areas (2.5%) compared to rural areas (2.0%). In terms of ethnicity, infant mortality was highest among mothers from the "Other" ethnic groups (3.9%), followed by Akan (2.8%) and Ga/Dangme (2.5%). The lowest rate was reported among Ewe mothers (0.6%). Age-related differences in infant mortality were minor, with the highest rate occurring among mothers aged 15–19 (3.7%) and the lowest among those aged 30–34 (1.9%).

Regarding educational attainment, mothers with no formal education had a slightly higher rate (2.7%) than those with higher education (1.7%). With the duration of pregnancy, infant mortality was exceptionally high for preterm births: 66.7% at 6 months, 32.3% at 7 months, and 32.0% at 8

months. In contrast, the mortality rate was only 1.3% for full-term births (9 months) and 1.2% for extended-term births (10 months). Among occupational groups, the highest mortality was observed among women self-employed in agriculture (11.1%) and those in sales (4.3%). Regarding wealth index, results showed higher mortality in the "Poorer" group (3.6%) and lowest in the "Richer" group (1.3%). Regionally, infant mortality ranged from 0.0% in Volta and Western North to 5.1% in Eastern and 4.4% in Central. Lastly, by place of delivery, the highest mortality rate was observed for births in polyclinics (4.0%) and home deliveries (2.5%). No statistically significant association was found between infant mortality and place of residence, ethnicity, maternal age, educational attainment, occupation, wealth index, region, or place of delivery. However, duration of pregnancy was significantly associated with child survival status ($\chi^2 = 301.35$, $p < .001$).

Table 3: Infant survival status by socio-demographic characteristics.

Variable	Infant Survival Status		Total	Chi-square	p-value
	Died n(%)	Alive n(%)			
Child survival Status	**47 (2.2)**	2104 (97.8)			
Place of residence				0.63	0.428
Urban	21 (2.5)	820 (97.5)	840 (100.0)		
Rural	26 (2.0)	1284 (98.0)	1310 (100.0)		
Ethnicity				4.12	0.390
Akan	20 (2.8)	686 (97.2)	706 (100.0)		
Ga/Dangme	2 (2.5)	77 (97.5)	79 (100.0)		
ewe	1 (0.6)	173 (99.4)	174 (100.0)		
Mole-Dagbani	23 (2.0)	1143 (98.0)	1166 (100.0)		
Others	1 (3.9)	25 (96.1)	26 (100.0)		
Age in 5-year groups				2.42	0.660
15-19	7 (3.7)	183 (96.3)	190 (100.0)		
20-24	11 (2.3)	469 (97.7)	480 (100.0)		
25-29	11 (1.9)	558 (98.1)	569 (100.0)		
30-34	9 (1.9)	464 (98.1)	473 (100.0)		
35-49	9 (2.1)	430 (97.0)	439 (100.0)		
Educational attainment				0.25	0.969
No education	13 (2.7)	587 (97.3)	600 (100.0)		
primary	7 (2.0)	334 (98.0)	341 (100.0)		
Secondary	24 (2.3)	1015 (97.7)	1039 (100.0)		
Higher	3 (1.7)	168 (98.2)	171 (100.0)		
Duration of pregnancy				**301.35**	**<0.001**
6	2 (66.7)	1 (33.3)	3 (100.0)		
7	10 (32.3)	21 (67.7)	31 (100.0)		

8	8 (32.0)	17 (68.0)	25 (100.0)		
9	26 (1.3)	1986 (98.7)	2012 (100.0)		
10	1 (1.2)	79 (98.8)	80 (100.0)		
Occupation				13.58	0.138
Not working	9 (1.7)	511 (98.3)	520 (100.0)		
Professional	3 (2.6)	113 (97.4)	116 (100.0)		
Clerical	0 (0.0)	19 (100.0)	19 (100.0)		
Sales	6 (4.3)	135 (95.7)	141 (100.0)		
Agricultural-self employed	1 (11.1)	8 (88.9)	9 (100.0)		
Agricultural-employed	1 (0.8)	119 (99.2)	120 (100.0)		
Services	18 (1.9)	928 (98.1)	946 (100.0)		
Wealth index				6.89	0.142
Poorest	12 (1.6)	705 (98.4)	717 (100.0)		
Poorer	19 (3.6)	516 (96.4)	535 (100.0)		
Middle	7 (1.9)	364 (98.1)	371 (100.0)		
Richer	4 (1.3)	307 (98.7)	311 (100.0)		
Richest	5 (2.3)	212 (97.7)	217 (100.0)		
Region				17.71	0.278
Western	2 (2.2)	87 (97.7)	89 (100.0)		
Central	5 (4.4)	109 (95.6)	114 (100.0)		
Greater Accra	2 (2.0)	97 (98.0)	99 (100.0)		
Volta	0 (0.0)	75 (100.0)	75 (100.0)		
Eastern	5 (5.1)	93 (95.0)	98 (100.0)		
Ashanti	5 (3.8)	125 (96.1)	130 (100.0)		
Western north	0 (0.0)	107 (100.0)	107 (100.0)		
Ahafo	1 (0.8)	128 (99.2)	129 (100.0)		
Bono	3 (3.5)	83 (96.5)	86 (100.0)		
Bono east	5 (3.5)	138 (96.5)	143 (100.0)		
Oti	4 (2.5)	152 (97.4)	156 (100.0)		
Northern	4 (1.7)	231 (98.3)	235 (100.0)		
Savannah	4 (2.2)	178 (97.8)	182 (100.0)		
North east	4 (1.9)	206 (98.1)	210 (100.0)		
Upper east	2 (1.2)	167 (98.8)	169 (100.0)		
Upper west	1 (0.8)	128 (99.2)	129 (100.0)		
Place of delivery				3.66	0.599
Home	8 (2.5)	312 (97.5)	320 (100.0)		
Government hospital	24 (2.7)	890 (97.3)	914 (100.0)		
Polyclinic	2 (4.0)	48 (96.0)	50 (100.0)		
Health center	7 (1.5)	458 (98.5)	465 (100.0)		
Chps	3 (1.6)	191 (98.4)	194 (100.0)		
Private hospital	3 (1.4)	205 (98.5)	208 (100.0)		

4.4 The Predictors of Infant Survival status

Table 4 presents the results of a multivariate analysis conducted to examine the predictors of infant survival status in Ghana. The results have been presented in both Crude and Adjusted logistic regression models. In the unadjusted model, it was observed that mothers in the "Poorer" category

were 54% times less likely to have their infants alive as compared to mothers in the "Poorest" category (cOR = 0.46; 95% C.I. = 0.22-0.96). Similarly, infants born at 9 months and 10 months were about 153 and 158 times, respectively, more likely to be alive compared to preterm infants delivered at 6 months.

In the adjusted model, infants born in the Eastern Region were 88% times less likely to be alive compared to infants born in the Western Region (aOR = 0.12; 95% CI: 0.01–0.96). Also, infants born at 9 months and 10 months were 227 and 234 times, respectively, more likely to be alive compared to preterm infants delivered at 6 months. Compared to moms without jobs, mothers in "sales" had an 80% lower chance of having a live child (aOR = 0.20; 95% CI: 0.05–0.77). Additionally, compared to moms in the poorest category, mothers in the "richer" category had an approximately eight-fold higher chance of having a surviving infant (aOR = 7.80; 95 percent CI: 1.35–45.03).

Table 4: The Predictors of Infant Survival Status.

Variables	cOR(95 C.I), p-value	aOR(95 C.I) p-value
Place of residence		
Urban	Ref	Ref
Rural	1.26(0.71-2.26),0.429	1.22(0.51-2.97),0.648
Ethnicity		
Akan	Ref	Ref
Ga/Dangme	1.12(0.26-4.89),0.878	1.72(0.27-10.90),0.564
Ewe	5.04(0.67-37.84),0.116	2.95(0.30-29.43),0.356
Mole-Dagbani	1.45(0.79-2.65),0.231	0.63(0.23-1.70),0.362
Others	0.73(0.09-5.64),0.762	1.02(0.06-18.45),0.989
Age of mother		
15-19	Ref	Ref
20-24	1.63(0.62-4.27),0.319	0.77(0.21-2.91),0.707
25-29	1.94(0.74-5.08),0.177	0.93(0.24-3.59),0.913
30-34	1.97(0.72-5.37),0.184	0.80(0.19-3.32),0.762
35-49	1.83(0.67-4.98),0.239	0.95(0.23-3.94),0.940
Region		
Western	Ref	Ref
Central	0.05(0.09-2.64),0.416	0.26(0.03-2.33),0.231

Greater Accra	1.11(0.15-2.65),0.914	0.19(0.03-2.75),0.221
Volta	-	-
Eastern	0.43(0.08-2.26),0.317	0.11(0.01-0.96), **0.046**
Ashanti	0.57(0.11-3.04),0.514	0.54(0.06-4.90),0.581
Western North	-	-
Ahafo	2.94(0.26-32.95),0.381	3.57(0.20-63.74),0.387
Bono	0.64(0.10-3.90),0.625	0.63(0.06-6.52),0.695
Bono East	0.63(0.12-3.34),0.592	0.27(0.03-2.56)0.258
Oti	0.87(0.16-4.87),0.877	0.72(0.07-7.41)0.786
Northern	1.32(0.24-7.38),0.746	0.88(0.09-8.47)0.909
Savannah	1.02(0.18-5.69),0.979	0.80(0.07-9.02),0.826
North East	1.18(0.21-6.58),0.847	1.16(0.11-11.72),0.903
Upper East	1.92(0.27-13.86),0.518	1.30(0.10-16.68),0.839
Upper West	2.94(0.26-32.95),0.381	1.97(0.11-35.43),0.646
Educational attainment		
No education	Ref	Ref
primary	1.06(0.42-2.67),0.907	1.03(0.34-3.16),0.952
Secondary	0.94(0.47-1.85),0.851	1.16(0.42-3.20),0.768
Higher	1.24(0.35-4.40),0.739	0.24(0.03-1.89)0.175
Duration of pregnancy		
6	Ref	Ref
7	4.2(0.34-51.98),0.264	3.79(0.14-102.60),0.429
8	4.25(0.33-54.06),0.265	2.74(0.10-75.27),0.551
9	152.77(13.43-1737.77)<**0.001**	220.54(9.28-5240.59)<**0.001**
10	158.00(7.07-3531.24)<**0.001**	246.76(5.80-10502.11)<**0.004**
Occupation		
Not working	Ref	Ref
Professional	0.66(0.18-2.49),0.543	1.58(0.19-13.43),0.674
Clerical	-	-
Sales	0.39(0.14-1.13),0.084	0.20(0.05-0.77)<**0.018**
Agricultural-self employed	0.14(0.01-1.25),0.078	0.08(0.01-1.07),0.057
Agricultural-employed	2.10(0.26-16.70),0.485	1.30(0.14-11.69)0.814
Services	0.91(0.40-2.03),0.815	0.69(0.26-1.83),0.455
Skilled manual	0.57(0.22-1.48),0.247	0.54(0.16-1.86)0.327
Unskilled manual	0.12(0.01-1.11),0.062	0.09(0.00-3.06),0.184
others	-	-
Wealth index		
Poorest	Ref	Ref
Poorer	0.46(0.22-0.96)<**0.039**	0.51(0.20-1.31),0.163
Middle	0.89(0.35-2.27),0.799	1.75(0.48-6.35),0.396
Richer	1.31(0.42-4.08),0.646	7.85(1.35-45.49),<**0.022**
Richest	0.72(0.25-2.07),0.544	3.29(0.45-24.17),0.242
Place of delivery		
Home	Ref	Ref

Government hospital	0.95(0.42-2.14),0.903	0.77(0.27-2.18)0.624
Polyclinic	0.62(0.13-2.98),0.547	1.47(0.17-12.87),0.727
Health center	1.68(0.60-4.67),0.322	1.53(0.46-5.08),0.487
CHPS	1.63(0.43-6.23),0.473	1.76(0.36-8.51),0.483
Private hospital	1.75(0.46-6.68),0.412	2.13(0.38-11.77)0.387

4.5 Variations of Infant Mortality Rate by wealth index, geographical location, and ethnicity

4.5.1 Wealth Quintiles

Figure 4.1 shows the distribution of infant mortality rates per 1,000 live births across different wealth quintiles. Among the poorer households, the highest number of infant deaths was observed, with 9 deaths per 1,000 live births, followed by the poorest group with 6 deaths per 1,000 live births. However, the middle-income group recorded 3 deaths per 1,000 live births, showing a moderate decline in infant mortality as household wealth improved. The richer and richest groups recorded the lowest number of infant deaths, with 2 deaths per 1,000 live births each, suggesting a potential protective effect of higher socio-economic status on infant survival.

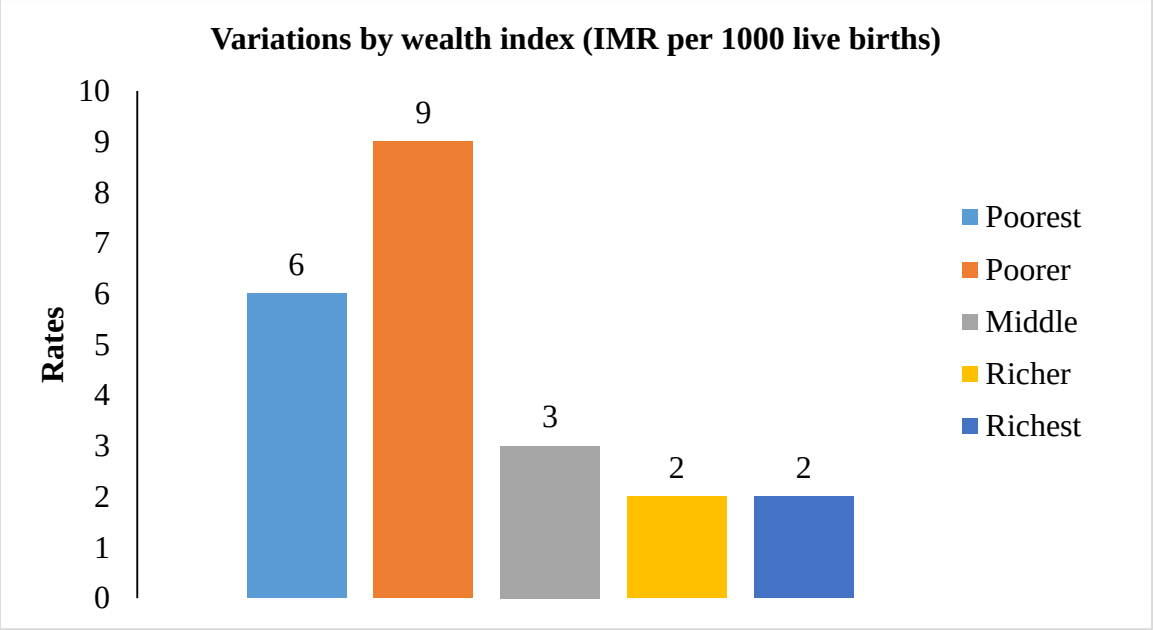

Figure 2: Variations of Infant Mortality Rate by Wealth Quintiles.

4.5.2 Geographical location (Regions)

An analysis of regional variations in the rate of infant mortality per 1,000 live births revealed noticeable disparities across the 16 regions of Ghana. The national average rate of infant mortality was **22 deaths per 1,000 live births**. Regions such as the Central, Eastern, and Ashanti regions recorded the highest rate classification, with 2 infant deaths per 1,000 live births, exceeding the national average. Similarly, the Bono East, Oti, Northern, Savannah, and North East regions also recorded high rates, each contributing 2 infant deaths per 1,000 live births. Conversely, regions including the Western, Greater Accra, Ahafo, Bono, Upper East, and Upper West regions recorded a lower rate of 1 infant death per 1,000 live births, falling below the national average. Notably, the Volta and Western North regions recorded the lowest classification, with zero infant deaths per 1,000 live births, highlighting areas of relatively better infant survival outcomes (Figure 3).

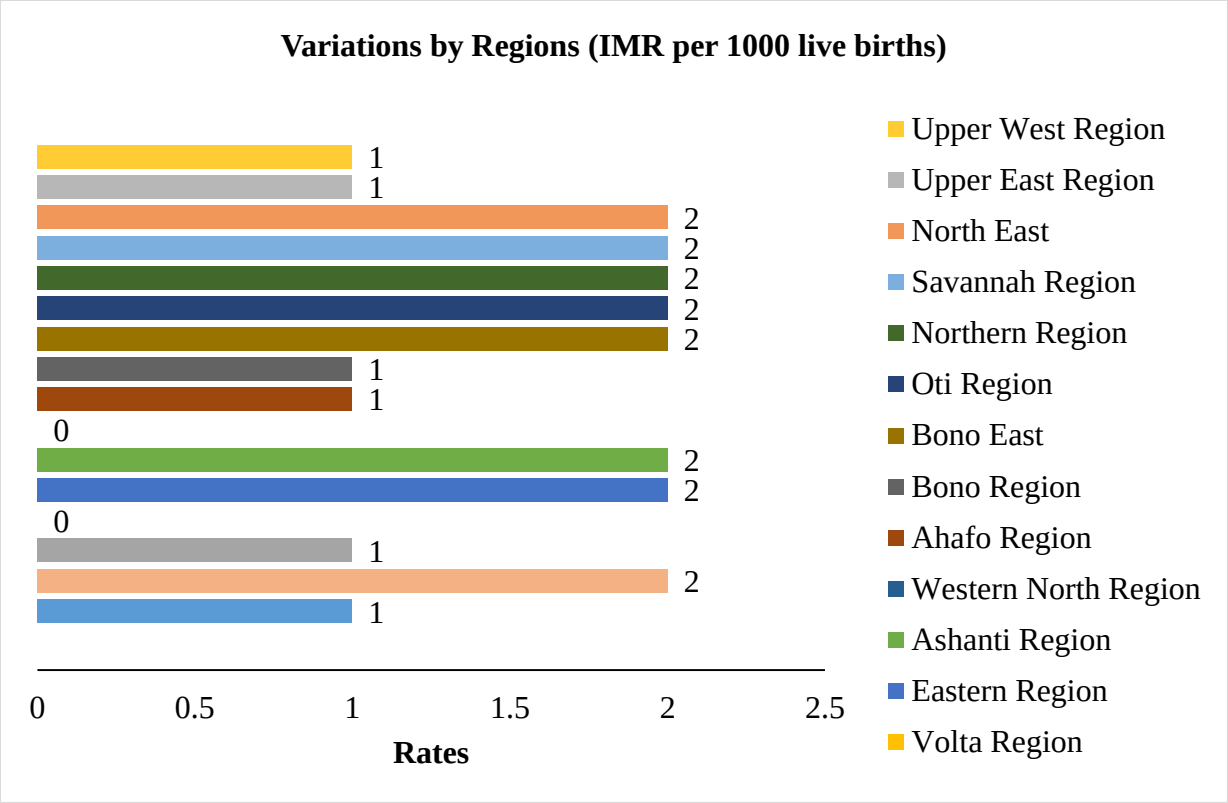

Figure 3: Variations of Infant Mortality Rate by geographical location (regions)

4.5.3 Ethnicity

An analysis of infant mortality by ethnic background reveals significant disparities. The Mole-Dagbani ethnic group recorded the highest number of infant deaths, with 10 deaths, followed closely by the Akan group, which accounted for 9 deaths per 1,000 live births. Ga/Dangme, Ewe, and Other ethnic categories each reported 1 death per 1,000 live births, indicating considerably lower rates of infant mortality among these groups (figure 4).

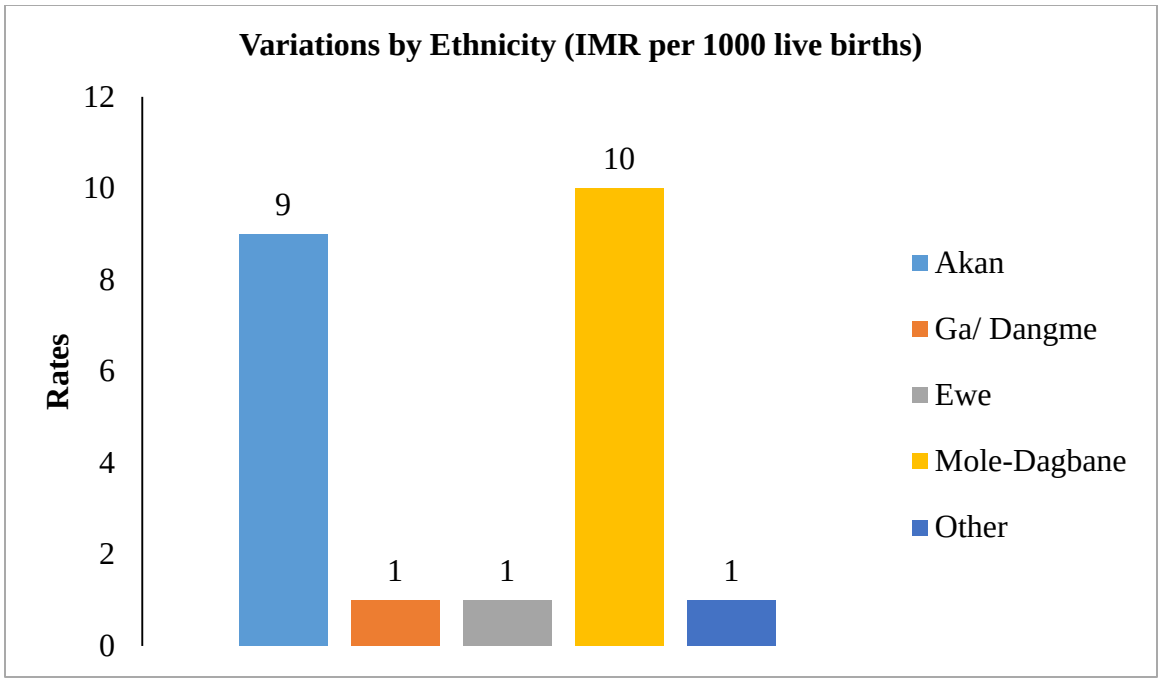

Figure 4: Variations of Infant Mortality Rate by ethnicity

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

This chapter presents a comprehensive discussion of the study's findings. The study sought to investigate the prevalence and predictors of child survival status in Ghana, focusing on the impact of various socio-demographic characteristics. The findings revealed an overall low infant mortality rate in the surveyed population, with significant associations found for pregnancy duration, birth region, maternal sales occupation, and belonging to the richest wealth quintile. These findings, along with the observed variations in infant mortality by geographical location, wealth index, and ethnicity, are discussed in depth below, drawing comparisons with existing literature and highlighting potential implications for public health interventions.

5.2 Rate of Infant Survival Status

The overall infant mortality rate of 2.2% reported in this study is relatively low when compared to Ghana's national infant mortality rate, which was reported as 31.60 deaths per 1000 live births in 2022 (MacroTrends, 2025) and 30.049 deaths per 1000 live births in 2024 (MacroTrends, 2025). This disparity could be attributed to the specific characteristics of the surveyed population or potential biases in data collection. While the study found that urban areas had slightly higher infant mortality (2.5%) than rural areas (2.0%), the difference was not statistically significant. This contrasts with some previous reports indicating higher infant mortality in rural areas of Ghana (Adam, 2016). The higher mortality rate among mothers from the "Other" ethnic groups (3.9%) and Akan (2.8%), compared to the lowest among Ewe mothers (0.6%), suggests potential ethnic disparities, though these were not statistically significant in the chi-square analysis. These findings

are consistent with previous research showing ethnic variations in infant mortality in Ghana (Gyimah, 2002).

The highest infant mortality rate was found for births in polyclinics (4.0%) and home deliveries (2.5%), though this relationship was not statistically significant. Home births are frequently associated with limited access to skilled birth attendants and emergency obstetric care, potentially increasing the risk of negative outcomes (Adongo and Ganle, 2023). The higher mortality rate in polyclinics compared to government hospitals (2.7%) and health centers (1.5%) is an intriguing finding that calls for further research. It may indicate differences in the quality of care or the types of cases handled at various healthcare facilities (Adongo and Ganle, 2023).

5.3 Predictors of Infant Survival Status

5.3.1 Duration of Pregnancy

The length of pregnancy and the child's survival status were found to be strongly correlated. Preterm deliveries (6, 7, and 8 months) had the highest infant mortality rates, while full-term and extended-term births (9 and 10 months) had far lower rates. This finding aligns with global trends and emphasizes the vulnerability of preterm infants (Poulin *et al.*, 2024).

5.3.2 Region

In the adjusted logistic regression model, infants born in the Eastern Region were significantly less likely to survive than infants born in the Western Region. This regional disparity may be indicative of variations in access to healthcare, quality of health services, socioeconomic conditions, or environmental factors across different regions of Ghana (Mohammed *et al.*, 2023).

5.3.3 Maternal Occupation

The adjusted model also revealed that mothers in "sales" were significantly less likely to have a surviving infant than unemployed mothers. This finding suggests that the nature of work in sales may pose challenges to child survival, possibly due to factors such as time constraints affecting childcare practices or exposure to specific occupational hazards (Abubakari *et al.*, 2023). This warrants further exploration to identify the specific mechanisms underlying this association.

5.3.4 Wealth Index

Interestingly, mothers in the "richer" wealth category were about 8 times more likely to have a surviving infant than mothers in the poorest category in the adjusted model. This finding emphasizes the significant role of socioeconomic status in child survival, aligning with numerous studies worldwide that demonstrate the protective effect of higher wealth on infant mortality (Mohammed *et al.*, 2023). This positive outcome is most likely due to improved access to nutrition, healthcare, and better living conditions associated with increased wealth. The crude odds ratio indicated a lower likelihood of infant survival in the "Poorer" category compared to the "Poorest," but this was not significant in the adjusted model.

5.4 Variations of Infant Mortality Rate

The graphical representation of infant mortality rates by wealth quintiles revealed a downward trend in mortality with increasing wealth, though the poorest group surprisingly had fewer deaths than the poorer group. The richer and richest groups had the fewest infant deaths, demonstrating the protective effect of higher socioeconomic status identified in the regression analysis.

The regional analysis revealed disparities throughout Ghana, with the Central and Eastern regions having the highest rates, which exceed the national average depicted in the graph. Conversely, the

Volta and Western North regions had the lowest rates. These variations highlight geographical inequalities in child survival, which may be linked to regional differences in healthcare access and socioeconomic development (Mohammed *et al.*, 2023).

Infant mortality rates differed by ethnicity, with the Mole-Dagbani and Akan groups having the highest number of deaths. This is consistent with the non-significant trend found in the prevalence table and previous research indicating ethnic disparities in infant mortality in Ghana. (Gyimah, 2002). More research is needed to understand the cultural, socioeconomic, and environmental factors influencing these ethnic differences.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study's findings show that pregnancy duration and wealth index have a significant impact on child survival in Ghana. The identification of the Eastern Region and maternal occupation in sales as risk factors in the adjusted model calls for further investigation to inform targeted interventions. The observed variations in infant mortality by geographical location and ethnicity emphasize the need for geographically and culturally sensitive public health strategies.

6.2 Recommendations

Based on these findings, the following recommendations are proposed:

1. The Ministry of Gender, Children and Social Protection should enhance economic support for vulnerable women. This can be achieved through expanded access to the Livelihood Empowerment Against Poverty (LEAP) program, and social health insurance coverage.
2. The Ghana Health Service should enhance antenatal care outreach, focusing on early detection and management of pregnancy complications. Training community health workers in preterm birth risk identification and neonatal intensive care should be prioritized, especially in rural areas.
3. The Ministry of Health should develop region-specific interventions, including strengthening referral systems, improving healthcare infrastructure, and increasing funding to these regions to address healthcare disparities.

4. To effectively lower baby morbidity and death, a variety of stakeholders, including the government and non-governmental organizations, should consider the predictors of child survival while designing interventions.

APPENDIX

APPENDIX I: AUTHORIZATION LETTER FOR STUDY DATA

Sep 17, 2024

jessica sedode
ensign global college
Ghana
Request Date: 09/17/2024

Dear jessica sedode:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Rate and causes of infant mortality":

Ghana

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

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

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Also, be aware that re-distribution of any DHS micro-level data, either directly or within any tool/dashboard, is not permitted. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers registered in your account for this research paper, you are authorized to share the data with them. All data users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: references@dhsprogram.com.

Sincerely,

Bridgette Wellington

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

REFERENCES

Abate, M.G., Angaw, D.A. and Shaweno, T. (2020) 'Proximate determinants of infant mortality in Ethiopia, 2016 Ethiopian demographic and health surveys: results from a survival analysis', *Archives of Public Health,* 78(1), p. 4. Available at: https://doi.org/10.1186/s13690-019-0387-4.

Abubakari, A. *et al.* (2023) 'Maternal Occupation and The Nutritional Status of Children Aged 6-24 Months in the Tamale Metropolis', *UDS International Journal of Development [UDSIJD],* 10 No. 1. Available at: https://doi.org/10.47740/776.UDSIJD6i.

Adam, A. (2016) 'Gender Differentials and Disease-Specific Cause of Infant Mortality: A Case Study in an Urban Hospital in Accra, Ghana', *African Journal of Reproductive Health,* 20(2), pp. 104–110. Available at: https://doi.org/10.29063/ajrh2016/v20i2.11.

Adebe, Kebede L. *et al.* (2023) 'Analysis of regional heterogeneity and determinants of perinatal mortality in Ethiopia: review', *Annals of Medicine and Surgery,* 85(4), pp. 902–907. Available at: https://doi.org/10.1097/MS9.0000000000000400.

Adebe, Kebede Lulu *et al.* (2023) 'Understanding correlates of infant mortality in Ethiopia using 2019 Ethiopian mini demographic and health survey data', *Annals of Medicine and Surgery,* 85(5), p. 1796. Available at: https://doi.org/10.1097/MS9.0000000000000629.

Adongo, E.A. and Ganle, J.K. (2023) 'Predictors of neonatal mortality in Ghana: evidence from 2017 Ghana maternal health survey', *BMC Pregnancy and Childbirth*, 23, p. 556. Available at: https://doi.org/10.1186/s12884-023-05877-y.

Adua, E. *et al.* (2017) 'Emerging issues in public health: a perspective on Ghana's healthcare expenditure, policies and outcomes', *EPMA Journal*, 8(3), pp. 197–206. Available at: https://doi.org/10.1007/s13167-017-0109-3.

Aheto, J.M.K. (2019) 'Predictive model and determinants of under-five child mortality: evidence from the 2014 Ghana demographic and health survey', *BMC Public Health*, 19, p. 64. Available at: https://doi.org/10.1186/s12889-019-6390-4.

Ahinkorah, B.O. (2021) 'Maternal age at first childbirth and under-five morbidity in sub-Saharan Africa: analysis of cross-sectional data of 32 countries', *Archives of Public Health*, 79(1), p. 151. Available at: https://doi.org/10.1186/s13690-021-00674-5.

Ahmed, A.T. *et al.* (2023) 'Determinants of early neonatal mortality (hospital based retrospective cohort study in Somali region of Ethiopia)', *Scientific Reports*, 13(1), p. 1114. Available at: https://doi.org/10.1038/s41598-023-28357-x.

Ali, D.A. *et al.* (2024) 'The risk factors of infant mortality in Somalia: evidence from the 2018/2019 Somali health & demographic survey', *BMC Pediatrics*, 24(1), p. 486. Available at: https://doi.org/10.1186/s12887-024-04964-z.

Amponsah, D. (2023) 'Determinants of Adolescent Pregnancy in Ghana: Policy Implications'.

Anaba, E.A. and Afaya, A. (2022) 'Correlates of late initiation and underutilisation of the recommended eight or more antenatal care visits among women of reproductive age: insights from the 2019 Ghana Malaria Indicator Survey', *BMJ Open*, 12(7), p. e058693. Available at: https://doi.org/10.1136/bmjopen-2021-058693.

Argawu, A.S. *et al.* (2021) 'Prevalence and Determinants of Anaemia among Reproductive-aged Women in Ethiopia: A Nationally Representative Cross-sectional Study', *Journal of Pharmaceutical Research International*, pp. 687–698. Available at: https://doi.org/10.9734/jpri/2021/v33i59B34434.

Bango, M. and Ghosh, S. (2023) 'Reducing infant and child mortality: assessing the social inclusiveness of child health care policies and programmes in three states of India', *BMC Public Health*, 23(1), p. 1149. Available at: https://doi.org/10.1186/s12889-023-15812-7.

Baraki, A.G. *et al.* (2020) 'Factors affecting infant mortality in the general population: evidence from the 2016 Ethiopian demographic and health survey (EDHS); a multilevel analysis', *BMC Pregnancy and Childbirth*, 20(1), p. 299. Available at: https://doi.org/10.1186/s12884-020-03002-x.

Baruah, R. *et al.* (2023) 'Determinants of Infant Mortality in Assam, India: Modelling with Generalised Linear Regression Model for Count Data', *Indian Journal of Science And Technology*, 16(40), pp. 3538–3548. Available at: https://doi.org/10.17485/IJST/v16i40.1948.

Bhatia, M. *et al.* (2019) 'Trends, patterns and predictive factors of infant and child mortality in well-performing and underperforming states of India: a secondary analysis using National Family Health Surveys', *BMJ Open*, 9(3), p. e023875. Available at: https://doi.org/10.1136/bmjopen-2018-023875.

de Bitencourt, F.H., Schwartz, I.V.D. and Vianna, F.S.L. (2019) 'Infant mortality in Brazil attributable to inborn errors of metabolism associated with sudden death: a time-series study (2002–2014)', *BMC Pediatrics*, 19(1), p. 52. Available at: https://doi.org/10.1186/s12887-019-1421-y.

Bugelli, A. *et al.* (2021) 'The Determinants of Infant Mortality in Brazil, 2010–2020: A Scoping Review', *International Journal of Environmental Research and Public Health*, 18(12), p. 6464. Available at: https://doi.org/10.3390/ijerph18126464.

Calais-Ferreira, L. *et al.* (2022) 'Birthweight, gestational age and familial confounding in sex differences in infant mortality: a matched co-twin control study of Brazilian male-female twin pairs identified by population data linkage', *International Journal of Epidemiology*, 51(5), pp. 1502–1510. Available at: https://doi.org/10.1093/ije/dyab242.

Dalinjong, P.A., Wang, A.Y. and Homer, C.S.E. (2018) 'The implementation of the free maternal health policy in rural Northern Ghana: synthesised results and lessons learnt', *BMC Research Notes*, 11(1), p. 341. Available at: https://doi.org/10.1186/s13104-018-3452-0.

Deressa, A.T. and Desta, M.S. (2023) 'Prevalence and determinants of neonatal near miss in Ethiopia: A systematic review and meta-analysis', *PloS One*, 18(2), p. e0278741. Available at: https://doi.org/10.1371/journal.pone.0278741.

Dwomoh, D. *et al.* (2020) 'Impact evaluation of the free maternal healthcare policy on the risk of neonatal and infant deaths in four sub-Saharan African countries: a quasi-experimental design with propensity score Kernel matching and difference in differences analysis', *BMJ Open*, 10(5), p. e033356. Available at: https://doi.org/10.1136/bmjopen-2019-033356.

Fenta, S.M. *et al.* (2022) 'Community and individual level determinants of infant mortality in rural Ethiopia using data from 2016 Ethiopian demographic and health survey', *Scientific Reports*, 12(1), p. 16879. Available at: https://doi.org/10.1038/s41598-022-21438-3.

Ghana Statistical Service (2021) *Ghana 2021 Population and Housing Census*. Available at: https://census2021.statsghana.gov.gh/gssmain/fileUpload/reportthemelist/PRINT_COPY_VERSION_FOUR%2022ND_SEPT_AT_8_30AM.pdf (Accessed: 29 August 2024).

Ghana Statistical Service (GSS) and ICF. (2024) 'Ghana Demographic and Health Survey 2022'. Accra, Ghana, and Rockville, Maryland, USA: GSS and ICF. Available at: https://www.dhsprogram.com/pubs/pdf/fr307/fr307.pdf.

Goeglein, S.K. and Yatchmink, Y.E. (2020) 'Maternal Depression Is a Public Health Crisis: The Time to Act Is Now', *Pediatrics*, 146(3), p. e2020010413. Available at: https://doi.org/10.1542/peds.2020-010413.

GSS (2023) 'Presentation on the 2022 Ghana Demographic and Health Survey Key Indicators Report', 5 June. Available at: https://www.moh.gov.gh/wp-content/uploads/2023/06/GDHS-KIR-release-presentation_short.pdf (Accessed: 3 October 2024).

Gudayu, T.W. (2023) 'Epidemiology of neonatal mortality: a spatial and multilevel analysis of the 2019 mini-Ethiopian demographic and health survey data', *BMC Pediatrics*, 23(1), p. 26. Available at: https://doi.org/10.1186/s12887-023-03838-0.

Gyimah, S. (2002) 'Ethnicity and Infant Mortality in Sub-Saharan Africa: The Case of Ghana', *PSC Discussion Papers Series*, 16(10). Available at: https://ir.lib.uwo.ca/pscpapers/vol16/iss10/1.

Irana, T. *et al.* (2023) 'Determinants of infant mortality in Oromia region, Ethiopia', *Annals of Medicine and Surgery*, 85(6), p. 2791. Available at: https://doi.org/10.1097/MS9.0000000000000842.

Islam, A., Tabassum, T. and Moni, M.A. (2022) 'Exploring the influencing factors for infant mortality: a mixed-method study of 24 developing countries based on demographic and health survey data', *Family Medicine & Primary Care Review*, 24(3), pp. 227–236. Available at: https://doi.org/10.5114/fmpcr.2022.118281.

Jim, G.P. and Friday, E.U. (2023) 'Infant Mortality Rate And Public Health Care in Nigeria (2000-2022)', *Social Sciences and Management International Journal*, 4(1).

Johnson, F.A. *et al.* (2015) 'Evaluating the Impact of the Community-Based Health Planning and Services Initiative on Uptake of Skilled Birth Care in Ghana', *PLOS ONE*, 10(3), p. e0120556. Available at: https://doi.org/10.1371/journal.pone.0120556.

Khadka, K.B. *et al.* (2015) 'The socio-economic determinants of infant mortality in Nepal: analysis of Nepal Demographic Health Survey, 2011', *BMC Pediatrics*, 15(1), p. 152. Available at: https://doi.org/10.1186/s12887-015-0468-7.

Kibret, G.D., Demant, D. and Hayen, A. (2023) 'The effect of distance to health facility on neonatal mortality in Ethiopia', *BMC Health Services Research*, 23(1), p. 114. Available at: https://doi.org/10.1186/s12913-023-09070-x.

Kim, Y.-N. *et al.* (2021) 'Maternal age and risk of early neonatal mortality: a national cohort study', *Scientific Reports*, 11(1), p. 814. Available at: https://doi.org/10.1038/s41598-021-80968-4.

Koffi, A.K. *et al.* (2017) 'Sociodemographic, behavioral, and environmental factors of child mortality in Eastern Region of Cameroon: results from a social autopsy study', *Journal of Global Health*, 7(1), p. 010601. Available at: https://doi.org/10.7189/jogh.07.010601.

Lambon-Quayefio, M. and Owoo, N.S. (2017) 'Determinants and the impact of the National Health Insurance on neonatal mortality in Ghana', *Health Economics Review*, 7(1), p. 34. Available at: https://doi.org/10.1186/s13561-017-0169-z.

Leal, M. do C. *et al.* (2017) 'Determinants of infant mortality in the Jequitinhonha Valley and in the North and Northeast regions of Brazil', *Revista de Saúde Pública*, 51. Available at: https://doi.org/10.1590/S1518-8787.2017051006391.

Li, Y., Quigley, M. and Hollowell, J. (2017) 'OP18 Ethnic variations in infant mortality in england and wales 2006–2012: a national cohort study using routinely collected data', *J Epidemiol Community Health*, 71(Suppl 1), pp. A10–A10. Available at: https://doi.org/10.1136/jech-2017-SSMAbstracts.18.

MacroTrends (2025) *Ghana Infant Mortality Rate 1960-2025 | MacroTrends*. Available at: https://www.macrotrends.net/global-metrics/countries/GHA/ghana/infant-mortality-rate (Accessed: 21 April 2025).

Madewell, Z.J. *et al.* (2022) 'Prioritizing Health Care Strategies to Reduce Childhood Mortality', *JAMA Network Open*, 5(10), p. e2237689. Available at: https://doi.org/10.1001/jamanetworkopen.2022.37689.

Mathews, T.J. and Driscoll, A.K. (2017) 'Trends in Infant Mortality in the United States, 2005–2014. NCHS data brief, no 279.', *Hyattsville, MD: National Center for Health Statistics.* [Preprint], (279).

Mfateneza, E. *et al.* (2022) 'Application of machine learning methods for predicting infant mortality in Rwanda: analysis of Rwanda demographic health survey 2014–15 dataset', *BMC*

Pregnancy and Childbirth, 22(1), p. 388. Available at: https://doi.org/10.1186/s12884-022-04699-8.

Mohammed, K. *et al.* (2023) 'Geographic disparities in the time to under-five mortality in Ghana', *PLOS ONE*, 18(9), p. e0291328. Available at: https://doi.org/10.1371/journal.pone.0291328.

Mohamoud, Y.A., Kirby, R.S. and Ehrenthal, D.B. (2019) 'Poverty, urban-rural classification and term infant mortality: a population-based multilevel analysis', *BMC Pregnancy and Childbirth*, 19(1), p. 40. Available at: https://doi.org/10.1186/s12884-019-2190-1.

Mosley, W.H. and Chen, L.C. (1984) 'An Analytical Framework for the Study of Child Survival in Developing Countries', *Population and Development Review*, 10, pp. 25–45. Available at: https://doi.org/10.2307/2807954.

Neal, S., Channon, A.A. and Chintsanya, J. (2018) 'The impact of young maternal age at birth on neonatal mortality: Evidence from 45 low and middle income countries', *PLOS ONE*, 13(5), p. e0195731. Available at: https://doi.org/10.1371/journal.pone.0195731.

Nsiah, R. *et al.* (2024) 'Predictors of Delayed Antenatal Care Initiation in a Rural District of Ghana: Insights from a Cross- Sectional Study', *Journal of Public Health Studies*, 3, pp. 17–35. Available at: https://doi.org/10.58425/jphs.v3i1.271.

Nwanze, L.D., Siuliman, A. and Ibrahim, N. (2023) 'Factors associated with infant mortality in Nigeria: A scoping review', *PLOS ONE*, 18(11), p. e0294434. Available at: https://doi.org/10.1371/journal.pone.0294434.

Oduro, C.A. *et al.* (2022) 'The burden and predictors of late antenatal booking in a rural setting in Ghana', *Nursing Open*, 10(4), p. 2182. Available at: https://doi.org/10.1002/nop2.1467.

Okwuwa, C.O. and Adejo, S.M. (2020) 'Infant Mortality, Access to Primary Health Care and Prospects for Socio-Economic Development in Bwari Area Council of Niger State, Nigeria', *Journal of International Women's Studies*, 21(1), pp. 289–308.

Osei-Poku, G.K. *et al.* (2023) 'The apparent burden of unexplained sudden infant deaths in Lusaka, Zambia: Findings from analysis of verbal autopsies', *Gates Open Research*, 7, p. 46. Available at: https://doi.org/10.12688/gatesopenres.14303.1.

Park, S. *et al.* (2022) 'The global burden of sudden infant death syndrome from 1990 to 2019: a systematic analysis from the Global Burden of Disease study 2019', *QJM: An International Journal of Medicine*, 115(11), pp. 735–744. Available at: https://doi.org/10.1093/qjmed/hcac093.

Patel, K.K., Prasad, J.B. and Biradar, R.A. (2021) 'Trends in and determinants of neonatal and infant mortality in Nigeria based on Demographic and Health Survey data', *Journal of Biosocial Science*, 53(6), pp. 924–934. Available at: https://doi.org/10.1017/S0021932020000619.

Poulin, D. *et al.* (2024) 'Infant mortality in Ghana: investing in health care infrastructure and systems', *Health Affairs Scholar*, 2(2), p. qxae005. Available at: https://doi.org/10.1093/haschl/qxae005.

Rai, S.K. *et al.* (2017) 'Causes of and contributors to infant mortality in a rural community of North India: evidence from verbal and social autopsy', *BMJ Open*, 7(8), p. e012856. Available at: https://doi.org/10.1136/bmjopen-2016-012856.

Ratnasiri, A.W.G. *et al.* (2020) 'Maternal and infant predictors of infant mortality in California, 2007–2015', *PLoS ONE*, 15(8), p. e0236877. Available at: https://doi.org/10.1371/journal.pone.0236877.

Schellekens, J. (2021) ‘Maternal education and infant mortality decline: The evidence from Indonesia, 1980–2015’, *Demographic Research*, 45, pp. 807–824.

Shibre, G. (2020) ‘Social inequality in infant mortality in Angola: Evidence from a population based study’, *PLoS ONE*, 15(10). Available at: https://doi.org/10.1371/journal.pone.0241049.

Shobiye, D.M. *et al.* (2022) ‘Infant mortality and risk factors in Nigeria in 2013-2017: A population-level study’, *EClinicalMedicine*, 51, p. 101622. Available at: https://doi.org/10.1016/j.eclinm.2022.101622.

Singh, P. and John, S. (2017) ‘Determinants Affecting Infant and Maternal Mortality in Madhya Pradesh’, *International Journal of Health Sciences* [Preprint], (11).

Suzuki, Y., Senda, Y. and Honjo, K. (2021) ‘[Maternal occupation and infant mortality in Japan: Insights from the Vital Statistics (Occupational and Industrial Aspects)]’, *[Nihon koshu eisei zasshi] Japanese journal of public health*, 68(10), pp. 669–676. Available at: https://doi.org/10.11236/jph.20-151.

Takramah, W.K. and Aheto, J.M.K. (2021) ‘Predictive model and determinants of odds of neonates dying within 28 days of life in Ghana’, *Health Science Reports*, 4(1), p. e248. Available at: https://doi.org/10.1002/hsr2.248.

Tamir, T.T. *et al.* (2023) ‘Prevalence, spatial distribution and determinants of infant mortality in Ethiopia: Findings from the 2019 Ethiopian Demographic and Health Survey’, *PLOS ONE*. Edited by B.H. Zegeye, 18(4), p. e0284781. Available at: https://doi.org/10.1371/journal.pone.0284781.

Taskaya, S. and Demirkiran, M. (2016) 'Determinants of infant mortality in last two decades: a bibliometric analysis', *International Journal Of Community Medicine And Public Health*, 3(4), pp. 776–780. Available at: https://doi.org/10.18203/2394-6040.ijcmph20160731.

Tesema, G.A. *et al.* (2021) 'Trends of infant mortality and its determinants in Ethiopia: mixed-effect binary logistic regression and multivariate decomposition analysis', *BMC Pregnancy and Childbirth*, 21(1), p. 362. Available at: https://doi.org/10.1186/s12884-021-03835-0.

Tesema, G.A. *et al.* (2022) 'Incidence of infant mortality and its predictors in East Africa using Gompertz gamma shared frailty model', *Archives of Public Health*, 80, p. 195. Available at: https://doi.org/10.1186/s13690-022-00955-7.

Tiruneh, G. *et al.* (2022) 'Using the Implementation Research Logic Model to design and implement community-based management of possible serious bacterial infection during COVID-19 pandemic in Ethiopia', *BMC Health Services Research*, 22(1). Available at: https://doi.org/10.1186/s12913-022-08945-9.

UN Inter-agency Group for Child Mortality Estimation (2024) *Child Mortality Estimates: Ghana*. Available at: https://childmortality.org/ (Accessed: 3 October 2024).

United Nations (2024) *Child-Related SDG Progress Assessment for Ghana, UNICEF DATA*. Available at: https://data.unicef.org/sdgs/country/gha/ (Accessed: 3 October 2024).

United Nations Inter-agency Group for Child Mortality Estimation (UN IGME) (2024) *Levels & Trends in Child Mortality: Report 2023, Estimates developed by the United Nations Inter-agency Group for Child Mortality Estimation, United Nations Children's Fund*. New York, 2024.

United Nations Inter-agency Group for Child Mortality Estimation (UNIGME) (2018) *Levels & Trends in Child Mortality: Report 2018, Estimates developed by the United Nations Inter-agency Group for Child Mortality Estimation', United Nations Children's Fund,*. New York, 2018. Available at: www.childmortality.org.

Weldearegawi, B. *et al.* (2015) 'Infant mortality and causes of infant deaths in rural Ethiopia: a population-based cohort of 3684 births', *BMC Public Health*, 15(1), p. 770. Available at: https://doi.org/10.1186/s12889-015-2090-x.

WHO (2024a) *Policy brief - Strengthening Maternal Mental Health in Ghana*. Available at: https://www.afro.who.int/sites/default/files/2024-02/Policy%20brief%20-%20Strengthening%20Maternal%20Mental%20Health%20in%20Ghana.pdf (Accessed: 25 October 2024).

WHO (2024b) *Social determinants of health*. Available at: https://www.who.int/health-topics/social-determinants-of-health (Accessed: 26 January 2024).

World Health Organisation [WHO] (2024) *Indicator Metadata Registry Details*. Available at: https://www.who.int/data/gho/indicator-metadata-registry/imr-details/1 (Accessed: 3 September 2024).