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DETERMINANTS OF STILLBIRTHS AT THE GHANA POLICE HOSPITAL, ACCRA 2024

BY

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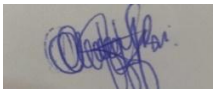
THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PHILOSOPY IN APPLIED EPIDEMIOLOGY AND DISEASE CONTROL DEGREE

18/03/2024

DECLARATION

I, Benjamin B. Mbangba, declare that except for the other people's investigations which have been duly acknowledged, this work is the result of my own original research, and that this dissertation, either in whole or in part has not been presented elsewhere for another degree.



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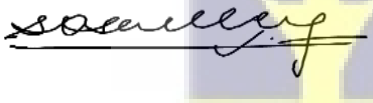

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DEDICATION

I dedicate this work to God Almighty, whose guidance and blessings have been my source of strength and inspiration; to my beloved wife and precious daughter, whose unwavering love and encouragement have been the foundation of this journey; and to my mother, whose sacrifices and support have carried me throughout my education and career.

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ABSTRACT

Background: Stillbirth refers to the death of a baby before birth, with no evidence of life at delivery, and characterized by a birthweight of at least 1,000 grams, a gestational age of at least 28 weeks, or a length of 35 centimeters. It is a critical indicator of perinatal care quality and a significant contributor to neonatal mortality. The Ghana Police Hospital, a secondary-level facility in Accra, serves predominantly the urban poor and vulnerable populations, including those in police or prison custody. Many of these patients cannot afford expensive healthcare options and often do not attend antenatal care or present late for services. This study was conducted to determine stillbirth rates, identify maternal, foetal, demographic, and facility-based determinants of stillbirths, and evaluate the impact of antenatal care (ANC) on stillbirth outcomes.

Methods: The study employed a 1:3 unmatched case-control design at the Ghana Police Hospital, involving 352 participants: 88 cases (stillbirths) and 264 controls (live births). Cases were defined as singleton stillbirths delivered at or after 28 weeks of gestation from 1st January 2021 to 31st December 2023, while controls were singleton live births during the same period. Data were collected from birth records and maternal medical records. Crude and adjusted odds ratios with 95% confidence intervals were calculated, with p-values < 0.05 considered statistically significant. Both bivariate and multivariate logistic and linear regression models were used to determine significant associations. Generalized linear regression models was used to assess the influence of ANC on stillbirth outcomes.

Results: A total of 353 women participated in this study: comprising 88 cases and 264 controls. The mean age was 32.2+-5.7 SD for cases and 30.8+-5.1 SD years for controls (range: 14-46 years). Stillbirth rates were 22.4, 16.8, and 19.5 per 1000 live birth for 2021, 2022, and 2023, respectively. Significant factors associated with stillbirths were maternal haemoglobin levels ≤9.6

g/dL (aOR = 2.14, p < 0.018), obstetric complications (aOR = 3.92, p < 0.001), pre-existing medical conditions (aOR = 3.11, p < 0.002), being a trader (aOR = 4.01, p < 001), birth weight <2.5 kg (aOR = 6.02, p < 0.001), and preterm birth ≤37 weeks (aOR = 3.41, p < 0.001). Women with fewer than eight ANC visits had higher odds of stillbirth (aOR = 3.03, p < 0.016) while an increase in ANC attendance showed 30% decrease in the odds of stillbirths aOR = 0.7 (95% CI 0.61-0.70). There was no significant association between stillbirth and parity, maternal age, or education.

Conclusion: Maternal haemoglobin, obstetric complications, being a trader and pre-existing medical condition were maternal determinants. Birth weight less than 2.5kg and birth under 37 weeks were foetal determinants. Antenatal care was a facility related determinant of stillbirths. Improving ANC utilization and early detection of high-risk pregnancies will improve pregnancy outcomes.

Keywords: Stillbirth, determinants, antenatal care, maternal health, neonatal mortality, Ghana.

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LIST OF ABBREVIATIONS

AMA – Advance Maternal Age

ANC – Antenatal Care

AOR – Adjusted Odds Ratio

APH – Antepartum Hemorrhage

BMI – Body Mass Index

ONC – Obstetric and Neonatal Care

ENAP – Every Newborn Action Plan

GMHS – Ghana Maternal Health Survey

HR – Hazard Ratio

IDSR – Integrated Disease Surveillance and Response

IPTP-Sp – Intermittent Preventive Treatment in Pregnancy with Sulfadoxine-Pyrimethamine

ITNs- Insecticide-Treated Nets

LMIC – Low to Middle Income Countries

PIH – Pregnancy Induced Hypertension

PROM – Premature rupture of membranes

SGA – Small for Gestational Age

SP – Sulfadoxine-Pyrimethamine

SSA – Sub-Saharan Africa

STI – Sexually Transmitted Infections

UN – United Nations

WHO – World Health Organization

CHAPTER ONE

1.0 Introduction

1.1 Background

The World Health Organization (WHO) describes a stillbirth as the birth of a baby showing no signs of life at or beyond 22 weeks of pregnancy but suggests using a 28-week threshold for international comparisons (WHO, 2022). According to the Ghana Integrated Disease Surveillance Response System (IDSR), a stillbirth refers to the death of a baby prior to delivery, with no signs of life at birth, meeting one or more of the following criteria: a birthweight of at least 1,000 grams, a gestational age of at least 28 weeks, or a length of 35 centimeters (Ghana IDSR, 2021).

The WHO and Ghana IDSR definitions of stillbirth differ in scope and application. The WHO provides a global standard, defining stillbirth as the death of a baby at or beyond 22 weeks of gestation, regardless of birthweight or length, and focuses on the absence of signs of life after birth. In contrast, the Ghana IDSR aligns with national needs, defining stillbirth as a fetal death at 28 weeks of gestation or more, with additional criteria of at least 1,000g birthweight or 35 cm length. The WHO definition prioritizes global comparability and data quality, while the Ghana IDSR addresses country-specific conditions (Kelly et al., 2021).

Most stillbirths are attributable to preterm birth, childbirth complications (including birth asphyxia or failure to breathe at birth), infections, and congenital defects (Camara et al., 2021). Maternal age, pre-existing medical conditions, poor maternal nutrition, inadequate prenatal care, and complications during delivery were identified as factors increasing the risk of stillbirths (Saleem et al., 2018). Identifying and addressing these risk factors through effective medical care and public health interventions can significantly lower the risk of stillbirths (Neogi et al., 2018).

Approximately 1.9 million stillbirths at or beyond 28 weeks of gestation were recorded globally in 2021, translating to one every 16 seconds. The global stillbirth rate was 13.9 per 1,000 births, with the majority occurring in Low- and Middle-Income Countries (LMICs). Sub-Saharan Africa and Southern Asia accounted for 75% of these cases, with sub-Saharan Africa having the highest stillbirth rate of 21.0 per 1,000 births, far exceeding the 2.9 per 1,000 reported in regions like Europe, Northern America, Australia, and New Zealand. The proportion of global stillbirths in sub-Saharan Africa increased from 26% in 2000 to 45% in 2021, largely due to population growth (Gerland & Spoorenberg, 2022).

Progress in reducing stillbirth rates has lagged behind the decline in under-five mortality. In Western and Central Africa, the stillbirth rate is estimated at 22.8 per 1,000 total births, significantly exceeding the global target of 12 per 1,000 total births (Hug et al., 2021).

Despite being a key indicator of health system quality, Stillbirths receive limited attention, particularly in developing countries. Although they are included in Every Newborn Action Plan (ENAP) by UNICEF and WHO, as well as in the UN Global Strategy for Women's, Children's, and Adolescents' Health (2016–2030), stillbirths are not specifically addressed in the Sustainable Development Goals (SDGs), and only a few countries have a national policy on stillbirths (Mensah Abrampah et al., 2023).

High stillbirth rates in sub-Saharan Africa arise from a combination of interconnected distal, intermediate, and proximal factors. Distal factors include women's low educational attainment, poor socioeconomic conditions, and limited decision-making power. Intermediate factors encompass maternal age at the extremes, inadequate knowledge of danger signs, delays in seeking hospital care, insufficient community resources, and poor maternal nutrition. Proximal factors

involve maternal and fetal health complications and the healthcare system's inability to effectively address these medical conditions (Saleem et al., 2018).

Poverty and limited education significantly affect healthcare-seeking behavior, reducing families' ability to recognize danger signs and access timely antenatal, delivery, or emergency services. Furthermore, in resource-constrained settings, healthcare facilities often lack essential equipment and resources needed to prevent adverse outcomes for mothers and babies, even when timely care is sought (Dahab & Sakellariou, 2020).

In Ghana, the precise prevalence of stillbirths is uncertain, with estimates ranging from 14 to 40 per 1,000 births (Angell et al., 2019). The 2017 Ghana Maternal Health Survey estimated the stillbirth rate at approximately 20 per 1,000 births, though the lack of reliable data on stillbirths and their causes hinders the development and implementation of effective and cost-efficient interventions (Ghana Statistical Service (GSS), Ghana Health Service (GHS), 2018).

There is a global call for comprehensive documentation of all stillbirths through national vital statistics to better define the scope of the problem. However, in many low-resource settings, including Ghana, challenges in data collection persist. The absence of accurate records and insights into contributing factors continues to impede efforts to reduce stillbirth rates (Tesema et al., 2021). A study at a major tertiary hospital in Kumasi, Ghana, identified the leading causes of stillbirth as hypoxic intrapartum death, antepartum hemorrhage, hypertension, and perinatal infections, with 33.8% of cases classified as unexplained antepartum deaths (Angell et al., 2019). Another study found that higher-quality antenatal care (ANC) significantly reduces the likelihood of stillbirth, cutting the risk by nearly half after accounting for delivery provider and facility type (Afulani, 2016).

At the Ghana Police Hospital in Greater Accra, the estimated stillbirth rate was 20 per 1,000 live births in 2022 - lower than the national average of 38.3 but still above the WHO target of less than 12 per 1,000. Although mortality audits are regularly conducted, no comprehensive study has examined the determinants of stillbirths at the facility. Facility-level estimates of stillbirth's risk factors are lacking, and there is no known documented study quantifying preventable stillbirths in the facility. In addition, documentation on the quality of antenatal and intrapartum care and how these contribute to stillbirths, remains inadequate. Therefore, an in-depth analysis is crucial to identify underlying causes and address the challenges hindering stillbirth prevention efforts.

1.2 Problem statement

Globally, approximately 2 million stillbirths occur annually, with one happening every 16 seconds. Nearly 40% of these occur during labor and are largely preventable through quality intrapartum care (Atkins et al., 2023). The vast majority of stillbirths (98%) occur in low- and middle-income countries, where access to maternal and newborn healthcare remains inadequate (WHO, 2023).

Progress in reducing stillbirth rates has been slower than the decline in maternal mortality, as targeted by the Millennium Development Goals. In Sub-Saharan Africa, stillbirths increased from 770,000 in 2000 to 882,000 in 2019, with a stillbirth rate of 21.7 per 1,000 births—the highest globally and over seven times the rate in developed countries, which stands at 3.1 (Estimation & Gaigbe-togbe, 2020).

A significant obstacle in addressing stillbirths and neonatal deaths is the lack of reliable data on their numbers and causes. Vital records, the primary source of information on births and deaths, often underreport or fail to capture perinatal deaths. Nonetheless, the majority of these deaths are preventable through targeted, quality interventions delivered by skilled healthcare providers (Dare

et al., 2021). In response to this challenge, the World Health Assembly launched Every Newborn Action Plan (ENAP) in 2014, aiming to reduce third-trimester stillbirths to 12 or fewer per 1,000 births by 2030 (WHO, 2014).

Despite Ghana's efforts toward achieving the ENAP target, the country's stillbirth rate remained at 38.3 per 1,000 births in 2019 - well above the global goal (Akombi & Renzaho, 2019). Various maternal conditions, including pre-eclampsia, obesity, diabetes, malaria, syphilis, and HIV, coupled with insufficient funding, pose significant barriers to progress (Dare et al., 2021). In the Greater Accra Region, around 2,000 stillbirths are recorded annually, with about 40% occurring during labor. Maternal factors such as pregnancy-induced hypertension, antepartum hemorrhage, premature rupture of membranes, and inadequate labor monitoring have been identified as major contributors (Vanotoo et al., 2023).

At the Ghana Police Hospital in Greater Accra, the estimated stillbirth rate was 20 per 1,000 live births in 2022 - lower than the national average of 38.3 but still above the WHO target of less than 12 per 1,000. Although regular mortality audits are conducted, no comprehensive study has investigated the determinants of stillbirths at the facility. Therefore, an in-depth analysis is crucial to uncover the underlying causes and address the challenges affecting stillbirth prevention efforts.

1.3 Justification

Stillbirths are a global challenge, especially in developing countries where healthcare systems face resource constraints and perinatal issues receive little attention. Although maternal deaths have declined significantly in recent years due to increased awareness and interventions, stillbirths remain a persistent problem that is often overlooked.

Accurate data on deaths occurring after 28 weeks of gestation is essential for policy decisions and healthcare interventions. The Ghana Police Hospital, located in the heart of the national capital, is one of the few hospitals that caters to the needs of the underprivileged and the urban poor who mostly cannot afford the cost of care at the larger hospitals and the private ones. This research aims to identify the determinants of stillbirths in the hospital and to examine how they may differ from those in other hospitals or regions of the country.

The study will help to design tailored interventions and to enhance perinatal care, thereby improving pregnancy outcomes and reducing stillbirth rates. Moreover, the findings from the study will guide policy makers and hospital managers in resource allocation. It will also provide evidence-based recommendations that can improve maternal and perinatal health outcomes among the urban poor.

1.4 Conceptual Framework

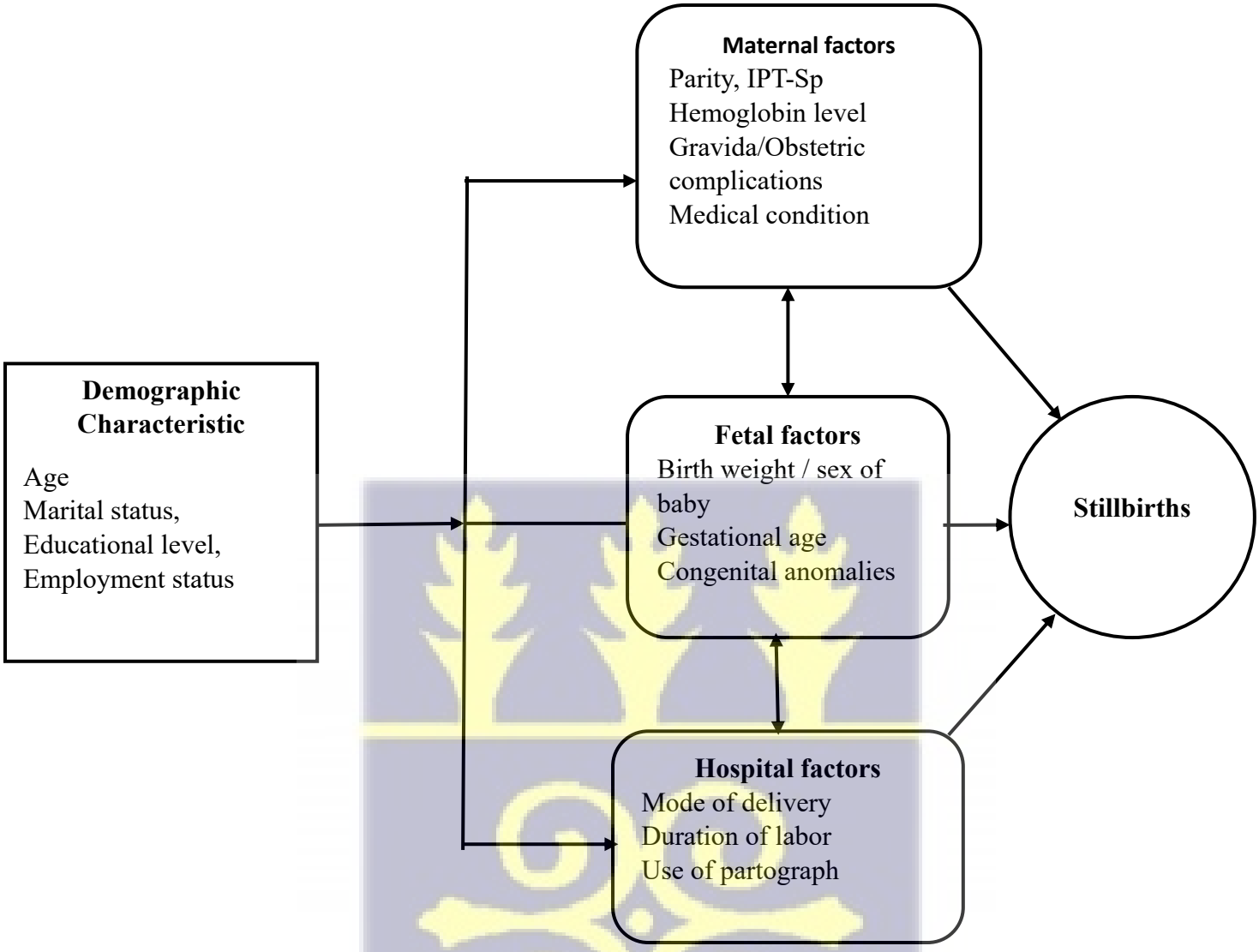

Figure 1: conceptual framework of stillbirths in a facility setting.

1.4.1 Conceptual Framework Narrative

The conceptual framework attempts to explain the complex factors contributing to stillbirths within a hospital or healthcare setting. The framework is organized into four main concepts: demographic characteristics, maternal factors, fetal factors and hospital or healthcare related factors.

Socio-Demographic characteristics such as age, marital status and religion directly and indirectly influence stillbirths. Maternal age has been identified as a key determinant for stillbirths, with older women having a greater risk of stillbirths. Teenagers may face challenges with inadequate antenatal care, while older women above 35 years have a greater risk of stillbirth. Marital status may influence a person's social status or support, which affects a woman's ability to access and adhere to antenatal schedule and recommendations. Religious beliefs may also influence a woman's health care decisions and when to report to a health facility for delivery.

Maternal factors such as parity, maternal medical conditions such as hypertension, diabetes, malaria are influenced by a woman's demographic characteristics, which also directly affect pregnancy outcome (stillbirths). The number of prior pregnancies and births may have implications for stillbirth risk. Primigravidae and multiparous women have different risk profiles of stillbirth. Medical conditions such as hypertension, whether pre-existing or gestational, increase the risk for stillbirth. Diabetes, both pre-existing and gestational, also increases the likelihood of stillbirth. Malaria is another maternal health condition that increases the chance of stillbirth during pregnancy as it may affect the hemoglobin level of the woman.

Antenatal Care (ANC) Visits emerge as a critical determinant. The frequency and adequacy of these visits play a vital role in detecting and managing risk factors. Insufficient or delayed care can lead to missed opportunities for intervention.

Utilization of Insecticide-Treated Nets (ITNs) represents a preventive measure against vector-borne diseases like malaria, which pose a substantial threat to fetal health in endemic areas. Compliance with guidelines for Intermittent Preventive Treatment in Pregnancy (IPTP) is instrumental in preventing malaria-related complications during pregnancy, including stillbirth.

Fetal Factors such as fetal birthweight, gestational age and congenital malformation have also been identified as fetal factors contributing to stillbirths. The sex of the fetus has been suggested to influence stillbirth risk in some studies, although the mechanisms behind this association remain under investigation. Fetal birthweight is associated with stillbirths, as fetal growth restriction and low birth weight are risk factors for stillbirth. Gestational Age, the timing of birth in relation to the expected duration of pregnancy, is important. Both preterm birth and post-term pregnancies are associated with a heightened risk of stillbirth. Structural congenital anomalies in the fetus also increase the likelihood of stillbirth.

Hospital-related factors such as the quality of care within the hospital setting play an instrumental role in determining the risk of stillbirth. The onset of delivery, whether spontaneous, induced, or requiring augmentation, can significantly influence the outcome. The duration of delivery, that is the length of time of labor, characterized by prolonged or rapid labor, also influences stillbirth. The mode of delivery, that is a choice between vaginal delivery and cesarean section, also affects the risk of stillbirth. An effective and immediate neonatal resuscitation measure initiated immediately after delivery reduces the risk of stillbirth. In a hospital setting where effective and immediate resuscitation measures are not available, the likelihood of stillbirths increases.

1.5 Research Questions

1. What are the stillbirth rates in the Ghana police hospital?
2. What are the maternal determinants of stillbirths in the Ghana police hospital?
3. What are the facility factors contributing to stillbirths in the Ghana police hospital?
4. What is the association between antenatal attendance and stillbirths in the Ghana police hospital?

1.6 Objectives

1.6.1 Main objectives

To assess the determinants of stillbirths in the Ghana police hospital from 2021 to 2022.

1.6.2 Specific Objectives

1. To determine the stillbirths rates in the Ghana Police Hospital
2. To identify the maternal factors contributing to stillbirths in Ghana Police Hospital
3. To assess the association between antenatal care and Stillbirths in the Ghana Police Hospital
4. To identify hospital factors contributing to stillbirths in the in Ghana Police Hospital

CHAPTER TWO

2.0 Literature review

2.1 Prevalence of stillbirths

The Every Newborn Action Plan (ENAP) targets a reduction of stillbirths to 12 or fewer per 1,000 births in all countries by 2030 (WHO, 2023). In 2024, the global stillbirth rate was 14.3 per 1,000 births, with sub-Saharan Africa recording 22.2 per 1,000, well above the ENAP target (UNICEF, 2024).

Zegeye et al., (2025), using Demographic and Health Survey data from 23 sub-Saharan Africa cpontries covering 75,451 women from 2015 to 2022, reported a stillbirth prevalence 6.18% (95% CI:6.01-6.35), highlighting the high prevalence of stillbirths in the region (Zegeye et al., 2025).

Within sub-Saharan Africa, Chipo (2023) reported a stillbirth rate of 44 per 1,000 births at Kitwe Hospital in Zambia. For comparison, rates of 29.7 per 1,00 and 11.2 per 1,000 were reported in tertiary hospitals in India (Dalal et al., 2021) and Turkey (Şimşek et al., 2021) respectively. These findings indicate the persistently high stillbirth rates, particularly in sub-Sahara Africa.

In Ghana, the stillbirth rate in 2024 was estimated at 19.4 per 1,000 births UNICEF, (2024). Ghana Maternal Health Survey, involving 18,114 women, also found the prevalence of stillbirth to be 10.4% (Ahinkorah et al., 2021).

2.2 Risk factors Associated with Stillbirths

Stillbirths have multiple and often overlapping causes, yet many are recorded as ‘unexplained’ or attributed to nonspecific conditions. Reported causes frequently include antepartum hemorrhage, maternal infections, and intrapartum hypoxia, with their distribution varying across high-, middle-, and low-income countries. A major challenge in determining the true causes of stillbirths lies in

the lack of standardized definitions and classification systems. For example, most low-income countries define stillbirth from 28 weeks of gestation, whereas many high-income countries apply a threshold of 20–24 weeks. These discrepancies hinder cross-country comparisons and the generation of reliable global estimates (*Sarah Hodin*, 2018). In sub-Saharan majority of the causes of stillbirths are preventable factors, with quality maternal care, more than half these deaths can be prevented. Studies from low- and middle-income countries have shown that obstetric complications during labor, such as preeclampsia, abnormal fetal presentation, prolonged labor, preterm birth, and cesarean delivery, are significant contributors to intrapartum stillbirth (Vanotoo et al., 2023). These risk factors were classified into five categories: maternal; sociodemographic and lifestyle; fetal; obstetric and delivery; and health system and unexplained/miscellaneous factors. A study by Mukherjee et al., (2024) reported Antepartum factors such hypertension, absence or delayed ANC and multiple gestations as prevalent factors causing stillbirths in Sub-Saharan Africa.

Kasa et al., (2023), in a study across eight sub-Saharan Africa countries, found that advanced maternal age, antepartum hemorrhage, and referral admissions were associated with increased odds of stillbirths, while higher educational attainment and early antenatal attendance were associated with reduced odds of stillbirths (Kasa et al., 2023a).

Maternal health during pregnancy plays a central role in stillbirth risk. In low- and middle-income countries, infections such as malaria, syphilis, and HIV account for 8–50% of stillbirths. In sub-Saharan Africa, malaria contributes to about 20% and syphilis to over 11% of stillbirths. Across all settings, maternal conditions including obesity, diabetes, and hypertension are estimated to cause about 10% of stillbirths globally. Other maternal factors, such as advanced age and smoking, further increase the risk. Other studies also indicate that stillbirths are commonly linked to

intrapartum complications, antepartum hemorrhage like placenta abruption, infections and maternal conditions like hypertensive disorders, often through pathways involving fetal growth restriction. Many of these causes are preventable with adequate nutrition, timely antenatal care, fetal growth monitoring, and access to safe intrapartum care (Estimation & Gaigbe-togbe, 2020).

Stillbirths have profound psychosocial and emotional consequences for families, including grief, guilt, and depression, which may lead to social isolation. Mothers often experience body image changes and long-term psychological effects such as post-traumatic stress disorder (PTSD). Gopichandran et al., (2018) reported that women who experienced stillbirth suffered intense grief and guilt, which were exacerbated by insensitive responses from the health system, healthcare providers, and their social environment, including friends and neighbors (Gopichandran et al., 2018).

Stillbirths also have severe financial and psychosocial effects on parents, families, and the wider community. The financial burden may include hospital bills, loss of income during hospitalization, and increased healthcare costs for both governments and insurance providers. Psychosocial effects include grief, anxiety, fear, and emotional distress, which often influence a mother's experience in subsequent pregnancies and can extend to the family and community through stigma and social isolation (Heazell et al., 2016).

Stillbirths are largely attributable to preventable maternal health conditions, especially in low- and middle-income countries, with key contributors including malaria in pregnancy, syphilis, hypertensive disorders, and complications such as antepartum hemorrhage. Sociodemographic factors such as advanced maternal age, obesity, diabetes, and smoking further increase the risk. Beyond clinical causes, stillbirths impose heavy psychosocial and financial burdens. Parents often endure grief, guilt, anxiety, and depression, with some mothers experiencing long-term effects

such as PTSD, exacerbated by inadequate support from healthcare providers, family, and friends. Studies also highlight community-level stigma, isolation, and financial hardship, underscoring the need for preventive care and comprehensive support systems.

2.3 Socio-Demographic Factors Associated with Stillbirths

Maternal age has been noted to influence pregnancy outcome. A study by Mukherjee et al., (2024) identified that advanced maternal age (AMA) of greater 35 years was an independent risk factor for stillbirth, compared with women aged less than35 years. The risk of stillbirth was found to be twice for women over 30 years and four times higher for those above 40 years, compared to those under 30 years. Dongarwar et al., (2020) in their study found that women over 30 years had a higher risk of stillbirth compared to those aged 20–29, suggesting an association between advancing maternal age and stillbirth risk. Similarly, Kim et al., (2022) in an analysis of 327,690 singleton births, reported a strong relationship between maternal age and stillbirth risk, with hazard ratios of 1.4 (95% CI: 1.12–1.75) for women aged 35–39 and 2.41 (95% CI: 1.8–3.23) for those aged 40 and above, indicating more than a two-fold increased risk for the latter group (Kim et al., 2022).

Dunne et al., (2022) assessed the impact of left-truncated data on the relationship between advanced maternal age and stillbirth. Their findings indicated a slight downward bias, particularly among women aged 40 years and older. They concluded that left truncation had a minimal effect on this association. (Mukherjee et al., 2024: Dongarwar et al., 2020: Gordon et al., 2013: Dunne et al., 2022).

A systematic review by Wodajo et al., (2024) reported that advanced maternal age (≥35 years) was significantly associated with stillbirth, with a pooled odds ratio of 1.43 (95% CI: 1.18-1.7)

compared with women aged 20-35 years. The cumulative effect showed a slightly increased risk of stillbirth with each additional year of maternal age (Wodajo et al., 2024).

A cohort study by Montori et al., (2021) found that from age 35 years and above, the odds of developing hypertensive disorders, diabetes, and the likelihood of labor induction increased progressively. The cumulative effect showed that women aged 40 years and above had a 2.45-fold higher risk of stillbirth compared with younger women (OR: 2.45, 95% CI: 1.15–5.21).

A study Zegeye et al., (2025) identified advanced maternal age as a strong predictor of stillbirth in sub-Saharan Africa. Women aged 35-49 years had 3.72 higher odds of experiencing stillbirth compared to those younger than 20 years (AOR= 3.72, 95% CI: 2.57-5.41). This finding underscore the elevated risk of stillbirth among older women (Zegeye et al., 2025).

Komboigo et al., (2023) observed that individuals below the age of 20 contributed to 19.3% of stillbirth cases, highlighting young maternal age as a potential risk factor for intrapartum mortality. They noted that limited reproductive experience is often linked to adverse pregnancy outcomes (Komboigo et al., 2023).

In Ghana, research by Badimsuguru et al., (2016) identified a higher risk of being born still among women aged 24 years or lower compared to those aged 25–34 years, with an adjusted odds ratio (AOR) of 3.0 (95% CI: 1.08–8.39) (Badimsuguru et al., 2016). Similarly, Carvalho et al., (2018) examined regional differences in stillbirth prevalence in Brazil and found that mothers under 20 years of age had 2.66 times the odds of experiencing stillbirth compared to mothers aged 20–24 years, even after accounting for other factors (AOR = 2.66, 95% CI: 1.11–6.40) (Carvalho et al., 2018). Tesema et al., (2021) further reported that maternal marital status significantly influenced stillbirth risk. Divorced, widowed, or separated women had almost trice the likelihood of

experiencing stillbirth (AOR = 2.99, 95% CI: 2.04–4.39), and single women had more than three times the odds (AOR = 3.24, 95% CI: 2.27–4.63) of experiencing stillbirth compared to their married counterparts (Tesema et al., 2021).

Tesema et al. (2021) in their study found that unmarried women faced a greater risk of stillbirth compared to married women. Unmarried women had a relative risk (RR) of 1.24 (95% CI: 1.21–1.26). The study also highlighted that the risk was particularly pronounced among unmarried women younger than 15 years and those older than 40 years (Tesema et al., 2021). Similarly, Zhu et al., (2016), utilizing data from China's National Maternal Near Miss Surveillance System, found that both a mothers educational and marital status were strongly associated with stillbirth in their unadjusted analysis. After adjusting for other sociodemographic factors, single women had more than twice the odds of stillbirth (aOR = 2.34, 95% CI: 1.82–3.03), while widowed or divorced women had 1.23 times the odds (aOR = 1.23, 95% CI: 0.6–2.52) compared to married women (Zhu et al., 2016).

Another study by Balayla et al., (2011) found that unmarried women had a higher risk of stillbirth than married women. The risk was even higher among unmarried women aged <15 (OR 1.43, 95% CI 1.27–1.60) and those aged 35–39, 40–44, and ≥45 (OR 1.36, 95% CI 1.29–1.42; OR 1.77, 95% CI 11.63–1.92; and OR 2.91, 95% CI 2.19–3.90, respectively (Balayla et al., 2011).

Afulani et al. (2016) in their study also identified that stillbirths were high in urbans areas than rural areas, with urban women having about twice the chance of delivering a stillborn baby than rural women. The percentage of stillbirths in urban areas was 2.3%, while in rural areas it was 1.3%. Education and wealth were found not to have strong influence on stillbirths but tend to increase slightly with higher level of both wealth and education (Afulani, 2016).

In another study by Ahinkorah et al., (2021) found that higher education levels were linked to more miscarriages, with the most educated women having the highest risk (AOR = 1.42, 95% CI = 1.13–1.78). Muslim women had fewer induced abortions but more miscarriages than Christian women (AOR = 0.65, 95% CI = 0.52–0.82 for abortions; AOR = 1.31, 95% CI = 1.13–1.52 for miscarriages (Ahinkorah et al., 2021).

From the various literature reviewed maternal demographic factors such age, marital status, education, and income level are established as independent risk factors of stillbirths across different settings.

2.4 Maternal Determinants of Stillbirths

Maternal parity is a significant risk factor for stillbirth. Studies have shown that women that are first-time mothers (primiparous) and women with multiple previous pregnancies (multiparous) are at a higher risk of stillbirth compared to women with one or two previous pregnancies. Primiparous women may be at greater risk due to factors related to the first pregnancy, while multiparous women may have an increased risk due to complications related to multiple pregnancies.

In their study, Ahinkorah et al., (2021) examined the risk factors for induced abortions, miscarriages, and stillbirths. They identified that women who had given birth before had a lower chance of stillbirth than nulliparous women. They concluded that a woman's marital status and parity were risk factors for stillbirths and other pregnancy loss (Ahinkorah et al., 2021).

Badimsuguru et al., (2016), in their study on the determinants of stillbirth in Northern Ghana, identified no association between parity and stillbirth. The crude odds ratio for nulliparous women was 1, while multiparous women had the following odds ratios: 1.5 for those with 1 child, 1.3 for

those with 2–3 children, and 1.0 for those with 4 or more children. The p-value for these associations was 0.443 (Badimsuguru et al., 2016).

A study by Muniro et al., (2019) examining the effect of grand multiparity on pregnancy outcomes, a significant relationship was found between grand multiparity and stillbirth. After adjusting for maternal age, education, residence, BMI, antenatal care visits, and gestational age, grand multiparity was identified as a significant risk factor for stillbirth, with grand multiparity women having 66% higher odds of experiencing a stillbirth (adjusted odds ratio = 1.66, 95% CI: 1.31–2.11) (Muniro et al., 2019).

Lin et al., (2021) conducted a study in China on parity and adverse birth outcomes, finding that compared to nulliparous women, multiparous mothers were older (30.9 vs. 26.5 years), more likely to live in rural areas, less educated, and had a higher pre-pregnancy BMI. While multiparous women had a slightly higher rate of preterm births (5.02% vs. 4.40%), nulliparous women had a higher prevalence of low birth weight (3.20% vs. 2.84%) and small for gestational age (SGA) infants (7.55% vs. 5.01%) (Lin et al., 2021).

Several studies have shown that maternal health conditions such as diabetes, hypertension, sexually transmitted infections (STIs) and obesity can significantly increase the risk of stillbirth. The prevalence of these conditions varies among pregnant women, and they may be more in multiparous women, further increasing their risk for stillbirths. In a study by Worede & Dagnew (2019) on determinants of stillbirths in specialized referral hospital identified that history of sexually transmitted infections (STI) during pregnancy were 5.7 times likely to experience stillbirth compared to mother without history of STIs, this could be as a result of placental transmission of infection leading to fetal infection and pregnancy loss. Additionally, premature rupture of membranes (PROM) was also identified as a significant predictor for stillbirth, with

mothers experiencing PROM having a fourfold higher risk of stillbirth, potentially attributed to perinatal asphyxia resulting in fetal demise (Worede & Dagnew, 2019).

Worede and Dagnew (2019) also found that women with a history of pregnancy loss are at an increased risk of experiencing stillbirth compared to those without such a history. This higher risk may be attributed to two factors: the maternal Rh factor, which can lead to erythroblastosis fetalis, and maternal chronic or recurring pregnancy-related comorbidities, which may result in fetal death (Worede & Dagnew, 2019).

Tesfay et al., (2022) conducted a study analyzing perinatal mortality data to identify factors associated with stillbirth. The study found a significant association between infections and stillbirth, with the odds of stillbirth being more than twice as high for perinates with infections (OR = 2.16) compared to those without. Additionally, perinates with congenital malformations, deformations, or chromosomal abnormalities were at a significantly higher risk of stillbirth (OR = 2.92). Maternal conditions during pregnancy were also linked to stillbirth. Women with complications involving the placenta, cord, and membranes had 1.3 times higher odds of stillbirth, while those with pregnancy-related complications had a 2.18 times higher risk compared to women without such conditions (Tesfay et al., 2022).

According to Gordon et al., 2013, pre-existing hypertension and diabetes were associated with antepartum stillbirth. Women with pre-existing hypertension and diabetes had 2.77 higher odds of stillbirth compared to women without preexisting condition. This indicates that mothers with preexisting hypertension and diabetes during pregnancy had almost three times the risk of antepartum stillbirth compared to those without preexisting hypertension and diabetes. However, mothers with gestational diabetes had 0.65 reduced odds of stillbirths (Gordon et al., 2013).

A study conducted by Tufa et al., (2024) in public hospitals in Central Ethiopia, reported that mothers with hypertension had a greater risk of stillbirth compared to mothers with no history of hypertension. Mothers with pre-eclampsia/eclampsia were 13.43 times more likely to experience stillbirth compared to those without hypertension during pregnancy (AOR = 13.43, CI = 5.67–31.82), (Tufa et al., 2024). Also, Odhiambo, (2022), in a study conducted at Kenyatta National Hospital in Kenya, found that the prevalence of stillbirths among mothers with hypertension was 15.8% (95% CI 12.4-19.8). In assessing determinants of stillbirths, the study reported that mother with Diastolic Blood Pressure (DBP) ≥ 110mmHg had more than twice the odds of experiencing stillbirth compared to those with normal diastolic blood pressure (OR = 2.23, 95% CI 1.24-3.92), (Odhiambo, 2022). Similarly, Kasa et al., (2023) reported that mothers with hypertension during pregnancy had a significantly higher risk of stillbirth compared to those without hypertension (aOR: 2.22, 95% CI: 1.70, 2.75) , (Kasa et al., 2023).

In their study, Badimsuguru et al. (2016) found that mothers who had labored for more than 12 hours had a higher risk of stillbirth compared to those who delivered within 12 hours of labor (aOR=3.5, 95% CI 1,94, 6.61). This indicates that mothers that had prolonged labor had 3.5 times higher likelihood of experiencing stillbirth compared to mothers who gave birth within 12 hours of labor (Badimsuguru et al., 2016).

A study by Welegebriel et al., (2017) on determinants of stillbirth at Bonga General and Mizan Tepi University Teaching Hospitals in Southwestern Ethiopia, found that duration of labor was significantly associated with stillbirths. Women who labored for more than 24 hours had 2.4 times higher odds of experiencing stillbirth compared to those whose labor lasted less than 24 hours (AOR = 2.44, 95% CI 1.4 - 4.26), (Welegebriel et al., 2017). However, another study by Tufa et al., (2024) in Central Ethiopia found that duration of labor was not significantly

associated with stillbirth. They reported that a labor duration of more than 18 hours was not significantly associated with stillbirth (aOR = 1,73, 0,62-4.82), (Tufa et al., 2024). A related study by Fikre et al., (2021), they reported that mothers who experience prolonged labor lasting more than 24 hours had six (6) times higher odds of stillbirth compared to mothers who gave birth within 24 hours (aOR = 6.5, 95%CI: 2.9 - 14.4) (Fikre et al., 2021).

In Tufa et al., (2024), the study they also found that mothers who delivered babies with birth weights below 2500g had nearly three times higher odds of stillbirth compared to those born with normal birth weight (Tufa et al., 2024). Badimsuguru et al., 2016, also reported that babies with birth weight of less than 2.5 kg had a lower risk of being born still compared to those with birth weight of 2.5kg or over (aOR= 0.3, 95% CI 0.12 – 0.74) (Badimsuguru et al., 2016).

Several studies have reported that low birth weight (<2.5 kg) increases the risk of stillbirth compared to normal birth weight. Okonofua et al. (2019) found that infants weighing 2.40–3.99 kg were 82% less likely to be stillborn compared to those weighing <1.50 kg (AOR = 0.18, 95% CI: 0.05–0.65) (Okonofua et al., 2019). Similarly, Kidanto et al. (2015) reported that very low birth weight (<1500 g) was strongly associated with stillbirth, with babies in this category having more than 23 times higher odds of being stillborn compared to those with normal birth weight (Kidanto et al., 2015).

Feresu et al., (2004) also reported that low birth weight, in both term and preterm infants, was associated with an increased risk of stillbirth. Babies born with a weight below 2500 g had more than twice the risk of stillbirth compared to those weighing above 2500 g (RR = 2.16, 95% CI: 2.02–2.31), (Feresu et al., 2004).

Studies have shown that during pregnancy, the type of Antenatal Care (ANC) a pregnant mother receives can significantly impact pregnancy outcomes. Regular and quality antenatal care can reduce the risk of stillbirth. However, inadequate access to or poor utilization of antenatal care services can increase the likelihood of stillbirth. Inadequate ANC utilization is particularly common among certain parity groups, especially primiparous mothers, thereby heightening the risk of stillbirth in these groups.

Komboigo et al., (2023) observed that antenatal care (ANC) consultations were predominantly conducted by midwives or gynecologists. However, when ANC consultations were performed by other health professionals, the odds of intrapartum stillbirth increased significantly, with an odds ratio of 4.86 ($p = 0.005$). This indicates that mothers receiving ANC from non-midwives or non-gynecologists were four times likely to experience intrapartum stillbirth compared to mothers who received care from midwives or gynecologists (Komboigo et al., 2023).

Similarly, Afulani et al. (2016) assessed the quality of ANC and its impact on stillbirth, finding that higher quality ANC significantly reduced the odds of stillbirth by nearly half. Women receiving higher quality ANC had about 40% lower odds of stillbirth compared to those with lower quality care, emphasizing the critical role of ANC in improving pregnancy outcomes, particularly in preventing stillbirths (Afulani, 2016).

Dheresa et al., (2022) also highlighted the association between ANC follow-up and perinatal mortality. Women who did not attend ANC had 67% higher likelihood of perinatal mortality compared to those who attended, with an adjusted odds ratio (AOR) of 1.67 (95% CI: 1.29–2.17). The study attributed this increased risk among non-ANC attendees to the lack of birth preparedness and complications readiness education and counseling typically provided during ANC visits (Dheresa et al., 2022).

Similarly, Gwako et al., (2021) reported an increased odds of stillbirths among women who did not attend antenatal care (ANC). Women who did not attend any ANC visit had three times higher odds of stillbirth compared to those who attended (OR = 3.0, 95% CI: 1.3–7.2). Similarly, attending only one or two ANC visits significantly increased the risk of stillbirth compared to the recommended four visits (OR = 2.9, 95% CI: 1.4–6.1 and OR = 2.9, 95% CI: 1.7–5.0, respectively), (Gwako et al., 2021). In contrast, attending more than four visits was associated with reduced odds of stillbirth. Timing of ANC initiation, however, did not show a significant association with stillbirth (Gwako et al., 2021). In another study, Mohammed-Ahmed et al., (2022), reported that lack of antenatal care (ANC) was significantly associated with stillbirth. Mothers who had no ANC visits were more than two times more likely to have stillbirth than those who had an ANC visit (AOR=2.8; 95% CI: 1.14–6.88), (Mohammed-Ahmed et al., 2022).

Feresu et al., 2017, in a systematic review, highlighted consistent evidence linking inadequate antenatal care with an increased risk of stillbirth (Feresu et al., 2017) and Aminu et al., (2019) also reported that insufficient antenatal care was associated with a higher likelihood of stillbirth (AOR = 3.50, 95% CI: 1.07–11.43), (Aminu et al., 2019). Similar associations have been documented in other settings, including Peru (OR = 3.39, 95% CI: 1.57–7.74), Nigeria (OR = 7.23, 95% CI: 3.94–13.26), Jamaica (OR = 2.0, 95% CI: 1.3–3.1), and Vietnam (OR = 2.56, 95% CI: 1.25–5.23) . Collectively, these findings underscore the critical role of adequate antenatal care in reducing the risk of stillbirth across diverse populations (Feresu et al., 2017). Another study conducted in Naples by Kc et al., (2022) also reported higher odds of stillbirth among mothers with no antenatal care attendance. Mothers who did not attend antenatal care had more than four times higher odds of stillbirth compared with those who attended (aOR 4.2, 95 % CI 3.2–5.4), (Kc et al., 2022) whiles

Id et al., (2023), found that higher quality ANC decreases the odds of antepartum stillbirth by almost 81%, (0.19 (AOR 0.19 at 95% CI; 0.088 to 0.435), (Id et al., 2023).

Findings from the reviewed studies indicate that antenatal care (ANC) attendance is significantly associated with stillbirth. The timing of first visits, the number of visits completed, and the quality of care provided during ANC are critical factors that can either reduce the risk of stillbirth or increase its likelihood when inadequate.

In addition to care quality and attendance, there are other specific maternal factors that contribute to stillbirth risks. Vanooto et al. (2023), in a study conducted across six public hospitals in the Greater Accra Region of Ghana, identified pregnancy-induced hypertension (PIH), premature rupture of membranes (PROM), and antepartum hemorrhage (APH) as significant determinants of intrapartum stillbirth. Among women who delivered stillbirths, 27% had PIH compared to 8.1% in the control group ($p < 0.001$). Similarly, 8.0% experienced PROM compared to 4.0% in the control group, and 24.8% reported APH compared to only 2.5% in the control group. These findings underscore the importance of addressing maternal complications during ANC to mitigate the risk of intrapartum stillbirth PIH (Vanotoo et al., 2023).

Using a binary logistic regression model, Vanotoo et al. (2023) further quantified the effects of maternal factors on intrapartum stillbirth. Mothers who experienced APH had 2.85 times higher odds of intrapartum stillbirth compared to those who did not experience APH. Similarly, PROM and PIH were associated with significantly higher odds of intrapartum stillbirth, with odds ratios of 3.28 and 3.59, respectively. These findings underscore the critical role of addressing maternal complications during ANC and delivery to mitigate the risk of intrapartum stillbirth (Vanotoo et al., 2023).

Li et al. (2022), in a multi-country cross-sectional study involving 795,642 women aged 15–49 from lower income countries, identified key risk factors for stillbirth. These included short maternal height, interpregnancy intervals of less than six months, a history of stillbirth, low maternal education, and low household wealth. Notably, uneducated mothers were 3.6 times more likely to experience stillbirth compared to those with some education. A prior stillbirth increased the likelihood by over threefold, while short maternal height and being from the poorest households were also significant risk factors. Conversely, reduced odds of stillbirth were associated with female-headed households and a previous caesarean section before the most recent pregnancy (Li et al., 2022).

Plasmodium falciparum is estimated to be responsible for approximately 200,000 stillbirths annually across Africa. Malaria during pregnancy is linked to various adverse outcomes, including congenital malaria, stillbirth, miscarriage, and preterm birth. Figueroa-Romero and Pons-Duran (2022) highlighted that Intermittent Preventive Treatment in pregnancy (IPTp) using sulfadoxine-pyrimethamine is a highly cost-effective strategy that can be used to lessen the burden of malaria in endemic regions of Sub-Saharan Africa. However, its efficacy is challenged by the increasing prevalence of drug resistance and its unsuitability for use during the first trimester of pregnancy (Figueroa-romero & Pons-duran, 2022).

Agyeman et al., (2020), in their study on the effectiveness of the revised Intermittent Preventive Treatment with Sulphadoxine Pyrimethamine (IPTp-SP) in the preventing malaria among pregnant women in Northern Ghana, demonstrated that receiving three or more doses of IPTp-SP significantly reduced the odds of late gestational peripheral malaria by 56% (aOR 0.44, 95% CI: 0.27–0.70, p=0.001), indicating a clear dose-dependent protective effect against maternal parasitemia at 36 weeks of gestation (Agyeman et al., 2020).

2.5 Fetal factors Associated with Stillbirths

Tesfay et al. (2022) Tesfay et al. (2022) investigated factors contributing to stillbirth in Ethiopia and found that perinates with congenital malformations, deformations, or chromosomal abnormalities had nearly three times the risk of stillbirth (relative risk = 2.92, $p < 0.05$) compared to those without such conditions (Tesfay et al., 2022).

Worede and Dagnew (2019) found a significant association between congenital anomalies and stillbirth, with the odds of stillbirth being 10.4 times higher for fetuses with congenital defects compared to those without. Similarly, Komboigo et al. (2023) found a significant association between fetal weight under 2,500 grams and intrapartum fetal death ($p < 0.001$) (Worede & Dagnew, 2019).

Dheresa et al. (2022), in a dynamic open cohort study in Eastern Ethiopia, identified birth weight and child sex as independent predictors of perinatal mortality. Low birth weight (<2,500 g) was associated with nearly fourfold increased odds of perinatal mortality (AOR 3.98; 95% CI: 3.04–5.20), while large birth weight (>4,000 g) was linked to over twice the odds (AOR 2.51; 95% CI: 1.76–3.57) compared to normal birth weight. Additionally, female neonates had significantly higher odds of perinatal mortality (AOR 3.24) compared to their male counterparts (Dheresa et al., 2022).

Dalal et al. (2021) identified significant associations between stillbirth and both preterm birth and congenital anomalies. The likelihood of stillbirth was substantially higher in preterm deliveries, with an odds ratio of 22.33 (95% CI: 15.35–32.50), and in cases involving congenital anomalies, with an odds ratio of 11.24 (95% CI: 6.99–18.06) (Dalal et al., 2021).

Şimşek et al. (2021) reported that fetal anomalies, gestational diabetes, and placental abruption are factors that can increase the risk of stillbirth. Placental abruption alone was associated with 18.22 odds of stillbirth (odds 18.22, 95% CI: 9.12–36.40), while fetal anomalies were linked to a 3.1 times higher risk (odds 3.17, 95% CI: 1.59–6.32, $p < 0.001$) (Şimşek et al., 2021).

Tufa et al., (2024) in a at public hospital in West Zone, central Ethiopia, reported that low birth weight <2500g was significantly associated with stillbirth, with affected babies having nearly threefold higher odds compared to those weighing ≥ 2500g (aOR 2.91; 95% CI: 1.28 – 6.59). Congenital anomalies were also linked to stillbirth, though the association was not statistically significant (aOR 2.4; 95% CI: 0.68-8.49), (Tufa et al., 2024). Another study by Dah et al., (2023) in a tertiary hospital in the Volta region, reported that very low birth weight (<1.5 kg) was associated with over eightfold higher odds of stillbirth compared to babies weighing ≥1.5 kg, though this was not statistically significant (aOR 8.51; 95% CI: 0.91–79.18). Preterm birth at 28–34 weeks was significantly associated with stillbirth, with more than ninefold higher odds compared to births after 35 week of gestation, (aOR 9.37; 95% CI: 1.18 – 74.53), (Dah et al., 2023).

2.6 Facility Related factors Associated with Stillbirths

A statistically significant association has been observed between the absence of obstetric ultrasounds during pregnancy and intrapartum stillbirth (OR: 7.49; 95% CI: 6.40–8.76). Obstetric ultrasounds are critical for detecting pregnancy complications and assessing childbirth prognosis. Komboigo et al. (2023) demonstrated that a single ultrasound performed between 28 and 32 weeks of gestation could significantly reduce intrapartum stillbirths (Komboigo et al., 2023).

Kiondo et al. (2021) identified key factors for intrapartum stillbirths among women delivering at Mulago Hospital, Uganda. Antepartum hemorrhage increased the likelihood of stillbirth by 6.2

times, prolonged labor by 5.1 times, and cesarean delivery by 7.7 times compared to vaginal delivery (Kiondo et al., 2021).

Mukherjee et al. (2023), in their study on stillbirth determinants in sub-Saharan Africa, found that macerated stillbirths were prevalent among women who delayed seeking care, accounting for 74% of stillbirths in pooled studies. High-quality antenatal care (≥7 visits) was associated with reduced stillbirth odds, while fresh stillbirths were linked to delays in reaching hospitals and receiving optimal care. Admission delays of over 24 hours increased stillbirth odds by 16.13 times, and referrals from other facilities were associated with 3.20 times higher odds. The use of partographs during labor reduced stillbirth odds by 80% (Mukherjee et al., 2023).

Abriham et al. (2024) reported that labor lasting more than 24 hours increased the likelihood of stillbirth by over threefold compared to shorter labor durations. Additionally, not using a partograph to monitor labor was linked to a 2.5 times greater risk of stillbirth compared to labor that was monitored with a partograph (Abriham et al., 2024).

Additionally, Ezadi et al., (2025) reported that referred from one facility to another was highly associated with stillbirth. That women who were referred had over three times higher odds of having a stillbirth (OR: 3.21, 95% CI: 1.12, 9.19) compared to those who were not referred, (Ezadi et al., 2025). Similarly, Abriham et al. (2024) also found that mothers referred from other health facilities had threefold higher odds of experiencing stillbirth (AOR 3.22; 95% CI: 1.43–7.23) compared to those not referred (Abriham et al., 2024).

CHAPTER THREE

3.0 Methods

3.1 Study design

An unmatched case control study was conducted at the Ghana Police Hospital in La-Dekotopon Municipality of the Greater Accra Region of Ghana. The study included only mothers who had singleton birth at the hospital. A sample of cases was selected from mothers who had stillbirth at the hospital from January 2021 to December 2022. A sample of controls was selected from mothers who delivered live singleton baby at the hospital from January 2021 to December 2022.

3.2 Study setting

The study was conducted at Ghana Police Hospital in the Greater Accra Region of Ghana. Located in the Tenashie sub-district of the La Dade-Kotopon Municipality. The Police Hospital is a public facility that serves the healthcare needs of the public nationwide. Its main clients are those in the low social class who cannot afford the expensive hospitals located in the municipality. It provides antenatal care (ANC) and secondary level maternal care services, including comprehensive Obstetric and Neonatal Care. The maternity ward has a 50-bed capacity and two operating theatres. The hospital has three (3) obstetrician-gynecological clinics offering daily services to patients. Hospital records showed that the facility performs an average of 1200 deliveries annually and has seen an increasing trend in stillbirths since 2020.

3.3 Study map of the Ghana Police Hospital, Accra

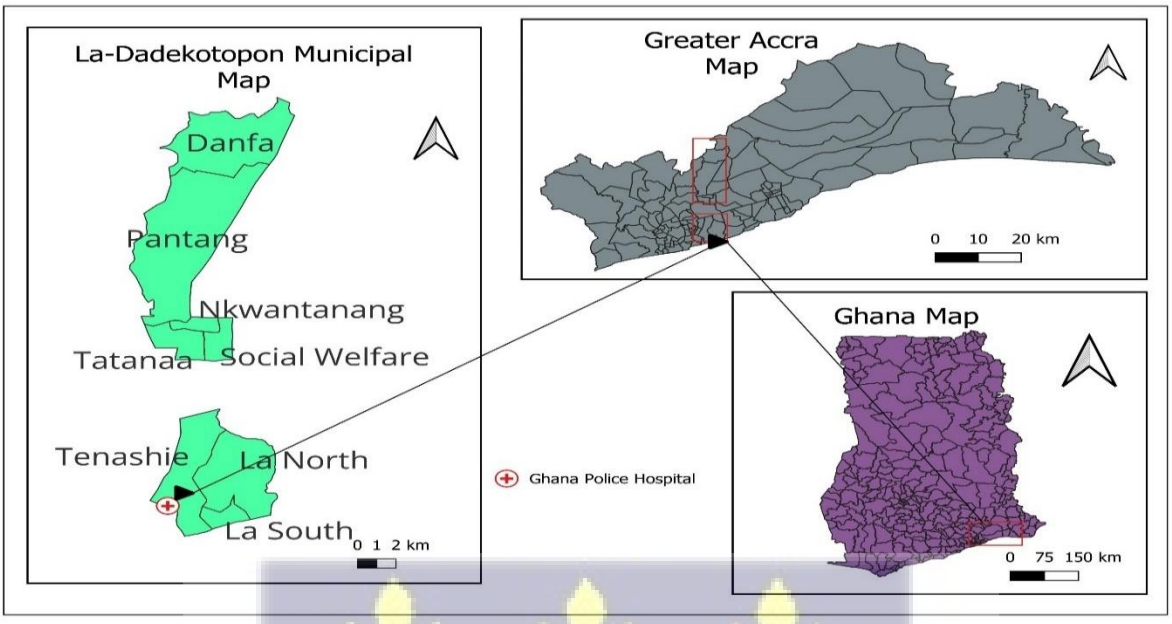

Figure 2: Map showing the location of Ghana Police Hospital

3.4 Study population

The source populace for the study included all mothers who had singleton birth at the Ghana Police hospital between 1st January 2021 to 31st December 2023. All stillbirth that occurred at the hospital during the period of January 2021 to December 2022 were included. For the controls, a simple random method was used to select a sample from all mothers who had singleton live birth at the police hospital during the period of 1st January 2021 – 31st December 2022. Mothers who had multiple births were excluded.

3.5 Sample size

Assumption for sample size estimation were informed by previous hospital-based case-control studies of stillbirth in Ghana, which reported 14.5% (ANC<4) for controls and 30.1% (ANC<4) for cases. Pregnancy-induced hypertension and advanced maternal have also been shown in studies in Ghana to increase the odds of stillbirth nearly three-fold in health facility studies (Amewu et al.,

2025), (Badimsuguru et al., 2016). Based on these previous studies an assumed exposure proportion of approximately 30.6% among cases and 14% among controls with a 95% confidence level and 90% statistical power and a case-to-control ratio of 1:3 was used to estimate the sample size use the Fleiss formular.

$$n_1 = \frac{\left[z_{\alpha/2}\sqrt{(r+1)\bar{p}\bar{q}} + z_{1-\beta}\sqrt{rp_1q_1 + p_2q_2} \right]^2}{r(p_1 - p_2)^2}$$

N_1 = number of cases

N_2 = number of controls

$Z_{\alpha/2}$ = significance level (α) z-score for two-tailed test based on α level 95% = 1.96

Z_{1}-β = power = 90% = 1.28

Ratio of case to controls (R) = 1:3

Proportion of cases exposed (P_1) = 30% = 0.306

proportion of controls exposed (P_2) = 14% = 0.14

$q_1 = (1-P_1) = 0.694$

$q_2 = (1-P_2) = 0.86$

$\bar{p} = 0.1815$

$\bar{q} = 1-\bar{p} = 0.8185$

If these are put in the formula above will yield a sample size of 84 cases

$N_1 = 84$

$N_2 = (r^* n_1) = 3*84 = 252$

Total minimum sample size = 336.

3.6 Sampling

A list of all mothers who gave at the hospital between January 2021 to December 2023 was obtained from the hospital records and categorized into two: a stillbirth and a live birth group. Each mother was assigned a unique sampling number with the aid of Microsoft excel random number generator. All cases from the stillbirth group were included in the study, while a random sample of 264 controls were selected from the live birth group to achieve sample size of 352.

3.7 Data source and data collection

The primary source of data for the study was from the hospital birth register, and additional data was collected from individual mothers' medical folders, antenatal attendance records and mortality audit reports. Each mother reporting to the facility for delivery is issued a folder and registered in the delivery book where every detailed information of the mother is recorded.

A data abstraction tool was used to collect data demographic characteristics such as maternal age, religion, education, employment and marital status. Obstetric data such as parity, gravida, obstetric complication, intake of intermittent preventive treatment with *Sulfadoxine-Pyrimethamine* (IPT-Sp), maternal medical condition, hemoglobin, systolic and diastolic blood pressure were abstracted from the delivery register.

Fetal characteristics including birth weight, gestational age, congenital abnormalities, baby's sex captured from the register. Also, facility related variables such as mode of delivery, duration of labor, antenatal care (ANC) utilization, and partograph use, were abstracted from delivery register.

For data not recorded in the delivery register, additional information was retrieved from the individual mothers' medical folders. When clarification was needed due to unclear or incomplete entries in the registers or folders, it was sought directly from the midwives and the consulting obstetrician to ensure data accuracy.

3.8 Data management and Data analysis

The collected data were reviewed for completeness, with missing or incorrectly entered data cross-checked and corrected against the source register. Each variable was examined to ensure that data were collected for analysis. The hospital stillbirth rates were calculated for each year from 2021 to 2023 using the total deliveries for each year. Trend of deliveries and stillbirths were presented in charts.

The outcome variable, stillbirth, was coded as stillbirth=1 and livebirth = 0. Maternal age was categorized as ≤ 24, 25-34, and ≥ 35, Marital status was grouped as married, single and separated. Religion was classified as Christianity or Islam, while educational status was categorized into No education, Basic, Senior high school and Tertiary. Employment status was recorded as formal employment, unemployed and trader.

Parity was grouped as ≤ 2 and > 2, and maternal Hemoglobin (Hb) levels were categorized as > 9.6 and ≤ 9.6g/dl. Gravida was grouped as ≤ 2 and > 2. Maternal medical conditions, obstetric complications and IPT-Sp were coded as yes = 1 and no = 0. Birth weight was categorized as <2.5kg, 2.5 – 3.9kg and ≥ 4kg. Gestational age was grouped as ≤ 37 and ≥ 38, while ANC attendance was categorized < 8 visits and ≥ 8 visits. Baby's sex was coded as female = 0 and male = 1, and congenital anomalies were coded as yes =1 and no = 0.

Mode of delivery was categorized as normal (spontaneous vaginal delivery), cesarian section and others. Labor duration was grouped as < 12 hours or ≥ 12 hours. Partograph use during labor was coded as yes = 1 and no = 0.

After data cleaning and coding, the dataset was imported into Stata 17.0 software (Stata Corp; College Station, Texas, USA) for analysis. Descriptive statistics were used to summarize the proportions and frequencies of cases and controls. A univariate analysis was performed to examine the crude associations between stillbirths and independent variables. Odds ratios, 95% confidence intervals, and p-values were calculated to identify significant associations, with statistical significance set at a p-value < 0.05.

A multivariable logistic regression model was used for further analysis using variables with p-value less than 0.05 and known risk factors. A multicollinearity test was performed to identify and exclude highly correlated variables. Additionally, a linear regression was conducted to determine the impact of antenatal care (ANC) on stillbirth and a generalized linear regression model was performed to assess the influence and impact of selected predictors on the stillbirth outcome.

3.9 Data quality

Two midwives involved in data collection were trained on the study objectives, methods, and basic data collection techniques. A senior midwife and a specialist gynecologist provided support during the data collection process, offering technical clarification on terms entered in the records. The data abstraction tool was tested at the hospital by collecting similar data, and any potential challenges were addressed before data collection began. All collected data were reviewed daily, with errors identified and corrected promptly.

3.10 Ethical considerations

Ethical approval for the study was obtained from the Ghana Health Service Ethics Review Committee (GHS-ERC). Additionally, Permission was secured from both the Ghana Police Hospital Medical Board and the head of Obstetrics and Gynecology Department at the Hospital. No personal identifying information was collected from either the cases or controls. The collected data was electronically stored with a password to prevent unauthorized access.

3.11 Operational Definitions

Stillbirth: defined as any death of a baby before birth and with no signs of life at birth, of at least 1000g birthweight and/or at least 28 weeks gestation and 35 cm long from 1st January 2021 to 31st December 2023.

Controls: defined as any live births after 28 weeks of pregnancy at the Ghana Police hospital within the period of 1st January 2021 to 31st December 2023.

3.12 Inclusion criteria

The inclusion criteria for the study were all pregnant women who reported for delivery at the Ghana Police Hospital between 1st January 2021 to 31st December 2023 and delivered a singleton baby. Additionally, we included those whose folders and birth records were obtained and reviewed.

3.13 Exclusion criteria

Mothers whose medical folders could not be retrieved or those with less than 70% of required information recorded were excluded.

3.14 Confidentiality

No personal identifiers such as names, addresses, telephone numbers were required for the study. All participants remained anonymous. All data and information collected were protected and

secured with a password to prevent unauthorized access. Only the results and findings from the study will be published to improve healthcare service delivery in hospitals.

3.15 Conflict of interest

There were no conflicts of interest in the conduct of this research study. The author solely funded the study.

3.16 Study Instruments

A data abstraction tool was used to abstract data from birth registers. Socio-demographic details of mothers, such as age, sex, occupation, marital status, education, and religion as well as maternal factors like parity, health conditions, use of ITNs, and antenatal attendance were obtained from birth and antenatal registers. Facility-related factors were also obtained from hospital records, patient folders and admission reports. Information that was not found in the birth register was sourced from either the patient folder, nurses' reports, doctors' notes, antenatal records and mortality audit forms.

CHAPTER FOUR

4.0 Results

4.1 Descriptive Analysis

4.1.1 Socio-Demographic and obstetric characteristics

A total of 3,918 deliveries were conducted at the hospital from 2021 to 2023, with 3,876 being singleton births. Among these, 2.3% (88/3876) were stillbirths. The study included 352 participants: 88 cases and 264 controls. The mean age of mothers was 32.2 ± 5.7 standard deviation (SD) years for cases and 30.8 ± 5.1 (SD) years for controls. The age distribution showed that the majority of participants were aged 25-34 years, comprising 55.7% (49/88) cases and 65.2% (172/264) controls. Additionally, 32.9% (29/88) of cases were above 35 years old, compared to 22.7% (60/264) of controls.

Regarding marital status, 79.1% (196/264) of controls and 62.5% (55/88) of cases were married. A higher proportion of cases were single 37.5% (33/88) compared to 20.9% (52/264) of controls being single.

The educational level of participants was varied, with 44.8% (39/88) of cases and 43.3% (112/264) of controls having secondary education. More controls 27.9% (72/264) had tertiary education than cases 20.7% (18/88). Christianity was the predominant religion among both cases 78.6% (66/88) and controls 87.5% (210/264), with 21.4% (18/88) of cases identifying as Muslims. Employment status showed that a higher proportion of controls were in formal employment 39.7% (93/264) compared to 22.4% (13/88) of cases. Also, a higher proportion of cases were traders 58.6% (34/88) compared to controls 34.2 (80/264).

Obstetric characteristics revealed that most of the participants had a parity greater than two, 78.4% (69/88) of cases and 76.5% (202/264) of controls. Gravida was similarly distributed among both cases and controls, 60.2% (53/88) of cases and 60.6% (160/264) of controls had gravida more than two. Antenatal care (ANC) attendance was lower among cases, with 14.8% (13/88) of cases never attending ANC, compared to only 0.8% (2/264) of controls. Most controls 57.9% (146/264) had eight or more ANC visits, compared to 25% (22/88) of cases. Regarding the mode of delivery, 23.9% (21/88) of cases and 26% (68/264) of controls underwent C-sections, while normal deliveries were more common among both cases and controls, 58% (51/88) and 70.2% (184/264) of cases and controls respectively. Vacuum delivery was more among cases 18.2% (16/88) compared to 3.8% (10/264) controls.

Table 1: Socio-Demographic and Obstetric characteristics of Participants at Ghana Police Hospital, 2021 – 2023.

Characteristics	**Cases (N = 88)**		**Control (N = 264)**		**Total (N = 352)**	
	N	%	N	%	N	%
Age (years)						
≤24	10	11.4	32	12.1	42	11.9
25-34	49	55.7	172	65.2	221	62.8
≥35	29	32.9	60	22.7	89	25.3
Marital status						
Married	55	62.5	196	79.1	251	74.7
Single	33	37.5	52	20.9	85	25.3
Educational status						
No	2	2.3	18	6.9	20	5.8
Basic	28	32.2	56	21.7	84	24.3
Secondary	39	44.8	112	43.3	151	43.8
Tertiary	18	20.7	72	27.9	90	26.1

Religion						
Christianity	66	78.6	210	87.5	276	85.2
Muslims	18	21.4	30	12.5	48	14.8
Employment status						
Formal	13	22.4	93	39.7	106	36.3
Not employed	11	18.9	61	26.1	72	24.7
Trader	34	58.6	80	34.2	114	39
Parity						
<=2	69	78.4	202	76.5	271	77
>2	19	21.59	62	23.5	81	23
Gravida						
<=2	35	39.8	104	39.4	139	39.5
>2	53	60.2	160	60.6	213	60.5
ANC visit						
0	13	14.8	2	0.8	15	4.4
less 8	53	60.2	104	41.3	157	46.2
>=8	22	25	146	57.9	168	49.4
Mode of delivery						
C/S	21	23.9	68	26.0	89	25.4
Induced/Vacuum	16	18.2	10	3.8	26	7.4
Normal	51	58.0	184	70.2	67	66.1

4.1.2 Stillbirth rates at the Ghana Police Hospital from 2021-2023

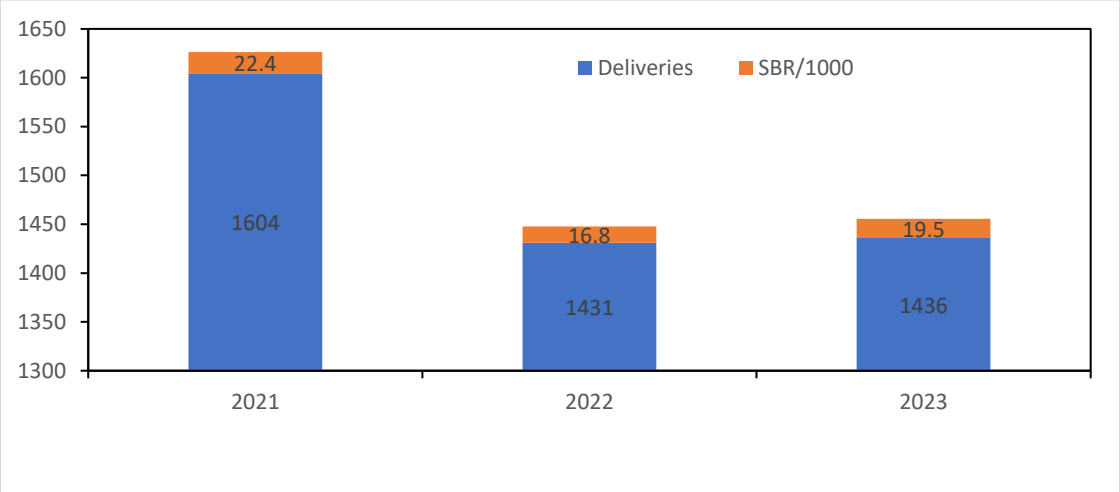

Figure 3: Deliveries and stillbirth rates at the Ghana Police Hospital from 2021 to 2023.

A total of 4,517 deliveries were conducted at the hospital between 2021 to 2023, with 88 stillbirths, resulting in an overall stillbirth rate of 19.5 per 1,000 births. Of the 4,517 deliveries, 4, 471 were single births. The stillbirth rates were 22.4 per 1000 births in 2021, 16.8 per 1000 births in 2022, and 19.5 per 1000 births in 2023.

4.1.3 Trend of deliveries and stillbirth rates at Ghana Police Hospital, 2021-2023.

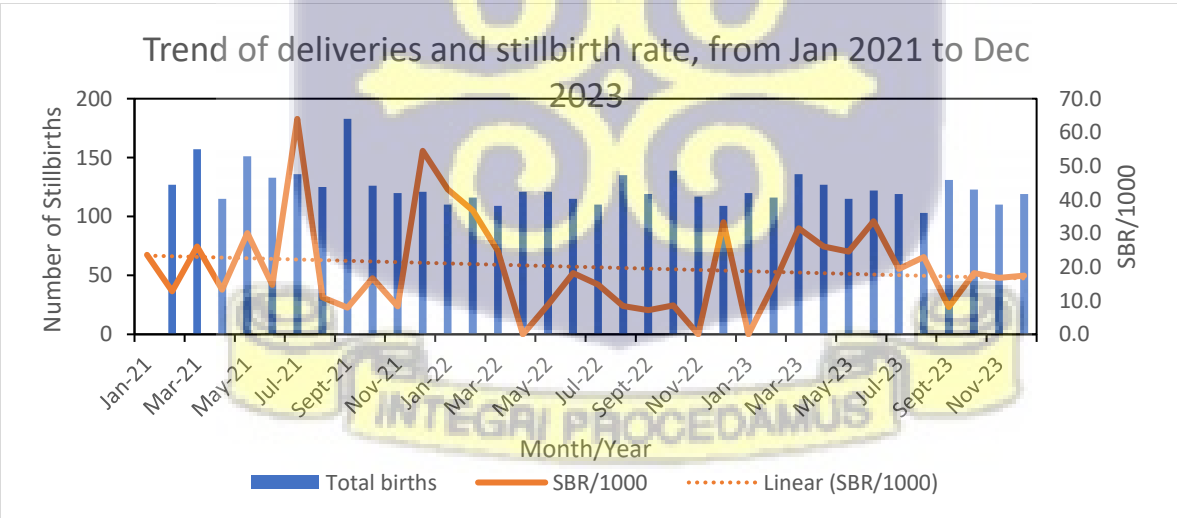

Figure 4: Trend of deliveries and stillbirth rate at the Ghana Police Hospital, Accra January 2021-December 2023.

Figure 2. shows the trends in the number of deliveries and the stillbirth rate (SBR) PER 1,000 births from January 2021 to December 2023. The number of monthly deliveries fluctuated between 100 and 150, with the stillbirth rate also varying throughout the period. In 2021, the SBR was around 23.6 per 1,000 births, initially declining before peaking significantly in July 2021 at 64 per 1,000 births. Both SBR and the number of deliveries declined steadily through mid-2022. Although there were intermittent SBR peaks in late 2022 to early 2023, the trend showed a gradual decline in the stillbirth rate, while the number of deliveries remained relatively stable with minor variations.

4.2 Socio-Demographic Determinants of stillbirth at Ghana Police Hospital

Demographic factors were analyzed at both the bivariate and multivariate levels to determine the association. The analysis revealed that maternal age was not significantly associated with stillbirths in the bivariate analysis ($p = 0.167$). Women aged ≤24 years had a crude odds ratio (cOR) of 1.097 (95% CI: 0.504–2.388) compared to women aged 25–34 years, while women aged ≥35 years had a cOR of 1.697 (95% CI: 0.984–2.926). In the multivariate model, after adjusting for other demographic factors, the adjusted odds ratio (aOR) for women aged ≤24 years was 0.685 (95% CI: 0.216–2.172, $p = 0.009$), indicating that mothers aged ≤24 had reduced odds of stillbirth compared to mothers aged 25–34 years. For women aged ≥35 years, the aOR was 1.241 (95% CI: 0.569–2.706), indicating no association between maternal age and stillbirth.

Marital status was significantly associated with stillbirths. Single mothers had higher odds of stillbirth, with a cOR of 2.391 (95% CI: 1.369–4.178, $p = 0.002$). After adjustment for other factors, single women had a significantly increased odds of stillbirth, with an aOR of 2.951 (95% CI: 1.233–7.060, $p = 0.015$). Women who were separated from their husbands did not show a

significant association with stillbirths in either the crude (cOR = 1.773, 95% CI: 0.515–6.107, p = 0.364) or adjusted analyses (aOR = 1.686, 95% CI: 0.158–18.002, p = 0.665).

Religion showed a borderline association with stillbirths in the bivariate analysis (p = 0.055), where women practicing Islam had higher odds of stillbirth compared to Christians (cOR = 1.909, 95% CI: 1.000–3.644, p = 0.05). However, this association was not significant in the multivariate analysis, with an aOR of 1.219 (95% CI: 0.489–3.037, p = 0.669), suggesting that religion play no significant role in stillbirth after adjusting for other variables.

The educational level of a mother showed no significant association with stillbirths. In the bivariate analysis, women with basic education had a cOR of 1.436 (95% CI: 0.802–2.569, p = 0.223) compared to mothers who had secondary education (SHS), while those with tertiary education had a cOR of 0.718 (95% CI: 0.382–1.351, p = 0.304). Women with no formal education had a cOR of 0.319 (95% CI: 0.071–1.438, p = 0.137). These associations did not remain significant in the multivariate analysis (p > 0.05).

Employment status was found to be significantly associated with stillbirths. In the bivariate analysis, traders had significantly higher odds of stillbirth compared to women in formal employment (cOR = 3.040, 95% CI: 1.501–6.157, p = 0.002). This association persisted in the multivariate model, with traders having an aOR of 4.014 (95% CI: 1.533–10.509, p = 0.005). Unemployment was not significantly associated with stillbirths in either the crude (cOR = 1.290, 95% CI: 0.543–3.065, p = 0.564) or adjusted analysis (aOR = 1.523, 95% CI: 0.524–4.428, p = 0.44). The overall model found demographic characteristics to be significantly associated with stillbirths, with marital status and employment status being significant determinants. Single mothers and women engaged in trade had significantly higher odds of stillbirths. Maternal age, religion, and education showed no significant association with stillbirths

Table 2: Demographic determinants of stillbirths among cases and control at the Ghana Police Hospital

	Cases (%)	Control (%)	cOR (95% CI)	P-value	aOR (95% CI)	P-value
Determinant	N=88	N=264				
Mother's Age				0.17		0.05
25-34	49 (55.7)	172 (65.2)	1		1	
≤24	10 (11.4)	32 (12.1)	1.09(0.50 - 2.39)		0.69(0.22 - 2.17)	
≥35	29 (33)	60 (22.7)	1.70(0.98 - 2.92)		1.24(0.57 - 2.71)	
Marital status				0.05		
Married	55 (62.5)	195 (79.3)	1		1	
Single	29 (33)	43 (17.5	2.39(1.369 - 4.18)	0.05	2.95(1.23 - 7.06)	0.02
Separated	4 (4.5)	8 (3.6)	1.77(0.52 - 6.12)	0.36	1.69(0.16 - 18.00)	0.67
Religion				0.055		
Christianity	66 (78.6)	210 (87.5)	1		1	
Islam	18 (21.4)	30 (12.5)	1.909(1.00 - 3.64)	0.05	1.22(0.49 - 3.04)	0.67
Educational level				0.07		
SHS	39 (44.8)	112 (43.4)	1		1	
Basic	28 (32.2)	56 (21.7)	1.436(0.80 - 2.57)	0.22	1.10(0.52 - 2.33)	0.79
Tertiary	18 (20.7)	72 (27.9)	0.72(0.38 - 1.35)	0.30	0.98(0.37 - 2.61)	0.98
No education	2 (2.3)	18 (7.0)	0.32(0.07 - 1.44)	0.14	0.45(0.05 - 4.39)	0.49
Employment status				0.002		
Formal	13 (22.4)	93 (39.7)	1		1	
Not employed	11 (18.9)	61 (26.1)	1.29(0.54 - 3.07)	0.56	1.52(0.52 - 4.43)	0.44
Trader	34 (58.6)	80 (34.2)	3.04(1.50 - 6.16)	0.002	4.01(1.53 - 10.51)	0.005

4.3 Maternal Determinants of stillbirths at Ghana Police Hospital

The maternal determinants were assessed using both bivariate and multivariate analyses. The results indicate varied associations between key maternal factors and the risk of stillbirths.

Parity showed no significant association with stillbirths in both the bivariate and multivariate analysis. Women with parity greater than two had a crude odds ratio (cOR) of 0.897 (95% CI: 0.501–1.606, p = 0.715) compared to women with parity of two or fewer. After adjusting for other factors, the adjusted odds ratio (aOR) was 1.525 (95% CI: 0.697–3.337, p = 0.29), indicating no significant association between parity and stillbirths.

Hemoglobin (Hb) levels, however, were significantly associated with stillbirths. Women with Hb levels ≤9.6 g/dL had significantly higher odds of stillbirths compared to those with Hb levels >9.6 g/dL (cOR = 2.14, 95% CI: 1.276–3.589, p = 0.004). This association remained significant after adjustment (aOR = 2.142, 95% CI: 1.141–4.022, p = 0.018), indicating that lower Hb levels are a key determinant of stillbirth among the study participants.

Gravidity did not show a significant association with stillbirths. In the bivariate analysis, the cOR for women with gravidity greater than two was 0.984 (95% CI: 0.601–1.611, p = 0.95), and the aOR was 0.865 (95% CI: 0.436–1.716, p = 0.678), indicating no association between gravida and stillbirth.

Mothers with pre-existing medical conditions during pregnancy showed a significant association with stillbirth. Women with pre-existing medical condition had a cOR of 3.474 (95% CI: 1.968–6.135, p < 0.001) compared to those without medical conditions, and this association remained significant in the multivariate analysis (aOR = 3.106, 95% CI: 1.531–6.300, p = 0.002).

Mothers who encountered obstetric complications were found to be associated with stillbirths. In the bivariate analysis, women with obstetric complications had a cOR of 4.99 (95% CI: 2.645–9.435, $p < 0.001$) compared to those without complications. After adjusting for other maternal variables, the odds remained elevated (aOR = 3.923, 95% CI: 1.801–8.546, $p = 0.001$), indicating that mothers with obstetric complications had almost four times the odds of having a stillbirth compared to mothers without any obstetric complications.

Intermittent preventive treatment in pregnancy with sulfadoxine-pyrimethamine (IPT-SP) intake was another key factor associated with stillbirths. Women who did not receive IPT-SP had substantially higher odds of stillbirths compared to those who did (cOR = 9.22, 95% CI: 5.066–16.792, $p < 0.001$). This association was also significant in the multivariate analysis, with an aOR of 9.734 (95% CI: 5.024–18.846, $p < 0.001$).

Low hemoglobin levels, pre-existing medical conditions, obstetric complications, and failure to take IPT-SP medication during pregnancy were significantly associated with stillbirths.

Table 3: Maternal determinants of stillbirths at the Ghana Police Hospital, 2021 – 2023.

	Cases (%)	Controls (%)	cOR (95% CI)	P-value	aOR (95% CI)	P-value
Determinant	N=88	N=264				
Parity				0.713		0.001
≤2	69 (78.4)	202 (76.5)	1		1	
>2	19 (21.6)	62 (23.5)	0.89(0.50 - 1.61)	0.715	1.53(0.69 - 3.34)	0.29
Hb level				0.004		
>9.6	54 (61.4)	205 (77.7)	1		1	
≤9.6	34 (38.6)	59 (22.4)	2.14(1.28 - 3.59)	0.004	2.14(1.14 - 4.02)	0.018
Gravida				0.949		
≤2	35 (39.8)	104 (39.4)	1		1	
>2	53 (60.2)	160 (60.6)	0.98(0.60 - 1.61)	0.95	0.87(0.44 - 1.72)	0.678
Medical condition				0.001		
No	56 (65.1)	227 (86.6)	1		1	
Yes	30 (34.9)	35 (13.4)	3.47(1.97 - 6.14)	0.001	3.12(1.53 - 6.30)	0.002
Obstetric complications				0.001		
No	61 (69.3)	237 (91.86)	1		1	
Yes	27 (30.7)	21 (8.14)	4.99(2.65 - 9.44)	0.001	3.92(1.80 - 8.55)	0.001
IPT-sp intake				0.001		
No	45 (51.1	222 (90.6)	1		1	
Yes	43 (48.9)	23 (9.4)	9.22(5.07 - 16.79)	0.001	9.73(5.02 - 8.55)	0.001

4.4 Fetal Determinants of stillbirths at Ghana Police Hospital

On fetal determinants, birth weight was significantly associated with stillbirths. Infants with a birth weight less than 2.5 kg had higher odds of stillbirth compared to those with a birth weight between 2.5–3.9 kg. In the bivariate analysis, the crude odds ratio (cOR) was 10.197 (95% CI: 5.517–18.848, p = 0.000001). This association was still significant in the multivariate analysis, with an adjusted odds ratio (aOR) of 6.019 (95% CI: 2.677–13.542, p = 0.00001), indicating a strong association between low birth weight and stillbirth. Conversely, birth weight ≥4 kg was not statistically significant in both bivariate analysis (cOR = 1.272, 95% CI: 0.454–3.565, p = 0.648) and multivariate analysis (aOR = 1.868, 95% CI: 0.562–6.209, p = 0.308).

Gestational age also showed a strong association with stillbirths. Infants born at or before 37 weeks had significantly higher odds of stillbirth compared to babies born at 38 weeks or later. The cOR for birth at or before 37 weeks was 6.872 (95% CI: 4.046–11.671, p = 0.000001) compared to those born at 38 weeks or later, and after adjusting for other factors, the aOR was 3.410 (95% CI: 1.655–7.027, p = 0.001), indicating a significant association between preterm birth and stillbirth.

Congenital anomalies were found not significantly associated with stillbirths in the study. In the bivariate analysis, the cOR for congenital anomalies was 2.162 (95% CI: 0.77–6.12, p = 0.146), compared to those born without any anomalies and after adjustment for other fetal factors, the aOR was 1.40 (95% CI: 0.41–4.85, p = 0.592), indicating no significant link between congenital defect and stillbirths.

Sex of the baby did show no significant association with stillbirths. Male infants had a cOR of 1.41 (95% CI: 0.85–2.35, p = 0.188) compared to female infants, and in the multivariate analysis, this association was also found not significant (aOR = 1.22, 95% CI: 0.61–2.43, p = 0.571).

Low birth weight and preterm birth were the most significant fetal determinants associated with stillbirths, while congenital anomalies and the sex of the baby were not statistically significant in both bivariate and multivariate analyses.

Table 4: fetal determinants of stillbirths at the Ghana Police Hospital, 2021 - 2023

	Cases (%)	Control (%)	cOR (95% CI)	P-value	aOR (95% CI)	P-value
Determinant	N=88	N=264				0.001
Birth weight				0.001		
2.5 - 3.9	41 (46.6)	219 (83.6)	1		1	
<2.5	42 (47.7)	22 (8.4)	10.197(5.517 - 18.848)	0.001	6.019(2.677 - 13.542)	0.001
≥4	5 (5.7)	21 (8.0)	1.272(0.454 - 3.565)	0.648	1.868(0.562 - 6.209)	0.308
Gestational age				0.001		
≥38	34 (38.6)	212 (81.2)	1		1	
≤37	54 (61.4)	49 (18.8)	6.872(4.046 - 11.671)	0.001	3.410(1.655 - 7.027)	0.001
Congenital anomalies				0.162		
No	54 (90.0)	214 (95.1)	1		1	
Yes	6 (10.0)	11 (4.9)	2.162(0.765 - 6.107)	0.146	1.404(0.406 - 4.849)	0.592
Sex of Baby				0.184		
Female	28 (31.8)	104 (39.7)	1		1	
Male	60 (68.2)	158 (60.3)	1.410(0.845 - 2.354)	0.188	1.220(0.613 - 2.429)	0.571

4.5 Facility Related Determinants of Stillbirth at the Ghana Police Hospital.

Mode of delivery, duration of labour, use of partograph and antenatal care (ANC) were facility related factors used for the analysis at the bivariate and multivariate level. In the bivariate analysis, mode of delivery was significantly associated with stillbirths. Babies delivered via cesarean section or other modes had higher odds of stillbirth compared to those delivered normally (Spontaneous Vaginal delivery), with a crude odds ratio (cOR) of 1.711 (95% CI: 1.038–2.819, p = 0.035). However, this association was lost in the multivariate analysis, with an adjusted odds ratio (aOR) of 1.711 (95% CI: 0.655–4.468, p = 0.273).

The duration of labor showed no significant association with stillbirths. Women who experienced labor lasting 12 hours or more had a cOR of 0.882 (95% CI: 0.358–2.169, p = 0.784) compared to those with shorter labor. This not significant association persisted in the multivariate analysis (aOR = 0.777, 95% CI: 0.283–2.134, p = 0.979).

The use of a partograph during labor was associated with stillbirths. Labour managed without partograph to monitor progress had a significantly higher odds of stillbirth, with a cOR of 4.356 (95% CI: 2.607–7.279, p = 0.001). In the multivariate analysis, the association remained statistically significant with aOR of 5.544 (95% CI: 2.051–14.981, p = 0.001).

Antenatal care (ANC) was also a significant determinant of stillbirth. Women who attended fewer than eight ANC visits had increased odd of stillbirth compared to those who attended eight or more visits. The cOR for fewer than eight ANC visits was 4.132 (95% CI: 2.399–7.115, p = 0.00001), and this association remained significant after adjustment (aOR of 3.026, 95% CI: 1.233–7.431, p = 0.016).

Table 5: Facility related determinants of stillbirths at the Ghana Police Hospital, 2021 – 2023

	Cases (%)	Control (%)	cOR (95% CI)	P-value	aOR (95% CI)	P-value
Determinants	N=88	N=264				0.001
Mode of Delivery				0.002		
Normal	51 (58.0)	184 (70.2)	1		1	
Cesearian section/others	37 (42.1)	78 (32.9)	1.711(1.038 - 2.819)	0.035	1.711(0.655 - 4.468)	0.273
Duration of Labour				0.783		
<12 Hours	49 (77.8)	156 (73.6)	1		1	
>=12 Hours	14 (22.2)	56 (26.4)	0.882(0.358 - 2.169)	0.784	0.777(0.283 - 2.134)	0.979
Use of Partograph				0.001		
Yes	41 (46.6)	209 (79.2)	1		1	
No	47 (53.4)	55 (20.8)	4.356(2.607 - 7.279)	0.001	5.544(2.051 - 14.981)	0.001
ANC Care				0.001		
>=8	22 (25.0)	146 (57.9)	1		1	
<8	66 (75.0)	106 (42.1)	4.132(2.399 - 7.115)	0.001	3.026(1.233 - 7.431)	0.016

4.6 Relationship between ANC visit and Stillbirth (Linear regression Analysis)

The study assess the influence of ANC visit on stillbirth, a linear regression analysis was performed. The result indicated ANC visit was a significant predictor of stillbirth with F-statistic of 63.08 ($p<0001$). The effect of ANC visits on stillbirth showed a coefficient of -0.057 (95% CI: -0.072 to -0.043) indicating an inverse relationship between ANC visits and the likelihood of stillbirth. An additional ANC visit by a mother, the log-odds of stillbirth decreases by 0.057 units or 5.6%.

Table 6: ANC care and stillbirth (linear regression analysis)

Variable	Coefficient	Standard Error	t-value	P-value
ANC visit	-0.057	0.007	-7.94	0.000
constant	0.676	0.057	11.88	0.000

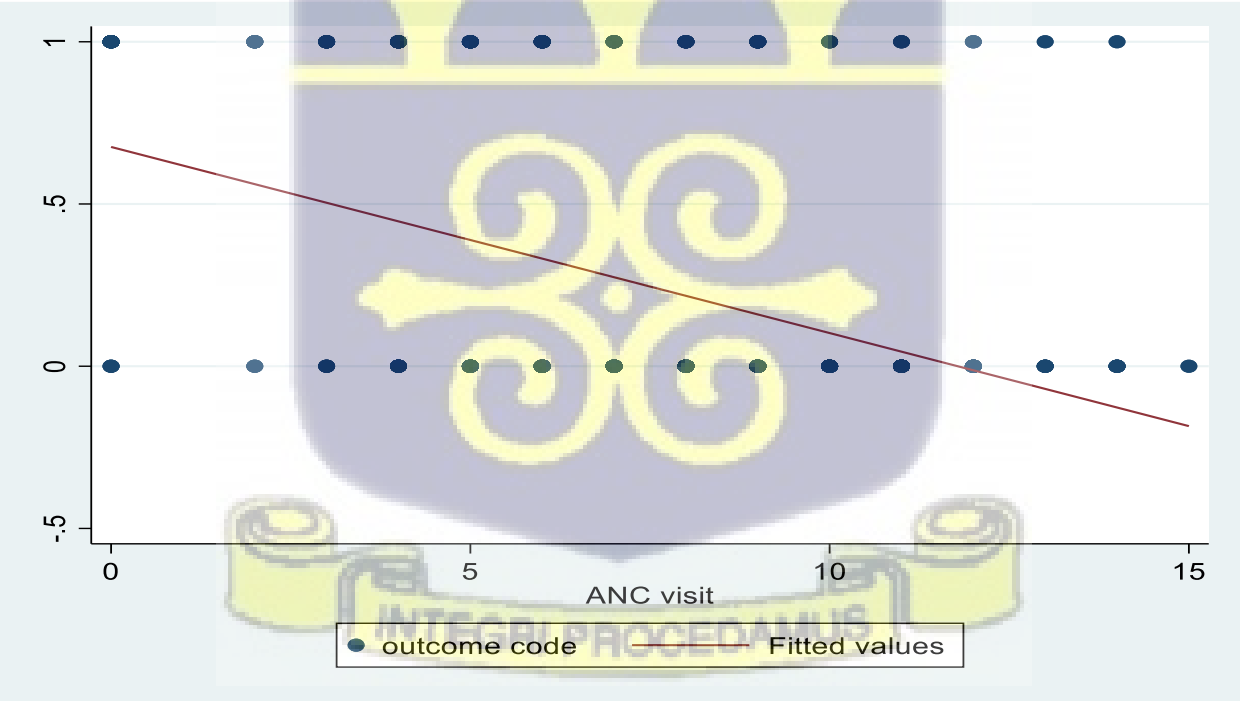

Figure 5: A graph showing the linear relationship between ANC visits and stillbirth.

4.7 Predictors of Stillbirths at the Ghana Police Hospital

A generalized linear regression model was used to assess the impact and influence of predictors of stillbirth. The model was fit with a deviance of 248.57 and Pearson's statistic of 522.42. The Akaike Information Criterion (AIC) was 0.78, and the Bayesian Information Criterion (BIC) was -1665.26, indicating a good model fit. The log-likelihood was -124.29. Key predictors in the model included maternal age, parity, hemoglobin level (Hb), gravida, antenatal care (ANC), and birth weight. Maternal age was associated with stillbirth (Coefficient = 0.1250, $p < 0.001$), suggesting that each one-year increase in age increases the log odds of stillbirth by 0.125 (95% CI: 0.0507 to 0.1994).

Parity showed a non-significant Coefficient of -0.0187 ($p = 0.926$, CI: -0.4110 to 0.3736) indicating no impact of parity on stillbirth. Maternal Hemoglobin level (Hb) had a significant negative association with stillbirths (Coefficient = -0.2643, $p < 0.033$, CI: -0.5071 to -0.0214), indicating higher Hb levels are protective. Gravida had a non-significant Coefficient of -0.0849 ($p < 0.590$, 95% CI: -0.3936 to 0.2237), indicating no substantial relationship with stillbirth.

ANC care showed a strong protective effect (Coefficient = -0.3634, $p < 0.001$, 95% CI: -0.4890 to -0.2377) aOR = 0.7 (95% CI 0.61-0.70), indicating that more antenatal care significantly reduces the risk of stillbirth. Birth weight was another significant predictor of stillbirth (Coefficient = -1.6032, $p < 0.001$, 95% CI: -2.1032 to -1.1033), indicating a lower birth weight is associated with a higher likelihood of stillbirth.

Table 7: Generalized linear regression showing the relationship between stillbirth and predictors.

Generalized Linear Regression Models

Number of obs = 336
Residual df = 329
Scale parameter = 1
AIC = 0.7814722
BIC = -1665.255

Deviance = 248.5746585
Pearson = 522.4187024

Log likelihood = -124.2873292

	OIM					
Stillbirth	Coefficient	standard Error	Z	P>(T)	95% Confidence Interval	
Mothers Age	0.1250224	0.379377	3.3	0.001	0.050666	0.199379
Parity	-0.0186918	0.2001474	-0.09	0.926	-0.4109734	0.37359
Hb	-0.2642866	0.1239018	-2.13	0.033	-0.5071296	-0.02144
Gravida	-0.0849448	0.1574993	-0.54	0.59	-0.3936376	0.223748
ANC care	-0.3633592	0.0641157	-5.57	0.001	-0.4890236	-0.23769
Birth Weight (Kg)	-1.603223	0.255075	-6.29	0.001	-2.103161	-1.10329
_cons	5.156891	1.751656	2.94	0.003	1.723709	8.590073

CHAPTER FIVE

5.0 DISCUSSIONS

5.1 Stillbirth rates

This study examined stillbirth rates and related maternal, fetal, sociodemographic, and health facility factors at the Ghana Police Hospital, a secondary-level facility in Accra, Ghana. Over the three-year period that data was analyzed, stillbirth rates fluctuated, peaking in 2021 at 22.4 per 1,000 births, likely due to the Covid-19 pandemic's disruption of healthcare services and access especially affecting people in the lower income bracket. Despite the effect of the covid pandemic, the Police Hospital, a security institution, continued operations which led to an increased number of deliveries and stillbirths during that period. This is similar to a study by Dah et al., (2023) in Ho Teaching Hospital, found an increased stillbirth rate 31.3 per 1000 births during the same period 2019 -2020 (Dah et al., 2023). Also, Dmello et al., (2024) also found an annual increased in stillbirths rates from 25 per 1000 live birth in 2017 to a peak of 38 per 1000 live birth in 2020 during the peak of the pandemic (Dmello et al., 2024). As the pandemic's impact eased in 2022, both stillbirth rates and deliveries declined suggesting improved antenatal access as more facilities resumed full operations in the capital. However, the stillbirth rate rose again in 2023 to 19.5 though not to the 2021 peak of 22.4. This pattern highlights the sensitivity of stillbirth rates to healthcare system disruptions, underscoring the need for consistent maternal healthcare interventions. Similar findings were reported by Khalil et al. (2020), who linked increased stillbirth rates during the pandemic to direct and indirect impacts of SARS-CoV-2, including reduced antenatal attendance due to healthcare disruptions (Khalil et al., 2020).

5.2 Socio-Demographic determinants

The study found no association between maternal age and stillbirth, contrasting with findings from other literatures that identify maternal age as a key determinant of stillbirth. This may be due to the size of cases and single hospital setting. Mukherjee et al. (2023) found that advance maternal age (≥ 35) doubled the risk of stillbirth, with a fourfold increase for women aged 40-49 years (Mukherjee et al., 2023). Similarly, Carvalho et al. (2018) in Brazil found youger maternal age (< 24 and < 20 years, respectively) to be associated with higher risk of stillbirth. Differnces in the sample size, case volume, and multi-centre data used in these studies likely explain the variations in findings (Carvalho et al., 2018).

The study identified maternal employment and marital status as significant determinants of stillbirth. More than half of the participants were traders or unemployed, with traders facing a fourfold odd of stillbirth compared to employed mothers. This elevated risk may be attributed to traders' long, demanding, and irregular work hours, which increase stress and limit access to antenatal services. Additionally, those who engaged in subsistence-based trading have limited time and financial resources for healthcare, further reducing antenatal care access. This finding aligned with Badimsuguru et al. (2016), who reported that mothers engaged in trading had twice the odds of stillbirth compared to housewife however this was not significant in multivariate analysis (Badimsuguru et al., 2016). Marital status was associated with stillbirths, single mothers had twice the likelihood of stillbirth compared to married mothers. In urban settings, single mothers often face financial challenges and lack of family support, increasing emotional stress during pregnancy. This is consistent with Tesema et al. (2021), who found higher stillbirth risk for births from single or divorced mothers (Tesema et al., 2021).

In terms of sociodemographic factors, this study found that maternal age, religion, and educational status were not significant determinants of stillbirth.

5.3 Maternal determinants

The study found that hemoglobin levels during pregnancy were significantly associated with stillbirth, with mothers having Hb levels ≤ 9.6 g/dL showing twice the likelihood of experiencing stillbirth compared to those with higher levels. This finding aligns with the findings of Kasa et al. (2023), that anemia during pregnancy more than doubled the risk of stillbirth (Kasa et al., 2023). Low hemoglobin during pregnancy may reduce the fetal heart rate and restrict fetal growth, which can likely lead to stillbirth. Additionally, mothers from lower socioeconomic backgrounds may face poor nutrition and limited financial capacity to afford prenatal supplements, further increasing the risk of stillbirth.

Stillbirth was also significantly associated with mothers who had pre-existing medical conditions before pregnancy. These mothers had three times the likelihood of experiencing stillbirth compared to mothers without any pre-existing conditions. Chronic medical conditions, such as hypertension, diabetes, heart conditions, and infections, were of particular concern, as they can complicate pregnancy due to altered metabolic and cardiovascular demands. This finding is consistent with Zile et al. (2019), who found that the presence of diabetes in pregnancy increased the risk of stillbirth fivefold (Zile et al., 2019).

Additionally, Tesfay et al., (2022) found a significant relationship between maternal infections during pregnancy and stillbirth, with the odds of stillbirth being more than twice as high in mothers with infections. In communities where resources are limited, mothers may also lack the financial capacity to access specialized care needed to manage these conditions, which further contributes to increased stillbirth risk.

Obstetric complications, including pre-eclampsia, placental abruption, and other placental issues, were found to be associated with increased odds of stillbirth. Mothers who experienced eclampsia, pre-eclampsia, or placental abruption had nearly a fourfold likelihood of stillbirth compared to mothers who did not experience these complications. This aligns with Mohammed-Ahmed et al. (2022), who noted that mothers who experience pregnancy complications were three times more likely to experience stillbirth compared to those who did not (Mohammed-Ahmed et al., 2022).

The study also found that the intake of intermittent preventive treatment with sulfadoxine-pyrimethamine (IPT-SP) during pregnancy was associated with reduced odds of stillbirth. Mothers who attended antenatal care (ANC) and received more than one dose of IPT-SP were less likely to experience stillbirth compared to those who did not attend ANC or receive IPT-SP. Dosoo et al. (2021) found that the prevalence of low birth weight and other adverse birth outcomes was 7.5% among mothers who received ≤1 dose of IPT-SP, with the highest rate of active placental malaria infection also occurring in this group (Dosoo et al., 2021). Furthermore, Figueroa-Romero & Pons-Duran (2022) demonstrated that IPT-SP significantly reduces the burden and impact of malaria in pregnancy within endemic communities (Figueroa-romero & Pons-duran, 2022).

On maternal factors low hemoglobin level, preexisting medical conditions, obstetric complications and failure to take IPT-Sp medication during pregnancy were significantly associated with stillbirths.

5.4 Fetal determinants

In this study, fetal birth weight was found to be associated with stillbirth. Neonates born with a low birth weight of less than 2.5 kg had sixfold higher odds of stillbirth compared with those born at a normal weight of 2.5 kg or above. This finding aligns with a study conducted in Eastern Ethiopia, which reported that babies born with low birth weight had three times higher odds of

stillbirth than those born at normal birth weight (Dheresa et al., 2022). Also, Komboigo et al. (2023) identified a statistically significant association between fetal weight below 2,500 grams and intrapartum fetal death (Komboigo et al., 2023).

Gestational age was also associated with stillbirth, with babies born at or before 37 weeks showing more than six times the odds of stillbirth compared to those born at 38 weeks or more. A study in South India similarly found that preterm birth was strongly associated with stillbirth, showing more than 22 times higher odds of stillbirth compared with full-term delivery (Dalal et al., 2021). This association may be partly due to insufficient or irregular antenatal care (ANC) attendance by mothers, where timely identification and management of fetal growth issues and other pregnancy-related problems could be lacking.

In this study, congenital defects and the sex of the baby were not associated with stillbirth, possibly due to the low number of cases recorded.

5.5 Facility related factors

From the study the use of partograph by midwives to monitor progress of labor was associated with reduced odds of stillbirth. Labor that was managed without partograph to monitor progress had more than twice the odds of stillbirth compared to those that partograph was used to monitor labor. Fikre et al., (2021) found that the odds of women whose labour were not monitored with partograph had up to 4 times higher risk of stillbirth compared to labor monitored with partograph (Fikre et al., 2021). The higher odds of labor not monitored with partograph might be due to delay in reaching hospital to receive proper care, this delay could be due to financial constraints or delayed from referral hospital. Other studies identified that a delayed in admission of >24 hours had more than 16 higher likelihood of stillbirth compared to those that report early for delivery. The mode of delivery was identified as a determinant of stillbirth, with induced deliveries having

a 1.7 times higher risk compared to normal deliveries. Similarly, a study in Southern Ethiopia found that Cesarean section deliveries had more than twice the odds of stillbirth compared to normal deliveries. These increased risks may be attributed to delays in reporting to the hospital or delays in decision-making by healthcare personnel, as most of these procedures were emergency Cesarean sections.

Evidence abounds on the importance of antenatal visits and the quality of antenatal care in influencing pregnancy outcome. The World Health Organization (WHO) recommends that pregnant women attend at least seven antenatal visits during pregnancy. Mothers who begin antenatal care early and attend regularly have reduced likelihood of stillbirth compared to those who start late or do not attend at all. In this study we found that women who attended fewer than eight antenatal visits had four times the odds of experiencing stillbirth compared to those who attended eight or more visit. A plausible explanation for this is that most mothers begin antenatal care after the first trimester and may lack the financial means to perform the recommended scans and purchase prescribed medications. The study further assessed the impact of antenatal visits on stillbirths in the hospital and identified that an increase in antenatal attendance by one visit reduces the likelihood of stillbirth by 5.6%. this finding is consistent with Dheresa et al. (2022) who found that odds of stillbirth among women did not attend antenatal were higher by 67% compared with those attended, the adjusted odds was almost twice among non-attendants compared to those who attended regularly (Dheresa et al., 2022), and Id et al. (2023) found that Higher quality ANC decreases the odds of antepartum stillbirth by almost 81% and mother who attend antenatal had a reduced odds of 0.19 of experiencing stillbirth compared (Id et al., 2023). The reasons for the higher odds among non-attendants might be because of lack of maternal education and birth preparedness.

To evaluate the key predictors of stillbirth, a generalized linear regression model was used incorporating known predictors from previous studies as well as statistically significant factors in this study. Although maternal age was not a significant predictor under sociodemographic factors, the model identified it as a predictor, with each additional year of maternal age, increasing the likelihood of stillbirth by 13%. Parity also emerged as a predictor, albeit with minimal impact; each additional parity was associated with a 1.9% decrease in stillbirth. In the model, antenatal visits showed a strong protective effect: each additional antenatal visit was associated with approximately a 30% decrease in the odds of stillbirth.

This was a retrospective, institutional-based study, so the accuracy of the data depends on the individuals who entered it, which may limit the generalizability of the findings.

CHAPTER SIX

6.0 CONCLUSION

The stillbirth rate fluctuated over the study period, with higher total deliveries corresponding to increased stillbirth rates. Sociodemographic, maternal, fetal, and facility-related factors were significantly associated with stillbirth. Marital status and employment type were key sociodemographic determinants. Maternal factors included low hemoglobin levels, existing medical conditions, obstetric complications, and use of IPT-SP drugs. Fetal determinants were low birth weight (<2.5 kg) and preterm birth (<37 weeks). Facility-related factors, such as antenatal care and the use of partographs to monitor labor, were also significantly associated stillbirth outcomes.

The implications of the findings indicate that stillbirth remains a significant challenge in urban areas, particularly among the urban poor. Strengthening antenatal care (ANC) utilization is crucial, with emphasis on promoting early and regular ANC visits, especially among vulnerable population to improve pregnancy outcomes.

Urban traders were identified as a subgroup with markedly higher odds of stillbirth, likely due to occupational barriers that limit their access to quality healthcare. Addressing these barriers through targeted interventions, such as community outreach and tailored support services, could significantly improve outcomes for this group.

Furthermore, the study underscores the importance of public health education in reducing stillbirths. Promoting regular health checks, encouraging ANC attendance, and raising awareness of risk factors are vital strategies to integrate into community health programs. Enhancing education and awareness can foster timely medical care and ultimately improve pregnancy outcomes among at-risk populations.

6.1 RECOMMENDATIONS

The facility's Public Health Unit should conduct regular community outreach programs to raise awareness on the importance of antenatal care (ANC), with special attention to vulnerable groups such as urban traders and women of lower socioeconomic status. The pregnancy school program should emphasize the benefits of early and consistent ANC attendance, address key maternal risk factors such as advanced maternal age, anemia and hypertension, and encourage partner involvement to strengthen family support.

Hospital management should strengthen routine use of partographs during labor monitoring and provide refresher training for staff to ensure adherence. In addition, the implementation of an electronic medical records (EMR) system will improve patient data management, facilitate the identification of high-risk pregnancies, and enhance continuity of care.

To reduce missed ANC visits, the facility should establish a maternal follow-up desk, with staff assigned to call and remind mothers of upcoming appointments and follow up with those who miss scheduled visits. Finally, future research should not only assess overall pregnancy outcomes but also quantify preventable stillbirths and evaluate the effectiveness of interventions aimed at reducing identified risk factors.

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APPENDIX 1:

Table 8: Data abstraction tool

s/no	Mother's Age	Marital status	Religion	Education	Empolyment status	Parity	Hb	Gravida	Medical conditions	ANC visit	IPT/Sp	obstetric complications	Birth weight (kg)	Gestation age	Congenital malformations	sex of baby	Duration of labour (hrs)	Mode of delivery	Partograph use	Delivered by	outcome
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					

APPENDIX 2

Research Questionnaires

Interview Guide

Demographic Characteristics

SNO	VARIABLES	RESPONSE
1	Mothers Age at the time of pregnancy	
2	**Marital status**	
	Single	
	Married	
	Separated	
	Divorced	
	Widowed	
3	**Educational level**	
	No education	
	Primary	
	Secondary	
	Tertiary	
4	**Employment status**	
	Farmer	
	Housewife	
	Trader	
	Government worker	
5	**Religion**	
	Christian	
	Islam	
	African traditional believer	
	Others	

Maternal factors

1. How many times have you delivered (Parity)? ----------
2. What week of gestation did you lose the baby? ----------
3. Did you have any medical condition during the pregnancy? ☐ Yes ☐ No
   If Yes, what was the medical condition? ----------
4. Did you use Insecticide Treated Net during pregnancy? Yes ☐ No ☐
5. How many times did you attend antenatal during the pregnancy? ----------
6. Did you receive IPT-Sp medicine during the pregnancy? ----------

Fetal factors

1. What was the weight of the baby at birth? ----------
2. What was the sex of the baby? Male ☐ Female ☐
3. What was the gestational age in weeks? ----------
4. What was the method of delivery; Vaginal------ Induced------- Caesarian Section ---------
5. What was your baby's weight? ----------
7. Did the baby have any anomaly or defect? Yes ☐ No ☐