

**ENSIGN GLOBAL UNIVERSITY,
KPONG, EASTERN REGION, GHANA**

FACULTY OF PUBLIC HEALTH DEPARTMENT OF COMMUNITY HEALTH

**PREVALENCE AND ASSOCIATED RISK FACTORS OF PREECLAMPSIA
AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC IN HO
MUNICIPAL HOSPITAL, VOLTA REGION, GHANA**

BY

ATAKORA SIRINA JACQUELINE

(257100327)

JUNE, 2026

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**A THESIS SUBMITTED TO THE DEPARTMENT OF COMMUNITY HEALTH,
FACULTY OF PUBLIC HEALTH, ENSIGN GLOBAL UNIVERSITY IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS FOR THE
MASTER OF PUBLIC HEALTH DEGREE**

JUNE, 2026

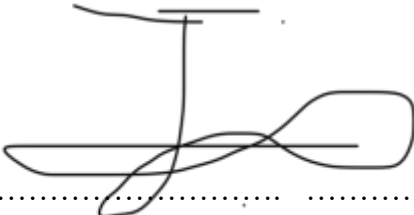
DECLARATION

I, Atakora Sirina Jacqueline, hereby certify that except for references to other people's work, which I have duly cited, this project submitted to the Department of Community Health, Ensign Global University, Kpong is the result of my own investigation, and has not been presented for any other degree elsewhere.

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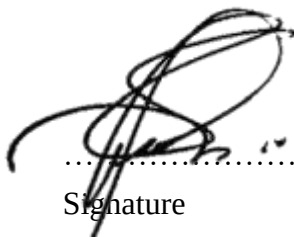
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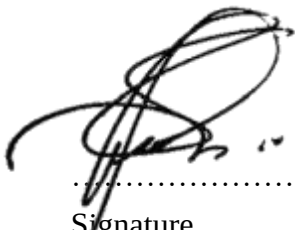
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DEDICATION

This work is dedicated to the lovely memory of my mother, Yaa Foruwaa Gladys Genfiorh, whose love, strength, and sacrifices continue to inspire and guide me. Though she is no longer with me, her presence remains deeply rooted in my journey and in every achievement I attain.

It is also dedicated to Dr. David Togbe Kodjo Nfodjo for his exceptional generosity, unwavering support, and selfless sacrifices in sponsoring my education. Your belief in me, even in moments when I doubted myself, and your guidance in shaping my academic path into Public Health have profoundly impacted my life. This milestone stands as a testament to your kindness and investment in my future.

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Finally, I am deeply grateful to my family, friends, and colleagues for their encouragement, prayers, and continuous support.

DEFINITION OF TERMS

Preeclampsia: New-onset hypertension (blood pressure $\geq 140/90$ mmHg) after 20 weeks of gestation with proteinuria or other signs of organ dysfunction, diagnosed according to ACOG (2020) criteria.

Malnutrition: Nutritional status classified as “malnourished” based on Mid-Upper Arm Circumference (MUAC) or Body Mass Index (BMI) recorded in antenatal records.

ANC Visits: Number of antenatal care visits attended, categorised as <4 visits or ≥ 4 visits.

Previous Caesarean Section: Documented history of at least one caesarean delivery in a previous pregnancy.

Primigravidity: Current pregnancy being the woman’s first gestation.

Age Group: Maternal age categorised as 15–34 years or 35–49 years.

Educational Level: Highest formal education attained (None, Primary, JHS, SHS, or Tertiary).

Occupation: Main occupation of the pregnant woman (Civil Servant, Farmer, Student, Trader, or Unemployed).

Income Level: Monthly household income categorised as Low, Middle, or High.

LIST OF ABBREVIATIONS

ACOG	American College of Obstetricians and Gynecologists
ANC	Antenatal Care
AOR	Adjusted Odds Ratio
BMI	Body Mass Index
CI	Confidence Interval
CS	Caesarean Section
GHS	Ghana Health Service
JHS	Junior High School
MUAC	Mid-Upper Arm Circumference
SDG	Sustainable Development Goal
SHS	Senior High School
WHO	World Health Organization

ABSTRACT

Background: Preeclampsia remains a leading cause of maternal and perinatal morbidity and mortality in low- and middle-income countries, including Ghana. Facility-specific data on its prevalence and associated risk factors at Ho Municipal Hospital in the Volta Region are limited.

Aim: This study aimed to determine the prevalence of preeclampsia and identify its associated risk factors among pregnant women attending the antenatal clinic at Ho Municipal Hospital, Volta Region, Ghana.

Method: A facility-based cross-sectional study was conducted using a retrospective review of antenatal records. A total of 438 pregnant women were systematically sampled. Data on sociodemographic, obstetric, and nutritional variables were extracted using a structured tool. Preeclampsia was diagnosed according to ACOG (2020) criteria. Data were analysed using chi-square tests for bivariate associations and binary logistic regression for multivariate analysis.

Results: The prevalence of preeclampsia was 4.34% (19/438). In bivariate analysis, only malnutrition was significantly associated with preeclampsia ($\chi^2 = 5.536$, $p = 0.019$). Multivariate logistic regression confirmed that malnutrition was the only independent predictor (AOR = 5.21, 95% CI: 1.12–24.34, $p = 0.036$). Age group, educational level, occupation, income, number of ANC visits, previous caesarean section, primigravidity, and gestational age were not statistically significant.

Conclusions: Preeclampsia affects approximately 4.34% of pregnant women attending antenatal care at Ho Municipal Hospital. Malnutrition is the only significant independent risk factor. Targeted nutritional screening and interventions during antenatal care are recommended to reduce the burden of preeclampsia in this setting.

Keywords: Preeclampsia, Prevalence, Malnutrition, Risk factors, Antenatal care, Ho Municipal Hospital, Ghana

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Preeclampsia is a multisystem disorder marked by new-onset hypertension and proteinuria or maternal organ dysfunction after 20 weeks of gestation in a previously normotensive woman. It remains a leading cause of maternal and perinatal morbidity and mortality worldwide (American College of Obstetricians and Gynecologists [ACOG], 2020; Rana *et al.*, 2019). The condition often arises in the third trimester and can progress quickly to severe complications, including maternal and foetal death. Although its exact cause remains unclear, strong evidence implicates the placenta, specifically abnormal placentation and the release of anti-angiogenic factors such as soluble fms-like tyrosine kinase 1 (sFlt1), as central to its pathogenesis (Rana *et al.*, 2019).

Hypertensive disorders of pregnancy, with preeclampsia as a major contributor, account for roughly 14% of maternal deaths annually (Say *et al.*, 2014). The burden is heaviest in low- and middle-income countries (LMICs), where timely access to prenatal care, diagnosis, and appropriate management remains limited (World Health Organization [WHO], 2019). If left untreated, preeclampsia leads to systemic maternal organ dysfunction and is a significant contributor to maternal deaths in low-resource settings (Mol *et al.*, 2016).

In sub-Saharan Africa, preeclampsia is the second leading cause of maternal mortality after haemorrhage (Fokom-Domgue & Noubiap, 2014). Regional prevalence ranges from 1.8% to 16.7% (Osungbade & Ige, 2011), exceeding the global average of 4.6% (Abalos *et al.*, 2013). The wide variation reflects underlying disparities in antenatal care coverage, health infrastructure, and socioeconomic conditions. Health system limitations, particularly in

diagnostic, preventive, and management capabilities, continue to hinder effective control (Osungbade & Ige, 2011).

In Ghana, preeclampsia prevalence increased from 4.6% to 6.6% between 2018 and 2020, averaging 5.6% during that period (Adwoa *et al.*, 2022). Common complications include preterm delivery, intrauterine foetal death, and future maternal cardiovascular disease (FokomDomgue & Noubiap, 2014). Research also shows women of African ancestry are more predisposed to preeclampsia, partly due to biological factors independent of socioeconomic status (Nakimuli *et al.*, 2015).

The underlying pathology involves abnormal placental development that triggers the release of foetal-derived factors into maternal circulation. These factors cause endothelial dysfunction and systemic inflammation (Bertolini *et al.*, 2009). Elevated levels of anti-angiogenic proteins such as sFlt1 and soluble endoglin contribute to vascular damage and maternal organ impairment (Bertolini *et al.*, 2009; Baumwell & Karumanchi, 2007). Other mechanisms include oxidative stress and placental hypoxia (Sanchez-Aranguren *et al.*, 2014). Known risk factors include nulliparity, multiple gestation, a history of preeclampsia, and pre-existing medical conditions (Phipps *et al.*, 2019).

In Ghana, socioeconomic indicators such as education level and occupation have shown strong associations with preeclampsia risk (Nyarko Adwoa *et al.*, 2022). Systemic weaknesses in the healthcare system, including inadequate prediction tools, poor screening practices, and limited capacity for clinical management, further compound the problem (Osungbade & Ige, 2011). Women affected by preeclampsia also face elevated long-term risks of cardiovascular disease (Baumwell & Karumanchi, 2007).

The Ho Municipal Hospital is a major referral facility in Ghana's Volta Region. It serves a broad demographic of pregnant women, yet current local data on preeclampsia prevalence and

its associated risk factors remain limited. Understanding the magnitude of this issue within the municipality is essential. First, it provides baseline data to support resource planning at both hospital and district levels. Second, identifying the specific risk factors in this population supports targeted prevention and early detection efforts. Third, this information is necessary to evaluate and improve antenatal care services, especially in managing high-risk pregnancies.

This study aims to assess the prevalence and associated risk factors of preeclampsia among pregnant women attending antenatal care at Ho Municipal Hospital. The goal is to generate local evidence to guide strategies that reduce preeclampsia-related morbidity and mortality in this setting.

1.2 Problem Statement

Preeclampsia remains a major preventable cause of maternal and perinatal mortality worldwide, especially in low- and middle-income countries (Firoz *et al.*, 2011; Osungbade & Ige, 2011). In Ghana, hypertensive disorders of pregnancy (HDP) are among the leading contributors to maternal deaths, accounting for 26–31.7% of maternal mortality in tertiary hospitals (Adu-Bonsaffoh *et al.*, 2013; Lee *et al.*, 2012). Despite these trends, there is no documented prevalence data specific to Ho Municipal Hospital, limiting the understanding of disease burden at the facility level.

Effective management is undermined by structural challenges, including limited resources, inconsistent clinical guidelines, a shortage of trained personnel, and weak health infrastructure (Atluri *et al.*, 2023; von Dadelszen *et al.*, 2013; Osungbade & Ige, 2011). These constraints hinder accurate risk assessment, surveillance, and targeted clinical response within the municipality.

Recent Ghanaian research identified several risk factors for preeclampsia, including physical inactivity, infrequent antenatal visits, analgesic use, caesarean delivery, parity, educational

level, and occupational status (Fondjo *et al.*, 2022; Nyarko *et al.*, 2022). Midwives, central to managing preeclampsia, face multiple barriers such as inadequate training, lack of midwifery-specific protocols, and constrained healthcare resources (Garti *et al.*, 2023). Complications linked to preeclampsia include preterm delivery, intrauterine foetal death, and maternal mortality (Nyarko *et al.*, 2022). Improving outcomes demands a coordinated approach involving behavioural change, system-level improvements, and supportive policies.

Strengthening antenatal screening, clinical monitoring, and postpartum follow-up is essential (Fondjo *et al.*, 2022; Garti *et al.*, 2023).

The absence of localized epidemiological data at Ho Municipal Hospital further undermines clinical practice and public health planning. Without accurate prevalence estimates, antenatal care providers may under-recognize the scope of the issue, risking delays in diagnosis and care. This gap also obstructs the creation of risk assessment tools appropriate for the local population. Preventive interventions, such as administering low-dose aspirin to high-risk women, may be overlooked despite evidence of benefit (Kupka *et al.*, 2024).

Given the rising prevalence at nearby Ho Teaching Hospital and the documented gaps in clinical preparedness, a facility-specific epidemiological study is urgently needed. This study aims to determine the current prevalence and identify the associated risk factors for preeclampsia among pregnant women at Ho Municipal Hospital. These findings will inform evidence-based interventions to reduce maternal morbidity and mortality in the facility's catchment area.

1.3 Rationale of the study

Conducting this research on the prevalence and associated risk factors of preeclampsia at Ho Municipal Hospital is justified by the urgent need to translate national and global maternal health priorities into effective local action. Although the global burden of preeclampsia,

particularly in Sub-Saharan Africa and Ghana, is well documented (Say *et al.*, 2014; Abalos *et al.*, 2013; Ghana Health Service [GHS], 2020), the implementation of effective interventions depends on context-specific epidemiological data. The lack of recent, facility-level prevalence data for Ho Municipal Hospital represents a critical gap. Without this data, healthcare providers and administrators cannot accurately gauge the local burden, measure intervention impact, advocate for resources, or tailor services to meet the needs of the population.

This study aims to fill that gap by providing a current estimate of preeclampsia prevalence among antenatal care attendees at Ho Municipal Hospital. National or regional averages often obscure local variation; thus, a facility-specific assessment is necessary to inform action where it matters most.

Beyond prevalence, the identification of locally relevant risk factors is essential for effective prevention and early detection. While established risk factors, such as nulliparity, chronic hypertension, obesity, and a history of preeclampsia, are widely recognized (Moura *et al.*, 2010), their significance and interaction with unique determinants in the Ho context remain underexplored. Factors such as dietary patterns specific to the Volta Region, particularly low vegetable consumption and high intake of processed foods, may alter risk profiles (Brantsaeter *et al.*, 2009). Local patterns of antenatal care attendance, endemic malaria exposure, genetic predispositions within ethnic groups, and socioeconomic constraints, such as limited transport, low educational attainment, and poor health literacy, further shape risk dynamics (Nyarko Adwoa *et al.*, 2022).

A study at Ho Teaching Hospital observed a rising preeclampsia prevalence from 4.6% in 2018 to 6.6% in 2020. Parity, education level, and occupation were found to be significant associated factors. Alarming, complications included preterm delivery (70.4%), intrauterine foetal death

(19.7%), and maternal death (5.4%) (Nyarko Adwoa *et al.*, 2022). These figures underscore the severity of preeclampsia outcomes in the region and the pressing need for more localized evidence to support early detection and intervention strategies.

By systematically investigating how local risk factors correlate with preeclampsia occurrence, this study will provide practical data for improving antenatal care protocols. Such evidence will help clinicians at Ho Municipal Hospital identify high-risk women earlier and initiate timely, evidence-based interventions, including low-dose aspirin prophylaxis for eligible individuals, as recommended by ACOG (2020).

The rationale extends beyond the clinic to broader health system planning and policy. The Ghana Health Service explicitly prioritizes the reduction of maternal mortality, with hypertensive disorders designated as a focus area (GHS, 2020). This study aligns with that agenda by generating actionable data for the Ho Municipal Health Directorate's strategic planning. Findings will guide the allocation of essential resources, such as blood pressure monitors, urine protein testing kits, magnesium sulphate, and trained personnel for high-risk care. They will also point to potential gaps in existing antenatal care services, informing improvements in risk screening, service delivery, and staff training.

Furthermore, identifying modifiable risk factors prevalent in the local population will support the design of targeted health education campaigns aimed at pregnant women and their families. These campaigns can raise awareness, improve health-seeking behaviours, and ultimately reduce preeclampsia incidence and complications within the municipality.

This research is expected to contribute meaningfully to reducing preeclampsia-related morbidity and mortality in Ho Municipality. It aligns with Ghana's health sector goals and supports Sustainable Development Goal (SDG) 3.1, which seeks to reduce the global maternal mortality ratio (United Nations, 2015). Therefore, this study is not only locally relevant but

also globally significant. It offers the evidence base needed to close a critical knowledge gap, improve clinical care, inform public health policy, and enhance maternal health outcomes in a high-risk setting.

1.4 Conceptual Framework

This study is guided by a conceptual framework adapted from the World Health Organization's social determinants of health framework and Andersen's behavioural model of health services use, which elucidates the multifaceted interplay of individual, clinical, and health system factors influencing preeclampsia prevalence among pregnant women attending antenatal clinics at Ho Municipal Hospital in Ghana's Volta Region. The framework positions preeclampsia prevalence, defined as the proportion of pregnant women diagnosed with preeclampsia, as the central outcome of interest, with a reported prevalence in Ghana ranging from 5.6% to 8.8% (Nyarko Adwoa *et al.*, 2022; E. Anto *et al.*, 2023). The prevalence of preeclampsia is hypothesised to result from the interaction of independent variables across three domains: socio-demographic, behavioural, and clinical factors. Socio-demographic factors encompass maternal age, parity, education level, occupation, and income, which shape health-seeking behaviours and biological susceptibility to preeclampsia (Nyarko Adwoa *et al.*, 2022; E. Anto *et al.*, 2023; V. Bilano *et al.*, 2014). These factors, prevalent in low- and middleincome settings like Ghana, influence access to antenatal care and health literacy, critical for early intervention (Fondjo *et al.*, 2022). Behavioural factors include adherence to antenatal care schedules and lifestyle practices such as diet and physical activity, which modulate maternal health and hypertensive disorder risk (Fondjo *et al.*, 2022). Clinical factors comprise preexisting conditions like chronic hypertension and obesity, obstetric history such as primigravida or previous caesarean section, and pregnancy complications like foetal growth restriction, all of which directly impact physiological pathways to preeclampsia (E. Anto *et al.*,

2023; V. Bilano *et al.*, 2014). Awareness and knowledge of preeclampsia, including its signs, risk factors, and the importance of antenatal care, serve as a moderating variable. Higher awareness, often limited in Ghana due to low health literacy, strengthens the relationship between independent variables and outcomes by promoting timely care-seeking and adherence to preventive measures (Fondjo *et al.*, 2022). Health system factors, including the quality of antenatal care, availability of diagnostic tools, referral pathways, and provider competence, act as contextual influences rather than independent variables. These factors, often constrained in Ghana by inadequate infrastructure and limited midwife roles, shape the effectiveness of preeclampsia detection and management (Fondjo *et al.*, 2022). By integrating these domains, the framework provides a comprehensive lens to examine how individual and systemic factors converge to influence preeclampsia prevalence, guiding the study's exploration of targeted interventions to reduce maternal and perinatal morbidity in Ho Municipality.

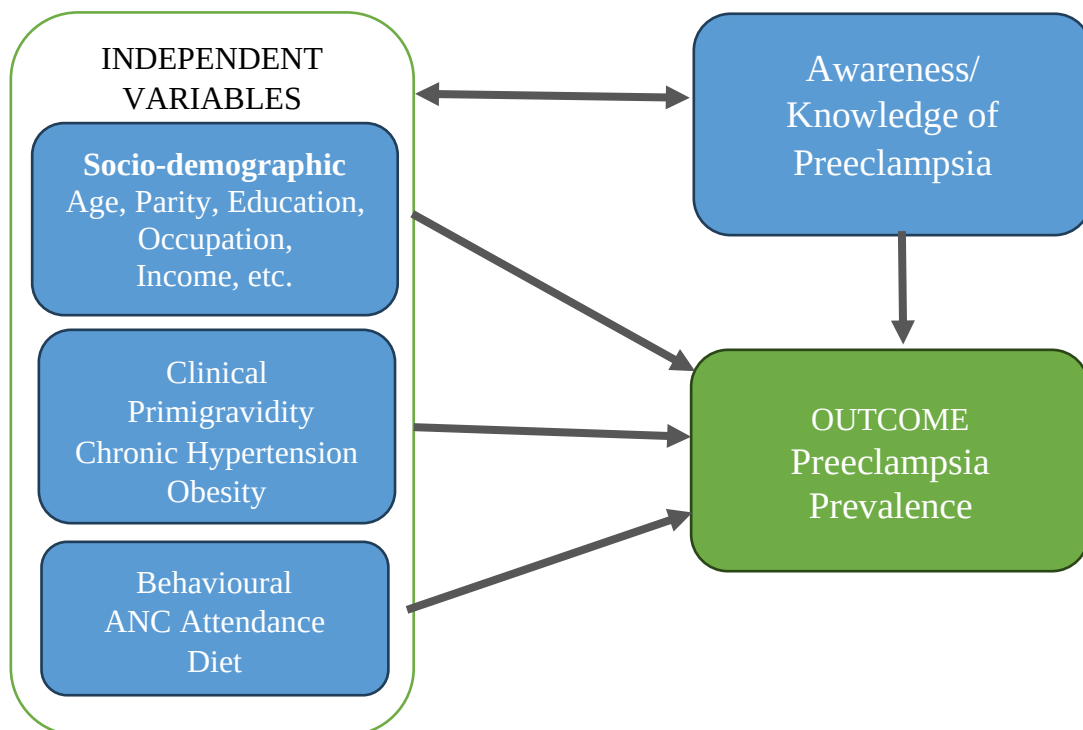


Figure 1: Conceptual Framework Illustrating Determinants of Preeclampsia Prevalence

Source: Author's Own Construct

1.5 Research Question, Objectives, and Hypotheses

1.5.1 Research Questions

General Research Question:

What is the prevalence of preeclampsia and what factors are associated with its occurrence among pregnant women attending the antenatal clinic at Ho Municipal Hospital?

Specific Research Questions:

1. What is the prevalence of preeclampsia, among pregnant women attending the antenatal clinic at Ho Municipal Hospital during the study period?
2. Which demographic characteristics (e.g., age, parity, educational level, occupation, marital status) and clinical characteristics (e.g., gestational age at booking, history of preeclampsia, family history of hypertension/preeclampsia) are significantly associated with the development of preeclampsia within this study population?
3. To what extent are pre-existing medical conditions, specifically chronic hypertension, pre-gestational diabetes mellitus, obesity (defined by Body Mass Index), and renal disease, associated with an increased risk of developing preeclampsia among these women?
4. How do antenatal care practices, including the timing of the first antenatal visit, regularity of attendance, completeness of blood pressure and urine proteinuria screening as per guidelines, and documented counselling on warning signs, relate to the timing of preeclampsia diagnosis and the initial severity of presentation at Ho Municipal Hospital?

1.5.2 Research Objectives

General Research Objective:

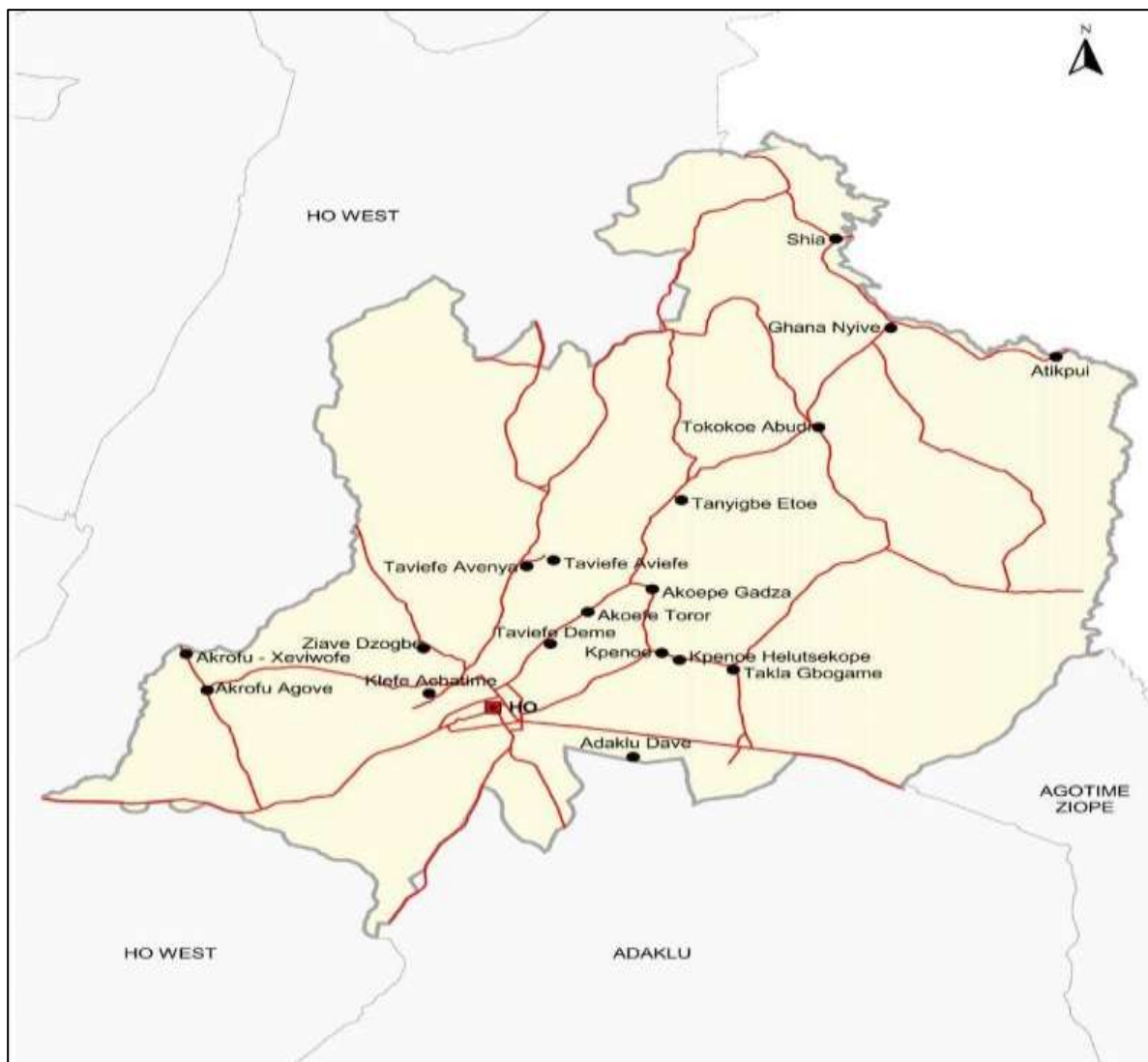
To determine the prevalence of preeclampsia and identify its associated risk factors among pregnant women utilizing antenatal care services at Ho Municipal Hospital.

Specific Research Objectives:

1. To determine the prevalence of preeclampsia among pregnant women attending antenatal clinic at Ho Municipal Hospital during the study period, calculated as the proportion of women diagnosed with preeclampsia according to standardized ACOG (2020) criteria.
2. To identify significant demographic (age, parity, education, occupation, marital status) and clinical factors (gestational age at booking, obstetric history including prior preeclampsia, family history of hypertension/preeclampsia) associated with preeclampsia in the study population, using appropriate statistical measures of association.
3. To assess the strength and significance of the relationship between specific pre-existing medical conditions (chronic hypertension, pre-gestational diabetes mellitus, obesity [BMI ≥ 30 kg/m²] and known renal disease) and the subsequent development of preeclampsia among the antenatal attendees.
4. To examine the relationship between antenatal care practices (gestational age at first ANC visit, number of ANC visits attended, documented adherence to blood pressure and urine protein screening protocols at each visit, and recorded counselling on preeclampsia warning signs) and outcomes related to preeclampsia, specifically the gestational age at diagnosis and the clinical severity (mild vs. severe features) at initial presentation.

1.5 Profile of the study Area:

The Ho Municipal is one of the five (5) Municipalities in the Volta Region of Ghana. It was established by a Legislative Instrument (L.I) 2074 of 2012. Municipality has Ho as its capital, which also serves as the capital and economic hub of the Volta Region. It is located between latitudes 6° 20' N and 6° 55' N and longitudes 0° 12'E and 0° 53'E. The Municipality shares boundaries with Adaklu and Agotime-Ziope Districts to the South, Ho West District to the North and West and the Republic of Togo to the East. Its total land area is 2,361 square kilometers, thus representing 11.5 % of the region's total land area. **Figure 2: Map of Ho**



Municipality in the Volta Region of Ghana

1.6 Scope of the Study

This study had clear boundaries to ensure feasibility and focus while addressing the core research questions. The investigation concentrated exclusively on the prevalence of preeclampsia and the identification of associated risk factors within the specific context of pregnant women utilizing antenatal care (ANC) services at Ho Municipal Hospital. Ho Municipal Hospital, functioning as a secondary-level healthcare facility within the Ho Municipality of Ghana's Volta Region, served as the sole study setting. This deliberate choice of setting facilitated the generation of highly relevant data for local service planning and clinical practice improvement within this specific healthcare infrastructure. The study population encompassed all pregnant women confirmed to be pregnant and actively receiving ANC services at Ho Municipal Hospital during a defined data collection period that spanned three months, specifically from July to September 2025. This timeframe provided a sufficiently large and representative sample of the ANC clientele while remaining practical for execution.

The research employed a facility-based cross-sectional study design. Data collection relied solely on a systematic review of existing patient medical records, including antenatal cards and hospital files. This approach ensured the extraction of documented clinical and sociodemographic information relevant to the study, such as blood pressure readings, gestational age, parity, body mass index, and any diagnosis of preeclampsia recorded during antenatal visits. The primary outcome variable was the diagnosis of preeclampsia, rigorously defined according to the American College of Obstetricians and Gynecologists (ACOG, 2020) criteria:

new-onset hypertension (systolic blood pressure ≥ 140 mm Hg and/or diastolic blood pressure ≥ 90 mm Hg on two occasions at least 4 hours apart) occurring after 20 weeks of gestation in a previously normotensive woman, accompanied by either proteinuria (≥ 300 mg per 24-hour urine collection, or protein/creatinine ratio ≥ 0.3 , or dipstick reading of 2+ if other methods

were unavailable) or, in the absence of proteinuria, new-onset thrombocytopenia, renal insufficiency, impaired liver function, pulmonary edema, or cerebral/visual symptoms.

Independent variables investigated for association with the outcome included core demographic factors (age, parity, educational attainment, occupation, marital status), anthropometric measures (Body Mass Index (BMI) calculated from measured height and weight at booking, or Mid-Upper Arm Circumference (MUAC) if weight measurement was impractical), clinical history (gestational age at first ANC booking, history of preeclampsia in previous pregnancies, family history of hypertension or preeclampsia), presence of specific pre-existing medical conditions (chronic hypertension, pre-gestational diabetes mellitus, known renal disease), behavioural factors (self-reported dietary habits assessed via a simplified food frequency questionnaire relevant to the local context), malaria history (diagnosed during the current pregnancy or self-reported history), and ANC utilization patterns (number of visits attended, gestational age at initiation of ANC, documented completeness of blood pressure and urine protein screening at visits, and documented counselling on preeclampsia warning signs). The scope of this study was intentionally bounded. It did not encompass other hypertensive disorders of pregnancy, such as chronic hypertension, gestational hypertension without proteinuria or organ dysfunction, or eclampsia, unless these were part of the patient's history contributing to risk assessment.

1.7 Organisation of the Study

This research is structured into five chapters that systematically examine preeclampsia prevalence and risk factors among pregnant women at Ho Municipal Hospital's antenatal clinic.

Chapter One: Introduction - Establishes the research foundation by presenting preeclampsia as a maternal health challenge, defining the problem and knowledge gaps at Ho Municipal

Hospital, stating research questions and objectives, outlining study scope and limitations of the research significance.

Chapter Two: Literature Review - Examines existing research on preeclampsia theories (abnormal placentation, endothelial dysfunction), reviews prevalence studies from global to local contexts, analyses established risk factors (demographic, clinical, obstetric, behavioural), and identifies research gaps this study addresses.

Chapter Three: Methodology - Details the cross-sectional study design, defines the study population of pregnant women at Ho Municipal Hospital, explains sampling methods and sample size calculation, describes data collection through structured interviews and medical records, outlines analysis procedures using statistical software, and addresses ethical considerations including consent and institutional approvals.

Chapter Four: Results and Discussion - Presents data analysis findings including preeclampsia prevalence rates, identifies significant risk factor associations, examines antenatal care relationships, and discusses results in context of existing literature and study objectives.

Chapter Five: Conclusions and Recommendations - Summarizes key findings, draws evidence-based conclusions answering the research questions, and provides actionable recommendations for policy development, clinical practice improvements at Ho Municipal Hospital, and future research directions to reduce preeclampsia-related complications.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

Preeclampsia (PE), characterized by new-onset hypertension and proteinuria after 20 weeks of gestation (Guevara-Ríos, 2019), remains a major global public health challenge and leading cause of maternal mortality (Vargas *et al.*, 2012; Al-Jameil *et al.*, 2013). Globally, hypertensive disorders account for approximately 14% of maternal deaths annually (Say *et al.*, 2014), disproportionately affecting low- and middle-income countries (LMICs) where access to medical services is limited (Vargas *et al.*, 2012). The disorder complicates 1.8% to 16.7% of pregnancies (Vargas *et al.*, 2012; Al-Jameil *et al.*, 2013) and often progresses to eclampsia (Al-Jameil *et al.*, 2013), posing lifelong cardiovascular risks to survivors (Al-Jameil *et al.*, 2013).

This literature review critically synthesizes existing evidence on PE prevalence, risk factors, and management frameworks to establish the theoretical and empirical foundation for the current study. By examining global trends, regional variations in Sub-Saharan Africa (SSA), and national data from Ghana, this chapter contextualizes the urgency of addressing PE within resource-constrained settings. It evaluates established and emerging risk factors, demographic, clinical, obstetric, and systemic, to identify gaps in understanding localized determinants in settings like Ghana's Volta Region.

The rationale for this review extends beyond academic synthesis; it directly addresses Ghana's maternal health priorities. Hypertensive disorders of pregnancy rank among the top causes of maternal mortality, accounting for 26.4–31.7% of maternal deaths in referral hospitals (Lee *et al.*, 2012; Adu-Bonsaffoh *et al.*, 2013). In these settings, the maternal mortality ratio ranges from 915 to 3,100 per 100,000 live births (Adu-Bonsaffoh *et al.*, 2013; Drechsel *et al.*, 2022).

Despite national policies promoting antenatal care (ANC), preeclampsia detection and management remain suboptimal in peripheral facilities like Ho Municipal Hospital, where delays in accessing emergency obstetric care and limited resources worsen outcomes (Lee *et al.*, 2012; von Dadelszen *et al.*, 2013). Contextual risk factors, such as endemic malaria exposure (Nyarko Adwoa *et al.*, 2022), nutritional deficiencies (Moura *et al.*, 2010), and barriers to ANC attendance (von Dadelszen *et al.*, 2013), may further amplify preeclampsia risk. This chapter bridges global evidence with local realities, underscoring the imperative for facility-specific research to inform targeted interventions in Ho Municipality.

2.2 Conceptual Clarification

Definition of Preeclampsia (Clinical and Diagnostic Criteria)

Preeclampsia is a pregnancy-specific syndrome defined by new-onset hypertension ($\geq 140/90$ mm Hg) after 20 weeks of gestation in a previously normotensive woman, accompanied by evidence of organ dysfunction (Melchiorre *et al.*, 2014; Tanner *et al.*, 2022). Hypertension must be confirmed on at least two occasions, four hours apart (American College of Obstetricians and Gynecologists [ACOG], 2020). While traditional diagnostic criteria require proteinuria, ≥ 0.3 g in a 24-hour urine collection, a protein/creatinine ratio ≥ 0.3 , or a dipstick reading of 1+ if quantitative methods are unavailable, current definitions permit diagnosis in the absence of proteinuria when hypertension is associated with one or more of the following: thrombocytopenia, impaired liver function, renal insufficiency, pulmonary edema, or new-onset cerebral or visual symptoms (Tanner *et al.*, 2022; ACOG, 2020). These clinical features reflect underlying placental dysfunction and maternal systemic inflammation (North, 2007; Norwitz *et al.*, 2002). Early-onset preeclampsia (≤ 34 weeks) is linked to more severe placentation defects and worse long-term cardiovascular outcomes compared to late-onset disease (>34 weeks) (Melchiorre *et al.*, 2014).

Classification and Stages

Preeclampsia is classified as mild or severe based on blood pressure and evidence of organ dysfunction. Mild preeclampsia features systolic blood pressure of 140–159 mm Hg or diastolic pressure of 90–109 mm Hg without significant end-organ involvement (Tranquilli, 2014; Martel, 2008). Severe preeclampsia is defined by systolic blood pressure ≥ 160 mm Hg or diastolic ≥ 110 mm Hg, or by the presence of severe organ complications such as marked elevation of liver enzymes, thrombocytopenia consistent with HELLP syndrome, renal impairment, pulmonary edema, or serious neurological signs (Aagaard-Tillery & Belfort, 2005; Martel, 2008; Tranquilli, 2014). Early-onset preeclampsia, occurring before 34 weeks of gestation, is associated with more pronounced placental vasculopathy and worse maternal and foetal outcomes compared to late-onset disease (Reis *et al.*, 2010; Tranquilli, 2014). Proper classification guides clinical management and facilitates comparability in research, since misclassification can adversely affect both maternal and neonatal prognoses (Reis *et al.*, 2010; Tranquilli, 2014).

Eclampsia represents the most severe manifestation of hypertensive disorders of pregnancy and is defined by the occurrence of generalized tonic–clonic seizures in a woman with preeclampsia that cannot be explained by other neurological conditions (Cipolla & Kraig, 2011; Lam & Dierking, 2017). It is a life-threatening emergency for both mother and foetus, requiring immediate seizure control, blood pressure management, and often prompt delivery to prevent severe complications such as stroke, intracerebral haemorrhage, or brain edema (Cipolla & Kraig, 2011; Reingardiené, 2003).

Key Terminologies

Gestational Hypertension:

Gestational hypertension refers to new-onset hypertension (systolic ≥ 140 mm Hg or diastolic ≥ 90 mm Hg) occurring after 20 weeks of gestation, in the absence of proteinuria or other signs of end-organ dysfunction (Leeman & Fontaine, 2008; Magee & von Dadelszen, 2018). It differs from preeclampsia in that it lacks evidence of systemic involvement such as renal, hepatic, haematological, or neurological abnormalities (Magee & von Dadelszen, 2018). The condition carries a 15–25% risk of progression to preeclampsia, especially when it develops before 28 weeks gestation (Romero-Arauz *et al.*, 2014). Regular monitoring, including blood pressure assessment and laboratory evaluations such as urinalysis, liver function tests, complete blood count, and serum creatinine, is essential for early detection of progression (Sullivan, 1973). Although often mild, gestational hypertension increases the likelihood of adverse pregnancy outcomes such as preterm delivery, intrauterine growth restriction, and placental abruption (Leeman & Fontaine, 2008; Sullivan, 1973).

Chronic Hypertension:

Chronic hypertension is defined as systolic blood pressure ≥ 140 mm Hg or diastolic blood pressure ≥ 90 mm Hg diagnosed before 20 weeks of gestation, or identified prior to pregnancy, or persisting beyond 12 weeks postpartum (Seely & Ecker, 2014). It affects up to 5% of pregnancies and is associated with increased risks of adverse outcomes such as superimposed preeclampsia, foetal growth restriction, and perinatal death (Ankumah & Sibai, 2017). Approximately 25% of women with chronic hypertension develop superimposed preeclampsia, particularly those with severe or poorly controlled blood pressure (Kim & Shin, 2015). Management includes regular blood pressure monitoring, foetal growth surveillance, and the

use of antihypertensive therapy when blood pressure exceeds 160/105 mm Hg, while mild cases without end-organ damage are often monitored without medication (Kim & Shin, 2015). Low-dose aspirin is recommended to reduce the risk of superimposed preeclampsia in high-risk patients (Kim & Shin, 2015).

Proteinuria:

Proteinuria is a key diagnostic criterion for preeclampsia, traditionally defined as ≥ 300 mg of protein in a 24-hour urine collection or a protein-to-creatinine ratio (PCR) ≥ 0.3 (Fishel Bartal *et al.*, 2020). Recent evidence suggests a threshold of ≥ 500 mg/24 hours may better predict adverse outcomes (Waugh *et al.*, 2005). Although 24-hour collection remains the gold standard, spot PCR at 30 mg/mmol offers high sensitivity and specificity (Geneen *et al.*, 2021). Urine dipstick testing is not recommended due to lack of clinical benefit (Fishel Bartal *et al.*, 2020). Proteinuria indicates renal impairment in preeclampsia, but its absence does not exclude the diagnosis (Fishel Bartal *et al.*, 2020). Alternative biomarkers are under investigation for cases without proteinuria, particularly in women with chronic kidney disease (Müller-Deile & Schiffer, 2014). Monitoring proteinuria levels after diagnosis is not required, as the amount does not correlate with maternal or neonatal outcomes (Fishel Bartal *et al.*, 2020).

Maternal Morbidity:

Maternal morbidity in preeclampsia includes acute organ complications and long-term health consequences. Early-onset preeclampsia carries higher rates of severe maternal morbidity, such as cardiovascular, respiratory, central nervous system, renal, and hepatic complications, compared to late-onset disease (Lisonkova *et al.*, 2014). Conditions like HELLP syndrome, stroke, and organ failure represent severe morbidity indicators, each associated with an elevated risk of maternal death (Ray *et al.*, 2018). Survivors of preeclampsia also face substantial long-term cardiovascular risk (Ghulmiyyah & Sibai, 2012). Monitoring of severe maternal morbidity

varies globally, with eclampsia most frequently tracked, highlighting inconsistencies in data collection (England *et al.*, 2020). Preventing and reducing these morbidities requires universal prenatal care access, timely hospital management, and precise diagnosis and treatment protocols, especially in resource-limited settings (Ghulmiyyah & Sibai, 2012).

2.3 Theoretical Perspectives

Pathophysiological Theories of Preeclampsia

Preeclampsia is a complex multisystem disorder whose pathophysiology remains incompletely understood, but several interrelated theories have gained wide acceptance, centering on abnormal placentation, endothelial dysfunction, and angiogenic imbalance.

Abnormal Placentation

The most widely accepted theory posits that preeclampsia originates from abnormal placentation during early pregnancy. In normal pregnancies, extravillous trophoblasts invade the maternal decidua and remodel the spiral arteries by replacing the endothelial and muscular layers, transforming them into low-resistance vessels that ensure adequate blood flow to the foetus (Brosens *et al.*, 2019; Fisher, 2015). In preeclampsia, this trophoblastic invasion is shallow and incomplete, resulting in inadequate spiral artery remodelling and subsequent placental ischemia (Kaufmann *et al.*, 2003; Saito & Nakashima, 2014; Fisher, 2015). This placental hypoperfusion leads to maternal endothelial dysfunction, which underlies the clinical manifestations of preeclampsia (Kaufmann *et al.*, 2003; Bertolini *et al.*, 2009).

Endothelial Dysfunction

Endothelial dysfunction is a central feature in the pathogenesis of preeclampsia, arising secondary to placental ischemia and the release of circulating factors such as soluble fms-like tyrosine kinase 1 (sFlt-1) (Maynard *et al.*, 2003). The maternal vascular endothelium becomes

activated and damaged, leading to increased vascular permeability, vasoconstriction, and a prothrombotic state, which contribute to hypertension, proteinuria, and multi-organ involvement characteristic of the disease (LaMarca, 2012; Maynard *et al.*, 2003). Additionally, oxidative stress, driven by factors such as reactive oxygen species, and inflammatory mediators, including TNF- α and IL-6, exacerbate endothelial injury, further impairing vascular homeostasis (LaMarca, 2012; Possomato-Vieira & Khalil, 2016).

Angiogenic Imbalance

A key molecular mechanism in preeclampsia involves an imbalance between proangiogenic and antiangiogenic factors secreted by the placenta. Proangiogenic factors, vascular endothelial growth factor (VEGF) and placental growth factor (PlGF), promote vascular growth and endothelial health, whereas antiangiogenic factors, soluble fms-like tyrosine kinase-1 (sFlt-1) and soluble endoglin (sEng), act as decoy receptors that bind and neutralize VEGF and PlGF (Tjoe *et al.*, 2007; Bertolini *et al.*, 2009). In preeclampsia, elevated levels of sFlt-1 and sEng reduce VEGF and PlGF bioavailability, leading to widespread endothelial dysfunction and the clinical manifestations of the disease (Tjoe *et al.*, 2007; Bertolini *et al.*, 2009). This angiogenic imbalance can be detected weeks before clinical onset, often as early as the second trimester, and correlates with disease severity (Stepan & Jank, 2009).

Application of the Life Course Approach and Social Determinants of Health

Preeclampsia risk is significantly influenced by socioeconomic factors, such as low maternal education and income, which are established risk factors in low- and middle-income countries (Silva *et al.*, 2008; Katushabe, 2023). Additional contributing factors include advanced maternal age, high body mass index, nulliparity, and pre-existing medical conditions (Bilano *et al.*, 2014; Katushabe, 2023). Limited access to quality antenatal care further exacerbates the likelihood of developing preeclampsia (Bilano *et al.*, 2014). Unfavourable socioeconomic and

psychosocial conditions, including chronic stress, may contribute to preeclampsia through ineffective allostatic responses (Salvador-Moysén *et al.*, 2014). In resource-limited settings like Ho Municipality, these social determinants interact with biological predispositions, amplifying the risk and severity of preeclampsia (Bertolini *et al.*, 2009; Katushabe, 2023). Addressing both socioeconomic and obstetric factors is essential for effective prevention and management of preeclampsia in such contexts (Katushabe, 2023).

2.4 Global Overview of Preeclampsia Prevalence

Preeclampsia affects approximately 4.6% of pregnancies worldwide (Abalos *et al.*, 2013). In low- and middle-income countries (LMICs), prevalence varies from 1.8% to 16.7% (Osungbade & Ige, 2011). It remains a leading cause of maternal and perinatal morbidity and mortality globally (Abalos *et al.*, 2013). Key risk factors include maternal age ≥ 30 years, low educational attainment, high body mass index, nulliparity, and pre-existing medical conditions (Bilano *et al.*, 2014). In LMICs, challenges such as delays in triage, transport, and treatment, combined with healthcare worker shortages, impede effective management (Firoz *et al.*, 2011). To address this burden, strategies like task-shifting to community health workers, prevention with aspirin and calcium supplementation, and enhanced detection tools are proposed. Strengthening health systems is essential for improving maternal and perinatal outcomes in LMICs (Firoz *et al.*, 2011; Osungbade & Ige, 2011).

Recent global estimates indicate that hypertensive disorders of pregnancy (HDPs), including preeclampsia, have increased in absolute numbers from 16.30 million cases in 1990 to 18.08 million in 2019 worldwide (Wang *et al.*, 2021). However, age-standardized incidence rates reveal divergent trends: high- and high-middle-income regions have experienced declines, while low- and low-middle-income regions show increasing incidence and prevalence (GBD

2020). This disparity reflects differences in healthcare access (Firoz *et al.*, 2011), socioeconomic conditions (Noubiap *et al.*, 2019), and maternal risk profiles (Bilano *et al.*, 2014).

In high-income countries, incidence rates are generally lower, ranging from 0.4% to 2.8%, due to widespread prenatal care, routine blood pressure monitoring, and better access to hospitals (Goldenberg *et al.*, 2011). In contrast, low- and middle-income countries (LMICs), particularly in sub-Saharan Africa and South Asia, report much higher rates, with some hospital-based studies showing prevalence up to 16.7% (Osungbade & Ige, 2011). These higher rates stem from limited healthcare infrastructure, such as shortages of trained staff and facilities, diagnostic delays due to atypical presentations, and a greater burden of underlying risk factors such as malnutrition and infectious diseases (Firoz *et al.*, 2011; Soundararajan *et al.*, 2024).

The global distribution of preeclampsia highlights the need for tailored interventions in highburden regions. Magnesium sulphate, the recommended first-line treatment for severe preeclampsia and eclampsia, reduces the risk of progression to eclampsia by 58%, yet its use remains limited in many low-resource settings (Altman *et al.*, 2002; Firoz *et al.*, 2011). Barriers include inconsistent drug procurement, inadequate training of healthcare providers, and reluctance to administer magnesium sulfate at lower-level facilities (Ridge *et al.*, 2010; Bigdeli *et al.*, 2013). Despite inclusion in national guidelines, implementation gaps persist, particularly in rural communities (Budhwani *et al.*, 2017). Early detection through routine antenatal care, specifically blood pressure and proteinuria screening, along with timely management, is critical to reducing preventable maternal and perinatal morbidity and mortality in high-burden regions (Firoz *et al.*, 2011).

2.5 Preeclampsia in Sub-Saharan Africa

Preeclampsia is a major public health concern in Sub-Saharan Africa (SSA), where its burden significantly contributes to high maternal mortality rates (Fokom-Domgue & Noubiap, 2015).

The incidence in SSA is higher than the global prevalence of approximately 4.6% (Abalos *et al.*, 2013), driven by socioeconomic challenges, such as poverty and limited access to healthcare services, and risk factors including primiparity, previous history of preeclampsia, high BMI, chronic hypertension, and anaemia during pregnancy (Meazaw *et al.*, 2020; Aliyu *et al.*, 2022). Limited healthcare infrastructure further exacerbates the burden of preeclampsia in the region (Aliyu *et al.*, 2022; Jikamo *et al.*, 2023).

Regional studies in Sub-Saharan Africa (SSA) report a high prevalence of hypertensive disorders of pregnancy (HDP), with approximately 10% of pregnancies affected, including a preeclampsia prevalence of around 4.4% (Noubiap *et al.*, 2019; Nyaga *et al.*, 2018). These rates exceed the global preeclampsia prevalence of 4.6% (Abalos *et al.*, 2013), driven by risk factors such as primiparity, previous history of preeclampsia, high BMI, chronic hypertension, and anaemia (Meazaw *et al.*, 2020). Limited healthcare infrastructure and lack of antenatal care visits exacerbate the burden, contributing to increased risks of maternal and perinatal complications (Meazaw *et al.*, 2020; Gemechu *et al.*, 2020).

Barriers to Detection and Management

In resource-limited settings in Sub-Saharan Africa (SSA), effective detection and management of preeclampsia face significant challenges. Inadequate healthcare infrastructure, including shortages of trained obstetric care providers and limited emergency obstetric care facilities, hinders timely care (Atluri *et al.*, 2023; Gudu & Sripad, 2020.). Shortages of essential medications, such as magnesium sulphate, and inadequate provider training restrict the use of recommended interventions, compounded by outdated management guidelines (Gudu &

Sripad, 2020.; Ndwiga *et al.*, 2018; Firoz *et al.*, 2011). Sociocultural factors, including low health literacy, poverty, and superstitious beliefs, contribute to delayed care-seeking and reduced antenatal care attendance (Aliyu *et al.*, 2022; Atluri *et al.*, 2023). Addressing these barriers requires improving healthcare infrastructure, enhancing provider training, ensuring drug availability, and promoting community education (Aliyu *et al.*, 2022).

Financial barriers in Sub-Saharan Africa (SSA) significantly restrict access to antenatal care (ANC), hindering early detection and management of preeclampsia. High out-of-pocket costs for services, such as laboratory tests, discourage consistent ANC attendance (Okedo-Alex *et al.*, 2019; Koster *et al.*, 2016). Low socioeconomic status, including limited income and lack of health insurance, further reduces the timing and frequency of ANC visits (Ebu & Gross, 2015; Ahinkorah *et al.*, 2021). Additional barriers, such as transportation difficulties and distance to health facilities, exacerbate delays in care-seeking (Ebu & Gross, 2015; OkedoAlex *et al.*, 2019). These systemic and socioeconomic factors increase the risk of adverse maternal and perinatal outcomes (Okedo-Alex *et al.*, 2019).

Addressing barriers to preeclampsia care in Sub-Saharan Africa (SSA) requires strengthening health systems through targeted training of healthcare providers, including midwives and community health workers, to enhance skills in identifying early signs of preeclampsia (Emilda *et al.*, 2023; Tin Tin Thein *et al.*, 2012). Community-based education raises awareness of preeclampsia risk factors, promoting timely antenatal care (ANC) attendance among women with low health literacy (Emilda *et al.*, 2023; Firoz *et al.*, 2011; Atluri *et al.*, 2023). Taskshifting to community health workers, such as lady health workers, addresses provider shortages and supports early detection and management (Firoz *et al.*, 2011; Atluri *et al.*, 2023). Integrating regular blood pressure monitoring and adherence to evidence-based ANC guidelines into

routine maternal health services is essential for effective management (Tin Tin Thein *et al.*, 2012).

2.6 National Overview: Ghanaian Context

Preeclampsia remains a major contributor to maternal morbidity and mortality in Ghana, driven by the burden of hypertensive disorders of pregnancy (HDP) and systemic health system challenges (Boachie-Ansah *et al.*, 2023; Drechsel *et al.*, 2022). Hospital-based studies report a preeclampsia prevalence of 8.8% in the Central Region and an increase from 4.6% in 2018 to 6.6% in 2020 at Ho Teaching Hospital, while HDP affects 37.2% of pregnancies in the Ashanti Region (Anto *et al.*, 2023; Nyarko Adwoa *et al.*, 2022; Boachie-Ansah *et al.*, 2023). These conditions are a leading cause of maternal deaths in referral hospitals, with a maternal death ratio of 3100 per 100,000 live births for women with HDP remote from term (Drechsel *et al.*, 2022). Enhanced antenatal care and targeted interventions are critical to reducing this burden (Boachie-Ansah *et al.*, 2023).

Health System Context

Antenatal Care (ANC) Coverage

Ghana has made progress in antenatal care (ANC) utilization, with most pregnant women attending at least one ANC visit, though achieving the recommended four or more visits varies across socio-geographic groups (Abubakari *et al.*, 2018; Duodu *et al.*, 2022). Urban women are more likely to complete these visits and receive higher-quality ANC compared to those in rural and peri-urban areas, where quality disparities limit screening for complications like preeclampsia (Boachie-Ansah *et al.*, 2023; Afulani, 2015). Socioeconomic factors, including education, health insurance, and wealth, positively influence ANC attendance (Abubakari *et al.*, 2018; Duodu *et al.*, 2022). Progress toward WHO's eight-visit recommendation remains

slow, particularly in resource-constrained settings (Duodu *et al.*, 2022). Targeted interventions are needed to improve ANC quality and utilization in underserved areas (Afulani, 2015; Boachie-Ansah *et al.*, 2023).

Referral Pathways

Ghana's referral system is designed to escalate obstetric complications, such as preeclampsia, from lower-level facilities to district and regional hospitals for advanced obstetric care (Bailey *et al.*, 2019). However, systemic challenges hinder timely management, with district hospitals resolving about two-thirds of referred cases due to low readiness at lower-level facilities (Bailey *et al.*, 2019). Delays arise from inadequate transportation, poor inter-facility communication, limited health personnel, and late recognition of danger signs, compounded by insufficient coordination during patient transfers (Daniels & Abuosi, 2020; Afari *et al.*, 2014). The unavailability of emergency obstetric medicines, such as magnesium sulfate, at peripheral facilities further complicates care (Amoakoh-Coleman *et al.*, 2022). These gaps increase the risk of adverse maternal and perinatal outcomes, with patients often arriving at referral hospitals with severe preeclampsia complications (Bailey *et al.*, 2019; Afari *et al.*, 2014).

Diagnostic Limitations

Diagnostic capacity for preeclampsia in Ghana is constrained by limited availability of essential equipment, particularly proteinuria testing kits and laboratory infrastructure, in rural and primary healthcare facilities (Meazaw *et al.*, 2022; Kuupiel *et al.*, 2020). This often requires women to travel long distances for diagnosis, delaying timely interventions (Kuupiel *et al.*, 2020). Healthcare providers in rural areas frequently lack adequate training in diagnosing and managing hypertensive disorders of pregnancy, hindering accurate case identification and appropriate clinical response (Atluri *et al.*, 2023; von Dadelszen *et al.*, 2013). These constraints

undermine early detection and classification of preeclampsia, contributing to delayed or missed opportunities for critical care in low-resource settings (Meazaw *et al.*, 2022; Atluri *et al.*, 2023).

2.7 Associated Risk Factors for Preeclampsia

2.7.1 Socio-demographic Factors

Socio-demographic factors significantly influence the risk of preeclampsia among pregnant women in Ghana. Younger maternal age (<20 years) increases the risk of preeclampsia and eclampsia, while advanced maternal age (≥ 35 years) is linked to decreased odds of eclampsia (T. Beyuo *et al.*, 2022). Primigravida status is a risk factor for preeclampsia, though one study suggests it may primarily relate to gestational hypertension (E. Anto *et al.*, 2023; W. Owiredu *et al.*, 2012). Other risk factors include obesity, family history of hypertension, and twin pregnancy (W. Owiredu *et al.*, 2012; T. Beyuo *et al.*, 2022). Socioeconomic factors, such as education level and occupation, also correlate with preeclampsia risk (Nyarko Adwoa *et al.*, 2022). These factors highlight the need for targeted interventions to address vulnerabilities in at-risk populations.

Parity influences the risk of preeclampsia among pregnant women in Ghana, with findings varying across studies. Primigravidity is associated with an increased risk of preeclampsia, while nulliparity is linked to gestational hypertension but not consistently to preeclampsia (Anto *et al.*, 2023; Owiredu *et al.*, 2012). Nulliparous pregnancies may face higher preeclampsia risk due to elevated anti-angiogenic factors (Bdolah *et al.*, 2014). Risk factors common to both nulliparous and multiparous women, such as high body mass and family history of hypertension, further shape the risk profile (Eskenazi *et al.*, 1991). The complex and context-dependent relationship between parity and preeclampsia underscores the need for targeted research and interventions in Ghana.

Educational attainment and income level are key socio-economic determinants of preeclampsia risk in Ghana. Women with no formal education are more likely to experience preeclampsia symptoms and face increased risk due to limited health literacy, which hinders interpretation of antenatal care information and reduces healthcare service utilization (Dinglas *et al.*, 2011; Lori *et al.*, 2014). Low income exacerbates these challenges by restricting access to quality care and essential resources, contributing to poor maternal health outcomes (Silva *et al.*, 2008). These barriers are particularly pronounced in rural areas, where low education, health literacy, and limited access to diagnostic tools and trained providers impede early detection and management of preeclampsia (Dinglas *et al.*, 2011; Atluri *et al.*, 2023). Addressing these socioeconomic challenges through educational outreach and improved antenatal care is critical to reducing preeclampsia risk.

In Ghana, women with low or no formal education and those in informal occupations face a higher risk of preeclampsia (Anto *et al.*, 2023; Dinglas *et al.*, 2011; Nyarko Adwoa *et al.*, 2022). These socio-demographic factors intersect with clinical risks, such as primigravidity, to increase vulnerability, particularly in rural areas where access to diagnostic tools and trained providers is limited (Anto *et al.*, 2023; Silva *et al.*, 2008; Dinglas *et al.*, 2011). Targeted health education interventions are needed to mitigate preeclampsia risk among these populations, though evidence on the role of social support interventions remains limited (Anto *et al.*, 2023; Dinglas *et al.*, 2011).

2.7.2 Clinical and Obstetric Factors

Clinical and obstetric factors significantly influence preeclampsia risk in Ghana. Chronic hypertension and a family history of hypertension are major risk factors for preeclampsia and pregnancy-induced hypertension (Owiredu *et al.*, 2012; Anto *et al.*, 2024). Obesity and gestational diabetes further increase preeclampsia risk (Hussein *et al.*, 2021). These conditions

contribute to complications such as caesarean section and preterm delivery (Dassah *et al.*, 2019). Screening and managing chronic medical conditions during antenatal care are critical to reducing preeclampsia risk and associated complications in Ghanaian pregnant women.

Multiple pregnancy is a recognized obstetric risk factor for preeclampsia in Ghana. Women with twins or higher-order multiples face a significantly higher risk of preeclampsia compared to those with singleton pregnancies, with incidences of 9.3% versus 1.1% respectively (Kuo *et al.*, 1995; Anto *et al.*, 2023). This risk is more pronounced among primiparous women (12.1%) than multiparous women (6.4%) with multiple gestations (Kuo *et al.*, 1995). Elevated levels of soluble fms-like tyrosine kinase-1 in multiple pregnancies may contribute to this increased risk (Maynard *et al.*, 2008). Early detection and management of multiple gestations are essential to reduce adverse maternal and neonatal outcomes (Budi Rahayu, 2023).

A previous history of preeclampsia increases the risk of recurrence in subsequent pregnancies in Ghana, with recurrence rates of preeclampsia or pregnancy-induced hypertension reaching 15.8% (Giannubilo *et al.*, 2014; Obed & Aniteye, 2010). This risk is particularly elevated with early-onset or severe disease (Giannubilo *et al.*, 2014). Women with a history of preeclampsia face higher risks of adverse outcomes, including caesarean section and preterm delivery (Dassah *et al.*, 2019). Targeted antenatal surveillance and individualized risk assessment are essential to improve outcomes in these high-risk pregnancies (Obed & Aniteye, 2010).

Advanced maternal age and obesity are significant risk factors for preeclampsia among Ghanaian women (Owiredu *et al.*, 2012). Metabolic abnormalities, such as those seen in women with gestational diabetes, may contribute to increased preeclampsia risk (Spradley, 2017). Physical inactivity and infrequent antenatal visits further elevate the likelihood of preeclampsia (Fondjo *et al.*, 2022). These clinical factors may interact with obstetric risks, such

as primigravidity, to heighten preeclampsia risk (Anto *et al.*, 2023). Addressing these factors through improved antenatal care is essential to reducing preeclampsia incidence in Ghana.

2.7.3 Behavioural and Lifestyle Factors

Behavioural and lifestyle factors significantly influence the risk of developing preeclampsia. Among these, diet, physical activity, and substance use have been extensively studied for their roles in modulating maternal vascular health and inflammatory status during pregnancy.

Diet

Dietary patterns influence preeclampsia risk among Ghanaian women. Pre-pregnancy obesity and excessive gestational weight gain increase the risk of preeclampsia (Owiredu *et al.*, 2012; Perry *et al.*, 2022). Diets high in processed meats, salty snacks, and sugar-sweetened beverages are associated with higher preeclampsia risk, while diets rich in fruits, vegetables, plant-based foods, and vegetable oils may reduce this risk (Brantsaeter *et al.*, 2009; Al-Jameil *et al.*, 2013). Adequate intake of calcium, vitamin D, and vitamin C through diet or supplementation may also lower preeclampsia risk, though excessive calcium intake is linked to haemorrhage risk in Ghana (Perry *et al.*, 2022; Al-Jameil *et al.*, 2013; Avoka, 2022). Promoting healthy dietary habits and appropriate weight management before and during pregnancy is essential to mitigate preeclampsia risk.

Physical Activity

Regular physical activity before and during early pregnancy is associated with a reduced risk of preeclampsia among women, including in Ghana (Sorensen *et al.*, 2003; Fondjo *et al.*, 2022). Activities such as brisk walking and stair climbing, particularly vigorous ones, may contribute to this protective effect (Sorensen *et al.*, 2003). Encouraging regular physical activity as part of preconception and prenatal care is important to help mitigate preeclampsia risk.

Substance Use

Methamphetamine use during pregnancy is associated with an increased risk of preeclampsia (Mischkot *et al.*, 2019; Gorman *et al.*, 2014; Hayer *et al.*, 2024). Addressing methamphetamine use through specialized prenatal care and addiction treatment is critical to improve maternal and neonatal outcomes (Dinger *et al.*, 2017).

2.7.4 Antenatal Care and Health System Factors

The timing, frequency, and quality of antenatal care (ANC) visits, as well as the nature of health worker-patient interactions, are critical determinants in the early detection and management of preeclampsia.

Timing and Frequency of ANC Visits

Early initiation of ANC, preferably within the first trimester, is essential for identifying and managing preeclampsia risk among pregnant women, including in Ghana (Fadilah & Devy, 2018; Agha & Tappis, 2016; Fondjo *et al.*, 2022). Regular ANC visits, particularly when started early, are associated with improved care quality and fewer maternal complications (Agha & Tappis, 2016; Beyuo *et al.*, 2023). Encouraging early and consistent ANC attendance is critical to improve outcomes.

Quality of ANC Services

Early initiation of low-dose aspirin (100-150mg daily) before 16 weeks gestation significantly reduces the risk of preeclampsia and intrauterine growth restriction in high-risk women (Bujold *et al.*, 2010; Wertaschnigg *et al.*, 2019). However, adherence to aspirin prophylaxis guidelines is low, with only 15-18% of eligible women receiving it (Ayyash *et al.*, 2022). Implementation faces challenges in low-resource settings, including inadequate antenatal care, late initiation of care, and concerns about potential increased risk of postpartum haemorrhage (Kupka *et al.*,

2024). Additionally, aspirin has limited effectiveness in preventing term preeclampsia (accounting for 75% of cases) (Kupka *et al.*, 2024).

Health Worker-Patient Interaction

High-quality patient-provider communication positively impacts trust and prenatal care satisfaction (Dahlem *et al.*, 2015). Factors such as showing empathy significantly improve patient satisfaction (Jepngetich *et al.*, 2013), while attitudes toward ANC are shaped by care experiences (Andrew *et al.*, 2014). Conversely, poor patient-provider relationships – including disrespectful care and inadequate communication – act as barriers to ANC uptake (Roberts *et al.*, 2015). Strengthening provider training to improve interpersonal skills and culturally sensitive communication is vital for optimizing ANC effectiveness (Roberts *et al.*, 2015).

2.8 Consequences of Preeclampsia

Preeclampsia contributes to maternal complications, particularly in low- and middle-income countries like Ghana, increasing the risk of adverse health outcomes (Fadilah & Devy, 2018; Beyuo *et al.*, 2023; Fondjo *et al.*, 2022). Effective antenatal care (ANC) is critical to mitigate these complications through early identification and management of preeclampsia risk. Strategies to enhance ANC include providing high-quality care at tertiary facilities or by specialist obstetricians/gynaecologists, which is associated with reduced morbidity outcomes (Beyuo *et al.*, 2023). Encouraging early and consistent ANC visits is essential to improve maternal health outcomes.

Maternal Outcomes

Women with preeclampsia face an increased risk of severe complications, including acute kidney injury, liver dysfunction, coagulopathy, and HELLP syndrome, often requiring intensive care unit (ICU) admission (Hilowle *et al.*, 2023; Gao *et al.*, 2017; Tran *et al.*, 2020).

Postpartum haemorrhage is also associated with severe preeclampsia, contributing to maternal complications, particularly in low- and middle-income countries like Ghana (Hilowle *et al.*, 2023; Fadilah *et al.*, 2018; Beyuo *et al.*, 2023). Effective management in tertiary care centers with experienced clinicians is critical to improve outcomes (Burton *et al.*, 2002; Tran *et al.*, 2020).

Perinatal Outcomes

Preeclampsia significantly increases the risk of adverse foetal outcomes, including preterm birth (46.6%), low birth weight, intrauterine growth restriction (IUGR), birth asphyxia, and intrauterine foetal death, particularly in low- and middle-income countries like Ghana (Arulparithi *et al.*, 2023; Doddamani & Doddamani, 2014; Bokhari *et al.*, 2016; Apriliana *et al.*, 2022; Fondjo *et al.*, 2022). Perinatal mortality rises with hypertension severity, from 6.3% at 140/90–149/94 mmHg to 23.4% at >160/110 mmHg, with an overall rate of 174 per 1000 births (Doddamani & Doddamani, 2014). These complications often require neonatal intensive care unit (NICU) admission, with 24% of infants affected due to issues like foetal distress, contributing to neonatal morbidity (Bokhari *et al.*, 2016; Apriliana *et al.*, 2022). Early recognition and management of preeclampsia are essential to reduce these adverse outcomes.

Economic and Psychological Impact

Preeclampsia imposes significant economic and psychological burdens on women, particularly in low- and middle-income countries like Ghana. The condition is associated with adverse outcomes such as preterm birth and low birth weight, which increase healthcare costs due to prolonged hospitalization and neonatal care (V. Bilano *et al.*, 2014; Fondjo *et al.*, 2022). Psychologically, women with preeclampsia face a higher risk of depression six months postpartum and emotional distress due to inadequate counselling and low knowledge of their diagnosis (L. Roberts *et al.*, 2022; Avina Joshi *et al.*, 2022). Resilience can mitigate depression

and improve mental quality of life post-preeclampsia (E. Mautner *et al.*, 2013). These impacts highlight the need for improved counselling, mental health screening, and early management to reduce the consequences of preeclampsia.

2.9 Summary of Gaps in the Literature

Despite the recognized burden of preeclampsia in Ghana, particularly in the Volta Region, critical gaps persist in the literature. Facility-level prevalence data for preeclampsia in Ho Municipality are limited, with a retrospective study at Ho Teaching Hospital reporting an overall prevalence of 5.6% from 2018 to 2020, increasing from 4.6% in 2018 to 6.6% in 2020 (Nyarko Adwoa *et al.*, 2022; Adwoa Nyarko *et al.*, 2024). Such data are sparse, limiting understanding of local epidemiology and the ability to address adverse outcomes like preterm birth and low birth weight (Bilano *et al.*, 2014; Fondjo *et al.*, 2022; Axame *et al.*, 2022). These gaps underscore the need for more comprehensive prevalence studies to inform targeted interventions in Ghana.

Despite the identified burden of preeclampsia in Ghana, with prevalence rates ranging from 5.6% to 8.8% (Nyarko Adwoa *et al.*, 2022; E. Anto *et al.*, 2023), there is an underrepresentation of context-specific risk factors in Ho Municipality. Studies have identified parity, education level, occupation, primigravida, previous caesarean section, and foetal growth restriction as risk factors (E. Anto *et al.*, 2023), but the interplay of socio-demographic and clinical determinants, such as chronic hypertension and obesity, remains underexplored in local settings (V. Bilano *et al.*, 2014; Fondjo *et al.*, 2022). This gap limits the development of targeted interventions to address adverse outcomes like preterm delivery and low birth weight (Nyarko Adwoa *et al.*, 2022).

There is a notable deficiency in studies linking health system gaps to preeclampsia risk and outcomes in Ghana. Challenges such as low health literacy among women, insufficient trained

staff, inadequate health infrastructure, and limited midwife roles in detection and management contribute to poor preeclampsia outcomes (Atluri *et al.*, 2023; von Dadelszen *et al.*, 2013; Fondjo *et al.*, 2022). Only 40% of hospitals meet readiness thresholds to treat complications, exacerbating referral delays from lower-level facilities (Bailey *et al.*, 2019). With preeclampsia prevalence ranging from 1.8% to 16.7% in developing countries, these gaps hinder effective early detection and management, increasing maternal and perinatal morbidity (Osungbade & Ige, 2011; Bailey *et al.*, 2019). Addressing these deficiencies is essential for designing interventions to improve outcomes.

Addressing these gaps through facility-based research in Ho Municipality will provide critical insights into the local epidemiology and determinants of preeclampsia, informing targeted strategies to strengthen maternal health services and improve outcomes.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

This chapter outlined the research methodology that was employed to examine the prevalence and associated risk factors of preeclampsia among pregnant women attending antenatal clinics at Ho Municipal Hospital. The study adopted a strictly quantitative approach, which enabled systematic measurement and statistical analysis of the prevalence and determinants of preeclampsia in the target population.

The chapter described the study design, population, sampling techniques, data collection methods, and analytical strategies that were utilized. Emphasis was placed on the use of structured instruments and validated clinical criteria to ensure reliability and validity of the data. The quantitative methodology facilitated objective assessment of associations between socio-demographic, clinical, behavioural, and health system factors and the occurrence of preeclampsia, thereby providing robust evidence to inform targeted interventions.

By employing a cross-sectional design with appropriate sample size and rigorous data analysis, this study generated prevalence estimates and identified statistically significant risk factors that contributed to preeclampsia in this Ghanaian setting. The quantitative approach also allowed for generalizability of findings to similar populations and supported evidence-based policy and clinical decision-making.

3.2 Study Design

This study adopted a facility-based cross-sectional design to estimate the point prevalence of preeclampsia and examine its associated risk factors among pregnant women attending antenatal clinics at Ho Municipal Hospital. The cross-sectional design involved collecting data

at a single point in time from a representative sample of pregnant women, enabling the determination of the proportion currently affected by preeclampsia within the study population.

The choice of a cross-sectional design was justified by its efficiency in providing prevalence estimates, which were critical for understanding the current burden of preeclampsia in the facility and informing resource allocation and intervention strategies. Additionally, this design allowed for the simultaneous assessment of multiple socio-demographic, clinical, and behavioural factors, facilitating the identification of statistically significant associations with preeclampsia.

Previous studies in Ghana have effectively employed cross-sectional designs to estimate preeclampsia prevalence, reporting rates ranging from 5.6% to 21.4%, and to identify associated risk factors, including primigravidity, previous caesarean section, foetal growth restriction, maternal age, parity, education level, and occupation (Nyarko Adwoa *et al.*, 2022; Adu-Bonsaffoh *et al.*, 2017; Anto *et al.*, 2023; Fondjo *et al.*, 2022; V. Bilano *et al.*, 2014). These findings demonstrated the suitability of a cross-sectional approach for the current study at Ho Municipal Hospital to assess preeclampsia prevalence and its risk factors.

Moreover, the cross-sectional approach enabled the use of logistic regression analyses to test hypotheses regarding the relationship between independent variables and preeclampsia status, providing evidence of association though not causality. This was appropriate given the study's objectives to quantify prevalence and identify correlates rather than establish temporal causation.

3.3 Study Area

This study was conducted at Ho Municipal Hospital, a key healthcare facility located in Ho Municipality, the administrative capital of Ghana's Volta Region. Serving a diverse population of urban and rural residents in the municipality and surrounding areas, the hospital served as a

central hub for maternal healthcare services in the region. Ho Municipal Hospital provides comprehensive antenatal care, including routine check-ups, screening for hypertensive disorders such as preeclampsia, and management of pregnancy complications. With a reported preeclampsia prevalence of 5.6% at the facility from 2018 to 2020, the hospital has played a critical role in addressing maternal health challenges (Nyarko Adwoa *et al.*, 2022; Adwoa Nyarko *et al.*, 2024).

The hospital's referral pathways connect lower-level health centres and peripheral facilities to its services, facilitating the transfer of complicated cases for specialised care. Limited diagnostic tools and provider capacity, common in Ghanaian healthcare settings, may influence the quality of preeclampsia management at the facility (Fondjo *et al.*, 2022). Ho Municipal Hospital's strategic position and scope of services made it an ideal site for this quantitative cross-sectional study to assess preeclampsia prevalence and associated risk factors among pregnant women attending antenatal clinics.

3.4 Study Population

The study population comprised all pregnant women attending antenatal clinics (ANC) at Ho Municipal Hospital in Ho Municipality, Volta Region, Ghana, during the study period. This population was critical for assessing preeclampsia prevalence, previously reported at 5.6% at the facility from 2018 to 2020, and associated risk factors in a low- and middle-income setting (Nyarko Adwoa *et al.*, 2022; Adwoa Nyarko *et al.*, 2024).

Inclusion criteria included pregnant women of any gestational age who were registered for ANC at Ho Municipal Hospital and provided informed consent to participate in the study. This ensured a representative sample reflective of the diverse ANC attendees, including those at risk of preeclampsia due to factors such as primigravidity or infrequent ANC attendance (Fondjo *et al.*, 2022).

Exclusion criteria encompassed women with incomplete medical records, those diagnosed with non-preeclamptic hypertensive disorders (e.g., chronic hypertension without proteinuria), or those unable to provide consent due to severe medical conditions. These criteria safeguarded data quality and focused the study on preeclampsia-specific outcomes, enabling precise quantitative analysis of prevalence and risk factors among ANC attendees at Ho Municipal Hospital.

3.5 Sample Size Determination

The sample size for this quantitative cross-sectional study, which assessed the prevalence and associated risk factors of preeclampsia among pregnant women attending antenatal clinics at Ho Municipal Hospital, was determined using the formula for a single population proportion:

$$n = \frac{z^2 \times p(1 - p)}{d^2} \quad 3$$

Where:

- n is the initial sample size
- Z is the Z-score corresponding to the 95% confidence level (1.96)
- p is the estimated prevalence (0.5, to ensure maximum variability)
- d is the margin of error (0.05)

Therefore,

$$n = \frac{(1.96)^2 \times 0.5(1 - 0.5)}{0.05^2}$$

$$n \approx 384.16$$

The initial sample size was approximated to be 384.

To account for an anticipated non-response rate of 15%, the final sample size was calculated as:

$$n_{final} = \frac{n_{adj}}{1 - 0.15} \quad (3.3)$$

$$n_{final} = \frac{384}{0.85}$$

$$n_{final} \approx 452.94$$

Therefore, the final estimated sample size was approximately 453 participants. This ensured adequate statistical power to estimate the prevalence of preeclampsia and assess associated risk factors among ANC attendees at Ho Municipal Hospital.

3.6 Sampling Technique

This quantitative cross-sectional study employed a systematic sampling technique to select medical records of pregnant women attending antenatal clinics (ANC) at Ho Municipal Hospital during the study period. Systematic sampling was appropriate for accessing available medical records, ensuring a representative sample of the ANC population, which had a reported preeclampsia prevalence of 5.6% (Nyarko Adwoa *et al.*, 2022; Adwoa Nyarko *et al.*, 2024).

A sampling frame was created by compiling a chronological list of all ANC attendees' medical records within the study timeframe. Based on the estimated sample size of approximately 414 participants (see Section 3.5), a sampling interval (k) was calculated by dividing the total number of records by the required sample size. Starting from a randomly selected record between 1 and k, every k-th record was selected until the target sample size was reached.

3.7 Data Collection Methods

This quantitative cross-sectional study collected data through a retrospective review of medical records of pregnant women attending antenatal clinics (ANC) at Ho Municipal Hospital during the study period. A structured data extraction tool, developed based on prior studies in Ghana

(Nyarko Adwoa *et al.*, 2022; Fondjo *et al.*, 2022), was used to systematically retrieve relevant variables from approximately 414 systematically sampled records (see Sections 3.5 and 3.6).

Key variables included preeclampsia diagnosis (prevalence reported at 5.6% from 2018 to 2020), socio-demographic factors (e.g., maternal age, parity, education level), clinical factors (e.g., primigravidity, previous caesarean section, chronic hypertension), and ANC attendance patterns (Nyarko Adwoa *et al.*, 2022; Adwoa Nyarko *et al.*, 2024; Fondjo *et al.*, 2022).

Trained research assistants extracted data under supervision to ensure accuracy and consistency, adhering to inclusion criteria (pregnant women registered for ANC with complete records) and exclusion criteria (e.g., non-preeclamptic hypertension, incomplete records). Data quality was maintained through double-entry checks and regular audits to minimise errors. This approach ensured reliable quantitative data for analysing preeclampsia prevalence and associated risk factors among ANC attendees at Ho Municipal Hospital.

3.8 Study Variables

The study variables for this quantitative cross-sectional study, examining preeclampsia prevalence and associated risk factors among pregnant women attending antenatal clinics at Ho Municipal Hospital, were derived from medical records and were aligned with the conceptual framework (Section 2.10).

The dependent variable was preeclampsia status, defined as a binary outcome (diagnosed or not diagnosed) based on standard clinical criteria, typically blood pressure $\geq 140/90$ mmHg after 20 weeks' gestation with proteinuria, as recorded in medical records, with a reported prevalence of 5.6% at the facility from 2018 to 2020 (Nyarko Adwoa *et al.*, 2022; Adwoa Nyarko *et al.*, 2024).

Independent variables included socio-demographic factors (maternal age, parity, education level, occupation, income), clinical factors (primigravidity, previous caesarean section, chronic hypertension, obesity, foetal growth restriction), and behavioural factors (ANC attendance frequency, dietary patterns), which have been associated with preeclampsia risk in Ghanaian settings (Nyarko Adwoa *et al.*, 2022; Anto *et al.*, 2023; Fondjo *et al.*, 2022; V. Bilano *et al.*, 2014).

These variables were extracted from medical records using a structured tool (Section 3.7), ensuring quantifiable data for statistical analysis to determine preeclampsia prevalence and its associated risk factors among ANC attendees.

3.9 Data Collection Instruments

This quantitative cross-sectional study utilised a structured data extraction tool to collect data from medical records of approximately 414 pregnant women attending antenatal clinics (ANC) at Ho Municipal Hospital during the study period. The tool, designed based on variables identified in prior Ghanaian studies (Nyarko Adwoa *et al.*, 2022; Fondjo *et al.*, 2022; Anto *et al.*, 2023), captured the dependent variable, preeclampsia status (binary: diagnosed or not diagnosed), and independent variables, including socio-demographic factors (maternal age, parity, education level, occupation, income), clinical factors (primigravidity, previous caesarean section, chronic hypertension, obesity, foetal growth restriction), and behavioural factors (ANC attendance frequency, dietary patterns) (Nyarko Adwoa *et al.*, 2022; Adwoa Nyarko *et al.*, 2024; Fondjo *et al.*, 2022; Anto *et al.*, 2023).

The tool was formatted with predefined fields (e.g., checkboxes, numerical entries) to ensure consistent and quantifiable data extraction from records. It was pre-tested on a small sample of records to verify clarity and completeness, with adjustments made to address any inconsistencies. Trained research assistants used the tool under supervision to extract data,

ensuring reliability and adherence to inclusion and exclusion criteria (Section 3.4). This instrument facilitated accurate data collection for statistical analysis of preeclampsia prevalence and risk factors among ANC attendees.

3.10 Data Processing and Analysis

Data for this quantitative cross-sectional study on preeclampsia prevalence and associated risk factors among pregnant women attending antenatal clinics at Ho Municipal Hospital was processed and analysed using Stata software to ensure robust statistical analysis. Data extracted from approximately 414 medical records (Sections 3.7 and 3.9) was entered into a database, cleaned to address missing or inconsistent entries, and verified through double-entry checks to maintain accuracy (Nyarko Adwoa *et al.*, 2022; Fondjo *et al.*, 2022).

Descriptive statistics, including means and standard deviations for continuous variables (e.g., maternal age) and frequencies and percentages for categorical variables (e.g., preeclampsia status) were used to summarise the study population's characteristics. Bivariate analysis employed Pearson's chi-square test to examine associations between independent variables (socio-demographic, clinical, and behavioural factors, such as primigravidity and ANC attendance) and the dependent variable, preeclampsia status.

Multivariable analysis used binary logistic regression to identify independent predictors of preeclampsia, adjusting for confounders. Variables for the logistic regression model were selected based on bivariate analysis results, with a liberal threshold of $p \leq 0.20$ from the chisquare test to include potentially significant variables, ensuring purposeful selection by considering statistical significance, clinical or public health relevance, and model fit (Anto *et al.*, 2023). This approach avoided prematurely excluding variables that became significant after confounder adjustment while maintaining parsimony.

Results were presented using tables for regression outputs, bar charts for categorical variable distributions, and pie charts for prevalence proportions, facilitating clear interpretation of preeclampsia prevalence and risk factors among ANC attendees.

3.11 Ethical Considerations

This quantitative cross-sectional study, examining preeclampsia prevalence and associated risk factors using medical records of pregnant women attending antenatal clinics at Ho Municipal Hospital, adhered to strict ethical standards to protect participants' rights and data. Ethical approval was sought from the Institutional Review Board (IRB) of a relevant academic or health institution in Ghana, ensuring compliance with national research guidelines.

Administrative clearance was obtained from Ho Municipal Hospital's management to access medical records, with formal agreements outlining data use and confidentiality protocols.

Given the retrospective nature of the study, informed consent was waived by the IRB, as data was extracted from existing records without direct participant interaction; however, where required, informed consent was sought from participants whose records were active, ensuring they were informed of the study's purpose, voluntary participation, and right to withdraw. Confidentiality was maintained by anonymising data during extraction, assigning unique identifiers instead of personal details, and storing data on password-protected devices accessible only to authorised research personnel. Data protection procedures complied with Ghanaian regulations, including secure storage and disposal of data after the study's completion. These measures ensured ethical integrity and safeguarded participant privacy in this record-based study.

3.13 Limitations of the Study

This study had several limitations. First, its cross-sectional design restricted the ability to establish causal relationships, as both exposures and outcomes were measured simultaneously

(Moura *et al.*, 2010). Second, the focus on a single facility, Ho Municipal Hospital, limited generalisability. The findings may not have reflected the experiences of pregnant women in other parts of the Volta Region or those who did not access formal antenatal care, introducing potential selection bias (Nyarko Adwoa *et al.*, 2022). Third, reliance on existing medical records, including antenatal cards, carried a risk of information bias due to possible documentation errors or missing data. Inaccuracies in patient files could have compromised the validity of some recorded exposures or outcomes. Lastly, resource constraints prevented the inclusion of advanced diagnostic tools such as angiogenic biomarkers or genetic screening, which limited the ability to verify underlying pathophysiological mechanisms of preeclampsia (Brantsaeter *et al.*, 2009; Moura *et al.*, 2010). These limitations were considered when interpreting the findings and planning future studies.

Additionally, the study did not track outcomes beyond the antenatal period, making it impossible to assess maternal or perinatal outcomes. The six-month data collection period may have missed seasonal variations in factors like malaria exposure and food availability. While the sample size supported the main objectives, it may have been underpowered for detecting less common associations.

Despite these constraints, the study offered a practical approach to addressing a key gap in local evidence on preeclampsia at the facility level.

3.14 Assumptions

The following assumptions underpinned this study:

1. The antenatal records at Ho Municipal Hospital were accurately and consistently documented with respect to the diagnosis of preeclampsia (according to ACOG, 2020 criteria), nutritional status (MUAC or BMI), and the socio-demographic and obstetric variables extracted for the study.

2. The systematic sampling technique adopted provided a representative sample of pregnant women attending the antenatal clinic at Ho Municipal Hospital during the study period.
3. Midwives and other healthcare providers at Ho Municipal Hospital applied uniform diagnostic criteria for preeclampsia and nutritional assessment when recording information in the antenatal cards and hospital registers.
4. The information recorded in the antenatal records reflected the true clinical and sociodemographic status of the pregnant women at the time of their antenatal visits.
5. Malnutrition, as classified by MUAC or BMI in the records, served as a reliable proxy for underlying nutritional deficiencies that could influence preeclampsia risk in this setting.

These assumptions were necessary to enable the retrospective review of existing records and the subsequent statistical analysis. Any violation of these assumptions, particularly incomplete or inaccurate documentation, was acknowledged as a potential limitation of the study in section 3.13.

CHAPTER FOUR

4.0 ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter presents the analysis and interpretation of data collected for the study on the prevalence and associated risk factors of preeclampsia among pregnant women attending antenatal clinic at Ho Municipal Hospital in the Volta Region of Ghana.

A total of 438 pregnant women were included in the analysis out of the projected working sample size of 453, thereby yielding a study response rate of about 97%. Descriptive statistics such as frequencies and percentages were used to summarize the socio-demographic and obstetric characteristics of the participants. Chi-square tests were used to examine the association between the independent variables and preeclampsia. Variables were further included in a logistic regression model to identify factors independently associated with preeclampsia. The results are presented in tables and interpreted in relation to the study objectives.

4.2 Socio-Demographic Characteristics of Respondents

Table 4.1 below presents the socio-demographic characteristics of the respondents included in the study. A total of 438 pregnant women participated in the study. Most respondents were 15–34 years, representing 364 (83.11%) of the participants. Women aged 35–49 years accounted for 74 (16.89%).

Regarding educational level, 97 (22.15%) had tertiary education, which represented the largest group. Respondents with no formal education were 90 (20.55%), while 87 (19.86%) had primary education. Participants with JHS education were 82 (18.72%), and 82 (18.72%) had SHS education.

In terms of occupation, farmers constituted the largest occupational group with 108 (24.66%) of respondents. Traders accounted for 98 (22.37%), while 91 (20.78%) were unemployed. Civil servants represented 74 (16.89%), and 67 (15.30%) were students.

With respect to income level, the largest proportion of respondents belonged to the middle income group with 159 (36.30%). Low-income respondents were 143 (32.65%), while 136 (31.05%) were in the high-income group.

Table 1: Socio-Demographic Characteristics of the Respondents

Variables	Category	Frequency (n)	Percentages (%)
Age Group	15–34 years	364	83.11
	35–49 years	74	16.89
Education	JHS	82	18.72
	None	90	20.55
	Primary	87	19.86
	SHS	82	18.72
	Tertiary	97	22.15
Occupation	Civil Servant	74	16.89
	Farmer	108	24.66
	Student	67	15.30
	Trader	98	22.37
	Unemployed	91	20.78
Income	High	136	31.05
	Low	143	32.65
	Middle	159	36.30

Source: Field Data, 2026

4.3 Clinical Assessments of Respondents

Figure 4.2 presents the clinical characteristics of the respondents.

Regarding antenatal care attendance, 279 (63.70%) respondents attended four or more ANC visits, while 159 (36.30%) attended fewer than four visits.

For previous caesarean section history, 220 (50.23%) respondents reported no previous caesarean section, while 218 (49.77%) reported a previous caesarean section.

With respect to nutritional status, 281 (64.16%) respondents were malnourished, whereas 157 (35.84%) had normal nutritional status.

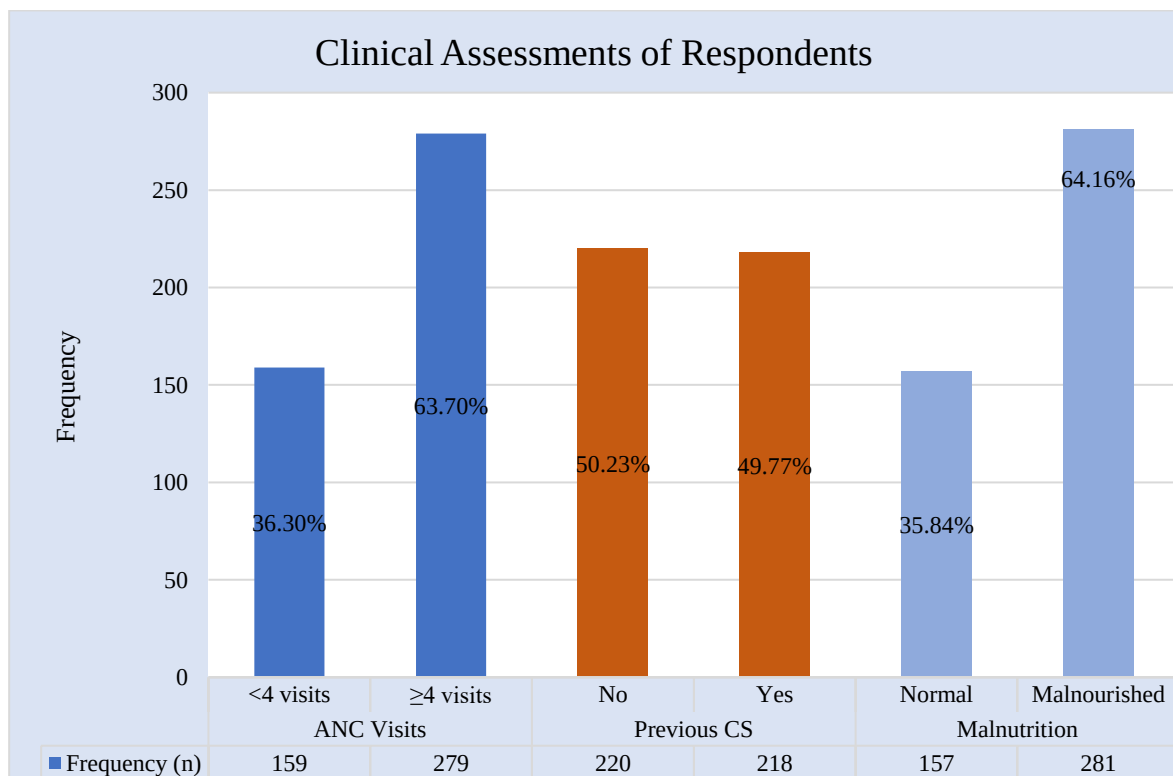


Figure 3: Clinical Assessments of Respondents

4.3 Prevalence of preeclampsia

A total of 438 pregnant women were included in the analysis. Nineteen (4.34%) tested positive for preeclampsia while 419 (95.66%) were negative.

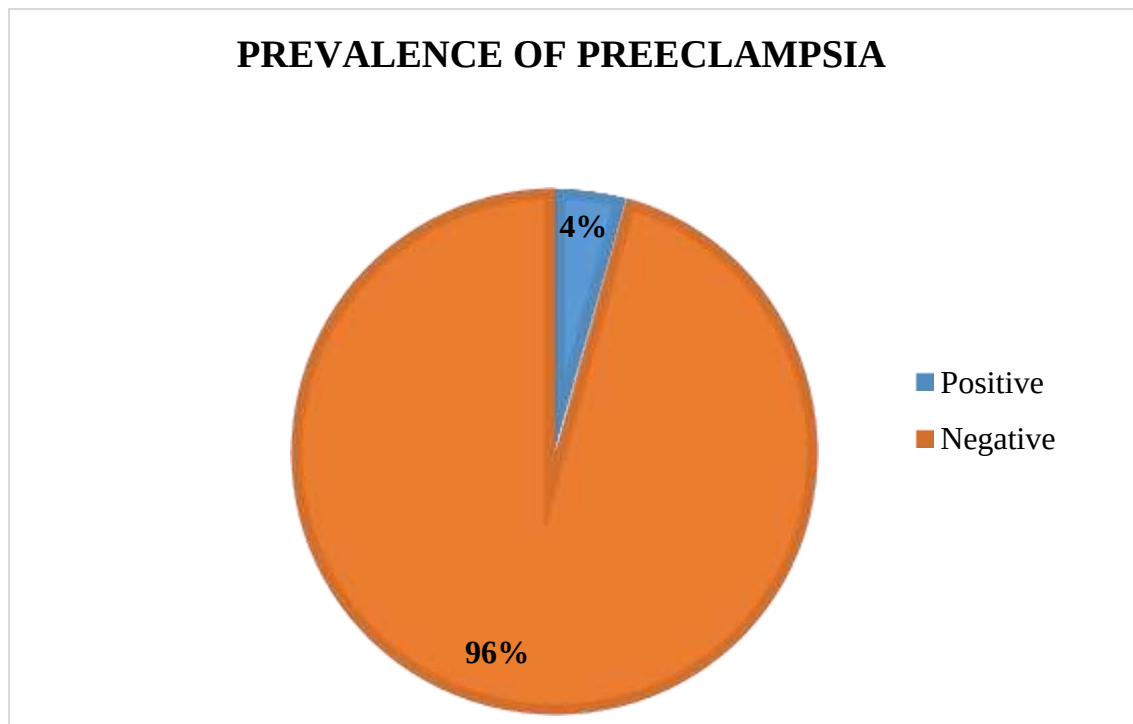


Figure 4: Prevalence of Preeclampsia

4.4 Bivariate Analysis of Factors Associated with Preeclampsia

The test for association on selected variable showed that Age group has no statistically significant association with preeclampsia ($\chi^2 = 3.050$, $p = 0.081$). Among women aged 15–34 years, 13 (68.42%) had preeclampsia compared with 6 (31.58%) among those aged 35–49 years.

Educational level showed no statistically significant association with preeclampsia ($\chi^2 = 6.2203$, $p = 0.183$). Among women with preeclampsia, 6 (31.58%) had JHS education and 6 (31.58%) had SHS education, while 3 (15.79%) had no education, 1 (5.26%) had primary education, and 3 (15.79%) had tertiary education.

Occupation showed no statistically significant association with preeclampsia ($\chi^2 = 6.312$, $p = 0.177$). Among women with preeclampsia, 7 (36.84%) were unemployed, 5 (26.32%) were farmers, 3 (15.79%) were students, and 2 (10.53%) each were civil servants and traders.

Income level showed no statistically significant association with preeclampsia ($\chi^2 = 2.608$, $p = 0.271$). Among women with preeclampsia, 8 (42.11%) were in the high-income group, 8 (42.11%) were in the middle-income group, and 3 (15.79%) were in the low-income group.

Number of antenatal care visits showed no statistically significant association with preeclampsia ($\chi^2 = 0.289$, $p = 0.591$). Among women with preeclampsia, 8 (42.11%) had fewer than four ANC visits while 11 (57.89%) had four or more visits.

Previous caesarean section showed no statistically significant association with preeclampsia ($\chi^2 = 2.763$, $p = 0.096$). Among women with preeclampsia, 13 (68.42%) had a previous caesarean section while 6 (31.58%) had no previous caesarean section.

Malnutrition status showed a statistically significant association with preeclampsia ($\chi^2 = 5.536$, $p = 0.019$). Among women with preeclampsia, 17 (89.47%) were malnourished while 2 (10.53%) had normal nutritional status.

Based on the chi-square test results, malnutrition status was the only variable significantly associated with preeclampsia at the bivariate level. All other variables were not statistically significant.

Table 2: Association Between Selected Socio-demographic and Obstetric Factors and Preeclampsia Among Pregnant Women Attending ANC at Ho Municipal Hospital

Variables	Preeclampsia Status		Total N(438)	Chi2 (Pvalue)
	Negative	Positive		
	n=419(95.66%)	n=19(4.34%)		
Age Group				3.050 (0.081)
15–34 years	351 (83.77)	13 (68.42)	364 (83.11)	
35–49 years	68 (16.23)	6 (31.58)	74 (16.89)	
Education				6.2203 (0.183)
JHS	76 (18.14)	6 (31.58)	82 (18.72)	
None	87 (20.76)	3 (15.79)	90 (20.55)	
Primary	86 (20.53)	1 (5.26)	87 (19.86)	
SHS	76 (18.14)	6 (31.58)	82 (18.72)	
Tertiary	94 (22.43)	3 (15.79)	97 (22.15)	

Occupation				6.312 (0.177)
Civil Servant	72 (17.18)	2 (10.53)	74 (16.89)	
Farmer	103 (24.58)	5 (26.32)	108 (24.66)	
Student	64 (15.27)	3 (15.79)	67 (15.30)	
Trader	96 (22.91)	2 (10.53)	98 (22.37)	
Unemployed	84 (20.05)	7 (36.84)	91 (20.78)	
Income				2.608 (0.271)
High	128 (30.55)	8 (42.11)	136 (31.05)	
Low	140 (33.41)	3 (15.79)	143 (32.65)	
Middle	151 (36.04)	8 (42.11)	159 (36.30)	
ANC Visits				0.289 (0.591)
<4 visits	151 (36.04)	8 (42.11)	159 (36.30)	
≥4 visits	268 (63.96)	11 (57.89)	279 (63.70)	
Previous CS				2.763 (0.096)
No	214 (51.07)	6 (31.58)	220 (50.23)	
Yes	205 (48.93)	13 (68.42)	218 (49.77)	
Malnutrition				5.536 (0.019)*
No (Normal)	155 (36.99)	2 (10.53)	157 (35.84)	
Yes (Malnourished)	264 (63.01)	17 (89.47)	281 (64.16)	

Source: Field Data, 2026 **NB:** The * represents the variables that are significant

4.3 Risk Factors Associated with Preeclampsia Among Pregnant Women

The table below presents the unadjusted and adjusted associations between maternal characteristics and the risk of developing preeclampsia. Odds ratios (ORs) with 95% confidence intervals (CIs) and p-values are reported for both models.

Age was not significantly associated with preeclampsia. Women aged 35–49 years had higher odds compared with those aged 15–34 years in both unadjusted (OR=2.38, 95% CI: 0.88–6.49, p=0.089) and adjusted models (AOR=1.86, 95% CI: 0.57–6.12, p=0.307), although these associations did not reach statistical significance.

Educational level showed no significant impact. Participants with no formal education or primary education had lower odds of preeclampsia compared with those with JHS education, but the CIs were wide, indicating uncertainty. Tertiary education and SHS also showed no significant associations.

Occupation and income level were not significantly associated with preeclampsia. Among occupations, unemployed women had higher odds in both unadjusted (OR=3.00, 95% CI: 0.60–14.90, $p=0.179$) and adjusted models (AOR=3.70, 95% CI: 0.68–20.02, $p=0.129$), but these were not statistically significant. Low- and middle-income levels showed no significant differences compared with high income.

Antenatal care (ANC) visits did not significantly affect preeclampsia risk. Women with four or more visits had similar odds compared with those with fewer than four visits.

The history of previous caesarean section showed a non-significant increase in odds. Women with a previous CS had a higher risk in both unadjusted (OR=2.26, 95% CI: 0.84–6.06, $p=0.105$) and adjusted models (AOR=2.56, 95% CI: 0.90–7.26, $p=0.078$).

Malnutrition was the only factor significantly associated with preeclampsia. Malnourished women had approximately five times higher odds compared with women with normal nutrition in both unadjusted (OR=4.99, 95% CI: 1.14–21.89, $p=0.033$) and adjusted models (AOR=5.21, 95% CI: 1.12–24.34, $p=0.036$).

First pregnancy status and gestational age were not significantly associated with preeclampsia. Women in their first pregnancy and those with term gestation had similar odds compared with their reference categories.

Overall, malnutrition emerged as the strongest predictor of preeclampsia in this cohort. Other factors, including age, education, occupation, income, ANC attendance, previous caesarean section, first pregnancy, and gestational age, did not show statistically significant associations.

Table 3: Unadjusted and Adjusted Odds Ratios of Factors Associated with Preeclampsia Among Pregnant Women Attending Antenatal Clinic in Ho Municipal Hospital, Volta Region, Ghana

Variable	Unadjusted Model		Adjusted Model	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Age Category				
15–34 years (Ref)	1		1	
35–49 years	2.38 [0.88, 6.49]	0.089	1.86 [0.57, 6.12]	0.307
Educational Level				
JHS (Ref)	1		1	
None	0.44 [0.11, 1.81]	0.253	0.43 [0.10, 1.89]	0.263
Primary	0.15 [0.02, 1.25]	0.079	0.17 [0.02, 1.51]	0.111
SHS	1.00 [0.31, 3.24]	1.000	1.19 [0.34, 4.22]	0.785
Tertiary	0.40 [0.10, 1.67]	0.211	0.48 [0.11, 2.09]	0.331
Occupation				
Civil Servant (Ref)	1		1	
Farmer	1.75 [0.33, 9.26]	0.512	1.86 [0.32, 10.74]	0.486
Student	1.69 [0.27, 10.42]	0.573	2.03 [0.29, 14.06]	0.475
Trader	0.75 [0.10, 5.45]	0.776	0.97 [0.12, 7.98]	0.975
Unemployed	3.00 [0.60, 14.90]	0.179	3.70 [0.68, 20.02]	0.129
Income Level				
High (Ref)	1		1	
Low	0.34 [0.09, 1.32]	0.120	0.34 [0.08, 1.42]	0.140
Middle	0.85 [0.31, 2.32]	0.748	0.80 [0.27, 2.40]	0.693
ANC Visits				
<4 visits (Ref)	1		1	
≥4 visits	0.77 [0.30, 1.97]	0.592	0.94 [0.35, 2.54]	0.899

Previous CS				
No (Ref)	1		1	
Yes	2.26 [0.84, 6.06]	0.105	2.56 [0.90, 7.26]	0.078
Malnutrition				
No (Normal) (Ref)	1		1	
Yes (Malnourished)	4.99 [1.14, 21.89]	0.033	5.21 [1.12, 24.34]	0.036*
First Pregnancy				
No (Ref)	1		1	
Yes (1st Preg)	0.84 [0.27, 2.59]	0.761	1.26 [0.35, 4.51]	0.724
Gestational Age				
Early Term (Ref)	1		1	
Term	1.74 [0.22, 14.00]	0.605	2.21 [0.23, 21.31]	0.493

Source: Field Data, 2026

*NB: The * represents the variables which are significant*

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

This chapter presents the discussion, conclusion, and recommendations of the study on the prevalence and associated risk factors of preeclampsia among pregnant women attending the antenatal clinic at Ho Municipal Hospital in the Volta Region of Ghana. The chapter summarizes the key findings from the analysis conducted in the previous chapter and draws conclusions based on the study objectives. It also provides recommendations based on the findings to inform clinical practice and maternal health interventions.

5.2 Discussion of Findings

5.2.1 Socio-Demographic Characteristics of the Respondents

The socio-demographic profile of the 438 pregnant women in this study directly relates to the second specific research objective, which sought to identify significant demographic characteristics (age, educational level, occupation, and income level, among others) associated with preeclampsia. These variables were operationalised as key independent factors in the study and examined in relation to the dependent variable, preeclampsia diagnosis according to ACOG (2020) criteria, through bivariate and multivariate analyses.

Most respondents were in the 15–34 years age group (364, 83.11%), with only 74 (16.89%) aged 35–49 years. This distribution is broadly consistent with patterns observed in other Ghanaian facility-based studies. Nyarko Adwoa *et al.*, (2022) at Ho Teaching Hospital reported that the majority of preeclampsia cases occurred among younger women, particularly in the 18–24 years bracket. Similarly, Anto *et al.*, (2023) in the Central Region documented a

predominance of younger antenatal attendees. However, in the present study, age group showed no statistically significant association with preeclampsia in bivariate analysis ($\chi^2 = 3.050$, $p = 0.081$), contrasting with Beyuo *et al.*, (2022), who linked younger maternal age (<20 years) to increased risk of preeclampsia and eclampsia, and with some reports associating advanced maternal age with higher risk in other contexts.

Educational attainment was diverse: tertiary education accounted for the largest single group (97, 22.15%), followed by no formal education (90, 20.55%), primary (87, 19.86%), and JHS and SHS (82 each, 18.72%). This heterogeneity reflects the mixed urban-rural catchment of Ho Municipal Hospital. In contrast to the literature, educational level was not significantly associated with preeclampsia ($\chi^2 = 6.2203$, $p = 0.183$). Nyarko Adwoa *et al.*, (2022) found education level to be significantly associated with preeclampsia, while Fondjo *et al.*, (2022) and Anto *et al.*, (2023) also reported links between lower educational attainment and increased risk, often attributing this to reduced health literacy and poorer utilisation of antenatal services. The lack of association in the current study may reflect the relatively balanced educational profile in this municipal sample or limitations in record documentation.

In terms of occupation, farmers formed the largest group (108, 24.66%), followed by traders (98, 22.37%), unemployed (91, 20.78%), civil servants (74, 16.89%), and students (67, 15.30%). Income distribution was fairly even, with the middle-income category being the largest (159, 36.30%), low-income (143, 32.65%), and high-income (136, 31.05%). These patterns align with the predominantly agrarian and informal economy of the Volta Region.

However, neither occupation ($\chi^2 = 6.312$, $p = 0.177$) nor income level ($\chi^2 = 2.608$, $p = 0.271$) showed statistically significant associations with preeclampsia. This finding diverges from Nyarko Adwoa *et al.*, (2022), who identified occupation as a significant associated factor at Ho Teaching Hospital, and from Anto *et al.*, (2023) and Fondjo *et al.*, (2022), who linked

occupational status and socioeconomic indicators to preeclampsia risk, often mediated through access to care, physical demands of work, or nutritional implications.

Overall, while the socio-demographic characteristics of respondents in this study are comparable to those reported in the Ghanaian literature (Nyarko Adwoa *et al.*, 2022; Anto *et al.*, 2023), none of these variables demonstrated statistically significant associations with preeclampsia in either bivariate or multivariate analyses. This contrasts with the broader patterns in sections 2.7.1 and 2.9 of the literature review, where socio-demographic factors such as education and occupation frequently emerged as important determinants. The discrepancy may be attributable to the specific characteristics of the Ho Municipal Hospital catchment population, the retrospective record-review design (which depends on completeness of documentation), or the overriding influence of malnutrition.

5.2.2 Prevalence of Preeclampsia

The prevalence of preeclampsia in this study was 4.34% (19 out of 438 pregnant women). This figure is consistent with the global estimate of 4.6% reported by Abalos *et al.*, (2013) and lies within the lower end of the sub-Saharan African range of 1.8%–16.7% documented by Osungbade and Ige (2011). Within the Ghanaian context, the observed prevalence is slightly lower than the 5.6% average (rising from 4.6% in 2018 to 6.6% in 2020) recorded at the nearby Ho Teaching Hospital (Nyarko Adwoa *et al.*, 2022).

The marginally lower rate at Ho Municipal Hospital compared with the teaching hospital may reflect differences in referral patterns: Ho Municipal Hospital serves as a secondary-level facility, whereas Ho Teaching Hospital receives more complicated cases from peripheral sites (Bailey *et al.*, 2019). The prevalence obtained in the present study therefore provides the first facility-specific estimate for Ho Municipal Hospital and confirms that preeclampsia remains a

notable burden even at the municipal level, aligning with national data indicating hypertensive disorders account for 26–31.7% of maternal deaths in Ghanaian tertiary hospitals (Adu-Bonsaffoh *et al.*, 2013; Drechsel *et al.*, 2022).

5.2.3 Factors Associated with Preeclampsia

In the bivariate analysis, only malnutrition showed a statistically significant association with preeclampsia ($\chi^2 = 5.536$, $p = 0.019$). All other variables—age group ($p = 0.081$), educational level ($p = 0.183$), occupation ($p = 0.177$), income level ($p = 0.271$), number of ANC visits ($p = 0.591$), and previous caesarean section ($p = 0.096$)—were not statistically significant.

Multivariate logistic regression confirmed that malnutrition remained the sole independent predictor after adjustment for confounders (AOR = 5.21, 95% CI: 1.12–24.34, $p = 0.036$). Malnourished women had over five times the odds of developing preeclampsia compared with those with normal nutritional status.

This finding contrasts with several Ghanaian studies that identified socio-demographic and obstetric factors as significant. Nyarko Adwoa *et al.*, (2022) reported significant associations with parity, educational level, and occupation at Ho Teaching Hospital. Similarly, Anto *et al.*, (2023) and Fondjo *et al.*, (2022) documented links between primigravidity, previous caesarean section, educational attainment, and occupational status in other regions of Ghana. The absence of significance for these variables in the present study may be attributable to the specific population characteristics of Ho Municipality or to the cross-sectional design, which captured only antenatal records and may have limited variability in some exposures.

The strong independent association with malnutrition, however, is biologically plausible and supported by broader literature. Nutritional deficiencies have been implicated in the pathogenesis of preeclampsia in sub-Saharan Africa through mechanisms such as oxidative stress and impaired placental development (Moura *et al.*, 2010; Osungbade & Ige, 2011). In

the present sample, 64.16% of all participants were classified as malnourished, indicating a high background prevalence of undernutrition that appears to interact directly with preeclampsia risk in this setting. This finding aligns with dietary pattern evidence from Brantsaeter *et al.*, (2009), which linked inadequate intake of protective nutrients to elevated preeclampsia risk, and extends the Ghanaian observations of Avoka *et al.*, (2022) on dietary factors in the Eastern Region.

Notably, variables such as the number of ANC visits and previous caesarean section, which reached borderline significance in bivariate analysis ($p = 0.591$ and $p = 0.096$ respectively), lost significance after adjustment. This suggests that any apparent crude associations were confounded by malnutrition status. The non-significance of pre-existing medical conditions and ANC practices in the final model also diverges from some regional reports (Fondjo *et al.*, 2022; Atluri *et al.*, 2023) but is consistent with the resource-constrained context of a municipal hospital where documentation of these factors may be incomplete.

5.2.4 Factors contributing to Preeclampsia among study respondents.

The multivariate binary logistic regression analysis directly addressed the second, third, and fourth specific research objectives by examining the independent contributions of sociodemographic, obstetric, and nutritional variables to preeclampsia risk among the 438 pregnant women. After adjusting for potential confounders, malnutrition emerged as the only statistically significant independent predictor of preeclampsia (AOR = 5.21, 95% CI: 1.12–24.34, $p = 0.036$). Malnourished women had over five times higher odds of developing preeclampsia compared with women with normal nutritional status. All other variables in the model—including age category (AOR = 1.86, 95% CI: 0.57–6.12, $p = 0.307$), educational level, occupation, income level, number of ANC visits (AOR = 0.94, 95% CI: 0.35–2.54, $p = 0.899$), previous caesarean section (AOR = 2.56, 95% CI: 0.90–7.26, $p = 0.078$), primigravidity

(AOR = 1.26, 95% CI: 0.35–4.51, $p = 0.724$), and gestational age—lost statistical significance in the adjusted model.

This finding contrasts sharply with several Ghanaian studies reviewed in Chapter Two. Nyarko Adwoa *et al.*, (2022) at the nearby Ho Teaching Hospital identified parity, educational level, and occupation as significant factors associated with preeclampsia. Similarly, Anto *et al.*, (2023) in the Central Region reported primigravidity, previous caesarean section, and foetal growth restriction as independent risk factors, while Fondjo *et al.*, (2022) highlighted infrequent ANC visits, physical inactivity, analgesic use, and occupational status as important contributors. The non-significance of these socio-demographic and obstetric variables in the present adjusted model differs from the patterns documented in sections 2.7.1 and 2.7.2 of the literature review. Possible explanations include the specific population characteristics captured in the systematically sampled antenatal records at this secondary-level municipal facility or the retrospective nature of data extraction, which may have reduced variability or completeness in documenting some exposures.

In contrast, the strong independent association with malnutrition is biologically plausible and supported by the literature on clinical and behavioural risk factors. Nutritional deficiencies have been implicated in the pathogenesis of preeclampsia in sub-Saharan Africa through mechanisms such as increased oxidative stress, impaired placental development, and endothelial dysfunction (Moura *et al.*, 2010; Osungbade & Ige, 2011). In this study sample, 281 women (64.16%) were classified as malnourished based on MUAC or BMI recorded in antenatal records, indicating a high background prevalence of undernutrition that appears to exert a dominant effect on preeclampsia risk in this setting. This result aligns with dietary pattern evidence from Brantsaeter *et al.*, (2009), which linked inadequate intake of protective nutrients (fruits, vegetables, and vegetable oils) to elevated preeclampsia risk, and extends local

Ghanaian observations by Avoka *et al.*, (2022) on the relationship between individual-level dietary intake and preeclampsia/eclampsia in the Eastern Region.

Notably, variables that showed borderline significance in bivariate analysis—such as previous caesarean section ($\chi^2 = 2.763$, $p = 0.096$) and age group ($p = 0.081$)—lost significance after adjustment. This suggests that any apparent crude associations were largely confounded by malnutrition status. The dominance of malnutrition in the final model also diverges from reports that emphasised pre-existing medical conditions or ANC practices (Fondjo *et al.*, 2022; Atluri *et al.*, 2023) but is consistent with the resource-constrained context of Ho Municipal Hospital, where nutritional vulnerabilities may overshadow other documented factors due to high background rates of undernutrition.

These logistic regression findings reinforce the conceptual framework, which positioned behavioural and clinical factors (including nutritional status) as key domains influencing preeclampsia prevalence. By identifying malnutrition as the sole independent contributor in this facility-specific context, the study highlights a modifiable risk factor that was underexplored in previous Volta Region research and addresses one of the critical gaps noted in the literature review (section 2.9). The results suggest that interventions targeting nutritional status during antenatal care may have greater potential impact in this municipal setting than strategies focused solely on socio-demographic or obstetric characteristics.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This final chapter summarises the major findings of the study on the prevalence and associated risk factors of preeclampsia among pregnant women attending the antenatal clinic at Ho Municipal Hospital. It draws conclusions based on the research objectives and presents targeted recommendations for clinical practice, health system strengthening, and future research. The conclusions and recommendations are grounded in the empirical results presented in Chapter Four and discussed in Chapter Five.

6.2 Conclusions

The prevalence of preeclampsia among pregnant women attending the antenatal clinic at Ho Municipal Hospital was 4.34%. Malnutrition was the only factor that demonstrated both bivariate and independent multivariate significance, with malnourished women exhibiting 5.21 times higher odds of preeclampsia ($p = 0.036$). No other socio-demographic, obstetric, or antenatal care variables retained statistical significance after adjustment. These results provide the first facility-specific epidemiological profile of preeclampsia at Ho Municipal Hospital and highlight malnutrition as the dominant modifiable risk factor in this local population, differing from the broader socio-demographic patterns reported in nearby teaching-hospital studies.

6.3 Recommendations

To the Management and Midwives of Ho Municipal Hospital

1. Integrate routine nutritional screening using Mid-Upper Arm Circumference (MUAC) or Body Mass Index (BMI) into every antenatal visit to identify malnourished pregnant women early.

2. Strengthen documentation of nutritional status in all antenatal records to support consistent risk assessment for preeclampsia.

To Midwives and Antenatal Care Providers at Ho Municipal Hospital

3. Provide targeted nutrition counselling to all pregnant women classified as malnourished during antenatal care sessions.

For Future Research

4. Researchers should conduct a prospective cohort study in Ho Municipality to establish the temporal relationship between malnutrition and preeclampsia and to evaluate the effectiveness of nutritional interventions in reducing preeclampsia occurrence.
5. Researchers should undertake multi-centre studies across facilities in the Volta Region to determine whether the dominance of malnutrition as a risk factor for preeclampsia is consistent or context-specific.

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APPENDIX

DATA EXTRACTION TOOL

Data Extraction Tool for Preeclampsia Prevalence and Risk Factors Study

Ho Municipal Hospital, Ho Municipality, Volta Region, Ghana

Instructions: Complete this tool for each selected medical record (~414 records) using closeended response options. Ensure data is extracted accurately from ANC records. Assign a unique identifier to each record for confidentiality. Do not record personal identifiers (e.g., name, contact details). Complete all fields where data is available; mark "Unknown" if data is missing.

A. Record Information

1. Unique Identifier: _____ (Assign a 4-digit code, e.g., 0001)
2. Date of ANC Record (DD/MM/YYYY): ____/____/____
3. Gestational Age at Last ANC Visit (weeks): ____ (Enter number, e.g., 28; mark Unknown if not recorded)

B. Dependent Variable: Preeclampsia Status

4. Preeclampsia Diagnosis:

☐ Yes (Blood pressure $\geq 140/90$ mmHg after 20 weeks' gestation with proteinuria)

☐ No

☐ Unknown

C. Independent Variables: Socio-Demographic Factors

5. Maternal Age (years): ____ (Enter number, e.g., 25; mark Unknown if not recorded)

6. Parity:

☐ Nulliparous (0 live births)

☐ Primiparous (1 live birth)

☐ Multiparous (≥ 2 live births)

☐ Unknown

7. Education Level:

☐ None

☐ Primary

☐ Secondary

☐ Tertiary

☐ Unknown

8. Occupation:

☐ Unemployed

☐ Farmer/Trader

☐ Professional (e.g., teacher, nurse)

☐ Other

☐ Unknown

9. Monthly Household Income (GHS):

☐ <500

☐ 500–1000

☐ >1000

☐ Unknown

D. Independent Variables: Clinical Factors

10. Primigravidity:

☐ Yes (First pregnancy)

☐ No

☐ Unknown

11. Previous Caesarean Section:

☐ Yes

☐ No

☐ Unknown

12. Chronic Hypertension (Diagnosed before pregnancy):

☐ Yes

☐ No

☐ Unknown

13. Obesity (BMI ≥ 30 kg/m² at first ANC visit):

☐ Yes

☐ No

☐ Unknown

14. Foetal Growth Restriction (Diagnosed by ultrasound):

☐ Yes

☐ No

☐ Unknown

E. Independent Variables: Behavioural Factors

15. ANC Attendance Frequency:

☐ <4 visits

☐ ≥ 4 visits

☐ Unknown

16. Dietary Patterns (Based on ANC nutrition counselling records):

☐ Adequate (Meets recommended fruit/vegetable intake)

☐ Inadequate

☐ Unknown

F. Data Quality Check

17. Record Completeness:

☐ Complete (All fields answered)

☐ Partially Complete (Some fields marked Unknown)

☐ Incomplete (Majority fields marked Unknown)

18. Extractor Initials: ____ (Enter initials, e.g., JA)

19. Date of Extraction (DD/MM/YYYY): ____/____/____

ETHICS APPROVAL LETTER



OUR REF: ENSIGN/IRB/EL/SN-327/02
YOUR REF:

December 4, 2025.

INSTITUTIONAL REVIEW BOARD SECRETARIAT

Jacqueline Sirina Atakora
Ensign Global University
Kpong.

Dear Jacqueline,

ETHICAL CLEARANCE TO UNDERTAKE POSTGRADUATE RESEARCH

At the General Research Proposals Review Meeting of the *INSTITUTIONAL REVIEW BOARD (IRB)* of Ensign Global University held on Wednesday, December 3, 2025, your research proposal entitled “**Prevalence and Associated Risk Factors of Preeclampsia Among Pregnant Women Attending Antenatal Clinic in Ho Municipal Hospital, Volta Region, Ghana**” was considered.

You have been granted Ethical Clearance to collect data for the said research under academic supervision within the IRB's specified frameworks and guidelines.

We wish you all the best.

Sincerely,

A handwritten signature in black ink, appearing to read "Rebecca Acquah-Arhin", with a flourish at the end.

Dr. (Mrs.) Rebecca Acquah-Arhin
IRB Chairperson