

**DETERMINANTS OF PREECLAMPSIA AND MATERNAL AND PERINATAL
OUTCOMES AMONG WOMEN IN NAROK COUNTY, KENYA**

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THE DEGREE OF MASTER OF SCIENCE IN CLINICAL MEDICINE
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UNIVERSITY**

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DECLARATION

I declare that this thesis is my original work and has not been presented for a degree or any other award at any other University.

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DEDICATION

I want to dedicate this research to my family, mentors, and patients. Your help, advice, and experiences have given me the most strength and motivation.

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ABSTRACT

Preeclampsia is a critical hypertensive disorder in pregnancy that significantly impacts maternal and neonatal health outcomes. The World Health Organization (WHO) recognizes it as a key direct factor in global maternal mortality, especially in low- and middle-income countries. The disease is prevalent in Sub-Saharan Africa, posing a considerable threat to women and their infants. In resource-limited settings like Narok County, Kenya, delays in accessing healthcare and gaps in screening and treatment have worsened the impact of preeclampsia. This study aimed to identify the key factors associated with preeclampsia and to evaluate its effects on mothers and their newborns in Narok County. A retrospective cross-sectional review of 5,801 delivery records from January to December 2023 was conducted, from which 331 were systematically sampled, and 217 met the inclusion criteria for final analysis using a standardized data extraction tool. Descriptive analysis revealed that most preeclampsia cases (88.2%) were severe and commonly presented with symptoms such as severe headache, followed by visual disturbances, and epigastric pain. Cesarean section was performed in 17.6% of cases, maternal complications occurred in 58.8%, and the maternal mortality rate was 5.9%. Common maternal complications included HELLP syndrome and eclampsia. Neonatal outcomes were poor, with 27.8% stillbirths, 50% low birth weight, and 44.4% low Apgar scores. Neonatal complications and deaths occurred in 7.7% and 5.6% of cases, respectively. Inferential analysis using Chi-square or Fisher's exact tests followed by binary logistic regression identified multiple gestation (OR = 3.46; 95% CI: 1.04–11.50; $p = 0.043$) and primigravidity ($p = 0.026$) as significant determinants of preeclampsia. Rural residence (OR = 4.50; $p = 0.054$) showed no significant association. Preeclampsia poses a substantial burden on maternal and perinatal health in Narok County. Multiple gestations and first-time pregnancy were identified as key determinants, and preeclampsia resulted to higher rates of antenatal complications, adverse maternal outcomes, and poor neonatal outcomes such as prematurity and low birth weight. Strengthening antenatal care through early screening, risk-based monitoring, and timely interventions is essential to mitigate these risks.

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ABBREVIATIONS AND ACRONYMS

ACOG- American College of Obstetrics and Gynecology

ANC- Antenatal Care

BMI- Body Mass Index

CDC- Centers for Disease Control

CKD- chronic kidney disease

DBP-Diastolic Blood Pressure

DIC- Disseminated Intravascular Coagulation

EOP-Early Onset Pre-eclampsia

FPC - Finite Population Correction

HDP- Hypertensive Disease of Pregnancy

HELLP- Hemolysis, Elevated Liver Enzymes, and Low Platelets

ICU- Intensive Care Unit

IREC - Institutional Research Ethics Committee

IUFD- Intrauterine Fetal Demise

KDHS- Kenya Demographic Health Survey

LBW- Low Birth Weight

LMIC- Low- and Middle-Income Countries

LOP-Late Onset Preeclampsia

MMR- Maternal Mortality Rate

MNM-Maternal Near Miss

NCRH- Narok County Referral Hospital

NICE- National Institute for Health and Care Excellence

OB- Obstetrics

OB/GYN- Obstetrics and Gynecology

OR- Odds Ratio

PET- preeclampsia

RDS- Respiratory Distress Syndrome

RH CO- Reproductive Health Clinical Officer

SBP- Systolic Blood Pressure

SGA- Small for Gestational Age

SLE- Systemic Lupus Erythematosus

WHO- World Health Organization

X² - Chi-Square

GLOSSARY OF TERMS

Adverse Maternal Outcome: Any serious health complication experienced by the mother during pregnancy, childbirth, or postpartum, such as eclampsia, HELLP syndrome, ICU admission, or maternal death.

Adverse Neonatal Outcome: Any unfavorable health condition affecting the newborn, including preterm birth, low Apgar score, admission to NBU, neonatal complications, or neonatal death.

Body Mass Index (BMI): Weight in kilograms divided by the square of height in meters (kg/m^2) is the formula for body mass index (BMI), categorized as underweight (<18.5), normal weight (18.5-24.9), overweight (25-29.9), or obese (≥ 30).

Cellulitis: A localized bacterial skin infection observed in some postpartum mothers.

Hyperglycemia: Elevated blood glucose levels documented in the mother during pregnancy.

Infant: A child from birth up to one year of age.

Maternal Deaths: The number of women who die during pregnancy, childbirth, or within 42 days postpartum owing to conditions related to or aggravated by the pregnancy or its management, excluding accidental or incidental causes.

Multiparity: A term used to describe a woman who has had two or more pregnancies that resulted in the birth of viable offspring

Neonatal death: Refers to the demise of an infant occurring within the initial twenty-eight days of life.

Newborn: A child from birth to 28 days of age.

Nulliparity: Describes a woman who has never carried a pregnancy to a viable stage, typically defined as 24 weeks of gestation or more. This includes women who have never been pregnant, as well as those whose pregnancies ended before reaching viability due to miscarriage or termination.

Perinatal death/loss: Denotes the demise of a fetus or neonate during the perinatal era.

Perinatal period: Pertains to the period immediately before (Twenty-Eight weeks of gestation) and after delivery (up to twenty-eight days after delivery)

Preterm birth: Refers to newborns delivered alive before thirty-seven completed weeks of gestation.

Primigravida: A woman experiencing pregnancy for the very first time.

Proteinuria: The detection of $\geq 1+$ protein on urine dipstick analysis in a pregnant woman after 20 weeks of gestation.

Stillbirth: Refers to the demise of a fetus beyond twenty-eight weeks of gestation, either before or during delivery.

Twin A: The first twin to be delivered or positioned closer to the cervix during pregnancy.

Twin B: The second twin to be delivered or positioned further from the cervix

CHAPTER ONE: INTRODUCTION

1.1 Background to the study

The World Health Organization (WHO) continues to release alarming statistics highlighting the persistent global crisis of maternal mortality. In 2020, approximately 287,000 women died from pregnancy- and delivery-related causes, corresponding to 223 maternal deaths per 100,000 live births (WHO, 2024). Strikingly, only 5% of these fatalities occurred in high-income countries, while 95% were concentrated in low- and middle-income countries (LMICs), with Sub-Saharan Africa alone accounting for nearly 70% (about 202,000 deaths) (WHO, 2024). Most of these deaths resulted from preventable conditions, predominantly direct obstetric complications such as pregnancy-related hypertension, which remains among the leading causes of maternal mortality worldwide, contributing to nearly 73% of maternal deaths (Say et al., 2014).

Kenya has recorded improvements, with maternal mortality declining from 708 deaths per 100,000 live births in 2000 to 308 per 100,000 in 2021. However, this figure remains higher than the global average of 223 per 100,000 live births and far above the Sustainable Development Goal (SDG) 3.1 target of fewer than 70 deaths per 100,000 live births by 2030 (Hajji Adam & Daba, 2024; Mwaura et al., 2023; WHO, 2021). Without accelerated interventions, Kenya risks failing to achieve SDG 3.1, particularly in the face of compounding challenges such as climate change and the lingering impacts of the COVID-19 pandemic (Hajji Adam & Daba, 2024; Masaba et al., 2022).

The five leading direct causes of maternal mortality worldwide are mainly linked to complications during pregnancy, labor, or the postpartum phase that are preventable or

treatable. These causes include postpartum hemorrhage, which remains the leading cause due to rapid blood loss; high blood pressure during pregnancy, such as preeclampsia and eclampsia, which can lead to seizures, organ failure, or death if not addressed; sepsis, a severe infection that can quickly become life-threatening without treatment; complications from unsafe or poorly managed abortions, particularly in areas where reproductive health services are difficult to access; and thromboembolism, the formation of blood clots that can travel to vital organs like the lungs and result in sudden death if not treated (Lawrence et al., 2022). In Kenya, the top two causes of maternal deaths are hemorrhage and high blood pressure during pregnancy, especially before and after childbirth. Three recent studies on Maternal Near Miss (MNM) confirm this finding (Guttmacher Institute, 2022; Mulongo et al., 2022; Owolabi et al., 2020).

Hypertensive diseases during pregnancy, which affect approximately 10% of pregnant women (Cífková, 2023), constitute a primary factor in morbidity and mortality for both mothers and their infants. These disorders can be categorized into several types: Gestational hypertension, chronic hypertension, preeclampsia/eclampsia, and chronic hypertension with superimposed preeclampsia. Chronic hypertension accounts for the majority, ranging from about 90-95%, of hypertensive conditions during pregnancy, and around 25% of these cases progress to preeclampsia later in the pregnancy. A high-impact case-control study done in Sierra Leone revealed that preeclampsia affects approximately 5.6% of all pregnancies. However, what is even more worrying is that hypertensive illnesses during pregnancy, among them preeclampsia, were killing almost 10% of mothers, showing how serious and frequently deadly high blood pressure may be when it

is not treated (Stitterich *et al.*, 2021a). This alarming statistic emphasizes the urgent need for early detection and effective management of hypertension during pregnancy to prevent maternal deaths (Gonzalez *et al.*, 2024).

Preeclampsia is characterized by blood pressure readings of 140/90 mmHg or above, recorded on two distinct occasions at least four hours apart, accompanied by substantial proteinuria (Brown *et al.*, 2018). This disorder arises after the 20th week of gestation in women with previously normal blood pressure and typically resolves entirely within six weeks postpartum. Alongside high blood pressure and proteinuria, the severe variant of preeclampsia may manifest with several maternal end-organ problems. These include acute kidney injury, which is shown by a serum creatinine level of 90 $\mu\text{mol/L}$ (1.1 mg/dL) or higher; liver dysfunction, which is shown by high alanine aminotransferase (ALT >40 IU/L) and usually comes with pain in the upper abdomen; and neurological symptoms like seizures, severe headaches, vision problems like blindness, or even stroke.

There may also be problems with blood cells, like thrombocytopenia (a platelet count of less than 150,000/ μL), disseminated intravascular coagulation (DIC), and hemolysis. Uteroplacental insufficiency is another dangerous condition that affects the fetus. It can cause intrauterine growth restriction (IUGR), aberrant umbilical artery Doppler waveforms, or stillbirth (Brown *et al.*, 2018). There can also be chest symptoms, including pulmonary edema, that make it hard to breathe. A blood pressure reading of 160/100 mmHg or higher is very worrying, as it indicates a serious risk of complications and requires prompt diagnosis and evaluation (Magee, Brown, et al., 2022).

Preeclampsia is a major global maternal health concern, affecting 2–8% of all pregnancies worldwide (“Gestational Hypertension and Preeclampsia,” 2020b). Although the incidence in high-income countries is relatively low, at around 0.4% (Khan et al., 2022; Osungbade & Ige, 2011), the condition continues to contribute significantly to maternal and perinatal morbidity and mortality, complicating up to 20% of first-time pregnancies and 5–10% of all pregnancies (Kahn mouei-Aghdam et al., 2015). Globally, preeclampsia is responsible for more than 70,000 maternal deaths and 500,000 neonatal deaths annually (CDC, 2022; Magee, Nicolaides, et al., 2022).

The burden, however, is disproportionately high in low- and middle-income regions, particularly in sub-Saharan Africa, where prevalence ranges from 1.8% to 19.1% (Mekonen et al., 2018). This wide variation is largely attributed to disparities in health system capacity, poor access to antenatal care, and late diagnosis. In contrast, the much lower rates in developed countries highlight the potential impact of robust screening, preventive, and management systems.

In Kenya, preeclampsia prevalence is estimated to be up to 18 times higher (7.2 vs 0.4) than in developed nations (Osungbade & Ige, 2011; Khan et al., 2022; Mwangi, 2021). A study conducted at Pumwani Maternity Hospital reported a prevalence of 7.3% between 2018 and 2019 (Mwangi, 2021), while recurrence rates of preeclampsia have been reported as high as 27% (Ayaya, 2023). However, most available studies in Kenya are hospital-based and in urban settings, limiting their generalizability to community-level populations where barriers to care could be greater. This highlights the need for region-

specific research that captures the unique demographic and healthcare challenges affecting maternal outcomes.

In Narok County, maternal health outcomes remain a critical concern. The county is characterized by a largely rural and nomadic population, limited health infrastructure, long distances to referral hospitals, approximately 70% of residents travel over 5 km to access a health facility, and delayed care-seeking behavior (Narok County Government, 2022; Kenya National Bureau of Statistics, 2022). These structural and access-related challenges amplify the risk of poor outcomes from conditions such as preeclampsia. Despite this high-risk environment, there is limited data on the prevalence, risk factors, and maternal and perinatal outcomes of preeclampsia in Narok County, making it difficult to design and implement effective prevention and intervention strategies.

Many factors have been shown to contribute to preeclampsia, including primiparity, previous preeclampsia or eclampsia, history of preeclampsia in the family, obesity/overweight, longstanding hypertension, anemia, and lack of antenatal care (ANC) visits (Meazaw *et al.*, 2020). Other health problems like diabetes, obesity, high blood pressure, autoimmune diseases like lupus, or extreme ages during pregnancy can also increase the risk. Recognizing these risk factors can help catch issues early and lead to better treatments, like using preventive drugs such as Aspirin, and quick referrals when needed to avoid complications (Chaemsaihong *et al.*, 2022; Chang *et al.*, 2023; Ndwiga *et al.*, 2020).

Research indicates that preeclampsia may lead to detrimental newborn and fetal outcomes, including stillbirth, low birth weight, prematurity, birth asphyxia, neonatal jaundice, and

prolonged neonatal unit admissions, which impose both financial and long-term health burdens on families (Sigei et al., 2023; Turbeville & Sasser, 2020). In Ethiopia, women with preeclampsia experienced significantly higher rates of complications, maternal death, ICU admission, and excessive bleeding as compared to women without the condition, underscoring its potentially life-threatening impact on maternal health (Jikamo et al., 2022).

Addressing preeclampsia in Narok is therefore urgent, not only to reduce maternal and neonatal mortality but also to advance progress toward Sustainable Development Goal (SDG) 3.1, which targets a reduction of maternal mortality. Beyond mortality, tackling preeclampsia will ease the economic burden on families, strengthen the capacity of the county health system, and improve equity in maternal healthcare delivery.

1.2 Statement of the Problem

Globally, preeclampsia is responsible for about 76,000 maternal deaths and 500,000 newborn deaths each year, making it one of the leading causes of poor maternal and perinatal outcomes worldwide (Poon et al., 2021). It is also strongly associated with serious complications such as preterm births, low birth weight, and long-term maternal conditions, including chronic kidney disease (Ishaku et al., 2021; Khan et al., 2022).

In Kenya, hypertensive disorders of pregnancy remain the second leading cause of maternal mortality and continue to pose a major challenge to reducing maternal deaths to fewer than 70 per 100,000 live births, the target set under Sustainable Development Goal (SDG) 3 (Mulongo et al., 2022). This persistent high mortality demonstrates the lack of

success in reducing maternal deaths from preeclampsia despite national and global commitments.

Regionally, Narok faces unique challenges in maternal health. Only 55% of pregnant women attend the recommended antenatal clinic (ANC) visits, the fertility rate is considerably higher than the national average (4.9% vs. 3.4%), and the maternal mortality ratio is estimated at 434 per 100,000 live births (Kenya National Bureau of Statistics, 2022; Monda, n.d.). These indicators, combined with the county's diverse cultural practices, limited healthcare access, and socioeconomic barriers, suggest that the predisposing factors and outcomes of preeclampsia in Narok may differ from other parts of Kenya.

There is limited published evidence on preeclampsia in Narok County, making it difficult for healthcare providers and policymakers to design effective interventions. This study aimed to address the gap by generating localized evidence on prevalence outcomes and risk factors to guide clinical practice, inform health policies, and reduce preventable maternal and neonatal mortality in the county

1.3 General objectives

To examine the determinants of preeclampsia and the maternal and perinatal outcomes among women in Narok County, Kenya

1.4 Specific objectives

- I. To analyze the demographic and clinical risk factors associated with the development of preeclampsia among women in Narok County, Kenya.

- II. To assess the maternal health outcomes among women diagnosed with preeclampsia in Narok County, Kenya.
- III. To describe fetal and neonatal outcomes among infants born to mothers with preeclampsia in Narok County, Kenya.

1.5 Research questions

- I. What demographic and clinical risk factors are associated with the development of preeclampsia among women in Narok County, Kenya?
- II. What are the maternal health outcomes experienced by women diagnosed with preeclampsia in Narok County, Kenya?
- III. What fetal and neonatal outcomes are observed among infants born to mothers with preeclampsia in Narok County, Kenya?

1.6 Justification and significance of the study

Preeclampsia is a primary contributor to maternal and newborn morbidity and mortality globally, particularly affecting low- and middle-income nations disproportionately. Notwithstanding progress in maternal healthcare, the prevention and management of preeclampsia continue to pose a considerable challenge, especially in resource-constrained environments such as Narok County. The absence of thorough local data regarding the drivers and outcomes of preeclampsia in this region has impeded healthcare providers and policymakers from formulating and executing tailored initiatives to alleviate its detrimental impacts. This investigation is thus warranted by the pressing necessity to rectify this data deficiency.

The findings of this study were expected to generate evidence-based insights that could improve clinical risk assessment, enhance early detection and management strategies, and support locally relevant policy formulation. Ultimately, the study aimed to contribute to the reduction of preeclampsia-related complications, thereby improving maternal and neonatal health outcomes in Narok County. In addition, the study identified priority areas for future research, offering a foundation for more effective, long-term, context-specific solutions to this persistent maternal health challenge.

1.7 Limitations of the Study

This study faced various limitations that could have affected the comprehensiveness and generalizability of the results. A primary challenge was associated with the nature of the data utilized. The medical records at Narok County Referral Hospital were primarily intended for treatment and clinical management, and not for research purposes. As a result, numerous records were deficient in essential variables or contained incomplete data, thereby constraining the analytical scope and introducing the possibility of information bias. To mitigate this limitation, a rigorous data screening and verification process was employed during sampling. In cases where critical data were missing, a cross-check was conducted with the maternity register to retrieve the missing information. If the necessary data could not be obtained, the file was excluded and replaced with another eligible record that met the inclusion criteria. This approach helped to maintain the integrity and completeness of the dataset used for analysis.

Additionally, the retrospective design of the study inherently relied on the accuracy and consistency of existing documentation, which varied across cases and departments. To

address this, research assistants were trained to identify inconsistencies and flag any ambiguous entries. Furthermore, the data extraction form was refined with guidance from an obstetrician specialist and the research supervisors to make sure it was complete, consistent, and in line with the goals of the study.

The study was further limited by being conducted in a single facility, which may not fully represent the broader population of Narok County. While this restricted the generalizability of the findings, focusing on the county's main referral hospital allowed for in-depth analysis of cases within a central healthcare setting where most high-risk pregnancies are managed. This setting provided a valuable starting point for understanding the burden of preeclampsia in the region.

Another limitation was the relatively small number of preeclampsia cases observed (17 out of 217 participants), which may have limited the statistical power to detect significant associations and could affect the generalizability of the results.

Despite these limitations, the study applied rigorous data collection procedures and verification methods to ensure reliability, and it provides a critical foundation for future research and policy formulation aimed at reducing the burden of preeclampsia.

1.8 Scope of the study

This study looked into the risk factors that can lead to preeclampsia and looked at the results for both the mother and the baby in women who had the condition. The study used clinical data from Narok County Referral Hospital in Kenya as its basis. It looked at deliveries that happened between January and December 2023, which allowed for a

focused investigation within a set time window using current medical records. It also followed strong ethical standards to protect patient privacy and data, even though the accuracy of the results hinged on how complete these records were. This study aimed to use real-world clinical data to generate insights for improving preeclampsia management within the local healthcare setting. The study offers practical guidance for clinicians, policymakers, and maternal health stakeholders. By identifying key risk factors and complications, the findings support early detection and better maternal and neonatal outcomes.

1.9 Assumptions of the study

This study was carried out with a few important assumptions in mind. First, it was assumed that the patient records accessed from Narok County Referral Hospital truly reflected the true picture of the care of the women included in the study. In other words, it was believed that the healthcare workers recorded accurate, honest, and consistent information about each woman's condition, diagnosis, treatment, and outcomes related to preeclampsia. This assumption was necessary, as the quality of the findings depended heavily on the reliability of these records.

It was also assumed that the records sampled for review represented, in a fair way, the broader group of women who sought maternity care at the hospital during the study period. In situations where key information was missing, the research team made efforts to verify details using the maternity register. If that wasn't possible, the file was replaced with another that met the inclusion criteria. These steps helped to ensure the final data set was as complete and accurate as possible.

Finally, this study assumed that the findings from Narok County Referral Hospital, being the main public facility serving pregnant women in the area, could be used to reflect the experiences and outcomes of the general population of pregnant women in Narok County. This helped give meaning to the results, allowing the findings to be useful not just within the hospital but also for guiding wider maternal health interventions and policy decisions in the region.

1.10 Operation definition of terms

Apgar Score: In this study, it refers to a rapid assessment conducted at 1 and 5 minutes post-delivery, evaluating five indicators: heart rate, respiratory effort, muscular tone, reflexive response, and skin pigmentation, with a cumulative score between 0 and 10.

Cesarean Section: A surgical intervention employed to deliver an infant via incisions in the abdomen and uterus.

Early Preterm: Birth occurring before 34 completed weeks of gestation.

Early-Onset Preeclampsia: Refers to preeclampsia that begins before 34 completed weeks of gestation, characterized by elevated blood pressure and proteinuria or related organ dysfunction arising during the early third or late second trimester.

Eclampsia: A serious consequence of preeclampsia characterized by seizures in a pregnant or postpartum woman, excluding alternative neurological etiologies.

Gravidity: The cumulative count of a woman's pregnancies, irrespective of the outcomes.

HELLP Syndrome: HELLP is a serious type of preeclampsia that includes hemolysis, high liver enzymes, and a low platelet count.

ICU Admission: Admission of the mother or neonate to the Intensive Care Unit due to significant problems such as eclampsia or respiratory distress.

IUFD: In this study, fetal death is defined as fetal death occurring after 20 weeks of gestation and confirmed by the absence of fetal heart sounds on ultrasound or clinical examination before delivery.

Late Preterm: Birth occurring between 34 and 36 completed weeks of gestation.

Late-Onset Preeclampsia: Refers to preeclampsia that begins at or after 34 completed weeks of gestation, characterized by elevated blood pressure and proteinuria or related clinical features arising in the later part of pregnancy.

Low Birth Weight (LBW): A birth weight of less than 2,500 grams, as documented at the time of delivery.

Maternal Mortality: The demise of a woman during gestation, labor, or within 42 days post-delivery due to issues associated with pregnancy.

Maternal outcomes: Clinical conditions or events affecting the mother during pregnancy, delivery, or postpartum as a result of preeclampsia, including but not limited to mode of delivery, eclampsia, ICU admission, and maternal death up to the time of discharge from the hospital.

Mode of delivery: Refers to the method by which the baby is born, either through vaginal delivery or cesarean section.

Multiple Gestation: A pregnancy in which two or more fetuses develop simultaneously in the uterus.

NBU (Newborn Unit): A specialized hospital unit where newborns, especially those requiring medical support, receive care.

Negative Preeclampsia: Any pregnant woman not meeting the criteria for positive preeclampsia.

Neonatal Complications: Any adverse health conditions affecting the newborn, such as respiratory distress, sepsis, or a low Apgar score.

Neonatal Survival Status: The recorded condition of the newborn at discharge, classified as alive or deceased within the neonatal period until the time of discharge of the mother.

Parity: The number of pregnancies carried to a viable gestational age (24 weeks and above).

Perinatal outcomes: Pertains to clinical conditions or occurrences affecting the fetus or neonate during the perinatal period, especially concerning preeclampsia. The outcomes encompass low birth weight, preterm birth, stillbirth, NICU hospitalization, and early neonatal mortality.

Perinatal Period: The time from 28 weeks of gestation through the first 7 days after birth.

Positive Preeclampsia: Diagnosed when a pregnant woman presents with elevated blood pressure ($\geq 140/90$ mmHg) and significant proteinuria ($\geq 1+$ on dipstick) after 20 weeks of gestation, or severe blood pressure alone ($> 160/110$ mmHg).

Preterm Birth: Any live birth that takes place before 37 full weeks of gestation.

Prevalence: The proportion of women diagnosed with preeclampsia.

Puerperal Sepsis: A bacterial infection of the vaginal tract that arises post-childbirth.

Stillbirth: The birth of an infant exhibiting no signs of life after 28 weeks of gestation.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of relevant literature on preeclampsia, focusing on areas that shaped the foundation of this study. It acknowledges the contribution made by other scholars. Google Scholar and PubMed are the primary search engines. It begins with a general introduction to preeclampsia, classification of hypertensive disease, preeclampsia classification, and the criteria used for diagnosis. The chapter then explores the global, regional, and local prevalence of the condition, helping to put the problem into context. It also reviews key biological, social, and demographic factors that have been shown to influence the risk of developing preeclampsia. Further sections examine the impact of preeclampsia on both maternal and perinatal outcomes, drawing insights from various studies. Lastly, the chapter introduces the conceptual framework that guided this research, outlining how different factors interact to influence the occurrence and consequences of preeclampsia

2.1.1 Introduction to Preeclampsia

Preeclampsia is a complex hypertensive disorder occurring during pregnancy, characterized by the onset of elevated blood pressure ($\geq 140/90$ mmHg) and proteinuria after 20 weeks of gestation in a previously normotensive woman. It remains a significant factor in maternal and perinatal morbidity and mortality globally, particularly in low- and middle-income countries (LMIC) where access to adequate prenatal care may be limited (Dimitriadis *et al.*, 2023). Although its exact pathophysiology is not fully understood, preeclampsia is believed to arise from abnormal placentation, systemic endothelial

dysfunction, immune maladaptation, and oxidative stress (Rana *et al.*, 2019). In the absence of prompt diagnosis and intervention, it may advance to serious consequences like eclampsia, HELLP syndrome, or multi-organ dysfunction. Understanding the underlying causes, associated risk factors, and clinical outcomes of preeclampsia is crucial for developing effective prevention strategies and improving the quality of care. Such insights are key to reducing its impact on both maternal and neonatal health.

2.1.2 Classification of hypertension in pregnancy

Hypertensive disorders in pregnancy are generally categorized into four main types based on when they develop, their severity, and the presence of proteinuria or other systemic signs. These include chronic hypertension, gestational hypertension, preeclampsia-eclampsia, and chronic hypertension with superimposed preeclampsia. Chronic hypertension is defined as elevated blood pressure ($\geq 140/90$ mmHg) that is detected either before pregnancy or before 20 weeks of gestation (Magee, Brown, *et al.*, 2022). Gestational hypertension refers to elevated blood pressure that occurs beyond 20 weeks of gestation, without the presence of proteinuria or severe symptoms. It usually goes away once the baby is born. Preeclampsia occurs when high blood pressure starts after 20 weeks of pregnancy and is accompanied by proteinuria or signs of end-organ failure, such as high liver enzymes, low platelets, or kidney damage. Eclampsia is when a woman with preeclampsia has seizures that cannot be explained by any other known cause. When a pregnant woman with preexisting hypertension develops new-onset proteinuria or other signs of preeclampsia, she is considered to have chronic hypertension with superimposed preeclampsia, posing greater risks (Brown *et al.*, 2018).

2.1.3 Definition and Diagnostic Criteria of Preeclampsia

Preeclampsia is a hypertensive disorder of pregnancy characterized by blood pressure readings equal to or greater than 140/90 mmHg, recorded on two separate occasions at least four hours apart. In addition, proteinuria is typically confirmed when protein levels exceed 0.3 grams in a 24-hour urine collection or when a urine dipstick test shows a reading of 1+ or higher. This must occur in a woman who had normal blood pressure before pregnancy and is over 20 weeks of gestation. Preeclampsia may manifest up to six weeks postpartum (Mayo Clinic, 2021).

Preeclampsia can have severe features. This means high blood pressure, 160/110 mm Hg or more, twice during bed rest (unless treated before). Other symptoms could include liver problems, shown by high enzyme levels (ALT or AST) or severe stomach pain that doesn't go away with medicine. There might also be severe headaches, breathing difficulty, and even low platelet counts. New problems with vision or seizures may occur (Lim, 2022).

When do these issues happen? Early onset occurs before 34 weeks of pregnancy, while late-onset happens after 34 weeks of gestation (Wójtowicz *et al.*, 2019). Interestingly, updated guidelines suggest that preeclampsia can be diagnosed even in the absence of proteinuria (Fishel Bartal *et al.*, 2022). A comparative study examined outcomes among women with proteinuric preeclampsia, non-proteinuric preeclampsia, and gestational hypertension. The findings revealed that while non-proteinuric preeclampsia was associated with poorer outcomes than gestational hypertension, such as a higher risk of preterm birth and small-for-gestational-age infants, women with proteinuric preeclampsia experienced the most severe complications overall (Homer *et al.*, 2008).

2.1.4 Classification of preeclampsia

Preeclampsia is a complex disorder that can be classified based on when it starts and how severe the clinical symptoms are. This is important for planning treatment and predicting outcomes. It is mostly split into early-onset and late-onset preeclampsia. Early-onset preeclampsia happens before 34 weeks of pregnancy and is commonly linked to problems with the placenta's growth, which makes things worse for both the mother and the baby. On the other hand, late-onset preeclampsia starts at or after 34 weeks and usually has a milder clinical course, but it still poses serious dangers (Brown *et al.*, 2018).

The National Institute for Health and Care Excellence (NICE) categorizes preeclampsia as mild or severe based on the severity of hypertension and the existence of systemic problems. Mild preeclampsia is characterized by blood pressure values of 140/90 mmHg or above, accompanied by proteinuria, although devoid of indications of significant organ dysfunction. Severe preeclampsia, also referred to as preeclampsia with severe features, is characterized by elevated blood pressure ($\geq 160/110$ mmHg) and may present with critical manifestations including thrombocytopenia, compromised hepatic or renal function, pulmonary edema, or neurological symptoms such as cephalalgia and visual disturbances (National Institute for Health and Care Excellence, 2019). This classification assists clinicians in prioritizing monitoring and therapies to avert progression to life-threatening diseases like eclampsia.

Preeclampsia can also be classified based on the clinical context in which it arises. One such approach differentiates between new-onset preeclampsia, which occurs for the first time in a current pregnancy, and recurrent preeclampsia, where the condition reappears in

subsequent pregnancies. Additionally, preeclampsia may be categorized as superimposed preeclampsia, where it develops in a woman with preexisting chronic hypertension, or as preeclampsia without prior hypertension, which emerges in women who previously had normal blood pressure (“Gestational Hypertension and Preeclampsia,” 2020a). These categories help give a clearer clinical picture and are important for tailoring care to each patient’s needs and assessing their risks.

2.1.5 Epidemiology of preeclampsia

Several major factors contribute to the development of preeclampsia, including maternal age, educational level, gestational age beyond six months, and pre-existing medical conditions. Epidemiological evidence indicates that the global prevalence of preeclampsia is gradually increasing over time. Longitudinal studies conducted in Denmark and Alberta between 2005 and 2018 demonstrated a consistent annual rise in preeclampsia incidence, with average yearly increases ranging from 0.03% to 0.06% (Lihme *et al.*, 2024; Singh *et al.*, 2023). Similarly, historical data show an upward trend, with prevalence rates rising from approximately 8% in 1988 to 11% by 2014 (Adwoa *et al.*, 2022; Shraga *et al.*, 2020). Surprisingly, a recent study in Ethiopia revealed a prevalence of 19.1% (Mekonen *et al.*, 2018). The increase in prevalence may be partly attributed to shifts in maternal demographics and health profiles, including higher maternal age, increased use of assisted reproductive technologies, and rising rates of comorbidities such as hypertension, diabetes, and autoimmune diseases.

Multiparity and lower education levels have also been identified as significant risk factors. These trends are concerning, as they suggest a growing burden of chronic health

conditions among pregnant women, which may exacerbate maternal and perinatal complications. This underscores the urgent need for enhanced public health interventions, early risk stratification, and improved antenatal surveillance to curb the rising incidence and mitigate the adverse outcomes associated with preeclampsia.

The rising incidence of preeclampsia constitutes a considerable public health issue, especially in low- and middle-income countries (LMICs), where healthcare systems are frequently underfunded and overburdened. Inadequate infrastructure, a shortage of healthcare professionals specialized in maternal health, and a deficiency of diagnostic and therapeutic resources impede the prompt and effective management of hypertension problems during pregnancy (S. Miller *et al.*, 2016). These systemic constraints not only undermine the quality of maternal care but also lead to avoidable maternal and newborn fatalities. Confronting this escalating burden necessitates continuous investment in maternal health care, enhancement of capabilities, and the incorporation of evidence-based clinical protocols to elevate outcomes for mothers and their infants.

2.1.6 Maternal outcome of preeclampsia

Preeclampsia often complicates maternal health outcomes and, in severe cases, can result in maternal death. Women affected frequently require prolonged hospital stays due to complications. Commonly reported outcomes include antepartum hemorrhage, eclampsia, HELLP syndrome, renal failure, and anemia. These complications pose a major burden on mothers and health systems. Globally, hypertensive disorders of pregnancy, including preeclampsia, remain among the leading direct causes of maternal deaths (Say *et al.*, 2014).

Studies have shown that Early-onset preeclampsia (EOP) has more severe maternal complications than late-onset preeclampsia (LOP). More commonly, EOP could lead to Eclampsia, acute tubular necrosis, DIC, and HELLP Syndrome as compared to LOP (Jehangir *et al.*, 2023). Even though LOP is about twice as common as EOP, cases of early-onset show higher risks for kidney issues, antepartum hemorrhage, IUGR, low birth weight, and lower Apgar scores. Additionally, preterm labor and the use of magnesium sulfate (MgSO₄) and antihypertensive medications were more common in early-onset preeclampsia (Shrestha *et al.*, 2022).

Long-term complications associated with preeclampsia include kidney failure or chronic kidney disease (CKD) and anemia. Hypertensive disorders during pregnancy (HDP), especially preeclampsia, are known to bump up the chances of CKD down the line (Ishaku *et al.*, 2021). Most of the preeclamptic women end up with cesarean deliveries (Nakimuli *et al.*, 2016). This signifies the high burden associated with this condition.

A Kenyan study conducted at Kenyatta National Hospital (KNH) showed that HELLP syndrome, renal dysfunction, Antepartum hemorrhage (APH), and prolonged maternal hospital stay of more than 7 days were the adverse effects of preeclampsia and specifically early-onset type (Ndwiga *et al.*, 2020). Other studies have shown that headache is the most common presenting symptom in patients with preeclampsia (E. C. Miller & Vollbracht, 2021) and, therefore, an important symptom to check when reviewing such patients.

2.1.7 Perinatal outcomes affected by preeclampsia

Preeclampsia is associated with adverse perinatal outcomes, including stillbirth, low birth weight, preterm, and other newborn morbidities. A recent study done in Zimbabwe, Mpilo

Central Hospital, showed a stillbirth prevalence rate of 9.8% in women with severe preeclampsia (Ngwenya *et al.*, 2022). Another study done at MTRH Kenya confirmed a 49.5 % prevalence of LBW in women with preeclampsia. They also found out that the majority of the LBW babies were premature (45%), and other immediate outcomes of these babies were congenital anomalies, birth asphyxia, hypothermia, neonatal jaundice, and sepsis (Sigei *et al.*, 2023).

Numerous other studies have shown that pre-eclampsia is markedly linked to negative perinatal outcomes across different gestational age cohorts. A study indicated a significantly heightened risk of small-for-gestational-age (SGA) children among individuals exposed to pre-eclampsia during all gestational weeks, with an adjusted odds ratio of 5.2 (Ulfsdottir *et al.*, 2024), signifying about a fivefold increase in risk relative to non-exposed infants. Moreover, pre-eclampsia is associated with an increased probability of diminished Apgar scores at 5 minutes postpartum, occurring at twice the frequency observed in unexposed fetuses. Infants born to women with pre-eclampsia faced about double the likelihood of necessitating rapid resuscitation (Ulfsdottir *et al.*, 2024).

Recent research has shown a lasting impact of preeclampsia on infants born to mothers with the condition. A notable study is an article entitled Preeclampsia Beyond Pregnancy. The researchers have emphasized that, besides the immediate postpartum complications faced by women with a history of preeclampsia, there is increasing evidence suggesting that children exposed to preeclampsia in utero may encounter elevated risks of long-term health issues (Turbeville & Sasser, 2020). Preeclampsia is identified as a significant

contributor to intrauterine growth restriction (IUGR) and premature delivery, both of which elevate the risk of developing hypertension and cardiovascular illnesses in later life. Importantly, this elevated risk is not limited to infants with low birth weight. Evidence suggests that even children and adolescents born to mothers with preeclampsia, who had birth weights above 2.5 kilograms, tend to have higher systolic blood pressure when compared to those born to mothers without preeclampsia. These findings are consistent with follow-up studies showing a higher incidence of stroke among individuals who were exposed to preeclampsia during fetal development (Turbeville & Sasser, 2020).

2.2 Prevalence and incidence trends

Preeclampsia affects approximately 2% to 5% of pregnancies worldwide and is associated with significant adverse health outcomes for both the mother and the infant, particularly when it develops early in gestation. About 76,000 women and 500,000 babies die from this disorder globally each year (Poon *et al.*, 2021). The global average shows that about 2-8% of pregnancies deal with this (“Gestational Hypertension and Preeclampsia,” 2020a).

A past detailed, systematic, and analytical review looked at many studies across Africa about Preeclampsia published from 1997 to 2017, where a total sample size of 854,304 pregnant mothers was reviewed during the puerperium period (Noubiap *et al.*, 2019). The team found various hypertension-related rates, including gestational hypertension affecting nearly 5%, while preeclampsia affected around 4%, severe cases were closer to 2%, and eclampsia showed up about 1% (Noubiap *et al.*, 2019). Summarily, this study

suggested that 1 in every 10 (10 %) pregnant women in Africa has a hypertensive disorder of pregnancy.

Another systematic review and meta-analysis study done by Gemechu, which included data from 19 countries spanning several years, revealed that hypertensive disorders affect about 8% of pregnancies. Pregnant women affected by these disorders faced markedly worse outcomes than their healthy counterparts. Maternal mortality was reported to be 17 times higher in this group, while the likelihood of cesarean delivery was more than tripled, alongside several other adverse outcomes (Gemechu *et al.*, 2020). In East Africa, a study to look at the magnitude of preeclampsia was conducted in Ethiopia, which revealed a prevalence of 15.7% (Alemu Degu Ayele & Zemenu Alemu Tilahun, 2022).

Studies conducted in Kenya have reported relatively higher prevalence rates of preeclampsia compared to some global estimates. The prevalence has been documented at approximately 7.3%, suggesting a considerable burden of the condition among pregnant women in the country (Mwangi, 2021). Furthermore, recurrent preeclampsia has been observed in about 28% of cases, highlighting its significant contribution to maternal morbidity (Ayaya, 2023). These findings underscore the seriousness of preeclampsia as a public health concern in Kenya.

2.3 Pathophysiology and Risk Factors

The exact cause of preeclampsia remains unclear; however, several contributing factors have been proposed, including placental abnormalities, immune dysfunction, genetic predisposition, nutritional influences, and cardiovascular complications. Patients may face preeclampsia when their placenta doesn't develop properly. This causes specific markers

in the body that lead to issues with blood vessels and can harm the lining of those vessels (Ives *et al.*, 2020).

Immune dysregulation has also been implicated in the development of preeclampsia. A breakdown in normal immune tolerance may trigger excessive, sterile inflammation during pregnancy, which in turn negatively affects maternal and fetal outcomes. This immune-mediated process contributes to the complex course and multisystem manifestations that characterize this vascular disorder in pregnancy (Lokki *et al.*, 2018; Tyrmi *et al.*, 2023).

According to National Institute for Health and Care Excellence (NICE) guidelines, there are two risk categories: high & moderate risk. High-risk women may have had hypertension in a previous pregnancy or have chronic conditions like diabetes, chronic kidney disease, systemic lupus erythematosus (SLE), or antiphospholipid syndrome. Moderate risks could include women over 40, first-time pregnant, or those who weigh over 35 kg/m², those with more than one fetus, and a history of a family member with PET (National Institute for Health and Care Excellence, 2019).

In a previous study in Bangladesh to check on the cardiovascular risk, attendance to ANC, and rural versus urban area settings, the prevalence of preeclampsia was notably higher in rural areas compared to urban areas. It also showed that being overweight or obese, with increased liver enzymes and uric acid, was more prevalent in preeclamptic pregnancies compared to non-preeclamptic pregnancies. Conversely, levels of high-density lipoprotein cholesterol are lower among those with preeclampsia. Furthermore, participants in rural areas who required occasional or regular use of antihypertensive medications and who did

not receive adequate antenatal care were found to be at increased risk of developing preeclampsia (Mou *et al.*, n.d.). Another study found that having preeclampsia in a previous pregnancy raises the risk of developing it again in future pregnancies (Mæland *et al.*, 2023). Additionally, other research has identified several factors that increase the likelihood of preeclampsia, including high blood pressure, first-time pregnancy, diabetes, carrying multiples, low education levels, and poverty (Khan *et al.*, 2022; Stitterich *et al.*, 2021b; Yang *et al.*, 2021). This is also supported by a 2020 systematic and meta-analysis review study conducted to examine factors associated with preeclampsia in sub-Saharan Africa, in which they identified primiparity, previous history of preeclampsia, family history of preeclampsia, anemia in pregnancy, obesity, chronic hypertension, and lack of antenatal care visits as among the contributors (Abalos *et al.*, 2014; Meazaw *et al.*, 2020). Additionally, women living in low-resource countries are at greater risk for these conditions due to fewer resources & education opportunities, leading to health disparities impacting pregnancies as compared to those in towns (Poon *et al.*, 2021). Others are maternal age, low socioeconomic status, education level, and gestation over 36 weeks, and a rural area setup (Eticha *et al.*, 2024).

A comprehensive study conducted between 2000 and 2014 at the Kilimanjaro Christian Medical Centre in Northern Tanzania revealed a preeclampsia/eclampsia prevalence of 4.2% among newly registered pregnant women. The findings painted a clear picture of the groups at greater risk: women aged 35 and above, those with higher levels of education (12 or more years of schooling), unmarried women, and those who were overweight or obese. In addition, women with a history of hypertension, anemia, or multiple pregnancies

were found to be especially vulnerable, particularly those with a history of hypertension, which emerged as the strongest predictor. On a more hopeful note, women who attended four or more antenatal care (ANC) visits were significantly less likely to develop preeclampsia. These findings were in line with a broad body of earlier research, reinforcing the need for focused preventive strategies and timely care in maternal health (Frank *et al.*, 2020; Kassa, Asnkew, *et al.*, 2023; Mekie *et al.*, 2020; Tessema, 2015).

2.4 Treatment of preeclampsia

The treatment of preeclampsia largely depends on how far along the pregnancy is and how severe the condition becomes. For women with mild preeclampsia, especially if the baby is not yet full term, doctors usually try to manage the condition conservatively. This often includes close monitoring of the mother's blood pressure, checking for signs of worsening disease, and frequent fetal assessments. The goal in such cases is to buy more time for the baby to grow while keeping both the mother and baby safe. On the other hand, if the condition is severe, with very high blood pressure, signs of organ damage, or distress to the baby, the safest option is usually to deliver the baby, even if it means an early birth. In these situations, the health of the mother takes priority, as delaying delivery can lead to life-threatening complications like eclampsia or stroke ("Gestational Hypertension and Preeclampsia," 2020a).

In terms of medications, the main focus is to control blood pressure and prevent seizures. Drugs like labetalol, nifedipine, or hydralazine are commonly used to bring high blood pressure down to safer levels. To prevent or treat seizures, magnesium sulfate is considered the gold standard and is widely used around the world. When an early delivery is likely,

especially before 34 weeks, steroids are often given to help the baby's lungs mature faster. Experts emphasize that each case should be managed individually, considering the mother's symptoms, the baby's condition, and the resources available. This is especially important in settings like Kenya, where access to advanced care may not always be guaranteed. Early detection, timely treatment, and the right decisions at the right time make all the difference in improving outcomes for both mother and baby (Magee, Brown, *et al.*, 2022).

2.5 Prevention of preeclampsia

Preventing preeclampsia begins with ensuring that every pregnant woman has access to comprehensive, high-quality, and timely antenatal care. Regular monitoring during pregnancy enables early identification of preeclampsia and its warning signs, which is critical in reducing adverse outcomes. Women considered to be at high risk, such as those with a history of preeclampsia, chronic hypertension, diabetes, or renal disease, may significantly benefit from a preventive regimen. One widely endorsed intervention is the use of low-dose aspirin (75–150 mg daily), initiated before 16 weeks of gestation. This has been shown to reduce the incidence of preeclampsia, particularly early-onset forms (Rolnik *et al.*, 2017). In addition to aspirin, calcium supplementation plays a crucial role, especially in populations where dietary calcium intake is insufficient.

The World Health Organization recommends a daily intake of 1.5 to 2 grams of calcium during pregnancy to lower the risk of preeclampsia and associated complications (World Health Organization, 2018). These measures are supported by robust scientific evidence and are integrated into international clinical guidelines. Furthermore, preventive strategies

should also include lifestyle modifications such as maintaining a balanced diet, engaging in appropriate physical activity, controlling body weight, and managing pre-existing conditions like diabetes or hypertension. Health education, early screening, and consistent follow-up form a holistic approach to prevention, ultimately enhancing maternal and neonatal outcomes and reducing the global burden of preeclampsia.

To sum up, while preeclampsia has been widely studied, there is still limited information on how it affects women in specific local settings such as Narok County. Most available evidence comes from broader national or global studies, which may not fully capture the unique risk factors and outcomes in this community. This study, therefore, seeks to fill that gap by providing context-specific data that can guide better maternal and newborn health interventions

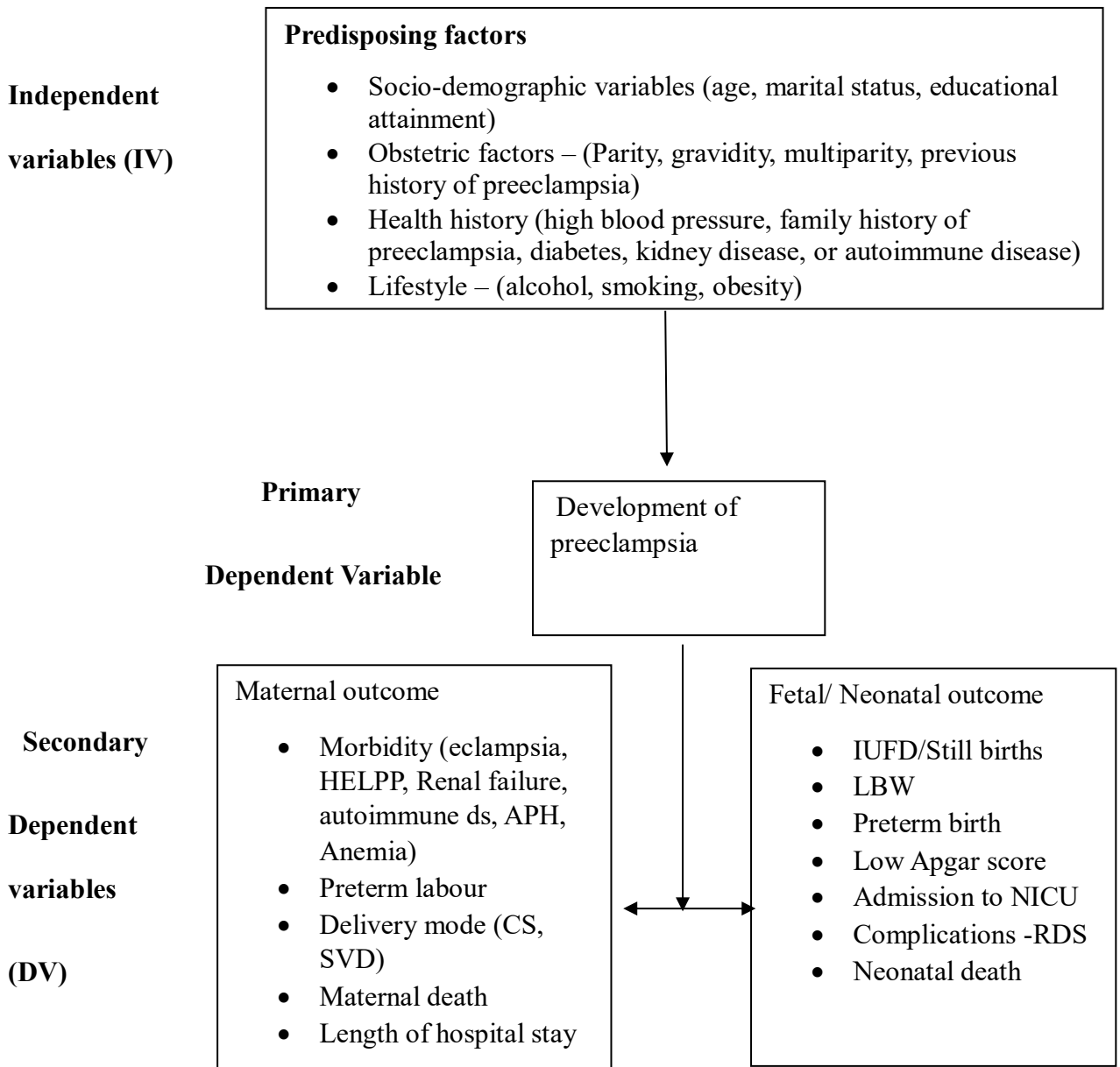
2.6 Conceptual Framework

Drawing from extensive literature, previous research, and guided by the Health Outcomes Model (Mitchell et al., 1998), this study developed a conceptual framework to illustrate how maternal factors influence the risk of developing preeclampsia and the subsequent effects on both mother and infant. As shown in Figure 2.1, the framework outlines key risk factors, such as maternal age, level of education, parity, history of preeclampsia, preexisting chronic illnesses, lifestyle habits like smoking or alcohol use, and antenatal care attendance, as independent variables that may directly or indirectly contribute to disease onset.

These factors are linked to maternal and perinatal outcomes, which serve as dependent variables and reflect the clinical severity and impact of preeclampsia. Maternal outcomes

include severe complications such as eclampsia, HELLP syndrome, renal failure, preterm labor, extended hospital stay, and maternal death. Neonatal outcomes comprise stillbirth, low birth weight, preterm delivery, neonatal intensive care unit (NICU) admission, and neonatal death. The conceptual framework offers a clear pathway that aligns with the Health Outcomes Model by connecting exposure to specific risk factors with quantifiable health consequences. This structured approach supports the understanding of how the interplay of biological, clinical, and social determinants contributes to maternal and neonatal health during hypertensive disorders of pregnancy.

Figure 2. 1 The Conceptual Framework



CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter outlines the research approach and procedures employed in conducting the study. It details how data were collected, managed, and analyzed, and explains the methodological framework that guided the investigation. The study focused on mothers who delivered at Narok County Referral Hospital (NCRH) between January and December 2023. Its primary aim was to explore the contributing factors to preeclampsia and assess its impact on maternal and neonatal health, including the frequency and severity of associated complications.

The chapter describes the study design, location, target population, sampling strategy, sample size determination, and data collection methods in detail. It also covers the inclusion and exclusion criteria, data collection tools, and specific procedures used to ensure the quality, reliability, and validity of the data. Ethical considerations observed throughout the research process are clearly outlined, including obtaining approvals and ensuring participant confidentiality. Lastly, the conceptual framework presented in Chapter Two is used to contextualize the key variables and guide the interpretation of findings within a theoretical and practical research lens.

3.2 Study Design

This study used a retrospective cross-sectional design with a quantitative approach to review medical records of all mothers who delivered at Narok County Referral Hospital from January 1 to December 31, 2023, regardless of preeclampsia diagnosis. The design was appropriate for determining the prevalence of preeclampsia, identifying its key

determinants, and describing the actual maternal and perinatal outcomes among mothers diagnosed with the condition. The quantitative approach enabled systematic collection and analysis of numerical data to present an accurate picture of clinical outcomes within the study population. This design was selected for its efficiency, cost-effectiveness, and suitability for examining existing data over a defined period (Puspa Zuleika & Legiran, 2022; Setia, 2016).

However, this study design does not permit the establishment of causal relationships between variables, as it captures data at a single point in time. Additionally, the use of secondary data from medical records may present challenges related to data quality and completeness. To address these limitations, records with missing or incomplete information were excluded and replaced with complete files. Furthermore, comprehensive data cleaning procedures were implemented to enhance the accuracy and reliability of the dataset.

3.3 Study area

The study was conducted at Narok County Referral Hospital (NCRH), which is located in Narok County, Kenya. NCRH was selected as the research site due to its central role in providing maternal health services within the county and its high patient volume, particularly among women presenting with obstetric complications such as preeclampsia.

Narok County faces significant challenges in maternal health, as highlighted by the 2022 Kenya Demographic and Health Survey (KDHS). Only about 55% of pregnant mothers in the county attend antenatal clinic (ANC) visits, meaning that 45% either do not attend or have fewer than the recommended visits. This could be attributed to limited healthcare

access. The county also has a high fertility rate of 4.9%, compared to the national average of 3.4% (Kenya National Bureau of Statistics, 2022), and a high (MMR) maternal mortality rate of 434 per 100,000 live births (Monda, n.d.). These statistics, coupled with the county's diverse ethnic, cultural, and socioeconomic landscape, make Narok a representative setting for studying maternal and perinatal health outcomes.

Narok County Referral Hospital is the largest healthcare facility in the county and serves as the only referral hospital, designated as a Level 5 facility. It is located about 500 meters northwest of Narok town center and caters to a catchment population of approximately 42,168 people, most of whom live in rural areas. The hospital operates 24 hours a day and manages over 4,000 deliveries each year, making it a vital hub for maternal care. In 2023, NCRH recorded a total of 5,801 deliveries. The facility has a bed capacity of 200 inpatients, with the Obstetrics and Gynecology ward providing 40 maternity beds and a Newborn Unit (NBU) equipped with 6 beds. The hospital consists of multiple departments, including Medicine, Surgery, Pediatrics, and specialized units such as the Intensive Care Unit (ICU), Operating Theatre, Renal Unit, and NBU. The Obstetrics and Gynecology (OB/GYN) department is staffed by a multidisciplinary team that includes Reproductive health specialists (Team lead), medical officers, clinical officers, nursing officers, medical interns in residency training, and medical students. These characteristics made Narok County Referral Hospital an appropriate and strategic site for investigating the determinants of preeclampsia and assessing the maternal and fetal outcomes among mothers diagnosed with the condition.

The map below displays the boundaries of Narok County, situated in the southern part of Kenya within the Rift Valley region.

Figure 3. 1 Narok Map



The county lies approximately between latitudes $0^{\circ}50'S$ and $2^{\circ}00'S$ and longitudes $35^{\circ}45'E$ and $36^{\circ}45'E$ (GeoCords, 2024). It borders Migori County to the west, Bomet and Nakuru Counties to the north, Kajiado County to the east, and the Republic of Tanzania to the south. Narok town, located centrally in the county, serves as the administrative headquarters. The county is accessible via major roads linking it to Nairobi, Naivasha, and Kisii. Its landscape is diverse, consisting of highland areas such as the Mau Escarpment and low-lying plains extending towards the Maasai Mara, a globally recognized wildlife conservation area. Altitude ranges from approximately 1,400 to 2,800 meters above sea level, influencing the county's climate, agriculture, and human settlement patterns.

3.4 Population

The target population comprised all expectant women residing in Narok County. The accessible population included women admitted to Narok County Referral Hospital

(NCRH) between January 1, 2023, and December 31, 2023, who delivered during this period. The study population consisted of mothers from this accessible group whose medical records were complete and met the inclusion criteria. In total, 5,801 deliveries were recorded at NCRH in 2023, from which the study sample was drawn.

The intended participants were all expectant women residing in Narok County. The accessible population consisted of expectant women who were admitted to Narok County Referral Hospital (NCRH) between January 1, 2023, and December 31, 2023, and who delivered their infants. The study group, which was selected from the available population as a whole, consisted of mothers who were admitted and gave birth at NCRH during the study period and had comprehensive and appropriate medical records. The study was able to select pertinent records for the investigation from the 5,801 deliveries that were documented in 2023, as indicated by hospital statistics.

3.5 Eligibility Criteria

3.5.1 Inclusion Criteria

The study included all pregnant women admitted to Narok County Referral Hospital for delivery during the study period, regardless of age. This encompassed women with both singleton and multiple pregnancies, varying obstetric histories, including primigravida and multigravidas, and diverse socioeconomic backgrounds. As this was a retrospective study utilizing existing medical records, individual consent was not required. However, formal permission to access and collect data was obtained from the hospital administration.

3.5.2 Exclusion Criteria

The study excluded non-pregnant women and pregnant women hospitalized for reasons unrelated to birth, including antepartum problems without delivery. Deliveries that occurred outside the study period (year 2023) were not included. Additionally, medical records with incomplete data and cases involving mothers who delivered before arrival at the facility (Born Before Arrival, BBA) were excluded from the study.

3.6 Sampling frame

The sampling frame comprised all delivery cases recorded in the maternity registers at Narok County Referral Hospital (NCRH) between 1st January and 31st December 2023. A total of 5,801 deliveries were documented during this period. These records formed a reliable and comprehensive database from which eligible cases, based on the study's inclusion and exclusion criteria, were identified for sampling. The use of the maternity register as the sampling frame ensured completeness, time specificity, and consistency in selecting review cases.

3.7 Sample size and sampling technique

Between January 1st and December 31st, 2023, a total of 5,801 pregnant women were admitted and delivered at Narok County Referral Hospital (NCRH), as recorded in the hospital's maternity register. The sample size for this study was determined using Cochran's formula for finite population correction, with a 95% confidence level and a 5% margin of error. A prevalence rate of 15.7% was derived from a comparable study conducted at Debre Tabor Specialized Hospital in Ethiopia, which investigated the extent and correlating factors of preeclampsia (Alemu Degu Ayele & Zemenu Alemu Tilahun,

2022). Based on this prevalence, the sample size was calculated using Cochran's formula for a finite population:

$n = N * Z^2 * P(1-P) / E^2(N-1) + Z^2 * P(1-P)$; Where:

- n is the sample size
- N is the population size of 5801 (total number of mothers admitted to maternity at NCRH during the study period).
- Z is the Z-score = 1.96 for 95% confidence.
- P is the estimated prevalence of preeclampsia in the previous study in Ethiopia was 15.7 (Alemu Degu Ayele & Zemenu Alemu Tilahun, 2022).
- E is the margin of error at 5% (0.05)
- Therefore n = 196

To account for potential missing or incomplete data, the sample size was increased by 15% using the formula:

Adjusted sample size = Required sample size / 1 - non-response rate; $196 / 0.85 = 231$

Thus, the final adjusted sample size was **231**.

The choice of 15.7% prevalence was guided by a cross-sectional, hospital-based study at Debre Tabor Specialized Hospital, Ethiopia (Alemu & Tilahun, 2022), which is methodologically comparable to the present study and was conducted in a similar referral-

level, rural context. Although a Kenyan study at MTRH reported a prevalence of approximately 10% (Buitendyk et al., 2023), MTRH serves a more urban and better-resourced population. In contrast, Narok County Referral Hospital caters to a predominantly rural and partly nomadic community with greater barriers to maternal healthcare. Therefore, a higher prevalence was reasonably expected in Narok, justifying the adoption of the Ethiopian estimate for sample size determination.

A **systematic random sampling technique** was used to select participants. Every 25th record in the maternity register was selected after identifying a random starting point. In cases where a record met the exclusion criteria or was incomplete, the next eligible file on the list was selected to maintain the required sample size.

3.8 Data collection instrument

A structured data extraction form was used to systematically collect all relevant variables from existing medical records. This tool ensured consistency, accuracy, and completeness during the data collection process. It was appropriate for this retrospective study, as all required information was already available in the hospital records, and no primary data collection was necessary. The tool also allowed for efficient categorization and retrieval of data across multiple patient files, minimizing potential errors or omissions. The data extraction form used is attached as Appendix 1 and serves as a consistent reference tool throughout the data collection process.

3.9 Variables of interest

The conceptual framework (see Figure 2.1) guided the selection of key variables, shaped the hypotheses regarding their relationships, and informed the analytical methods used to

examine the factors influencing preeclampsia and its outcomes. These variables were grouped into three main categories: determinants of preeclampsia, maternal outcomes, and fetal or neonatal outcomes among women diagnosed with preeclampsia.

3.9.1 Determinants of Preeclampsia

The determinants comprised a combination of social, obstetric, and clinical factors thought to elevate the risk of preeclampsia development. Socio-demographic characteristics, including maternal age, marital status, educational attainment, occupation, and residential area (rural or urban), were analyzed. Obstetric and clinical factors encompassed gravidity, parity, gestational age at delivery, occurrence of multiple gestations, frequency of antenatal care (ANC) visits, prior history of preeclampsia, previous cesarean deliveries, and underlying conditions such as chronic hypertension and diabetes.

3.9.2 Maternal Outcomes

Maternal outcomes pertain to the health consequences that mothers experience after a diagnosis of preeclampsia. The factors considered included the mode of delivery, spontaneous vaginal or cesarean, and the incidence of complications such as eclampsia, postpartum hemorrhage, HELLP syndrome, sepsis, acute kidney injury, and anemia. Additional outcomes evaluated included ICU admission, maternal mortality, and duration of hospital stay, indicating the severity and impact of the condition on maternal health.

3.9.3 Fetal and Neonatal Outcomes

Fetal and neonatal outcomes captured the health and survival status of the baby. Key indicators included birth weight (classified as low or normal), Apgar scores at one and five minutes, gestational age at birth (preterm, term, or post-term), and whether the newborn

required admission to a neonatal unit. The study also recorded complications such as respiratory distress syndrome, neonatal sepsis, and hypoglycemia. Crucially, it examined perinatal mortality, including stillbirths and early neonatal deaths, and the overall pregnancy outcome, categorized as either a live birth or stillbirth.

3.10 Validity and reliability of the research instrument

The data extraction tool was carefully developed with input from an obstetrician specialist to ensure it is both accurate and relevant to the clinical context. It underwent a thorough review and validation by research supervisors, who ensured that it captured all necessary information clearly and effectively. To ensure reliability, the tool was designed for simplicity and clarity, making it easy to use without confusion. The research assistants received extensive training to apply the tool consistently, and ongoing oversight was maintained through regular checks to ensure the accuracy and dependability of the data collected throughout the study.

3.11 Data collection procedure

Following the acquisition of necessary approvals from the Baraton University Ethical Review Committee and the research license from the National Commission for Science, Technology and Innovation (NACOSTI), authorization to collect data was requested from the Narok County administration and Narok County Referral Hospital (NCRH). Data were collected using a structured data extraction form (Appendix 1), which captured key study variables including socio-demographic characteristics, medical history, pregnancy-related information, preeclampsia diagnosis, maternal outcomes, neonatal outcomes, and other potential risk factors. The principal investigator, assisted by four trained research

assistants, conducted the data collection. The research assistants were oriented and trained to ensure uniformity, accuracy, and confidentiality in data extraction. Data sources included individual medical files and the maternity register at NCRH. Throughout the data collection process, the principal investigator continuously reviewed the extracted data alongside the medical files to ensure completeness and accuracy, making corrections as necessary before the files were returned. All extracted data were securely stored in a lockable cabinet accessible only to the principal investigator, ensuring the confidentiality and integrity of the data throughout the study.

3.12 Data analysis

Data were coded, cleaned, and analyzed using IBM SPSS Statistics version 29. Since all study variables were categorical, data were summarized using the mode. The Chi-square (χ^2) test or Fisher's exact test was applied to compare frequencies between women with and without preeclampsia, as appropriate. Binary logistic regression was used to identify risk factors associated with preeclampsia. Univariate analysis examined maternal, fetal, and neonatal outcomes. A *p*-value of less than 0.05 was considered statistically significant.

3.13 Ethical consideration

Prior to initiating data collection, ethical approval for the project was secured from the Institutional Research Ethics Committee (IREC) of Baraton University (appendix 3) to guarantee compliance with established ethical norms and procedures. After the IREC approval, a research license was acquired from the National Commission for Science, Technology and Innovation (NACOSTI) (appendix 5). Furthermore, legal authorization was obtained from the Narok County Government (Appendix 6) and the administration of

Narok County Referral Hospital (NCRH) (Appendix 7) to access pertinent medical information and conduct data collection within the hospital.

To ensure confidentiality and safeguard the privacy of individuals whose medical records were examined, all patient files were anonymized through the use of unique identification codes. No names or personally identifiable information were recorded or utilized in any aspect of data collection, analysis, or presentation of findings. All finalized data extraction forms and associated materials were securely stored in a locked cabinet, accessible solely to the principal investigator. All other non-significant raw data were disposed of appropriately.

The study utilized a retrospective design, relying on secondary data from existing hospital records, which eliminated the need for direct patient contact and individual informed consent. Institutional consent from the hospital administration was secured to permit access to the records (appendix 7). No financial or material compensation was offered to any participants in this study. The research findings were presented to the hospital management following the completion of data collection and analysis, along with evidence-based recommendations aimed at enhancing maternal and perinatal care services at the facility. The findings and recommendations were communicated to the county health management.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This chapter delineates the study's findings regarding the determinants of preeclampsia and assesses its maternal and perinatal outcomes among women delivering at Narok County Referral Hospital. The data, drawn from patient records spanning January through December 2023, are organized in alignment with the study's objectives. From the 231 medical records targeted for review, 14 were excluded due to missing critical variables, leaving 217 complete records for final analysis. Descriptive statistics summarized the key characteristics of the study population. Binary logistic regression, Fisher's exact test, and chi-square tests were used to identify significant predictors of preeclampsia, while univariate analysis evaluated maternal and perinatal outcomes.

The analysis and results discussed in this chapter directly correspond to the Conceptual Framework outlined earlier (Figure 2.1), which guided the study's approach to understanding how various risk factors, such as maternal age, parity, medical history, and socio-demographic characteristics, influence the development of preeclampsia and subsequent outcomes. By applying this framework, the study systematically investigates both the direct and indirect pathways through which these factors affect maternal and neonatal health.

Furthermore, comparisons to existing literature in the discussion section contextualize these findings within broader clinical and epidemiological knowledge, reinforcing or challenging established patterns and highlighting potential areas for intervention in the local setting.

4.2 Baseline Characteristics of Study Participants

The demographic and clinical characteristics of the study participants are presented in Table 4.1. A total of 217 study participants were enrolled in the study. Age categorization showed that 14 (6.5 %) study participants were <17 years, 119 (54.8%) were aged between 18≤25 years, 69 (31.8%) participants fell between 26≤35 years, while 15 (6.9%) study participants were ≥36 years. There were 132 (60.8%) respondents who resided in rural areas, while 85 (39.5%) lived in urban settings. Notably, 171 (78.8%) participants were married, whereas 46 (21.2%) were single. Gravity varied among the study participants, with 86 (39.6%) being primigravida, 101 (46.5%) having between 2 and 4 pregnancies, while 30 (13.8%) had 5 or more previous pregnancies. Additionally, parity showed that 90 (41.5%) were nulliparous women with no prior deliveries beyond 24 weeks, 98 (45.2%) had one to three previous viable deliveries of at least 24 weeks' gestation, while 29 (13.3 %) women had a history of four or more such deliveries.

Prenatal care attendance revealed maternal health service participation. One to three ANC visits were made by 114 (52.5%) participants. Nine (4.1%) participants did not attend any prenatal care appointments, while 94 (43.3%) participants attended at least four visits, meeting the WHO's minimum recommended level. Concerning pregnancy type, 27 (12.4%) participants reported multiple gestations in either the current or a previous pregnancy, while 190 (87.6%) had singleton pregnancies. Of all participants, 201 (92.6%) had no preexisting medical conditions. In contrast, 13 (6%) had chronic hypertension, 2 (0.9%) had diabetes, and 1 (0.5%) had both hypertension and diabetes. Family history of preeclampsia was reported in 5 (2.3%) participants, while 212 (97.7 %) had no family

history. Furthermore, 4 (1.8%) study participants experienced preeclampsia in a previous pregnancy, while 213 (98.2%) reported no prior history of preeclampsia.

Preeclampsia screening revealed that 17 (7.8%) study participants were positive, while 200 (92.2%) participants were negative. Notably, 3 (17.6%) and 14 (82.4%) of the preeclampsia cases were early-onset and late-onset preeclampsia, respectively. There were 186 (85.7%) study participants with normal blood pressure ($\leq 140/90$ mmHg), 17 (7.8%), had pressure range between 140–160 mmHg systolic and 90–110 mmHg diastolic, while 14 participants (6.5%) presented with severe hypertension, exceeding 160/110 mmHg. Gestational age at delivery among the respondents indicated that 164 (75.6%) delivered at term (≥ 37 weeks), 43 (19.8%) had late preterm deliveries between 34 and 36 weeks, while early preterm deliveries, occurring before 34 weeks, were reported in 10 (4.6%) participants. Vaginal delivery was the mode of birth for most participants, accounting for 187 (86.2%) cases, while 30 (13.8%) underwent cesarean section. After delivery, 214 (98.6%) mothers survived, while 3 (1.4%) maternal deaths were recorded.

The pregnancy outcomes revealed that 209 infants (93.7%) were born alive, while 14 (6.3%) were stillbirths or intrauterine fetal deaths. Among all infants, 179 (80.3%) had normal birth weights, and 44 (19.7%) were classified as low birth weight. Admission to the newborn unit (NBU) was necessary for 18 (8.1%) infants, whereas 205 (91.5%) did not require admission. Overall, neonatal outcomes indicated that 201 newborns (90.1%) survived beyond the neonatal period, with a total of 22 (9.9%) deaths recorded, including both stillbirths and deaths that occurred after delivery.

Table 4.1 Demographic and clinical characteristics of study participants

Characteristics	N (%)
Preeclampsia	
Positive	17 (7.8)
Negative	200 (92.2)
Onset of Preeclampsia	
Early	3 (17.6)
Late	14 (82.4)
Highest Blood pressure reading	
Normal ($\leq 140/90$ mmHg)	186 (85.7)
Mild ($>140 \leq 159 / >90 \leq 109$ mmHg)	17 (7.8)
Severe ($\geq 160/110$ mmHg)	14 (6.5)
Age in years	
<18	14 (6.5)
$18 \leq 25$	119 (54.8)
$26 \leq 35$	69 (31.8)
≥ 36	15 (6.9)
Residence	
Rural	132 (60.8)
Urban	85 (39.2)
Marital status	
Married	171 (78.8)
Single	46 (21.2)
Gestational age in weeks at delivery	
<34	10 (4.6)
$34 \leq 36$	43 (19.8)
≥ 37	164 (75.6)
Gravidity	
1	86 (39.6)
$2 \leq 4$	101 (46.5)
≥ 5	30 (13.8)
Parity	
0	90 (41.5)
$1 \leq 3$	98 (45.2)
≥ 4	29 (13.4)
Number of antenatal (ANC) visits	
0	9 (4.1)
$1 \leq 3$	114 (52.5)
≥ 4	94 (43.3)
Preexisting medical conditions	
Non	201 (92.6)
Diabetes	2 (0.9)
Chronic hypertension	13 (6)

Diabetes and chronic hypertension	1 (0.5)
Family history of preeclampsia	
Yes	5 (2.3)
No	212 (97.7)
Previous history of preeclampsia	
Yes	4 (1.8)
No	213 (98.2)
Multiple gestations (current pregnancy or previous)	
Yes	27 (12.4)
No	190 (87.6)
Mode of delivery	
Cesarean section	30 (13.8)
Vaginal delivery	187 (86.2)
Maternal outcome	
Survived	214 (98.6)
Died	3 (1.4)
Fetal outcome	
Live birth	209 (93.7)
Stillbirth/intra-uterine fetal death	14 (6.3)
Birth weight	
Normal	179 (80.3)
Low birth weight	44 (19.7)
Admission to the Newborn unit (NBU)	
Yes	18 (8.1)
No	205 (91.9)
Neonatal survival status	
Survived	201 (90.1)
Dead	22 (9.9)

Data are presented as numbers and proportions (%) of study participants. ≤, less than or equal to. <, less than. ≥, greater than or equal to. >, greater than.

4.3 Determinants of Preeclampsia

Determinants of preeclampsia are presented in Table 4.2.

Socio-demographic factors:

Age was not associated with preeclampsia ($p > 0.05$). Although the proportion of cases was higher among women residing in rural areas compared to urban areas (88.6% vs. 11.2%; $p = 0.016$), the association did not reach statistical significance in the logistic regression model (OR = 4.501, 95% CI: 0.973–20.822, $p = 0.054$). Marital status was significantly associated with preeclampsia in the chi-square analysis ($p = 0.036$); however, the odds ratio was not statistically significant (OR = 2.647, 95% CI: 0.892–7.86, $p = 0.080$).

Clinical and obstetric factors:

Multiple gestation showed a significant association with preeclampsia (OR = 3.457, 95% CI: 1.040–11.495, $p = 0.043$). Gravidity was also significant, with 58.8% of preeclampsia cases occurring among primigravida compared to 17.6% with gravidity 2–4 and 23.5% with gravidity ≥ 5 (Fisher's exact test, $p = 0.026$). Similarly, 58.8% of the cases were nulliparous compared to 17.6% with 1–3 previous births and 23.5% with ≥ 4 births ($p = 0.036$). Antenatal care attendance was not significantly associated with preeclampsia ($p = 0.179$), nor was the history of preeclampsia ($p = 0.197$).

Table 4.2 Determinants of Preeclampsia Among Study Participants

Variable	Positive Preeclampsia (n=17)	Negative preeclampsia (n=200)	<i>p</i> -value (χ^2)	OR [95 % CI]	<i>p</i> -value (Wald)
Age					
< 18 years	2 (11.8)	12 (6)	0.376*		
18≤25	9 (52.9)	110 (55)			
26≤35	4 (23.5)	65 (32.5)			
>35 years	2 (11.8)	13 (6.5)			
Residence					
Rural	15 (88.2)	117(58.5)	0.016	4.501 [0.973-20.822]	0.054
Urban	2(11.8)	83(41.5)		Ref	
Gravidity					
0	10 (58.8)	76 (38)	0.026*		
2-4	3 (17.6)	98 (49)			
≥5	4 (23.5)	26 (13)			
Parity					
0	10 (58.8)	80 (40)	0.036*		
1≤3	3 (17.6)	95(47.5)			
≥4	4 (23.5)	25(12.5)			
Multiple gestation (current and past)					
Yes	5(29.4)	22(11)	0.027	3.457 [1.040-11.495]	0.043
No	12(70.6)	178(89)		Ref.	
Antenatal care visits (ANC)					
<4	7 (41.2)	116 (58)	0.179		
≥4	10 (58.8)	84 (42)			
Preexisting medical condition					
Yes	1 (5.9)	15(7.5)	0.806		
No	16(94.1)	185(92.5)			
Past history of preeclampsia					
Yes	1(5.9)	3(1.5)	0.197		
No	16(94.1)	197(98.5)			
Marital status					
Single	7(41.2)	39(19.5)	0.036	2.647 [0.892-7.86]	0.080
Married	10(58.2)	161(80.5)		Ref.	

Data are presented as numbers and proportions (%) of study participants. ≤, less than or equal to. <, less than. ≥, greater than or equal to. >, greater than. OR, Odds Ratio. %, percentage. CI, 95 percent confidence intervals. *, Fisher-Freeman-Halton Exact Test. (χ^2), Pearson Chi-square *P*-value. Ref., reference category.

4.4 Maternal Outcomes among Women Diagnosed with Preeclampsia

Maternal outcomes among study participants with preeclampsia are presented in Table 4.3. Late-onset preeclampsia accounted for 14 (82.4%) of cases, whereas early-onset preeclampsia comprised 3 (17.6%). Additionally, most cases presented with severe disease, with 15 (88.2%) classified as severe preeclampsia and only 2 (11.8%) as mild. Among the reported symptoms, severe headache was the most common, occurring alone in 6 cases (35.3%), while severe headache combined with visual disturbances was reported in 2 cases (11.2%). Other symptoms, including epigastric pain, occurred in 1 (5.9%) case and a combination of severe headache and epigastric pain in another 1 (5.9%); however, 7 (41.2%) presented with no symptoms. Blood pressure measurements revealed that 13 (76.5%) participants had severely elevated readings ($\geq 160/110$ mmHg), whereas 4 (23.5%) exhibited mildly elevated levels (140–159/90–109 mmHg).

In preeclamptic cases, vaginal delivery was the predominant mode of delivery, occurring in 14 (82.4%) participants, while 3 (17.6%) underwent cesarean section. There was 1 (5.9%) maternal death, and 16 (neurological injury (11.8%), eclampsia (5.9%), eclampsia with HELLP syndrome (5.9%), anemia (5.9%), and complex cases involving a combination of eclampsia, HELLP syndrome, cellulitis, and hyperglycemia (5.9%).

The most commonly reported postpartum complication was puerperal sepsis, affecting 4 (23.5%) participants, either alone or in combination with comorbidities such as diabetic foot and anemia. However, the majority, 13 (76.5%), did not experience any postpartum complications. Prolonged hospital stays were reported in 10 (58.8%) cases (defined as 5

or more days for cesarean deliveries and 3 or more days for vaginal deliveries), while the remaining 7 (41.2%) cases were discharged within the expected timeframe.

Table 4.3 Maternal Outcome Among Women Diagnosed with Preeclampsia

Maternal Outcome Characteristics	n (%)
Severity of preeclampsia	
Mild	2 (11.8)
Severe	15 (88.2)
Cases with symptoms	
Epigastric pain	1 (5.9)
Severe headache	6 (35.3)
Severe headache and epigastric pain	1(5.9)
Severe headache and visual disturbances	2 (11.2)
No symptoms	7 (41.2)
Systolic and diastolic blood pressure readings	
Mild ($140 \leq 159/90 \leq 109$ mmHg)	4 (23.5)
Severe ($\geq 160/110$ mmHg)	13 (76.5)
Mode of Delivery	
Cesarean section	3 (17.6)
Vaginal delivery	14 (82.4)
Maternal mortality	
Survived	16 (94.1)
Died	1 (5.9)
Maternal Complication	
No complications reported	7 (41.2)
Yes	10 (58.8)
Type of antenatal complications	
AKI	2 (11.8)
Eclampsia alone	1 (5.9)
Eclampsia + HELLP syndrome	1 (5.9)
Eclampsia + HELLP syndrome + cellulitis + hyperglycemia	1 (5.9)
HELLP syndrome	4 (23.5)

Anemia	1 (5.9)
None	7 (41.2)
Type of postpartum complications	
Puerperal sepsis	1 (5.9)
Anemia + puerperal sepsis	1 (5.9)
Puerperal sepsis + Prolonged hospital stays	1 (5.9)
Sepsis + Prolonged hospital stays, Diabetic foot + cervical tear grade 4	1(5.9%) 13 (76.5)
None	
Prolonged hospital stays (CS \geq 5, SVD \geq 3)	
Yes	10 (58.8)
No	7 (41.2)

Data are presented as numbers and proportions (%) of study participants with preeclampsia. \leq , less than or equal to. $<$, less than. \geq , greater than or equal to. $>$, greater than. +, and. CS, Caesarean section. SVD, Spontaneous vertex delivery. AKI, Acute Kidney Injury. HELLP, Hemolysis Elevated Liver Enzymes and Low Platelets.

4.5 Fetal and Neonatal Outcomes

The fetal and neonatal outcome of infants delivered by the study participants with preeclampsia is presented in Table 4.4. Among the 18 neonates delivered by 17 study participants with preeclampsia, including one set of twins, 13 (72.2%) were live births while 5 (27.8%) were stillbirths. The gestational age at delivery showed that 11 (61.1%) neonates were born at term, 4 (22.2%) were late preterm, and 3 (16.7%) were early preterm. Birth weight was evenly divided, with 9 (50%) neonates classified as normal weight (≥ 2500 grams) and 9 (50%) as low birth weight (< 2500 grams).

Apgar score assessments indicated that 10 (55.6%) neonates had normal scores of 7 or higher at both 1 and 5 minutes, while 8 (44.4%) had low scores below 7. Of those with low scores, only 1 (7.7%) required admission to the newborn unit, while 12 (92.3%) were not admitted. The five stillbirths were excluded from this admission assessment.

Neonatal complications were assessed only among the live births and were reported in 1 (7.7%) neonate, while the remaining 12 (92.3%) experienced no adverse events. At the time of hospital discharge, 12 (66.7%) neonates had survived, 5 (27.8%) were stillbirths, and 1 (5.6%) neonate had died.

Table 4.4 Fetal and Neonatal Outcomes of Infants Delivered by Women with Preeclampsia

Fetal / Neonatal characteristics	n (%)
Fetal status at delivery	
Live birth	13 (72.2)
Stillbirth	5 (27.8)
Fetal age at delivery	
Early preterm	3 (16.7)
Late preterm	4 (22.2)
Term	11 (61.1)
Birth weight	
Normal (≥ 2500 grams)	9 (50.0)
Low birth weight (< 2500 grams)	9 (50.0)
Apgar score at 1 and 5 minutes	
≥ 7 (normal)	10 (55.6)
< 7 (low)	8 (44.4)
Neonatal admission to NBU	
No	12 (92.3)
Yes	1 (7.7)
Congenital abnormality recorded	
Yes	0 (0.0)
No	18 (100.0)
Neonatal complications	
No	12 (92.3)
Yes	1 (7.7)
Neonatal survival status	
Survived	12 (66.7)
Not applicable (were stillbirths)	5 (27.8)
Death	1 (5.6)

Data are presented as numbers and proportions (%) of fetal outcomes. \leq , less than or equal to. $<$, less than. \geq , greater than or equal to. $>$, greater than. NBU, Newborn Unit.

4.6 Discussion

This study aimed to identify the key determinants of preeclampsia in Narok County, Kenya, and found that multiple gestation was significantly associated with its development, while rural residence showed a higher proportion of cases but did not reach statistical significance. Although women living in rural areas were more likely to develop preeclampsia, this trend did not remain significant in the regression analysis, though it echoes findings from similar studies in Ethiopia and Zambia (Eticha *et al.*, 2024; Katore *et al.*, 2021; Sinkala, 2021). These patterns may still suggest reduced access to quality antenatal care in rural areas. This hypothesis is reinforced by a previous study reporting that pregnant women living in rural areas have limited access to antenatal care due to some factors like low socioeconomic status, low education level, and a very low number of health facilities, and the problem is further compounded by poor road networks (Wairoto *et al.*, 2020).

In contrast, some studies have demonstrated different patterns. For example, research in Ghana found urban residency to be associated with preeclampsia, a link attributed to sedentary lifestyles and higher rates of overweight and obesity among urban women (Van Middendorp *et al.*, 2013; Ofori-Asenso *et al.*, 2016). Similarly, the current finding aligns with an Indian study that reported no significant association between rural or urban residency and preeclampsia (Lakhute *et al.*, 2021). This suggests that the relationship between residence and preeclampsia may be context-specific, influenced by healthcare systems, cultural practices, and population characteristics (Marazi & Pandit, 2024). Evidence from Kenya also supports this context-dependent interpretation, as a case-

control study in Nairobi showed a non-significant trend toward higher risk among urban women compared to those from rural areas, further highlighting the variability of findings across different settings (Logan *et al.*, 2020).

This study's findings that multiple gestations are associated with an increased risk of preeclampsia are in line with those of an earlier study conducted in Ethiopia (Kassa, Asnkew, *et al.*, 2023). One possible explanation for this observation is that many pregnancies lead to a larger placenta, which can cause aberrant placentation and endothelial dysfunction (Maynard *et al.* 2008). This dysfunction causes the placenta to make too much of antiangiogenic factors like soluble fms-like tyrosine kinase-1 (sFlt-1) and soluble endoglin (sEng), which fight against placental growth factor (PlGF) and vascular endothelial growth factor (VEGF). This makes angiogenesis worse and leads to high blood pressure, proteinuria, and other problems for the mother that are linked to preeclampsia (Bdolah *et al.*, 2009). Therefore, targeted interventions that address the unique needs of both rural and urban pregnant women are essential for reducing disparities in preeclampsia outcomes.

The present study identified several maternal complications in pregnant women with preeclampsia, including HELLP syndrome, eclampsia, acute kidney injury, anemia, sepsis, and maternal deaths, which often resulted in prolonged hospital stays. These findings align with previous studies conducted in Ethiopia and Tanzania (Godana *et al.*, 2021; Luyeko & Mwampagatwa, 2021; Tura *et al.*, 2024; Waziri *et al.*, 2023). The occurrence of these complications can be attributed to the systemic endothelial dysfunction and multi-organ involvement that characterize preeclampsia, leading to widespread tissue ischemia, organ

damage, and heightened risk of adverse maternal outcomes (Maynard *et al.* 2008). Severe headache was the most commonly reported symptom, followed by visual disturbances, while epigastric pain was less frequent. These neurological symptoms are likely due to endothelial damage in the brain, causing inflammation and vascular changes (E. C. Miller & Vollbracht, 2021). The predominance of severe symptoms and complications underscores delayed detection and advanced disease, particularly among rural populations with limited access to timely and quality care (Kassa, Tiruneh, *et al.*, 2023). Taken together, pregnant women with pre-eclampsia experience suffering that is more prevalent, complex, and severe, justifying the need for urgent, well-coordinated care, including early screening and aggressive management protocols, to increase the chances of successful treatment.

Fetal and neonatal outcomes in this study highlighted the devastating impact of preeclampsia, with multiple serious complications observed. The stillbirth rate was notably high, aligning with findings from a Kenyan study (Ndwiga *et al.*, 2020). This high rate of stillbirths could be attributed to chronic hypoxia resulting from abnormal placental development and decreased blood flow (Zamir *et al.*, 2021). Moreover, the documented rates of preterm delivery and low birth weight substantially resemble those recorded at Moi Teaching and Referral Hospital, where infants born to preeclamptic mothers were frequently underweight (Sigei *et al.*, 2023). LBW and preterm birth could stem from uteroplacental insufficiency, which leads to poor blood supply and chronic hypoxia (Burton & Jauniaux, 2018). It is also important to highlight that the majority of participants in the current study had severe preeclampsia, a condition known to be associated with low

Apgar scores (Godana *et al.*, 2021). This finding is consistent with a study in Indonesia, which observed a higher incidence of low Apgar scores in babies from preeclamptic mothers (Susilo *et al.*, 2015). The low Apgar scores observed suggest perinatal distress, which may result from impaired placental function and subsequent fetal hypoxia (Zamir *et al.*, 2021). However, the findings of the current study revealed a lower proportion of reported neonatal complications compared to a recent Ethiopian study, which documented that more than 50% of neonates born to mothers with preeclampsia or eclampsia developed complications (Godana *et al.*, 2021). The differences in overall neonatal complications may be explained by variations in the timing of preeclampsia onset, with the majority of cases in this study being late-onset, which is typically associated with less severe neonatal outcomes (Teka *et al.*, 2023; Thakur *et al.*, 2025). Taken together, there are many adverse fetal outcomes of preeclampsia, and hence, a short-term special medical care program is required to take care of these patients.

CHAPTER FIVE: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter is a summary of the study's results, its main conclusions, and suggestions that are in line with its goals. The goal of this study was to look into preeclampsia in Narok County, Kenya, and how it affects the health of mothers and babies, focusing on associated risk factors and related maternal and neonatal outcomes.

5.2 summary of findings

The study discovered numerous significant risk factors for preeclampsia, including multiple gestation, nulliparity, and first-time pregnancy. Severe preeclampsia became the predominant maternal presentation, frequently associated with symptoms including persistent headaches, vision abnormalities, and upper abdominal pain. Significant maternal consequences included HELLP syndrome, eclampsia, and acute renal damage, with certain instances leading to maternal fatality. Notwithstanding these difficulties, vaginal delivery continued to be the predominant method of childbirth. Negative perinatal outcomes were observed, including elevated incidences of stillbirths, premature births, low birth weight, and suboptimal Apgar scores. A significant number of newborns required specialized care in neonatal units, and in some cases, neonatal deaths occurred, underscoring the profound impact of preeclampsia on both maternal and neonatal health.

5.3 Conclusion

This study demonstrates that preeclampsia remains a critical public health concern in Narok County. The findings aligned with the study objectives are as follows:

- I. The study found that the demographic and clinical risk factors significantly associated with preeclampsia were multiple gestation, primigravidity, and nulliparity. Other factors, including maternal age, marital status, residence, antenatal care attendance, and history of preeclampsia, showed no significant association.
- II. Women diagnosed with preeclampsia experienced substantial maternal complications, including eclampsia, HELLP syndrome, anemia, antepartum hemorrhage, and prolonged hospitalization, highlighting the heavy maternal burden of the condition.
- III. Infants born to mothers with preeclampsia faced adverse perinatal outcomes such as stillbirth, low birth weight, preterm delivery, low Apgar scores, and neonatal death, reflecting the condition's impact on perinatal survival and health.

These findings underscore the urgent need to strengthen antenatal surveillance, promote early diagnosis, and provide comprehensive maternal and neonatal care to reduce the burden of preeclampsia and improve outcomes for mothers and infants in Narok County.

5.4 Recommendations based on the findings

In light of the aforementioned facts and results, the study presents the following recommendations:

- I. Prioritize the integration of focused antenatal screening for preeclampsia risk factors, both in urban and rural settings, by strengthening routine assessment of women with multiple gestations and first-time pregnancies, and enhancing community awareness to improve early ANC attendance.

- II. Enhance the capacity of health facilities to manage preeclampsia by ensuring continuous mentorships and training for healthcare providers, establishing clear clinical protocols, and maintaining consistent availability of essential diagnostics and medications for timely detection and effective management of maternal complications.
- III. Improve fetal and neonatal outcomes by equipping rural health facilities with functional neonatal care units, scaling up routine fetal monitoring, and implementing timely obstetric interventions to reduce the burden of preterm births, low birth weight, and neonatal morbidity related to preeclampsia.

5.5 Recommendations for Future Studies:

1. Conduct community-based longitudinal studies to explore broader biological, social, and environmental determinants of preeclampsia beyond hospital populations, including how these factors interact across different settings.
2. Evaluate the effectiveness of antenatal interventions, such as improved screening protocols, nutritional support, and community education, in reducing the incidence and complications of preeclampsia.
3. Assess the quality and consistency of preeclampsia management protocols in Narok County compared to national guidelines, focusing on health system preparedness, referral efficiency, and provider capacity.

4. Examine the long-term physical, psychological, and social impacts of preeclampsia on mothers and their children to inform comprehensive care strategies and support services.
5. Evaluate the effectiveness and efficiency of health system components, including referral networks, emergency obstetric care preparedness, and resource allocation, in optimizing preeclampsia management and improving maternal-fetal outcomes in rural healthcare settings.
6. Analyze healthcare providers' competencies, perceptions, and clinical decision-making processes regarding preeclampsia management to identify critical barriers and facilitators influencing early diagnosis and treatment adherence.
7. Investigate genetic, molecular, and socio-economic predictors of preeclampsia risk, severity, and outcomes to support early diagnosis, targeted prevention, and personalized interventions.
8. Explore the role of male partner involvement in antenatal care and its influence on early detection and management of preeclampsia, especially in patriarchal or resource-limited settings.
9. Investigate disparities in preeclampsia outcomes between public and private healthcare facilities to understand how infrastructure, staffing, and service delivery models impact maternal and neonatal health.

10. Conduct cost-effectiveness studies on various preeclampsia screening and intervention strategies to guide health policy and resource prioritization in low- and middle-income countries like Kenya.

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APPENDICES

Appendix 1: Data Extraction Form

Preeclampsia Prevalence, Risk Factors, Maternal, and Fetal Outcomes

Section A: Patient Identification and Admission Details

1. Patient ID (de-identified): _____
2. Date of Admission: _____
3. Date of Delivery: _____
4. Gestational Age at Delivery (in weeks): _____
5. Preeclampsia Diagnosis Confirmed?
 - Yes
 - No
6. Date of Preeclampsia Diagnosis: _____

Section B: Demographic Information (As documented in medical records)

7. Age (in years):
 - 18-25
 - 26-35
 - 36-45
 - Above 45
8. Marital Status:
 - Single
 - Married
9. Education Level:
 - No formal education
 - Primary school
 - Secondary school
 - Tertiary education
10. Occupation:
 - Unemployed

- Self-employed
- Salaried employment

11. Residence:

- Urban
- Rural

Section C: Obstetric and Clinical History (Document from patient files)

12. Onset of Preeclampsia (if diagnosed)

- Early (<34 weeks)
- Late (\geq 34 weeks)

13. Blood Pressure Readings (highest during pregnancy)

- Systolic (mm Hg)
- Diastolic (mm Hg)

14. Gravidity (number of pregnancies)

- G1 (first pregnancy)
- G2
- G3
- G4
- G5+ (5 or more pregnancies)

15. Parity (number of births beyond 28 weeks)

- P0 (no previous viable births)
- P1
- P2
- P3
- P4+ (4 or more births)

16. Number of Antenatal Care (ANC) Visits Attended: _____

17. Previous History of Preeclampsia?

- Yes
- No

18. Preexisting Medical Conditions (Check all documented):

- Chronic Hypertension
- Diabetes Mellitus
- Obesity (BMI > 30)
- Renal Disease
- None

- Other (specify if available): _____

19. Family History of Preeclampsia:

- Yes
- No
- Not documented

20. Multiple Gestation (Twins, Triplets, etc.):

- Yes
- No

21. Pre-pregnancy Body Mass Index (BMI) (If available):

- Underweight (BMI < 18.5)
- Normal weight (BMI 18.5–24.9)
- Overweight (BMI 25–29.9)
- Obese (BMI ≥ 30)
- Not documented

22. Presence of Urinary Tract Infection (UTI) During Pregnancy:

- Yes
- No
- Not documented

23. Smoking Status (If documented):

- Yes
- No
- Not documented

24. Alcohol Consumption During Pregnancy (If documented):

- Yes
- No
- Not documented

Section D: Maternal Outcomes (As per patient records)

25. Mode of Delivery:

- Vaginal delivery
- Cesarean section (CS)

26. Reason for Cesarean Section (if applicable):

- Failed labor
- Fetal distress
- Maternal health condition
- Other: _____

27. Pregnancy Complications (Check all documented):

- None
- Hemorrhage
- Eclampsia
- Placental abruption
- HELLP syndrome
- Kidney Failure (renal)
- Other (specify): _____

28. Postpartum Complications (Check all documented):

- None
- Postpartum hemorrhage
- Infection
- Prolonged hospital stays
- Other (specify): _____

29. Duration of Hospital Stay Post-Delivery (in days): _____

30. Maternal Mortality:

- Survived
- Died

Section E: Fetal and Neonatal Outcomes (From delivery and neonatal records)

31. Fetal Status at delivery:

- Live birth

- Stillbirth
32. Gestational Age at Birth (in weeks): _____
33. Birth Weight:
- < 2.5 kg (Low birth weight)
 - ≥ 2.5 kg (Normal birth weight)
34. Apgar Score (If available):
- 1 min: _____
 - 5 min: _____
 - Not documented
35. Neonatal Admission to NBU:
- Yes
 - No
36. Neonatal Complications (Check all documented):
- None
 - Respiratory distress syndrome (RDS)
 - Intraventricular hemorrhage (IVH)
 - Sepsis
 - Jaundice
 - Other (specify): _____
37. Neonatal Survival Status:
- Survived
 - Died
38. Congenital Abnormalities (If any, documented in neonatal records):
- Yes (specify): _____
 - No

Section F: Laboratory and Clinical Data (From patient medical files)

39. Blood Pressure at Admission: _____ mmHg
40. Proteinuria (Urine Protein):

- Negative
- Trace
- 1+
- 2+
- 3+

41. Hemoglobin Levels (at admission): _____ g/dL

42. Platelet Count: _____ cells/mm³

43. Serum Creatinine: _____ mg/dL

44. Liver Enzyme Levels (AST/ALT): _____ U/L

45. Other Relevant Laboratory Findings (if available): _____

N.B.: Please follow the guidelines below while completing this form:

- Complete the form only if you are a trained data extractor authorized for this study.
- Use patient medical records only. Do not infer, estimate, or assume any missing information.
- If data is not documented, mark it as “Not documented” or leave the field blank where appropriate.
- De-identify all patient records. Use a unique patient ID in place of names or identifiers.
- Take your time to carefully and accurately extract all relevant data from the medical files.
- Maintain strict confidentiality and adhere to the study’s approved ethical guidelines.
- After completing each form, submit it to the Lead Investigator for verification and logbook entry.
- For any questions or clarifications during the process, consult the Lead Investigator directly.

Appendix 2: Ethical Review Request Letter



Kirinyaga University

Tel: +254 701562092, +254 728499650, +254 709742000/30
P.O. Box 143-10300 Kerugoya.

Email: info@kyu.ac.ke
Website: www.kyu.ac.ke

SCHOOL OF HEALTH SCIENCES

DATE: October 30, 2024

OUR REF: KyU/SHS/VOL.1/2024

Baraton Main Campus
P.O. Box 30-30306
BARATON, KENYA
Tel: 0720 556215/0725 556120.
Email: baratonacademic@gmail.com.

RE: RECOMMENDATION FOR ROTICH KIBET ARON (ID NO. 24938695)

The above named person is a Third-year student pursuing MSc. Clinical Medicine (Reproductive and Maternal Health) at Kirinyaga University. His thesis project is titled "PRECLAMPSIA PREVALENCE AND ITS MATERNAL AND PERINATAL OUTCOMES WITH ASSOCIATED RISK FACTORS AMONG WOMEN IN NAROK COUNTY".

This is therefore to support submission of the aforementioned proposal for ethical clearance.

Thank you.



Dr. David Nderu
COD, HEALTH SCIENCES



KyU is ISO 9001:2015 certified

Tel: +254 709 742 000/30, +254 728 499 650
P.O. Box: 143-10300 Kerugoya
Email: vc@kyu.ac.ke
Website: www.kyu.ac.ke

Kirinyaga University is Zero Tolerant to Corruption

Appendix 3: Ethics Review Committee Board Approval



OFFICE OF THE CHAIRPERSON
INSTITUTIONAL SCIENTIFIC ETHICS REVIEW COMMITTEE
UNIVERSITY OF EASTERN AFRICA, BARATON
P.O. BOX 2500-30100, Eldoret, Kenya, East Africa

B0213122024

December 13, 2024

TO: Rotich Aron Kibet
Clinical Medicine in Maternal and Reproductive Health
Kirinyaga University

Dear Rotich,

RE: Preeclampsia Prevalence and It's Maternal and Perinatal Outcomes with Associated Risk Factors Among Women in Narok County.

This is to inform you that the Institutional Scientific Ethics Review Committee (ISERC) of the University of Eastern Africa Baraton has reviewed and approved your above research proposal. Your application approval number is UEAB/ISERC/02/12/2024. The approval period is from December 13th, 2024 to December 13th, 2025.

This approval is subject to compliance with the following requirements;

- i. Only approved documents including (informed consents, study instruments, MTA) will be used.
- ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by the Institutional Scientific Ethics Review Committee (ISERC) of the University of Eastern Africa Baraton.
- iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to the Institutional Scientific Ethics Review Committee (ISERC) of the University of Eastern Africa Baraton within 72 hours of notification.
- iv. Any changes, anticipated or otherwise that may increase the risks or affected the safety or welfare of study participants and others, or affect the integrity of the research must be reported to the Institutional Scientific Ethics Review Committee (ISERC) of the University of Eastern Africa Baraton within 72 hours.
- v. Clearance for export of biological specimens must be obtained from relevant institutions.
- vi. Submission of a request for renewal of approval at least 60 days prior to the expiry of the approval period. Attach a comprehensive progress report to support the renewal.
- vii. Submission of an executive summary report within 90 days upon completion of the study to the Institutional Scientific Ethics Review Committee (ISERC) of the University of Eastern Africa Baraton.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology, and Innovation (NACOSTI) <https://oris.nacosti.go.ke> and also obtain other clearances needed.

Sincerely yours,

Prof. Catherine Amimo, PhD
Chairperson, Institutional Scientific Ethics Review Committee



A SEVENTH-DAY ADVENTIST INSTITUTION OF HIGHER LEARNING
CHARTERED 1991

Appendix 4: NACOSTI Request Letter



Kirinyaga University

Tel: +254 701562092, +254 728499650, +254 709742000/30
P.O. Box 143-10300 Kerugoya.

Email: info@kyu.ac.ke
Website: www.kyu.ac.ke

SCHOOL OF HEALTH SCIENCES

DATE: January 9, 2025

OUR REF: KyU/SHS/VOL.1/01

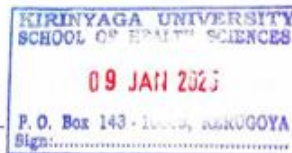
National Commission for Science Technology and
Innovation (NACOSTI)
Off Waiyaki Way, Upper Kabete,
P. O. Box 30623, 00100
NAIROBI, KENYA.

RE: RECOMMENDATION FOR ROTICH KIBET ARON (ID NO. 24938695)

The above named person is a Third-year student pursuing MSc. Clinical Medicine (Paediatrics and Child Health) at Kirinyaga University. Her thesis project is titled "Preeclampsia Prevalence and Its Maternal and Perinatal Outcomes with Associated Risk Factors Among Women in Narok County".

This is therefore to support submission of the aforementioned proposal for ethical clearance.

Thank you.



Dr. David Nderu

SCHOOL OF HEALTH SCIENCES



KyU is ISO 9001:2015 certified

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Email: vc@kyu.ac.ke
Website: www.kyu.ac.ke

Kirinyaga University is Zero Tolerant to Corruption

Appendix 5: NACOSTI Permit

REPUBLIC OF KENYA
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Ref No: **330468**

RESEARCH LICENSE



This is to Certify that Mr., Rotich Kibet Aron of Kirinyaga University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Narok on the topic: PREECLAMPZIA PREVALENCE AND IT'S MATERNAL AND PERINATAL OUTCOMES WITH ASSOCIATED RISK FACTORS AMONG WOMEN IN NAROK COUNTY for the period ending : 10/February/2026.

License No: **NACOSTI/P/25/415532**

Applicant Identification Number: **330468**

Director General
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Verification QR Code



NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013 (Rev. 2014)
Legal Notice No. 108: The Science, Technology and Innovation (Research Licensing) Regulations, 2014

The National Commission for Science, Technology and Innovation, hereafter referred to as the Commission, was established under the Science, Technology and Innovation Act 2013 (Revised 2014) herein after referred to as the Act. The objective of the Commission shall be to regulate and assure quality in the science, technology and innovation sector and advise the Government in matters related thereto.

CONDITIONS OF THE RESEARCH LICENSE

1. The License is granted subject to provisions of the Constitution of Kenya, the Science, Technology and Innovation Act, and other relevant laws, policies and regulations. Accordingly, the licensee shall adhere to such procedures, standards, code of ethics and guidelines as may be prescribed by regulations made under the Act, or prescribed by provisions of International treaties of which Kenya is a signatory to.
2. The research and its related activities as well as outcomes shall be beneficial to the country and shall not in any way:
 - i. Endanger national security
 - ii. Adversely affect the lives of Kenyans
 - iii. Be in contravention of Kenya's international obligations including Biological Weapons Convention (BWC), Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Chemical, Biological, Radiological and Nuclear (CBRN).
 - iv. Result in exploitation of intellectual property rights of communities in Kenya
 - v. Adversely affect the environment
 - vi. Adversely affect the rights of communities
 - vii. Endanger public safety and national cohesion
 - viii. Plagiarize someone else's work
3. The License is valid for the proposed research, location and specified period.
4. Neither the license nor any rights thereunder are transferable.
5. The Commission reserves the right to cancel the research at any time during the research period if in the opinion of the Commission the research is not implemented in conformity with the provisions of the Act or any other written law.
6. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research.
7. Excavation, filming, movement, and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
8. The License does not give authority to transfer research materials.
9. The Commission may monitor and evaluate the licensed research project for the purpose of assessing and evaluating compliance with the conditions of the License.
10. The Licensee shall submit one hard copy, and upload a soft copy of their final report (thesis) onto a platform designated by the Commission within one year of completion of the research.
11. The Commission reserves the right to modify the conditions of the License including cancellation without prior notice.
12. Research, findings and information regarding research systems shall be stored or disseminated, utilized or applied in such a manner as may be prescribed by the Commission from time to time.
13. The Licensee shall disclose to the Commission, the relevant Institutional Scientific and Ethical Review Committee, and the relevant national agencies any inventions and discoveries that are of National strategic importance.
14. The Commission shall have powers to acquire from any person the right in, or to, any scientific innovation, invention or patent of strategic importance to the country.
15. Relevant Institutional Scientific and Ethical Review Committee shall monitor and evaluate the research periodically, and make a report of its findings to the Commission for necessary action.

National Commission for Science, Technology and
Innovation(NACOSTI),
Off Waiyaki Way, Upper Kabete,
P. O. Box 30623 - 00100 Nairobi, KENYA
Telephone: 020 4007000, 0713788787, 0735404245
E-mail: dg@nacosti.go.ke
Website: www.nacosti.go.ke

Appendix 6: County Permission Grand



NAROK COUNTY GOVERNMENT DEPARTMENT OF HEALTH AND SANITATION

Telegrams: "HEALTH", Narok
Telephone: Narok 22300 and 22308
Fax: (050) 22394
Email: countyhealthdirectornarok@gmail.com

COUNTY DIRECTOR OF HEALTH
NAROK COUNTY
P.O. BOX 11- 20500
NAROK

When replying please quote our Ref and date

OUR REF: DIR/NRK CNTY/MOH/60/VOL.VI/55

12th February,2025

Rotich Kibet Aron
Kirinyaga University
P.O BOX 143,
KERUGOYA.

RE: AUTHORIZATION FOR DATA COLLECTION.

Reference is made to your letter dated 10th February,2025 and the letter Ref No. UEAB/ISERC/O2/12/2024/ dated 13th December,2024 from the University of East Africa of Baraton Research Committee.

Authority is hereby granted to you to carry out research in Narok West Sub County, Narok County on the topic "*Preeclampsia prevalence and its material and perinatal outcomes with associated risk factors among women in Narok County*" for the period ending **10th February 2026**

Regards.

A handwritten signature in blue ink, appearing to be "FK".



Dr. Francis K. Kiio
County Director of Health
NAROK COUNTY GOVERNMENT.

C.C. Medical Superintendent – Narok County Referral Hospital
NAROK COUNTY GOVERNMENT

Appendix 7: NCRH Permission Letter



NAROK COUNTY GOVERNMENT DEPARTMENT OF HEALTH AND SANITATION

Telegrams: "HEALTH", Narok
Telephone: Narok 22300 and 22308
Fax: (050) 22394
Email: medsupnarok@yahoo.com
When replying please quote our ref and date

**MEDICAL SUPERINTENDENT
NAROK COUNTY REFERRAL
HOSPITAL
P.O. BOX 11 - 20500
NAROK**

OUR REF: NCRH 17466/026/25

13th February, 2025

TO WHOM IT MAY CONCERN

**RE: AUTHORIZATION FOR ROTICH KIBET ARON TO CONDUCT RESEARCH AT
NAROK COUNTY REFERRAL HOSPITAL**

I am pleased to inform you that your request to collect data in our facility on Pre-eclampsia and its Maternal and fetal outcomes with associated risk factors among women in Narok County has been approved, subject to compliance with the institutional guidelines and ethical standards



We look forward to supporting your research and anticipate valuable contributions to medical science.

Kind regards,

Dr. Emejen John Losepicho
Medical Superintendent
NAROK COUNTY REFERRAL HOSPITAL



Appendix 8: Certificate of Acceptance and Publication

 www.IJRR.COM	International Journal of Research Publication and Reviews (Open Access, Peer Reviewed, International Journal) (A+ Grade, Impact Factor 6.844)	ISSN 2582-7421	Sr. No: <u>IJRR</u> <u>133320-1</u>
<i>Certificate of Acceptance & Publication</i>			
<p>This certificate is awarded to "Rotich Kibet Aron", and certifies the acceptance for publication of paper entitled "Determinants of Preeclampsia and Its Maternal and Perinatal Outcomes Among Women in Narok County, Kenya " in "International Journal of Research Publication and Reviews", Volume 6, Issue 6 .</p>			
Signed _____ <i>Arthur Oyando</i>		Date _____ 13-06-2025	
			
Editor-in-Chief International Journal of Research Publication and Reviews			

Appendix 9: Similarity Index



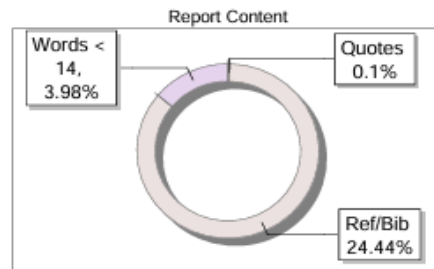
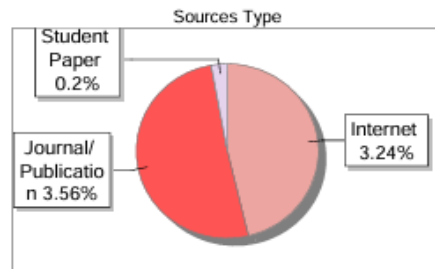
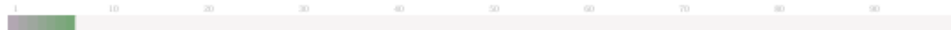
The Report is Generated by DrillBit Plagiarism Detection Software

Submission Information

Author Name	Aron
Title	DETERMINANTS OF PREECLAMPSIA AND MATERNAL AND PERINATAL OUTCOMES AMONG WOMEN IN NAROK COUNTY, KENYA
Paper/Submission ID	4333756
Submitted by	s.gacheru@kyu.ac.ke
Submission Date	2025-09-08 15:44:21
Total Pages, Total Words	108, 20730
Document type	Thesis

Result Information

Similarity **7 %**



Exclude Information

Quotes	Excluded
References/Bibliography	Excluded
Source: Excluded < 14 Words	Not Excluded
Excluded Source	0 %
Excluded Phrases	Not Excluded

Database Selection

Language	English
Student Papers	Yes
Journals & publishers	Yes
Internet or Web	Yes
Institution Repository	Yes

A Unique QR Code use to View/Download/Share Pdf File



Similarity Index- page 2



DrillBit Similarity Report

7

SIMILARITY %

101

MATCHED SOURCES

A

GRADE

A-Satisfactory (0-10%)
B-Upgrade (11-40%)
C-Poor (41-60%)
D-Unacceptable (61-100%)

LOCATION	MATCHED DOMAIN	%	SOURCE TYPE
2	repository.mua.ac.ke	<1	Publication
5	www.preeclampsia.org	<1	Publication
7	kyuspace.kyu.ac.ug	<1	Publication
9	REPOSITORY - Submitted to Dr. NTR UNIVERSITY OF HEALTH SCIENCES on 2024-09-26 17-26 2352498	<1	Student Paper
10	siicsalud.com	<1	Internet Data
11	Increased thrombin generation in women with a history of preeclampsia by R-2009	<1	Publication
12	ir-library.ku.ac.ke	<1	Publication
13	biomedcentral.com	<1	Internet Data
14	www.ncbi.nlm.nih.gov	<1	Internet Data
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Determinants of Preeclampsia and Its Maternal and Perinatal Outcomes Among Women in Narok County, Kenya

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ABSTRACT

Preeclampsia is a critical hypertensive disorder in pregnancy that significantly impacts maternal and neonatal health outcomes. The World Health Organization (WHO) recognizes it as a key direct factor in global maternal mortality, especially in low- and middle-income countries. The disease is prevalent in Sub-Saharan Africa, posing a considerable threat to women and their infants. In resource-limited settings like Narok County, Kenya, delays in accessing healthcare and gaps in screening and treatment have worsened the impact of preeclampsia. This study aimed to identify the key factors associated with preeclampsia and to evaluate its impact on mothers and their newborns in Narok County. Using a hospital-based cross-sectional design, medical records of mothers who delivered between January and December 2023 at Narok County Referral Hospital were systematically reviewed with a standardized data extraction tool. Binary logistic regression was utilized to identify factors associated with preeclampsia, while univariate analysis characterized maternal and perinatal outcomes. Key findings indicated that rural residence (OR = 4.50, $p = 0.054$) was not statistically significant, but multiple gestation (OR = 3.46, $p = 0.043$) was significantly associated with preeclampsia. The majority of cases (88.2%) were classified as severe and commonly presented with symptoms such as severe headache and epigastric pain. Cesarean section was performed in 17.6% of cases, maternal complications occurred in 58.8%, and maternal mortality was reported at 5.9%. Common maternal complications included HELLP syndrome and eclampsia. Neonatal outcomes revealed 27.8% stillbirths, 50% low birth weight, and 44.4% low Apgar scores, with neonatal complications and deaths reported in 7.7% and 5.6% of cases, respectively. In conclusion, preeclampsia significantly compromised maternal and neonatal health in Narok County, with rural residence and multiple gestations emerging as key risk factors. These findings underscore the imperative to enhance antenatal care by early screening, risk-based monitoring, and timely intervention to mitigate the impact of preeclampsia and improve pregnancy outcomes

Keywords: Adverse Maternal outcome, Adverse perinatal outcome, Determinants, Global burden, Preeclampsia