Global Scientific JOURNALS

GSJ: Volume 10, Issue 5, May 2022, Online: ISSN 2320-9186
www.globalscientificjournal.com

# PREVALENCE AND FACTORS ASSOCIATED WITH PRE-ECLAMPSIA AMONG PREGNANT WOMEN ATTENDING MUHIMA DISTRICT HOSPITAL, RWANDA

**MBILA WABENYA Christine**

**MPH/2018/39765**



**A Thesis Submitted in Partial Fulfillment for the Award of a Degree in**

**Master of Public Health (Global Health) of Mount Kenya University**

**MAY 2022**

## DECLARATION

This research study is my original work and not been presented to any other Institution. No part of this research should be reproduced without the authors' consent or that of Mount Kenya University Rwanda.

**Student's Name:** MBILA Christine WABENYA

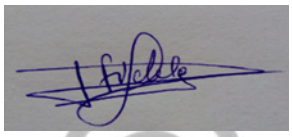
Signature: _____ Date: _____

Declaration by the supervisors:

This research has been submitted with our approval as The Mount Kenya University Rwanda (MKUR).

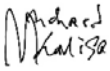
**Co-Supervisor:**

Name: Fidele NIZEYIMANA, PhD Candidate

Signature:  Date: 28th /02/2022

**Principal Supervisor:**

Name: Dr. Richard KALISA, MBCh.B, M.Med (Pead & CH), MSc (HEP), PhD

Signature:  Date: 02nd /03/2022



## DEDICATION

This work is dedicated to my children; my family members and relatives; my friends and colleagues and my fellow classmates for their encouragement to further my studies.

## ACKNOWLEDGEMENTS

At the stage where I am with this research, I would like to express my deep gratitude to all who in one way or another have contributed to this work.

I am grateful to the almighty God for his love and protection throughout my life.

I am also grateful to my supervisors, Dr. Richard Kalisa and Fidele Nizeyimana for their valuable time and guidance during this research. Their criticism, suggestions of new insights and encouraging remarks have been invaluable to this study.

Special acknowledgments goes to all lectures of School of Public Health especially in Master of Public Health (MPH) of Mount Kenya University Rwanda who helped me to complete this level of education; if it was not their guidance and encouragement, it would have been difficult to complete it.

Thanks to all my classmates and colleagues with whom I shared everything during my academic life at MKUR.

May God bless you!

# ABSTRACT

Pre-eclampsia has a huge adverse impact on maternal and perinatal health especially in low and middle income countries. The magnitude of this problem in some places across the world is still somehow not fully known, especially in low and middle-income countries.This study aimed to assess the prevalence and factors associated with pre-eclampsia among pregnant women attending Muhima district hospital, Rwanda. The School of Postgraduate study Mount Kenya University Rwanda, was first approved the research proposal and ethical clearance was obtained from the Institutional Research and Ethics committee of Mount Kenya University Rwanda. The study design was cross sectional conducted between March and June 2021. Pregnant women of gestational age 20 weeks and above who had attended antenatal care (ANC) at Muhima hospital were targeted in this study. Women meeting eligibility criteria were interviewed until a sample size of 336 was achieved. Data were collected using WHO standardized observation checklists through a face-to-face interview technique. Data was entered into Microsoft Excel software and then transferred to SPSS v.21 for further analyses. Logistic regression analysis was used to identify the factors associated with preeclampsia development. Study findings revealed that 21.7% were diagnosed with pre-eclamspia. Thus, the majority of respondents was married 86.0%, had mean age of 28.8 years [6.02 ± 28.8], and completed primary education 57.7%. worked in private or public sector 70.2%, protestants 43.2%, had got a diversified diet 42.8% and 66.4% were insured under RSSB. The present study revealed that most of pregnant women 63.1% had not had fetal complications, 55.7% of respondents were multigravidity while 53.6% had given at most one birth,45.2% were attending their first ANC, 79.8% had ever had a history of chronic disease especially pregnancy induced hypertension (PIH) 52.9% and 77.7% have not encounterd maternal complications during their pregnancie 20.5% had had preterm births, 12.3% experienced still births while 4.1% experienced IUGR during their pregnancy. Less than a half 31.5% had had NICU admission during their post delivery, 28.8% had known low APGAR sore, 8.2% had had early neonatal birth while 31.5% had no neonatal complications. Factors such as smoking (AOR=6.1; 95% CI: [3.03–35.7]; $p < 0.001$), having psychological stress during pregnancy (AOR=5.2; 95% CI: [1.97-13.89]; p<0.001), multiparity (AOR=2.7; 95% CI: [1.25–4.60]; p=0.036), history of chronic disease (AOR=1.5; 95%CI: [1.18–3.81]; p=0.024), stillbirth (AOR=2.7; 95% CI: [1.42–7.46]; p=0.015) and by NICU admission (AOR=3.1; 95% CI: [1.65–9.76]; p=0.020) were found to be statistically significantly associated with preeclampsia. The study discovered that one in five women who attended ANC at Muhima district hospital were diagnosed with preeclampsia. Predictor variables like the psychological stress, having multiple pregnancies, having a history of chronic disease, stillbirth, and NICU admission were factors associated with pre-eclampsia. Thus, antenatal care sessions should empharize on obstetric and neonatal danger signs, health seeking behavior towards pregnant women's should be encouraged, which provide a chance to diagnose preeclampsia as early as possible and to prevent the coming imminiment complication towards preeclampsia.

**Key words:** Prevalence, Preeclampsia, Factors associated, Pregnant women

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# LIST OF ACRONYMNS AND ABBREVIATIONS

**ANC** **:** Antenatal Care

**CHWs** **:** Community Health Workers

**DBP** **:** Diastolic Blood Pressure

**HELLP** **:** Hemolysis, Elevated Liver Enzymes, and Low Platelet

**IUGR** **:** Intrauterine growth restriction

**MDGs** **:** Millennium Development Goals

**MMR** **:** Maternal Mortality Rate

**MOH** **:** Ministry of Health

**NICU** **:** Neonatal Intensive Care Unit

**NISR** **:** National Institute of Statistics of Rwanda

**PIH** **:** Pregnancy Induced Hypertension

**PPH** **:** Postpartum haemorrhage

**SBP** **:** Systolic Blood Pressure

**SMO** **:** Severe Maternal Outcomes

**SPSS** **:** Statistical Package for Social Science

**TNF** **:** Tumor Necrosis Factor-alpha

**VEGF** **:** Vascular Endothelial Growth Factor

**WHO** **:** World Health Organization

# OPERATIONAL DEFINITIONS OF KEY TERMS

**Eclampsia**

The new onset of seizures during pregnancy or postpartum.Unrelated to other cerebral pathological conditions in a woman with pre-eclampsia.

**Pre-eclampsia**

It denotes condition for women with blood pressure of ≥140 mmHg systolic or ≥ 90 mmHg diastolic on two separate readings taken at least four to six hours apart after 20 weeks gestation in an individual with previously normal blood pressure and proteinuria in pregnancy.

**Pregnancy Induced Hypertension**

A condition specific to pregnancy where there is development of hypertension at or after 20 weeks gestation. PIH is diagnosed when after resting the woman's blood pressure rises above 140/90mmHg on at least two occasions no more than one week apart, in woman known to be normotensive.



**Severe Maternal Outcome (SMO):**

A severe maternal outcome (SMO) is defined as a maternal near-miss plus materal death.

**Maternal near-miss**

Maternal near-miss is an event in which a pregnant woman comes close to maternal death, but does not die. When a woman nearly dies but survives a complication during pregnancy, childbirth or within 42 days of termination of pregnancy, her case is defined as a 'maternal near-miss. The World Health Organization (WHO) identifies a maternal near miss signs of organ dysfunction that follow life-threatening conditions

# CHAPTER ONE: INTRODUCTION OF THE STUDY

## 1.0 Introduction

This chapter includes a background of the study, a problem statement, objectives of the study, research questions, significance of the study, limitations of the study, scope of the study and an organization of the study.

## 1.1 Background of the Study

Globally, Preeclampsia is among the leading causes of important cause of maternal mortality and severe maternal morbidity in the world (Ghlumiyyah,.et al, 2017). The major causes of maternal deaths are similar across low income countries, often obstetric in origin, and mainly severe preeclampsia, eclampsia, and infection (Alvarez, et al., 2019).



According to the World Health Organization (WHO), preeclampsia is recognized as an important cause of maternal, perinatal and neonatal morbidity and mortality. About 2–8% of complications related to pregnancies are attributed to the pre-eclempsia (WHO, 2018). In developing countries, preeclampsia incidence is almost seven times higher than in developed countries on average of 2.8% of live births versus 0.4% (Kartika, *et al.*, 2017).

In 2017, the WHO estimated that there were 295 000 maternal deaths; 35% lower than in 2000 when there were an estimated 451 000 maternal deaths globally. The global maternal mortality rates (MMR) in 2017 was estimated at 211 maternal deaths per 100 000 live births, representing a 38% reduction since 2000, when it was estimated at 342 deaths (WHO, 2019). On the World Bank Report side, pregnancy induced hypertensions like pre-eclampsia is rated as one of the primary causes of death (World Bank Report, 2018).

Maternal deaths have been described as the tip of the iceberg and maternal morbidity as the base. For every woman who dies of pregnancy-related causes, 20 or 30 others experience acute or chronic morbidity, often with permanent sequelae that undermine their normal functioning (Tabassum, *et al*., 2013). In view of the social and economic implications of this condition, great efforts have been made to expeditiously prevent, diagnose and treat pre-eclampsia (Jauniaux & Steer, 2016).

Many studies showed different maternal risk factors which increase the incidence of pre-eclampsia in pregnant women like maternal age, obesity, poverty, hypertension pre-pregnancy, westernization of lifestyle, and younger age at marriage which leads to higher pre-eclampsia incidence (Al-Kayat, e*t all*., 2016). Primigravidity, high parity, younger or older women, poor nutrition, obesity, bad socioeconomic status, chronic medical illnesses and family history are the frequent risk factors for pre-eclampsia (Altaei,*et all*., 2015).

In other sub-Saharan African countries like Rwanda , screening for pre-eclampsia, which should occur during ANC, upon admission and throughout labor and delivery, includes measurement of blood pressure and urine protein, and enquiring about PE/E related danger signs (WHO, 2011).

Clinical management of severe pre-eclampsia and eclampsia during pregnancy, labor and delivery involves administration of parenteral magnesium sulfate (MgSO4) for prevention or management of convulsions and anti-hypertensive medications. The other key component is timing and route of delivery based on factors such as gestational age (Rawlins, *et al.*, 2018).

Clinical factors remain an inexpensive and rapid way to predict the occurrence of pre-eclampsia. To date, there are few studies on risk factors associated with preeclampsia that have been conducted. According to the study conducted in CHUK, the most common causes of maternal near miss and maternal death were found to be sepsis/severe systemic infection (33.9%), postpartum hemorrhage (28.1%), and complications from eclampsia (18.2%) and severe pre-eclampsia (5.8%) (Benimana, *et al.*, 2018).

In a study conduct at Ruhengeri Hospital in Rwanda, preeclampsia was found to be the leading cause of maternal mortality at 30.7%, while sepsis/peritonitis following cesarean section had the highest mortality index with 33.3%. A total of 77.9 % of SMO cases were referred from other facilities with critical conditions and 28.3 % were admitted into the Intensive Care Unit. Several indicators such as administration of oxytocin, magnesium sulfate and antibiotics were found to be suboptimal (Kalisa, *et al.*, 2016). Because of great burden of pre-eclampsia on society by mothers' loss or neonatal morbidity and mortality and on national health system in addition to scarcity of literature on the risk factors and outcomes of pre-eclampsia, this study will assess the prevalence and factors associated with pre-eclampsia among pregnant women who attend gyneco-obstetric service to find out the maternal and perinatal outcomes associated with this burden.



### 1.2 Problem Statement

Pre-eclampsia is an important cause of maternal, perinatal and neonatal morbidity and mortality; it complicates about 2–8% of pregnancies (WHO, 2018). Pre-eclampsia, characterised by hypertension and proteinuria, complicates 3%–5% of pregnancies worldwide (Hutcheon *et al.,* 2016). Pre-eclampsia can develop into eclampsia, characterised by the seizures that may be fatal for both mother and fetus (Dolea, *et al.*, 2015).

In 2013, the prevalence of pre-eclampsia/eclampsia in the East African region (ie, Democratic Republic of Congo, Kenya and Uganda) was 1.02%, 2.27% and 1.15%, respectively (Fantu, *et al.*, 2016).

In Rwanda, a combined retrospective and prospective study at 2 teaching hospitals in Kigali performed over a 2-year period has revealed that out of 19,746 deliveries, there were 454 cases of preeclampsia and eclampsia giving an overall prevalence of 2.3% (2.0% and 0.3%, respectively) (Mutabazi, *et al.*, 2020). This was similar to WHO statistics which estimate the prevalence of preeclampsia in developing countries to be 2.8% (WHO, 2011). The magnitude of the problem in some places across the world is still somehow not fully known, especially in low and middle-income countries. In particular, the actual prevalence of pre-eclampsia remains largely unknown (Thornton, *et al.*, 2017). This is usually due to suboptimal reporting of the cases, leading to constraints on public health applicability.



Another important aspect is the identification of pregnant women at risk of developing pre-eclampsia, especially in nulliparous women with no track record of any pregnancy outcomes (Roberts, *et al.*, 2017). As for pre-eclampsia's adverse maternal and perinatal outcomes, there is limited information and research assessing the magnitude of risks in low-resource areas where the impact is thought to be more severe. It is in this view that, this study assessed the prevalence and factors associated with preeclampsia among pregnant women attending Muhima District Hospital.

### 1.3 Objectives of the study

#### 1.3.1 General Objective

To assess the prevalence and factors associated with preeclampsia among pregnant women attending district hospitals in Rwanda.

### 1.3.2 Specific Objectives

(i) To determine the prevalence of preeclampsia among pregnant women attending Muhima District Hospital;

(ii) To determine factors associated with preeclampsia among pregnant women attending Muhima District Hospital.

(iii) To determine the maternal and perinatal outcomes of preeclampsia among pregnant women attending Muhima District Hospital;

## 1.4 Research Questions

(i) What is the prevalence of preeclampsia among pregnant women attending Muhima District Hospital?

(ii) What are the factors associated with preeclampsia among pregnant women attending Muhima District Hospital?

(iii) What are the maternal and perinatal outcomes of preeclampsia among pregnant women attending gyneco-obstetric service Muhima District Hospital?



## 1.5 Significance of the study

The study will be an added-value to the existing literature in this area of factors associated with preeclampsia among pregnant women attending gyneco-obstetric service. The study findings will be used by future researchers as literature.

## 1.6 Limitations of the study

Even though this study contributes as an input for the policy makers towards the decrement of the maternal morbidity and mortality, it has its own limitations. The study results derived from single health facility setting. Thus, findings might not be generalizable to the whole national health facilities. Since a cross-sectional study design was implemented, it can't directly

establish cause effect relationship between the predictor variables and dependent variables. Recall bias might be expected for the past history of chronic disease. Finally, since the study was hospital-based study, the result will not be generalizable to the general population of the catchment area.

### 1.7 Scope of the study

The scope of this study included the concept and content, geographical and time scopes. In relation to the concept and content, this study focused on the factors associated with preeclampsia among women attending gyneco-obstetric service. Geographically, this study was conducted at Muhima District Hospital, Rwanda between March and June 2021.

### 1.8 Organization of the study

To come up with the research objectives, this study contained five chapters. Chapter one was the general introduction. Chapter two presented the review of related literature. The third chapter described the research methodology. Chapter four focused on the key findings, its interpretations and discussion. And lastly, the chapter five reports to the summary of findings, conclusions, recommendations and suggested areas for further researchers.

# CHAPTER TWO: REVIEW OF RELATED LITERATURE

## 2.0 Introduction

This section summarized the literature that is already in existence regarding to the factors associated with the occurrence of pre-eclampsia. It presented an overview of previous work on related topics that provide the necessary background for the purpose of this research.

## 2.1 Theoretical Literature

### 2.1.1 Preeclampsia as a public health problem

On the World Bank Report side, pregnancy induced hypertensions like pre-eclampsia is rated as one of the primary causes of death *(*World Bank Report, 2018. Preeclampsia is a major maternal health issue worldwide that is responsible for maternal and neonatal severe morbidity and mortality and has substantial contributions to prematurity of the fetus and long-term cardiovascular disease (CVD) in the mother (Kuklina, *et al*., 2019). Preeclampsia has remained a significant public health threat in both developed and developing countries contributing to maternal and perinatal morbidity and mortality globally (Shah, *et al.*, 2019), (McClure, et al., 2019). However, the impact of the disease is felt more severely in developing countries (Adamu, *et al.*, 2016), (Igberase, *et al.*, 2016), where, unlike other more prevalent causes of maternal mortality such as haemorrhage and sepsis, medical interventions may be ineffective due to late presentation of cases (Ikechebelu, *et al.*, 2015) (Onuh, *et al*, 2015), (Onakewhor, *et al.*, 2018).

Hypertensive disorders complicate 2 to 8% of all pregnancies (Duley, *et al.*, 2019). The WHO estimates the incidence of preeclampsia (PEC) and eclampsia (EC) to be higher in developing countries (2.8% of live births) than in developed countries (0.4%) (WHO, 2019), (Say, 2014). The reasons for the variations in rates are largely unknownthough geographic,

sociodemographic, racial and economic contributors have all been postulated (Bilano, *et al.*, 2014).

Preeclampsia (PEC), either alone or superimposed on chronic hypertension, accounts for 10-15% of maternal deaths worldwide (Ghlumiyyah,*.et al*, 2017). In countries where maternal mortality is lower, the relative proportion of deaths from preeclampsia/eclampsia and cardiovascular disease is higher likely due to reduction in mortality from hemorrhage and infection (Ozimek,*et al.*, 2018), (Kassebaum, *et al.*, 2016). The rate of PEC and EC in Rwanda is not well documented, though anecdotally it is felt to be a common pregnancy complication (Mutabazi, *et al.*, 2020).

### 2.1.2 Maternal health care services in Rwanda and health care initiatives

Over the last two decades, Rwanda has made substantial efforts to decrease maternal mortality and morbidity, and it is one of the few African countries that have managed to fulfil the 5$^{th}$ MDG (United Nations Economic Commission of Africa, 2015), (NISR, 2020) and (Condo, et al., 2014). These efforts came about through political commitment and were accompanied by many health innovations such as the use of CHWs; the education of new categories of health care providers such as midwives, clinical officers, and hospital managers; an increase in the number of students in health-related fields; the use of RapidSMS application to communicate the emergency needs of pregnant women from the community level to higher levels in the health care system; an increase in the number of ambulances at district hospitals; payment-based financing for health care providers; and the community-based health insurance (Bucagu, *et al*., 2012), (Abbott, *et al*., 2017), (Ministry of Health [Rwanda], 2018).

Antenatal care (ANC) from a skilled provider is important to monitor pregnancy and reduce morbidity and mortality risks for the mother and child during pregnancy, at delivery, and during the postnatal period (42 days after delivery) (NISR & ICF, 2020).

The MMR dropped from 476 to 203 per 100,000 live births during the same period in Rwanda (NISR, 2020). The 2015-20 RDHS results show that practically all of Rwandan women (98%) who gave birth in the 5 years preceding the survey received antenatal care from a skilled provider at least once for their last birth. Forty-seven percent of women had four or more ANC visits (NISR & ICF, 2020).

### 2.1.3 Management of preeclempsia

Each day around the world, 830 women die from pregnancy- and childbirth-related causes. The second most common cause (after postpartum hemorrhage) is a hypertensive disorder during pregnancy, such as preeclampsia and eclampsia (PE/E), life-threatening, pregnancyinduced high blood pressure and excess protein in urine, which can lead to seizures and other fatal complications. One in four preterm infants dies as a result of their mother's PE/E. These deaths are preventable, yet essential medicines and tools to treat this disorder are often unavailable in low-resource settings (USAID, 2020).

Recently, the WHO has provided guidelines for treatment of preeclampsia in low resource settings. A summary of facts and recommendations as stated by the World Health Organization is as follows: (i) Ten percent of maternal mortality in Africa is due to hypertensive disorders in pregnancy (gestational hypertension, preeclampsia, eclampsia), most of these maternal deaths are avoidable, (ii) Women at high risk for developing preeclampsia should take 75 mg acetylsalicylic acid (aspirin) daily, (iii) Calcium supplementation (1.5-2.0 grams daily) is recommended in settings with low calcium intake, (iv) Women with severe hypertension

require treatment in pregnancy, (v) Women with severe preeclampsia at pre-viable gestational ages should be delivered, (vi) Women with severe preeclampsia above 34 weeks, delivery should be considered, (vii) Women with severe preeclampsia at term should be delivered,

(viii) Women with severe preeclampsia prior to 34 weeks, can be expectantly managed as long as the maternal and fetal status is stable (no uncontrolled hypertension, labs not worsening, fetal heart tones category I), (ix) Women with mild preeclampsia or gestational hypertension, induction of labor at term is recommended, (x) Antihypertensives should be continued in the postpartum period until blood pressure normalizes, and (xi) It is not recommended to treat patients with mild or severe preeclampsia with bed rest, Vitamins C,D, or E, or diuretics (WHO, 2011).

## 2.2 Empirical Literature

Globally, preeclampsia is a leading cause of maternal and neonatal mortality and morbidity, predominantly in developing countries (Alemayehu, *et al.*, 2019). Preeclampsia is a multisystemic disease characterized by the development of hypertension after 20 weeks of gestation in a previously normotensive woman, with the presence of proteinuria or, in its absence, of signs or symptoms indicative of target organ injury (Moussa *et al*., 2014).

### 2.2.1 Prevalence of preeclampsia among pregnant women

The World Health Organization (WHO) estimated, at least 16% of maternal deaths in low- and middle-income countries (LMICs) result from hypertensive disorders of pregnancy, of which eclampsia is the primary contributor (Khan, *et al*., 2016). Globally, preeclampsia is a leading cause of maternal and neonatal mortality and morbidity, predominantly in developing countries (Alemayehu, et al., 2019). Preeclamptic women in LMICs are also three times likelier to progress to eclampsia than women in high-income countries (AbouZahr, et al., 2016).

Largely on the basis of clinical data, the incidence of eclampsia ranges between 2% and 10%, depending on the population studied and the definition of eclampsia used (WHO, 2018); clinical studies suggest that the proportion of deliveries impacted by eclampsia in Indian women ranges from as low as 0.9% to as high as 7.7% (Abalos, *et al*., 2013).

The prevalence of preeclampsia in developing countries ranges from 1.8 to 16.7% (Lakew, et al., 2013). It is a hazardous obstetrical disease accompanied by high rates of maternal morbidity and mortality especially in developing countries. For instance, the prevalence of pre-eclampsia occurs in 10% of pregnancies in African women, which is significantly higher than the global average of approximately 2% (Nakimuli, *et al.*, 2014).

In Ethiopia, the estimate of the maternal mortality ratio for the 7-year period preceding the 2016 Ethiopian demographic health survey (EDHS) is 412 deaths per 100,000 live births; that is, for every 1000 births in Ethiopia, there are about 4 maternal deaths (MoH (Ethiopia), 2018). In Rwanda, maternal mortality is estimated to 210 per 100,000 live births and main obstetric complications are hypertensive disorders during pregnancy, obstructive/prolonged labour, post-partum haemorrhage (PPH) and sepsis/infections (Semasaka, *et al*., 2018).

### 2.2.2 Factors associated with preeclampsia among pregnant women

Severe pre-eclampsia can result in maternal organ dysfunctions such as renal insufficiency, liver involvement, neurological complications, haematological complications, and utero-placental dysfunction, including fetal growth restriction (Tranquilli, *et al*., 2014).

A study conducted in Iraq revealed that increased maternal age was a significant maternal risk factor for pre-eclampsia (Yusra, et al., 2018). The change of partner increases the risk for pre-eclampsia in 1.6%, which increases up to 2.9% in a woman whose second pregnancy is the

result of union with a man who has had a previous partner with preeclampsia. Change of partner also plays a predisposing or protective role, depending of the presence or absence of the disease in the first pregnancy (Wikström, et al., 2015).

A study conducted on primiparous women in Finland revealed that advanced maternal age was a risk factor for pre-eclampsia (Lamminpää, *et al*., 2016). Other study carried out in Ireland found that effective management of pre-eclampsia was achieved for younger age more than older age women in reproductive period ( Kenny, *et al.*, 2015).

Recent study in Japan documented that pregnancy of maternal age more than 40 years is highly accompanied by adverse maternal outcomes like pre-eclampsia, severe eclampsia, cesarean section and placenta previa and age effect differs according to conception way a nd parity (Ogawa, *et al.*, 2017). The results found in a study conducted in UK which revealed that arterial stiffness is increased in women with preeclampsia specifically among primigravida women.



This finding is in agreement with results of a study done in Netherlands which reported that in women with pre-eclampsia, the cesarean section risk is predicted (van der Tuuk, *et al*., 2015). Studies conducted in India, Taiwan and 29 low-and-middle-income countries have revealed that women who have given birth to twins, triplets, or multiple fetuses are more likely to develop pre-eclampsia compared to the singleton pregnancies (Agrawal, *et al.*, 2016).

A study focusing on pre-eclampsia according to severity of disease showed that a history of pre-eclampsia doubled the risk of developing early-onset pre-eclampsia (<32 weeks) in a subsequent pregnancy as opposed to late-onset pre-eclampsia *(*Odegard *et al.*,2019*).*

Other studies have reported a 5% to 17% recurrence risk of early-onset pre-eclampsia (<34 weeks) in the index pregnancy for those with a prior history of early-onset pre-eclampsia

(Langenveld, et al., 2010). A systematic review of 11 studies including 2377 women showed that the pooled recurrence risk of early-onset pre-eclampsia is approximately 8% in women who require delivery at less than 34 weeks following the development of early-onset pre-eclampsia in the first pregnancy (Langenveld *et al.*, 2018)

Although most cases of pre-eclempsia are sporadic, a familial susceptibility to pre-eclempsia has been documented. Daughters or sisters of women with pre-eclempsia are 3–4 times more likely to develop the condition than women without a family history. The mode of inheritance seems to be complex, including numerous variants, which individually have small effects, but collectively contribute to an individual's susceptibility to the disorder (Williams,*et,al*.,2017)
There are certain medical conditions that predispose women to developing pre-eclempsia. These include hyperglycemia in pregnancy (pre-pregnancy type 1 and type 2 diabetes mellitus, overt diabetes in pregnancy, and gestational diabetes requiring insulin treatment), pre-existing chronic hypertension, renal disease, and autoimmune diseases such as systemic lupus erythematosus and antiphospholipid syndrome (Liona, *et al*., 2019).

Recently, a systematic review and meta-analysis evaluated clinical risk factors at less than or equal to 16 weeks of gestation from a population of 25 million pregnant women in 27 countries revealed that patients with a history of chronic hypertension had a higher risk of developing pre-eclempsia than those without this condition.

Pre-existing diabetes mellitus, systemic lupus erythematosus and antiphospholipid syndrome and chronic kidney disease are also associated with an increased risk of developing pre-eclempsia (Bartsch, *et al.*, 2016). Interestingly, pre-existing diabetes mellitus and pre-

eclempsia share many risk factors including advanced maternal age, nulliparity, pre-pregnancy obesity, nonwhite racial propensity, and multiple pregnancy (Mudd,*et al*.,2018).

History of diabetes mellitus has been found as an independent predictor variable for preeclampsia. Women with no history of diabetes mellitus are less likely to be pre-eclamptic than those with a history of diabetes mellitus. This finding is in line with the studies conducted in Sweden ( Hanson et al., 2015), in Ireland (Kenny *et al*., 2015) and in Germany (Schneider, *et al*., 2016).

This might be explained by that diabetes is a disease in which the blood glucose, or blood sugar, levels are too high which will cause narrowing of blood vessels and interfere with the normal physiological response during pregnancy. Findings of a study conducted in Southwestern Ethiopia showed that pregnant women with kidney disease during current pregnancy were more likely to developed PIH as compared to pregnant women with pregnant did not have kidney disease during pregnancy and being psychologically stressed during pregnancy increases the likehood of PIH by six times when compared to those pregnant women who did not have psychological stress during pregnancy. Pregnant women from a rural residence were five times more likely to develop PIH when compared to those of pregnant women residing in urban areas (Tesfaye,*et al.*, 2018).

A review study conducted on the causes of maternal mortality in Ethiopia indicated that the proportion of maternal mortality in Ethiopia due to hypertensive disorders between the year of 1980 and 2012 was in an increased trend from 4%-29% (Berhan, *et al.*, 2014). The prevalence of pre-eclampsia is also explained by several risk factors, that include maternal age under 20

years old or over 40 years old, history of pre-eclampsia, previous hypertension, autoimmune diseases, and obesity (Grand'Maison, 2016).

Similarly, being psychologically stressed during pregnancy increases the likelihood of pregnancy induced hypertension by six times. This result was consistent with a study conducted in New York (Abeysena, *et al*.,2016) and also this finding is in lined with a study conducted in Sri Lanka with a slight difference (Landsbergis,et al., 2016). Stress activates the hypothalamus-pituitary-adrenal cortex system (HPA), which in turn increases in levels of corticosteroids and catecholamine. Stress also activates the sympathetic nervous system and affects the immune system and increased levels of corticotrophin-releasing hormone and increased sympathetic activity which increases the risk of PIH (Hernandez-Diaz,*et al.*,2017). A study conducted by Yusra (2018) revealed that low birth weight had a significant adverse perinatal outcome of pregnant women with pre-eclampsia.

Factors such as sedentary lifestyle, stress, chronic diseases, smoking and alcohol intake also influence the development of arterial hypertension, which are the most worrying among modifiable factors (Ferrazzo, et al., 2016). It was found that smokers had a higher prevalence rate than non-smokers, and individuals who ingested alcohol were more likely to exhibit hypertension than those who did not consume.

Paradoxically, cigarette smoking during pregnancy is associated with a reduced risk of preeclampsia possibly due to modulation of angiogenic factors (Wikstrom, et al., 2015). Severe pre-eclampsia was found to be associated with an 8.7-fold risk of composite maternal complication (Ghimire, 2016). The risk of a woman in the developing countries dying from a

maternal-related cause is 33 times higher than a woman in the developed countries (Imarengiaye, et al., 2015).

In a study conducted by Yusra (2018) found that the obesity of pregnant women was a significant risk factor for pre-eclampsia, with high odds of risk in developing pre-eclampsia reaching about 54 times probability of risk. This finding was consistent with results of a study done in Ethiopia which stated that obesity of young age women is related to high risk of pre-eclampsia development in pregnancy (Endeshaw et al., 2016).

Elevated body mass index (BMI, kg/m2) is also associated with preeclampsia. Given the obesity epidemic in the United States and around the world, this is one of the largest attributable and potentially modifiable risk factors for pre-eclampsia. The high prevalence of obesity and projected increase have substantial implications for pregnancy since obesity is associated with infertility, spontaneous miscarriage, fetal malformations, thromboembolic complications, gestational diabetes, stillbirth, preterm delivery, cesarean section, fetal overgrowth and hypertensive complications (Yogev,*et al.*, 2019). Elsewhere, obesity was found to increase the overall risk of pre-eclampsia to approximately 2- to 3-fold (Bodnar, *et al*., 2015). The risk of pre-eclampsia progressively increases with increasing BMI, even within the normal range. Importantly, it is not only the late or mild forms of pre-eclampsia that are increased, but also early and severe preeclampsia, which are associated with greater perinatal morbidity and mortality (Catov, *et al.*, 2017).

### 2.2.2 Maternal and perinatal outcomes of preeclampsia among pregnant women

Researches across the world have demonstrated that maternal hypertensive disorders are more likely to cause significant adverse perinatal outcomes in LMIC. It is estimated that 2.6 million stillbirths occur each year, and 98% occur in LMIC (Subki, *et al.*, 2018). Other serious neonatal outcomes from maternal hypertension include prematurity, low birth weight (LBW), intrauterine fetal demise (IUFD), intrauterine growth restriction (IUGR), respiratory distress, admission at neonatal intensive care unit (NICU), and neonatal death (Endeshaw,*et al*, 2015). Globally, maternal hypertensive disorders in pregnancy significantly increase both maternal and perinatal morbidity and mortality. Maternal hypertension affects 14% of pregnanciesand the early detection and management are critical for improving the health outcomes of both mother and neonate (Uwizeyimana, *et al*., 2020).

A systematic review and meta-analysis of 55 studies in the United States (Hassan, *et al*., 2015) reported pregnant women with chronic hypertension had a higher incidence of superimposed preeclampsia (25.9%), a cesarean delivery (41.4%), preterm birth at 37 weeks or less (28.1%) of <2500 grams (16.9%) NICU care (20.5%) and perinatal death (4.0%) (Brown, *et al*., 2018). In Sub Saharan Africa (SSA), perinatal loss rates are higher than in high-income countries. In South Africa, a prospective study of pregnant women with preeclampsia at three tertiary facilities, had 1589 births (including 42 twins), revealed a 21% perinatal mortality rate, and of this 84.5% were stillbirths (Nathan, *et al*., 2018). Of the live births (n=1308), 70.0% were born preterm (<37 weeks), and of those, 41.7% were born at <34 weeks' gestation (Nathan, et al., 2018).

In Southern Ethiopia, a retrospective study of women hospitalized with a hypertensive disorder reported a 49% preterm birth rate (Nathan, *et al*., 2018). In Uganda, a cross-sectional study compared adverse neonatal outcomes with good neonatal outcomes, and found pregnant

women with preeclampsia were nearly six times more likely to have a preterm birth (Kiondo, et al., 2014).

The Rwanda Demographic Health Survey (RDHS), 2014-2015 showed that neonatal and post-neonatal mortality rates were at 20 deaths per 1,000 live births and 13 deaths per 1,000 live births, respectively. The perinatal mortality rate was 29 deaths per 1,000 pregnancies (MoH (Rwanda), 2014).

A retrospective study conducted at a Referral Hospital in Rwanda revealed that neonatal outcomes were including low birth weight (75.4%), prematurity (59.6%), admission to neonatal intensive care unit (50.4%), intrauterine growth restriction (32.4%), and neonatal death (22.8%). Nearly two-thirds (62%) of mothers targeted in this study had found with preeclampsia (Uwizeyimana, *et al.*, 2020). A similar study documented that adverse neonatal outcomes of pre-eclampsia is not limited to prematurity only, it also included early and late neonatal complications and the low birth weight is most prevalent early neonatal complication of pre-eclampsia (Backes, *et al*., 2014).

In conclusion, severe maternal outcomes (SMO) are frequent. The high ratios of SMO and coverage of life saving interventions call for improvements in the quality of case management and follow up of pregnant women in order to reduce maternal morbidity and mortality. In Rwanda, postpartum haemorrhage, eclampsia and ruptured uterus were the conditions that need particular attention as these are major causes of SMO and their case fatality rates are high (Kalisa, *et al.*,2017).

### 2.3 Critical Review and Research Gap identification

Literature review shows that developing countries especially Sub Saharan African countries still suffering from maternal deaths. Incidence of pre-eclampsia in developing countries is

approximately seven times higher than in developed countries on average 2.8% of live births versus 0.4% (Kartika *et al*., 2017).

The rate of pre-eclampsia and eclampsia in Rwanda is somehow not well defined, even though it is felt to be a common pregnancy complication. There is no available data describing seasonal variability in the incidence of preeclampsia and eclampsia in Rwanda. So, the study's overall aim will be to determine the hospital-based prevalence of pre-eclampsia and its associated factors among women attending gyneco-obstetric at Muhima District Hospital in Rwanda.

### 2.4 Theoretical framework

Pre-eclampsia is a pregnancy-specific disorder that affects 2 to 8% of all pregnancies and remains a leading cause of maternal and perinatal morbidity and mortality worldwide (Jeyabalan, 2014). Its etiology is elusive and theories abound regarding its pathogenesis. Pre-eclampsia can cause changes in virtually all organ systems. Several organ systems are consistently and characteristically involved. Any satisfactory theory on the pathophysiology of pre-eclampsia must account for the observation that hypertensive disorders due to pregnancy are very much more likely to develop in the woman who is exposed to the chorionic villi for the first time; this exposure maybe due to super abundance of chorionic villi as with twins or hydatidiform mole; has preexisting vascular disease and is genetically predisposed to hypertension developing during pregnancy. Vasospasm is basic to the pathophysiology of pre-eclampsia and eclampsia (Barton,*et al.,* 2018)

#### 2.4.1 Remodeling of Spiral Artery/Acute Atherosis in the Placenta

Abnormal spiral artery remodelling was first postulated over five decades ago (Brosens, 1977) and has been accepted as the underlying cause of pre-eclampsia (Burton, *et al*., 2009). Referred to as the two-stage process (Robertset *et al.,* 2017), for over two decades, most researchers

have argued that the development of pre-eclampsia stems from abnormal spiral artery modification leading to placental hypoxia, increase in oxidative stress and aberrant maternal systemic inflammatory responses (Naljayan,*et al*.,2015).

Latest studies have shown that such defects are not specific to pre-eclampsia (Lyall, Robson, & Bulmer, 2013), and are also associated with placental abruption, preterm premature rupture of membranes and intrauterine fetal death (Avagliano, *et a*l., 2011), indicating that abnormal spiral artery remodelling may be a common underlying contributing factor for abnormal placentation, but is not specific to pre-eclampsia.

Burke *et al*. concluded that neither gestational hypertension nor deficient placental growth was an outcome of impaired spiral artery remodelling (Burke, *et al*., 2010). Moreover, pre-eclampsia may occur in twin pregnancy despite normal uterine artery velocity waveform (Rizzo, et al., 2015). Finally, a meta-analysis on the performance of first trimester uterine artery Doppler showed similar predictive accuracy for pre-eclampsia and other complications such as stillbirths and abruption (Velauthar, *et al.,* 2014). The test had high specificity, but low sensitivity, and this pattern of performance was noticed across various conditions including pre-eclampsia. This once again indicates that the shallow trophoblastic invasion in the spiral arteries resulting in progressive utero-placental ischaemia may relate to a more generalized remodelling pathology and is not the initiator of pre-eclampsia per se (Burke, *et al*.,2016).

### 2.4.2 The accelerator and brake theory of pre-eclampsia

**a)** In this theory, the dysregulation of endogenous protective pathways consists to ‘the brakes’ [CSE which generates H2S and HO-1 that produces CO] leading to maternal endothelial activation. As a consequence, there is an increase in anti-angiogenic factors ‘the accelerator’ (sVEGFR-1, sEng and soluble E-slectin and a decrease in angiogenic

factors PlGF and eNOS, which generates NO). These biochemical changes lead to a generalized endothelial dysfunction, renal injury and generation of reactive oxygen species, which precedes the clinical onset of pre-eclampsia. After 20 weeks of gestation, the clinical symptoms manifest themselves as high BP and proteinurea, which are concurrent with excessive inflammation as indicated by increase in pro-inflammatory cytokines (Th1 cytokine production) and ET-1 release (Asif,*et al.*, 2015).

**b)** The Role of Homocysteine prevailing evidence is that endothelial cell activation is the centerpiece in the contemporary understanding of the pathogenesis of pre-eclampsia. Homocysteine concentrations are slightly increased in normotensive pregnancies that later develop pre-eclampsia and are considerably increased once pre-eclampsia is established. It is currently unclear whether high concentrations of circulating homocysteine cause pre-eclampsia or whether this is merely a secondary phenomenon reflecting, perhaps metabolic alterations that result from the disorder.If causally linked, the concentrations would be elevated earlier in gestation and they might be useful for early detection. Moreover, the potential to control hyper-homocysteinemia pharmacologically (e.g., by vitamin supplementation) might lead to strategies for preventing pre-eclampsia (Brett *et al.*, 2015).

Most studies qualitatively showed a positive association between hyper-homocysteinemia in pregnancy and pre-eclampsia. It was unclear how hyper-homocysteinemia developed because none of the purported factors (folate, vitamin B12, and genetic polymorphisms) showed an association. However, researchers observed a biologically plausible role for oxidative stress and endothelial dysfunction, factors through which hyper-homocysteinemia may lead to pre-eclampsia (Luciano *et al.*, 2016*).*

### c. The three-delay model

The recent decrease seen in maternal mortality is a product of interdisciplinary efforts that used multiple approaches to increase service availability and remove financial barriers to care (UNFPA, 2015). An early model provided an invaluable framework for understanding not only the factors contributing to the mortality resulting from obstetric emergencies but also the initiatives that may have most potential impact (Nyamtema *et al.,* 2011).

A later model focused on the three main factors that affected the outcome of emergency presentation during pregnancy. These factors were defined, chronologically, as the lengths of the delays in: (i) the decision to access care, (ii) the identification of – and transport to – a medical facility, and (iii) the receipt of adequate and appropriate treatment (Thaddeus & Maine, 2014).

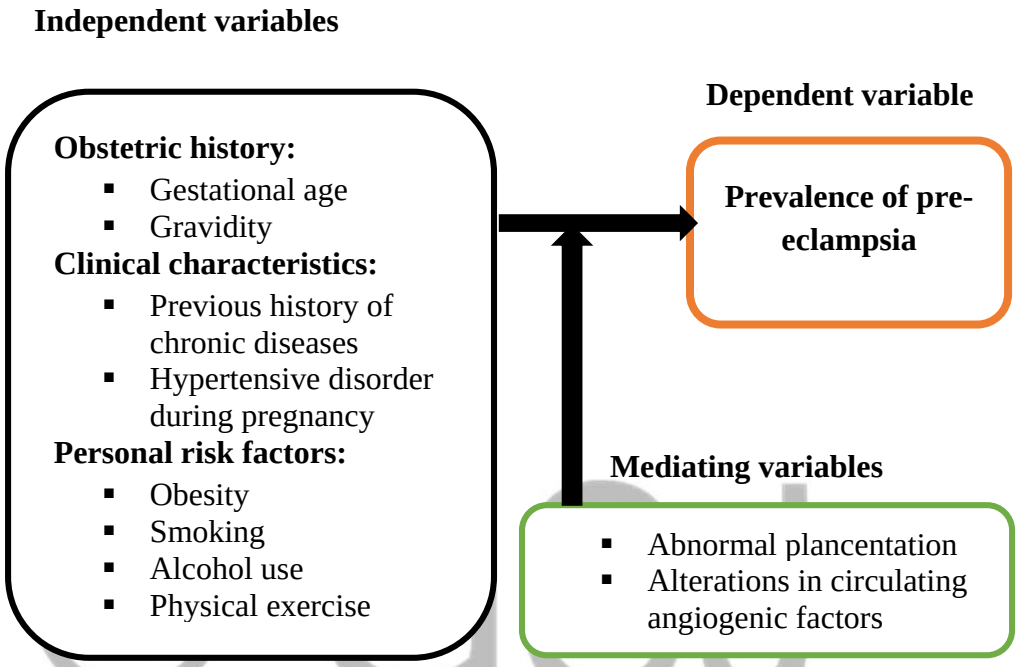


Socioeconomic and cultural factors, accessibility of facilities and quality of care may independently affect the lengths of these three delays. This so-called three-delay model illustrated that maternal mortality was not due solely to a lack of economic and human resources but was a product of numerous interwoven factors. A poor patient outcome is likely to result if any of these factors contribute to an undue delay. For example, an inability to recognize an emergency may extend the delay in the decision to seek care. While the ability of the patient or a caregiver to recognize an emergency is partially dependent upon the patient's or caregiver's level of education, studies have shown that true obstetric emergencies may not be perceived as emergencies in areas where they commonly occur *(* Echoka *et al., 2014).* Additionally, in various cultures, women's status can affect both the ability of women to decide to seek care and their subsequent ability to reach care (Kloos *et al., 2017).*

## 2.5 Conceptual framework

The conceptual framework explains schematically the relationship existing between the study variables, namely independent variables, dependent variables and intervening variables.

**Figure 2. 1:Conceptual framework**




**Source:** Researcher, 2021

Figure 2.1 shows factors independently associated with pre-eclampsia. There are obstetric history, clinical characteristics and personal risk factors that either alone or in combination may contribute to the high risk of pre-eclampsia prevalence. Potential confounders might not be controlled like abnormal plancentation and alterations in circulating angiogenic factors.

## 2.6 Summary

This second chapter has highlighted many issues from different literature. A number of studies on preeclampsia and its associated factors have been explored. Literature review raised questions about the way in which the role of the knowledge of the etiology and/or pathophysiology of pre-eclampsia has been evaluated and disseminated. Literature review identified risk factors such as parity, age, lifestyle, diabetes mellitus, socio-economic status,

and multiple pregnancies to be associated with pre-eclampsia. Critical review of the existing literature and research gap in this study area have been done. Some theories on the preeclampsia and key points on preeclampsia management have been highlighted in this section.



# CHAPTER THREE: RESEARCH METHODOLOGY

## 3.0 Introduction

The present chapter discussed the research design, target population, sample design data collection methods, data analysis procedure, and ethical considerations.

## 3.1 Research Design

This research was a hospital-based cross sectional study conducted among pregnant women who attended Muhima district hospital, between March and June 2021. Muhima District Hospital is located within the city of Kigali. It serves as district hospital for Nyarugenge

District but receives referrals from nearby district hospitals and health centers. Annually, Muhima hospital conducts 7,000 delivers with 30 babies per day. It receives daily expentant women coming to attend gyneco-obstetric service and as well provides comprehensive obstetric care (Ndayambaje,*et a*l., 2017).

## 3.2 Target Population

The target population was all pregnant women attending gyneco-obstetric service at Muhima district hospital between March and June 2021.

### 3.3 Sampling procedures

#### 3.3.1 Sample size

Sample size was estimated using single proportion formula using the following assumptions: Proportion of preeclampsia **(p)** = 5.8% (Benimana, *et al*., 2018), 95% CI, 2.5% margin of error.

**n** = $(Z_{\alpha}/2)^2$ p(1-p) / $E^2$ = $(1.96)^2$ x 0.058 (1-0.058) / $(0.025)^2$ = 335.6 ≈ **336**

After the application of the formula, the total sample size was calculated to be 336. The sample size was calculated based on the magnitude of pre-eclampsia in Rwanda as found by Benimana, Small, & Rulisa (2018) in their study at 95% CI, 2.5% margin of error.

All pregnant women attending gyneco-obstetric service with gestational age greater than 20 weeks were included in the study. Pregnant women with gestational age less than 20 weeks and those who were critically ill and unable to communicate after full course of treatment were excluded in the study.

#### 3.3.2 Sampling technique

Convenience sampling technique was used. This technique was a consecutive enrollment of pregnant women for high-risk obstetric cases with signs or symptoms of pre-eclampsia

transferd from health centers and others district hospitals in nyarugenge district attending gyneco-obstetric service at Muhima District Hospital until the sample was achieved.

### 3.3.3 Criteria for Preeclampsia diagnosis

- *Blood pressure:* 140 mm Hg or higher systolic or 90 mm Hg or higher diastolic after 20 weeks of gestation in a woman with previously normal blood pressure.
- *Proteinuria:* 0.3 g or more of protein in a 24-hour urine collection (usually corresponds with 1+ or greater on a urine dipstick test).

## 3.4 Data collection methods

### 3.4.1 Data Collection Instruments

The researcher used an observation checklist (See Appendix 3) adapted from the WHO standards for screening and management of pre-eclampsia/eclampsia manual (WHO, UNICEF & UNFPA, 2000). The researcher also used a questionnaire (See Appendix 2) which was comprised of questions regarding socio-demographic, antenatal/prenatal history, obstetric history, maternal and prenatal outcomes.



### 3.4.2 Procedures of Data Collection

After consent was obtained from the respondent, data were collected through face to face using data collection checklists developed from WHO standard for screening and management of pre-eclampsia and eclampsia (WHO, UNICEF & UNFPA, 2000). Four (4) midwives and principle investigator were involved in the data collection process. They were trained on this tool as well tested before being used for the data collection. This data collection checklist was firstly prepared in English then translated to the local language (Kinyarwanda) and back to English to maintain conceptual consistency. Medical records were also reviewed for some clinical and laboratory investigation data including proteinuria. Data collectors and supervisor

took one day orientation to understand the objective of the study, research question, different sections of questionnaire and interviewing techniques. The respondents were allowed to take rest for five-ten minutes before the blood pressure is measured. Blood pressure readings were taken while the woman is seated in the upright position using a mercury sphygmomanometer apparatus which covers two-thirds of the upper arm. The measurement was taken from respondent's right hand. The cuff was inflated at a rate of 2–3 mmHg per second. Systolic blood pressure (SBP) was taken up on hearing the first sound, and diastolic blood pressure (DBP) was taken up on 4th (muffled) Korotkoff sound. The attendants found with abnormal findings were checked again and again and then were undergone for another BP measurement after four hours in order to confirm the diagnosis. Nonetheless, those clients found with severe preeclampsia (BP of 160/110 mmHg) were urgently referred to be re-checked by the hospital obstetrician for further assessment. Data regarding proteinuria and other clinical data were accessed from the client's obstetric records. Proteinuria was assessed using urine dipstick method and was part of the routine investigation for all expectant women. The urine protein dipstick test measures the presence of proteins, such as albumin, in a urine sample. Albumin and protein can also be measured using a blood test. Those women levels of + 1 and above were classified as having proteinuria (See Appendix 5).

### 3.5 Reliability and validity of the research instrument

For the reliability of the research instrument, the internal consistency was measured using Cronbach's Alpha by using the SPSS. The research instrument has been found with a very relatively high alpha coefficient of 0.74. Based on this α coefficient and these items display strong reliability. For the validity test, the data collection checklist was pre-tested at Nyarugenge District Hospital. Eight data collection checklists were pre-tested in this hospital

before being applied to the target population to make sure that the instrument is clear and measures what is intended to measure. Researcher worked closely with the supervisors and cross reviewed the data collection checklist to ensure the validity of research instrument.

### 3.6 Data analysis

The completed data collection checklist was checked for completeness, cleaned manually and entered into Microsoft Excel software and then transferred to SPSS for further analyses. Descriptive statistics were used to explore the data in relation to relevant variables. Binary logistic regression was used to assess the association between the dependent and independent variables. For the variables found with p-value less than or equal to 0.05 were fitted to multiple logistic regression analysis.



### 3.7 Ethical Considerations

The School of Postgraduate studies, Mount Kenya University Rwanda, first approved the research proposal and ethical clearance was obtained from the Institutional Research and Ethics committee of Mount Kenya University Rwanda. After obtaining ethical approval, permission was sought from the director general of Muhima District Hospital for authorization to proceed with the data collection and informed consent of study participants obtained. Confidentiality was maintained by storing data into a password-protected Excel-based database and data were not contained participant identifiers such as names.

# CHAPTER FOUR: RESEARCH FINDINGS AND DISCUSSION

## 4.0 Introduction

This chapter presents the findings of the study. The results are presented and interpreted based on the objectives of the study. A total of 336 respondents contributed into the research giving a response rate of 100%. The results are presented in tables and figures.

## 4.1 Characteristics of the respondents

This section presents the sociodemographic characteristics of pregnant women attended the gyneco-obstetric service at Muhima District Hopital during the period of the study. As indicated in Table 4.1, the majority (99.1%) of respondents were coming from urban areas: This may be explained by the fact that Muhima Hospital is located in the midtown and receiving patient transferred from health facilities in the catchment area. Most pregnant women (86.0%) were married, 57.4% were aged between 21-30 years (Mean age: 28.8 years, Stand. Dev.: 6.02, Minimum age: 17 years and Maximum age: 45 years), more than a half (57.7%) had primary education, 70.2% were working in private or public sector, 43.2% were protestants, 42.8% said they got a diversified diet and 66.4% were insured by RSSB.

**Table 4. 1 Sociodemographic characteristics of women attending Muhima hospital**

| Variables | | Frequency (n=336) | Percent (%) |
|---|---|---|---|
| **Residence** | Urban | 333 | 99.1 |
| | Rural | 3 | 0.9 |
| **Marital status** | Single | 47 | 14.0 |
| | Married | 289 | 86.0 |
| **Age (years)** | ≤ 20 years | 23 | 6.8 |
| | 21-30 years | 193 | 57.4 |
| | 31-35 years | 70 | 20.8 |
| | >35 years | 50 | 14.9 |
| **Education level** | Primary | 194 | 57.7 |
| | Secondary | 120 | 35.7 |
| | University | 22 | 6.5 |

| | | | |
|---|---|---|---|
| **Occupation** | Housewife | 26 | 7.8 |
| | Merchant | 74 | 22.0 |
| | Private/Government | 236 | 70.2 |
| **Religion** | Catholic | 128 | 38.1 |
| | Protestant | 145 | 43.2 |
| | Muslim | 59 | 17.5 |
| | No religion | 4 | 1.2 |
| **Lifestyle** | Alcohol consumption | 32 | 9.5 |
| | Smoking | 11 | 3.4 |
| | Getting a diversified diet | 144 | 42.8 |
| | Psychological stress | 82 | 24.4 |
| | Physical exercise | 67 | 19.9 |
| **Medical Insurance** | RSSB | 223 | 66.4 |
| | Private | 78 | 23.1 |
| | None | 35 | 10.5 |

**Source: Primary data (2021)**

As gravidity is defined as the number of times that a woman has been pregnant and the parity defined as the number of times that a woman has given birth to a fetus with a gestational age of 24 weeks or more regardless of whether the child was born alive or was stillborn. Results in Table 4.2 indicated that 55.7% of respondents were multigravidity while 53.6% had given at least one birth, 64.4% of respondents was in the preterm period (≤ 36 weeks) as gestational age (Mean: 31.57 weeks, Stand. Dev.: 6.48, Minimum: 20 weeks and Maximum: 40 weeks) and 45.2% were attending their first ANC, 79.8% had ever had a history of chronic disease especially pregnancy induced hypertension (PIH) (52.9%). A total of 77.7% have not encounterd maternal complications during their pregnancies.

**Table 4. 2 Obstetric and clinical characteristics of pregnant women at Muhima DH**

| Variables | | Frequency (n=336) | Percent (%) |
|---|---|---|---|
| **Gravidity** | Primigravida | 149 | 44.3 |
| | Multigravida | 187 | 55.7 |
| **Gestational age (weeks)** | ≤36 weeks | 47 | 64.4 |
| | >37 weeks | 26 | 35.6 |
| **Parity** | 1 | 180 | 53.6 |
| | 2-4 | 132 | 39.3 |
| | ≥5 | 24 | 7.1 |
| **ANC visits** | 1 | 152 | 45.2 |
| | 2-3 | 135 | 40.2 |
| | ≥4 | 49 | 14.6 |
| **Past medical history** | Yes | 68 | 20.2 |
| | No | 268 | 79.8 |
| **If "Yes", past medical history of: (n=68)** | Chronic HTA | 17 | 25.0 |
| | PIH | 36 | 52.9 |
| | Diabetes | 11 | 16.2 |
| | Renal disease | 4 | 5.9 |
| **Current obstetric complications** | Preeclampsia | 73 | 21.7 |
| | Placental abruption | 2 | 0.6 |
| | No complication | 261 | 77.7 |

**Source: Primary data (2021)**



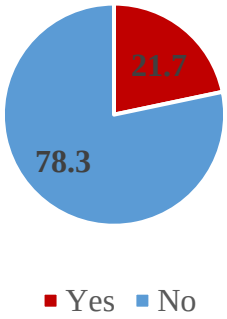
### 4.2 Presentation of findings

The presentation of findings and its interpretations were organized according to the research objectives and they are answered to the study research questions.

#### 4.2.1 Prevalence of preeclampsia among the respondents

As the prevalence measures the proportion of individuals in a defined population that have a disease or other health outcomes of interest at a specified point in time or during a specified period of time, the researcher has put attention on investigating prevalence of preeclempsia among pregnant women attending Muhima Hospital. In a total of 336 pregnant women enrolled in the study, the results in Figure 4.1 revealed that the prevalence of pre-eclempsia was 73/336 (21.7%).

**Figure 4. 1 Prevalence of preeclampsia among pregnant women at Muhima DH**




**Source: Primary data (2021)**

### 4.2.2 Factors associated with preeclampsia at Muhima District Hospital

The researcher sought to determine the factors associated with preeclempsia among pregnant women attending Muhima Hospital. Study findings are presented in the following tables. As indicated in Table 4.4, a multivariable analysis revealed that there was an association between preeclempsia and marital status ($p=0.047$) and pregnant women's lifestyle ($p<0.001$).

### 4.2.3 Maternal and perinatal outcomes of preeclampsia among pregnant women

The research tried to find out the maternal and perinatal outcomes of preeclampsia among pregnant women attending Muhima District Hospital. Findings in Table 4.2 revealed that most of pregnant women (63.1%) had not had fetal complications, 20.5% had had preterm births, 12.3% experienced still births while 4.1% experienced IUGR during their pregnancy. Less than a half (31.5%) had had NICU admission during their pregnancy, 28.8% had known low APGAR sore, 8.2% had had early neonatal birth while 31.5% had no neonatal complications.

**Table 4. 3 Maternal and perinatal outcomes of pregnant women with preeclampsia**

| Variables | Frequency (n=73) | Percent (%) |
|---|---|---|

| | | | |
|---|---|---|---|
| **Fetal complications** | Preterm birth | 15 | 20.5 |
| | Still birth | 9 | 12.3 |
| | IUGR | 3 | 4.1 |
| | No complication | 46 | 63.1 |
| **Neonatal** | NICU admissions | 23 | 31.5 |
| **complications** | Low APGAR score | 21 | 28.8 |
| | Early neonatal birth | 6 | 8.2 |
| | No complication | 23 | 31.5 |

**Source: Primary data (2021)**

**Table 4. 4 Sociodemographic factors associated with preeclampsia among women attending Muhima district hospital**

| **Variables** | | **Preeclampsia** | | **Chi-square** | **P-value** |
|---|---|---|---|---|---|
| | | **Yes n(%)** | **No n(%)** | | |
| **Residence** | Urban | 73(21.9) | 260(78.1) | 0.840 | 0.359 |
| | Rural | 0(0.0) | 3(100.0) | | |
| **Marital status** | Single | 5(10.6) | 42(89.4) | 3.95 | **0.047** |
| | Married | 68(23.5) | 221(76.5) | | |
| **Age (years)** | ≤ 20 years | 6(26.1) | 17(73.9) | 5.545 | 0.136 |
| | 21-30 years | 48(24.9) | 145(75.1) | | |
| | 31-35 years | 14(20.0) | 56(80.0) | | |
| | >35 years | 5(10.0) | 45(90.0) | | |
| **Education level** | Primary | 45(23.2) | 149(76.8) | 1.149 | 0.563 |
| | Secondary | 25(20.8) | 95(79.2) | | |
| | University | 3(13.6) | 19(86.4) | | |
| **Occupation** | Housewife | 5(19.2) | 21(80.8) | 0.262 | 0.877 |
| | Merchant | 15(20.3) | 59(79.7) | | |
| | Private/Government | 53(22.5) | 183(77.5) | | |
| **Religion** | Catholic | 37(28.9) | 91(71.1) | 7.571 | 0.056 |
| | Protestant | 22(15.2) | 123(84.8) | | |
| | Muslim | 13(22.0) | 46(78.0) | | |
| | No religion | 1(25.0) | 3(75.0) | | |
| **Lifestyle** | Alcohol consumption | 8(25.0) | 21(75.0) | 192.29 | **<0.001** |
| | Smoking | 11(78.6) | 3(21.4) | | |
| | Psychological stress | 36(56.2) | 28(43.8) | | |
| | Diversified diet | 6(4.0) | 144(96.0) | | |
| | Physical exercise | 12(15.2) | 67(84.8) | | |
| **Medical** | RSSB | 72(32.3) | 151(67.7) | 3.108 | 0.468 |
| **Insurance** | Private | 0(0.0) | 78(100.0) | | |
| | None | 1(5.0) | 19(95.0) | | |

**Source: Primary data (2021)**

Findings in Table 4.5 showed that there was an association between preeclempsia and the parity (p = 0.001) and history of chronic disease (p<0.001). The gravidity, ANC attendace, have not found to be associated with preeclempsia in the bivariate analysis (p value > 0.005).

**Table 4. 5 Obstetric and clinical outcomes associated with preeclampsia**

| Variables | | Preeclampsia | | Chi-square | P-value |
|---|---|---|---|---|---|
| | | Yes n(%) | No n(%) | | |
| **Parity** | 1 | 39(24.2) | 122(75.8) | 8.959 | **0.011** |
| | 2-4 | 26(23.6) | 84(76.4) | | |
| | ≥5 | 2(9.1) | 20(90.9) | | |
| **Gestational age (in weeks)** | ≤ 36 weeks | 11(23.4) | 36(76.6) | 0.001 | 0.975 |
| | > 37 weeks | 6(23.1) | 20(76.9) | | |
| **Gravidity** | Primigravida | 35(23.5) | 114(76.5) | 0.490 | 0.484 |
| | Multigravida | 38(20.3) | 149(79.7) | | |
| **ANC visits** | 1 | 31(22.3) | 108(77.7) | 2.572 | 0.276 |
| | 2-3 | 21(17.8) | 97(82.2) | | |
| | ≥4 | 15(41.7) | 21(58.3) | | |
| **Past medical history** | Yes | 13(19.1) | 55(80.9) | 32.17 | **<0.001** |
| | No | 60(22.4) | 208(77.6) | | |
| **If "Yes", past medical history of: (n=68)** | Chronic HTA | 0(0.0) | 17(100.0) | 0.902 | 0.825 |
| | PIH | 1(2.8) | 35(97.2) | | |
| | Diabetes | 0(0.0) | 11(100.0) | | |
| | Renal disease | 0(0.0) | 4(100.0) | | |

**Source: Primary data (2021)**

According to the results presented in Table 4.6, the researcher concluded that fetal complications (p<0.001) and neonatal complications (p<0.001) were statistically significantly associated with preeclampsia among pregnant women attended Muhima hospital. No association has been found between gestational age and preeclampsia (p>0.05).

**Table 4. 6 Maternal and perinatal outcomes associated with preeclampsia**

| Variables | Preeclampsia | P-value |
|---|---|---|

| | | Yes n(%) | Yes n(%) | Chi-square | |
|---|---|---|---|---|---|
| **Fetal complications** | Preterm birth | 13(86.7) | 2(13.3) | 58.877 | **<0.001** |
| | Still birth | 7(77.8) | 2(22.2) | | |
| | IUGR | 1(33.3) | 2(66.7) | | |
| | None | 6(13.0) | 40(87.0) | | |
| **Neonatal** | NICU admission | 19(82.6) | 4(17.4) | 24.220 | **<0.001** |
| **complications** | Low APGAR score | 5(23.8) | 16(76.2) | | |
| | Early neonatal birth | 3(50.0) | 3(30.0) | | |
| | None | 4(17.4) | 19(82.6) | | |

**Source: Primary data (2021)**

Independent variables which had a statistically significant association with preeclampsia in the bivariate analysis were submitted to the multivariable analysis to determine to which extent they were associated with the dependent variable. Six factors were predictive of preeclampsia in bivariate analysis: marital status, lifestyle, parity, fetal and neonatal complications ($p<0.05$). However, adjusted odds ratios (AOR) were somewhat compared to the crude odds ratios (COR) calculated at 95% confidence interval.

Smoking (AOR=6.1; 95% CI: [3.03–35.7]; $p < 0.001$) and having psychological stress during pregnancy (AOR=5.2; 95% CI: [1.97-13.89]; $p<0.001$) were more likely associated with developing preeclampsia compared to those were practicing physical exercise. The risk of developing preeclampsia was 2.1 times (AOR=2.1; 95% CI: [1.05–3.42]; p=0.036) higher among women with 2-4 births compared to women who had given at least one birth. Pregnant women with a history of chronic disease has found with 1.5 times of developing preeclampsia compared to pregnant women with no history of chronic disease (AOR=1.5; 95%CI: [1.18–3.81]; p=0.024). Pregnant women with stillbirth as fetal complication were 2.7 times more likely to develop preeclampsia compared to pregnant women without fetal complications

during pregnancy (AOR=2.7; 95% CI: [1.42–7.46]; p=0.015) and pregnant women with NICU admission as neonatal complication were 3.1 times more likely to develop preeclampsia compared to pregnant women without neonatal complications (AOR=3.1; 95% CI: [1.65–9.76]; p=0.020).

**Table 4. 7 Predictors of preeclampsia among pregnant women at Muhima hospital**

| Characteristics | | Crude OR (95%CI) | P-value | Adjusted OR (95%CI) | P-value |
|---|---|---|---|---|---|
| **Marital status** | Single | Ref. | | Ref. | |
| | Married | 2.5(0.98-6.79) | 0.054 | 1.7(0.42-4.78) | 0.064 |
| **Lifestyle** | Physical exercise | Ref. | | Ref. | |
| | Smoking | 5.3(3.28–22.7) | <0.001 | 6.1(3.03–35.7) | **<0.001** |
| | Psychological stress | 4.8(2.30-14.5) | <0.001 | 5.2(1.97-13.8) | **<0.001** |
| | Diversified diet | 0.5(0.41–1.97) | 0.060 | 0.8(0.57–2.65) | 0.077 |
| | Alcohol consumption | 0.9(0.04–1.69) | 0.074 | 0.8(0.63–1.32) | 0.081 |
| **Parity** | 1 | Ref. | | Ref. | |
| | 2-4 | 1.9(1.54-3.71) | 0.029 | 2.1(1.05–3.42) | **0.036** |
| | ≥5 | 0.3(0.07-1.39) | 0.764 | 0.7(0.25–3.60) | 0.613 |
| **Past medical history** | Yes | 1.2(1.01–2.57) | 0.0186 | 1.5(1.18–3.81) | **0.024** |
| | No | Ref. | | Ref. | |
| **Fetal complications** | Preterm birth | 1.4(0.56-3.52) | 0.459 | 1.2(0.71–2.24) | 0.312 |
| | Still birth | 2.3(1.33-13.9) | 0.001 | 2.7(1.42–7.46) | **0.015** |
| | IUGR | 3.3(0.26-42.6) | 0.355 | 2.6(0.92–37.1) | 0.290 |
| | None | Ref. | | Ref. | |
| **Neonatal complications** | NICU admission | 2.7(1.91-10.3) | <0.001 | 3.1(1.65–9.76) | **0.020** |
| | Low APGAR score | 1.4(0.34-6.47) | 0.599 | 1.5(0.49–3.15) | 0.897 |
| | Early neonatal birth | 4.7(0.69-32.7) | 0.114 | 2.6(0.42–22.1) | 0.294 |
| | None | Ref. | | Ref. | |

**Source: Primary data (2021)**

### 4.3 Discussion of key findings

The overall prevalence of preeclampsia in our study was 21.7% which was different with what found in a study conducted in 2 teaching hospitals in Kigali where the prevalence was 2.3% (2.0% preeclempsia; 0.3% eclampsia) (Mutabazi, et al., 2020). Our finding was also inconsistent to WHO statistics which estimate the prevalence of preeclampsia in developing countries to be 2.8% (WHO, 2011). The prevalence of preeclampsia varies worldwide and in African countries varies from 1.8% to 7.1 % (WHO, 2011). Variation between countries likely reflects variation in socioeconomic status, access to care and timeliness of diagnosis as well as background prevalence of hypertension and preeclampsia.

The study finding was found to be high compared with the results of other studies conducted in different areas where the prevalence was found to be 3% in Norway (Klungsøyr, *et al.*, 2012), 2.31% in German (Schneider, et al., 2014), 9.5% in Mustafa hospital of Ilam in the west of Iran (Khosravi,*et al.*, , 2016) and 0.17% in Shiraz Southern Iran (Zibaeenezhad, *et al.*, 2017) and 4.8% in Brazzaville teaching hospital in the Repulic of Congo (Kimbally, *et al.*, 2017).

In comparison with the other studies conducted in different areas of the world, it was also found to be high as compared with the studies conducted in different parts of Ethiopia, where 8.4% in Dessie referral hospital (Tessema, *et al.*, 2015) and 2.23% in Dilla (Vata, *et al*., 2015). In Zanzibar, a study revealed a high prevalence (26.3%) of severe pre-eclampsia among postpartum women in Zanzibar (Mwashamba, *et al.*,2020). This discrepancy might be due to the fact that there is a difference in study setting, socio-economical factors, methodological aspect and a difference in study duration. Moreover, the variation of prevalence of preeclampsia might be to the different distribution of maternal risk factors, availability/accessibility of health services and diagnostic capacities (Bilano, *et al.*, 2014),

(Khader, e*t al.*, 2018). In addition, in low income countries, the quality of data might be impacted by a lack of funds and therefore of manpower for routine and systematic registration of data.

Multiparity was found to be significantly associated with the risk of developing preeclampsia among pregnant women. This study finding was inconsistent with the studies conducted in Egypt (El-Moselhy, *et al*., 2017), and in Ireland (Kenny, *et al.*, 2015) where no association was been found between parity and preeclampsia. This was somehow strange as studies have confirmed that change of partner raises the risk for preeclampsia in subsequent pregnancies. Immune maladaptation on the fetal maternal interface could be an underlying mechanism (Tubbergen, *et al.*, 2014).

Pregnant women with history of a chronic disease like diabetes were 1.5 times more likely to be pre-eclamptic than those without a history of chronic diseases. This finding is in line with the studies conducted in Sweden (Haglund, *et al*.,2015), in Ireland (Kenny, *et al*., 2015) and in Germany (Schneider, *et al.*, 2016). This might be explained by that diabetes is a disease in which the blood glucose, or blood sugar, levels are too high which will cause narrowing of blood vessels and interfere with the normal physiological response during pregnancy.

Our findings revealed that stillbirth was a significant adverse perinatal outcome of pregnant women with preeclempsia. This is because newborns were with no signs of life at or after 28 completed weeks of pregnancy. This finding was consistent with what found in a study conducted in Iraq (Yusra, *et al.*, 2018). Some hospital based prospective and retrospective studies from Nepal and Ethiopia showed that respective proportions of 13% and 30.2 % of babies were delivered premature (Tesfaye, *at al*., 2019). These are in line with our findings,

though reported proportions of prematurity were comparatively low (20.5%). This discrepancy resides in the methods and enrolled pregnant women into research studies.

Likewise, Backes *et al*. acknowledged that adverse neonatal outcomes of preeclampsia is not limited to prematurity only, it is also inclusive low birth weight, early and late neonatal complications as the most prevalent early neonatal complication of pre-eclempsia (Backes, *et al*., 2014). According to Yusra (2018), the prematurity is also a significant adverse perinatal outcome of preeclempsia. Those findings were in contrast with our study findings because the gestational age has not found to be associated with pre-eclampsia in the multivariable analysis.

In our study, hypertension disorders were mainly chronic HTA, PIH and Diabetes. This has also been the reason for the high proportion in neonatal outcomes as compared to other studies conducted in Southwest, Ethiopia (Tesfaye, *at al*., 2019) and (Doddamani, et al., 2018). Yusra (2018) found that the NICU admission was significantly higher for neonates of pre-eclamptic women. Although this finding was related with preterm infants in Yusra's study, and coincided with results of Masoura et al.' study in Greece (Masoura, *et al.*, 2016).

Also lower Apgar score was not found to be statistically significant associated with pre-eclampsia. This finding was inconsistent with what found by Yusra in Iraq (2018) where the Apgar scores at 1 and 5 minutes were significantly lower among neonates of preeclemptic women than controls. These findings were consistent with results of Doddamani study in India (Doddamani, *et al.*, 2018).

# CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

## 5.0 Introduction

This chapter contains the summary of the key findings, conclusion and recommendations. The chapter also provides suggestions for further studies that might be carried out in the future.

## 5.1 Summary of findings

The study intended to assess the prevalence and factors associated with pre-eclampsia among pregnant women attending gyneco-obstetric service at Muhima hospital, Rwanda.

### 5.1.1 Prevalence of preeclampsia at Muhima District Hospital

In this study, the total sample size was 336 pregnant women. The results revealed that the prevalence of preeclampsia was found to be 21.7% among pregnant women attending Muhima District Hospital.

### 5.1.2 Factors associated with pre-eclampsia at Muhima District Hospital

Factors like smoking (AOR=6.1; 95% CI: [3.03–35.7]; $p < 0.001$), having psychological stress during pregnancy (AOR=5.2; 95% CI: [1.97-13.89]; $p<0.001$), having given 2-4 births (AOR=2.1; 95% CI: [1.05–3.42]; p=0.036), past medical history of chronic disease (AOR=1.5; 95%CI: [1.18–3.81]; p=0.024), stillbirth (AOR=2.7; 95% CI: [1.42–7.46]; p=0.015) and NICU admission (AOR=3.1; 95% CI: [1.65–9.76]; p=0.020) have been found to be statistically significantly associated with preeclampsia.

### 5.1.3 Maternal and perinatal outcomes of preeclampsia at Muhima District Hospital

The present study revealed that most of 55.7% of respondents were multigravidity while 53.6% had given at least one birth, 45.2% were attending their first ANC, 79.8% had ever had a history of chronic disease especially pregnancy induced hypertension (PIH) (52.9%). A total of 77.7%

have not encounterd maternal complications during their pregnancy.Pegnant women (63.1%) had not had fetal complications, 20.5% had had preterm births, 12.3% experienced still births while 4.1% experienced IUGR during their pregnancy. Less than a half (31.5%) had had NICU admission during the neonatal period, 28.8% had known low APGAR sore, 8.2% had had early neonatal birth complicstion while 31.5% had no neonatal complications.

## 5.2 Conclusion

The prevalence of preeclampsia in this study was 21.7%. Predictor variables like the psychological stress, multiparity, having a history of chronic disease, stillbirth, and NICU admission were factors associated with preeclampsia. Thus, antenatal care sessions should empharize on obstetric and neonatal danger signs, health seeking behavior towards pregnant women's should be encouraged, which provide a chance to diagnose preeclampsia as early as possible and to prevent the coming complication towards preeclampsia.

## 5.3 Recommendations

Based on the study key findings, the researcher made the following recommendations to the:

### 5.3.1 Ministry of Health

i. Avail the calcium supplementation before pregnancy for the prevention of preeclampsia and its complications as recommended by WHO.

ii. Significant efforts should be directed to close monitoring and management of mothers with preeclampsia to save the lives of mothers, and neonates Newborn.

### 5.3.2 Muhima District Hospital

i. Pregnant women should be mobilized to diagnose preeclampsia as early as possible and to prevent the coming complication towards preeclampsia.

ii. During ANC, expectant mothers should be provided with information on obstetric and neonatal danger signs, birth preparedness and complication readiness tailored

on symptoms of pre-eclampsia to enable them detect and take timely and appropriate actions when these are noticed.

iii. To perform systematic debriefing counselling at the time of discharge to all women who have experienced pregnancy and delivery-related complications.

iv. All pregnant women of gestation age 20 weeks should be screened for pre-eclampsia by checking blood pressure and testing urine for proteinuria and another latter check-up for those who reach 35 gestational weeks.

v. ANC clients should be educated on the need to have adequate preparations for any obstetric complications that may set in the course of the pregnancy.

### 5.3.3 Community level

i. To conduct regular campaigns focused in the community to increase awareness of the vulnerability of pregnant women who prior experienced pregnancy and delivery-related complications in order to make the community understand its role in giving psychological and social support in order to avoid stigma and isolation among the affected women.

ii. Increase community awareness on advantages of skilled birth attendance

### 5.3.4 Family and indivual level

- To sensitise pregnant women and their families about the importance of attending all recommended ANC visits and to give childbirth at a health facility with skilled birth attendants.

## 5.4 Suggestion for further study

This study provided a comprehensive description of the situation of women who have experienced pregnancy-related complications in Rwanda. Further researchers should provide a comprehensive description of children born to these women and to link their potential problems or challenges to the conditions experienced by their mothers in order to complete our understanding of the effect of adverse health conditions on the mother-child pair.

# REFERENCES

Kenny, et al. (2015). Risk factors and effective management of preeclampsia. *Integrated Blood Pressure Control,* 8:7-12.

Hanson et al., 2015. (n.d.). Gestational diabetes and preeclampsia. *Eur J Obstet Gynecol Reprod Biol*, 113(1):12–6.

Abalos, E., Cuesta, C., Grosso, A., Grosso, L., Chou, D., & Say, L. (2013). Global and regional estimates of preeclampsia and eclampsia: a systematic review. *Eur J Obstet Gynecol Reprod Biol.,* 170(1):1–7.

Abbott, P., Sapsford, R., & Binagwaho, A. (2017). Learning from success: how Rwanda achieved the millennium development goals for health. *World Development*, 92:103-16.

Abeysena, et al.,2016. (n.d.). Effect of psychosocial stress on maternal complications during pregnancy. A cohort study. *Int. J. of Collaborative Research on Internal Medicine and Public Health*, 2(12): 436-448.

AbouZahr, C., & Dolea, C. (2013). *Global burden of hypertensive disorders of pregnancy in the year 2000. In: Global burden of diseases, evidence and information for policy (EIP).* Geneva: World Health.

ACOG Committee on Obstetric Practice. (2002). ACOG practice bulletin. Diagnosis and management of preeclampsia and eclampsia. No. 33, January 2002. American College of Obstetricians and Gynecologists. *Obstet Gynecol.*, 99:159–67.

Adamu, Y., Adams, M., Salihu, H., Saleh, M., Sathiakumar, N., & Alexander, G. (2013). Maternal mortality in Northern Nigeria: a population-based study. *European Journal of Obstetrics Gynecology and Reproductive Biology*, 109(2):153–159.

Agrawal, S., & Walia, G. (2014). Prevalence and risk factors for symptoms suggestive of pre-eclampsia in Indian women. *J. Womens Health*, 3, 2–9.

Alemayehu, S., & Wudad, T. (2019). Prevalence and associated factors of pre-eclampsia among pregnant women attending anti-natal care at Mettu Karl referal hospital, Ethiopia: cross-sectional study. *Clinical Hypertension*, 25:14.

Al-Kayat, E. (2016). Maternal Mortality in cities of Iraq for Three Years. *Int J Curr Microbiol App Sci*, 5(1): 590-611.

Altaei, A., & Mohammad, J. (2015). Incidence and Risk Factors of Pre-eclampsia among Iraqi Pregnant women. *AJPS*, 12(2): 52-60.

Alvarez, et al. (2019). Factors associated with maternal mortality in Sub-Saharan Africa: an ecological study. *BMC Public Health*, 9: 462.

Anguiano-Robledo, L. (2017). Renal angiotensin-II receptors expression changes in a model of preeclampsia. *Hypertens Pregnancy*, 26:151–61.

Asif, A., & Wenda, R. (2015). Unravelling the theories of pre-eclampsia: are the protective pathways the new paradigm? . *British Journal of Pharmacology* , 172(6):1574-86.

Avagliano, L., Bulfamante, G., Burak, P., Morabito, A., Marconi, A., & Emiliano, M. (2011). Abnormal spiral artery remodelling in the decidual segment during pregnancy: from histology to clinical correlation. *J Clin Pathol.*, 64:1064–1068.

Backes, C., Markham, K., Moorehead, P., Cordero, L., Nankervis, C., & Giannone, P. (2014). Maternal Preeclampsia and Neonatal Outcomes. *Journal of Pregnancy*, 21:43-65.

Barton, J., & Sibai, B. (2018). Prediction and prevention of recurrent preeclampsia. *Obstet. Gynecol*, 112:359–72.

Bartsch, et al. (2016). Clinical risk factors for pre-eclampsia determined in early pregnancy: Systematic review and meta-analysis of large cohort studies. *BMJ*, 353:i1753.

Benimana, C., Small, M., & Rulisa, S. (2018). Preventability of maternal near miss and mortality in Rwanda: A case series from the University Teaching Hospital of Kigali (CHUK). *PLoS ONE*, 13(6): e0195711.

Berhan, Y., & Berhan, A. (2016). Cause of maternal mortality in Ethiopia. *Ethiopian journals of health Sciences*, ISSN 1029-1857, 15.

Bilano, L., Ota, E., Ganchimeg, T., Mori, R., Souza, J., Bilano, V., & Souza, J. (2016). Risk factors of pre-eclampsia/eclampsia and its adverse outcomes in low-and middle-income countries: a WHO secondary analysis. *PLoS ONE*, 9.

Bodnar, et al. (2015). The risk of preeclampsia rises with increasing prepregnancy body mass index. *Ann Epidemiol*, 15(7):475–482.

Brosens, I. (1977). Morphological changes in the utero-placental bed in pregnancy hypertension. *Clin Obstet Gynaecol.*, 4:573–593.

Brown, M., Magee, L., Kenny, L., Karu-manchi, S., McCarthy, FP, & Saito, S. (2018). Hypertensive disorders of pregnancy: ISSHP classification, diagnosis, and management recommendations for international practice. *Hypertension*, 72:24–43.

Bucagu, M., Kagubare, J., Basinga, P., Ngabo, F., Timmons, B., & Lee, A. (2012). Impact of health systems strengthening on coverage of maternal health services in Rwanda, 2000–2010: a systematic review. *Reproductive health matters*, 20(39):50-61.

Burke, et al.,2016. (n.d.). Spiral artery remodeling in preeclampsia revisited. *Hypertension*, 62:1013–1014.

Burke, S., Barrette, V., Bianco, J., Thorne, J., Yamada, A., & Pang, S. (2016). Spiral arterial remodeling is not essential for normal blood pressure regulation in pregnant mice. *Hypertension*, 55:729–737.

Burton, G., Burton, J., Woods, A., Chris, W., Jauniaux, E., & Kingdom, J. (2015). Rheological and physiological consequences of conversion of the maternal spiral arteries for uteroplacental blood flow during human pregnancy. *Placenta*, 30:473–482.

Catov, et al. (2017). Risk of early or severe pre-eclampsia related to pre-existing conditions. *Int J Epidemiol*, 36(2):412–419.

Condo, J., Mugeni, C., Naughton, B., Hall, K., Tuazon, M., & Omwega, A. (2016). Rwanda's evolving community health worker system: a qualitative assessment of client and provider perspectives. *Human resources for health*, 12(1):71.

Doddamani, et al., 2018. (n.d.). Perinatal Outcome in Pre-Eclampsia: A Prospective Study. *Sch. J. App. Med Sci.*, 2(1C):291-293.

Dolea, C., & AbouZahr, C. (2015). *Global burden of obstructed labour in the year 2000. Evidence and Information for Policy World Health Organization.*

Duley, L. (2019). The global impact of preeclampsia and eclampsia. *Semin Perinatol.* , vol. 33, no.3, p.130-137.

El-Moselhy, A., Khalifa, O., Amer, M., Mohammad, K., El-Aal, H. E.-M., Khalifa, H., & Amer, S. (2017). Risk factors and impacts of pre-eclampsia: an epidemiological study among pregnant mothers in Cairo, Egypt. *J Am Sci*, 7(5):311–23.

Endeshaw et al. (2016). Obesity in young age is a risk factor for preeclampsia: a facility based case-control study, northwest Ethiopia. *BMC Pregnancy and Childbirth*, 16:237.

Endeshaw, G., & Berhan, Y. (2015). Perinatal Outcome in Women with Hypertensive Disorders of Pregnancy : A Retrospective Cohort Study.

Fantu, S., Segni, H., & Alemseged, F. (2010). Incidence, causes and outcome of obstructed labor in jimma university specialized hospital. *Ethiop J Health Sci* , 20:145–51.

Ferrazzo, K., Meinke, G., & Silva, M. (2015). Pre-hypertension, arterial hypertension and associated factors in dental patients: a cross-sectional study in the city of Santa Maria in Brazil. *Journal of Dentistry of UNESP*, 43(5):305.

Ghimire, S. (2016). Eclampsia: feto-maternal outcomes in a tertiary care centre in Eastern Nepal. *JNMA J Nepal Med Assoc*, 54(201):24–28.

Ghlumiyyah, L., & Sibai, B. (2016). Maternal Mortality From Preeclampsia/Eclampsia. *Seminars in perinatology 36(1):56-9*, 36(1):56-9.

Haglund, et al.,2015. (n.d.). Gestational diabetes and preeclampsia. *Eur J Obstet Gynecol Reprod Biol*, 113(1):12–6.

Hassan, M., Begum, M., Haque, S., Jahan, N., Yasmeen, B., & Mannan, A. (2015). Immediate Outcome of Neonates with Maternal Hyper-tensive Disorder of Pregnancy at a Neonatal Intensive Care Unit. 6:57–60.

Hernandez-Diaz,et al.,2017. (n.d.). Risk of pre-eclampsia in first and subsequent pregnancies: prospective cohort study. *BMJ*, 338:b2255.

Huang, S. (2018). Pre-eclampsia is associated with dendritic cell recruitment into the uterine decidua. *J. Pathol.*, 214:328–36.

Hutcheon et al. (2017). Epidemiology of pre-eclampsia and the other hypertensive disorders of pregnancy. *Best practice & research Clinical obstetrics & gynaecology*, 25(4):391-403.

Igberase, G., & Ebeigbe, P. (2016). Eclampsia: ten-years of experience in a rural tertiary hospital in the Niger delta, Nigeria. *Journal of Obstetrics and Gynaecology*, 26(5):414–417.

Ikechebelu, J., & Okoli, C. (2015). Review of eclampsia at the Nnamdi Azikiwe University teaching hospital, Nnewi . *Journal of Obstetrics and Gynaecology*, 22(3):287–290.

Imarengiaye, C., & Isesele, T. (2015). Intensive care management and outcome of women of women with hypertensive diseases of pregnancy. *Niger Med J*, 56(5):333–337.

Jeyabalan, A. (2016). Epidemiology of preeclampsia: Impact of obesity. *Nutr Rev*, 71(0 1): 10.

Kalisa, R., Rulisa, S., van den Akker, T., & van Roosmalen, J. (2016). Maternal Near Miss and quality of care in a rural Rwandan hospital. *BMC Pregnancy and Childbirth volume*, 16:324.

Kartika et al. (2017). Risk factor of severe preeclampsia in Dr. Soetomo HospitalSurabaya in 2015 . *Majalah Obstetri Ginekologi*, 25, 6–9.

Kartika, A., Akbar, M., & Umiastuti, P. (2017). Risk factor of severe preeclampsia in Dr. Soetomo Hospital Surabaya in 2015. *Majalah Obstetri Ginekologi*, 25, 6–9.

Kassebaum, N., Barber, R., Bhutta, Z., Dandona, L., Gething, P., & Hay, S. (2016). Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet*, 388(10053):1775–812.

Kenny, et al., 2015. (n.d.). Risk factors and effective management of preeclampsia. *Integr Blood Press Control*, 8:7.

Khader, Y., Batieha, A., Al-njadat, A., Hijazi, S., Khader, S., Al-njadat, R., & Hijazi, S. (2018). Preeclampsia in Jordan: Incidence, risk factors, and its associated maternal and neonatal outcomes. *Matern. Fetal. Neonatal Med*, 31, 770–776.

Khan, K., Khna, S., Wojdyla, D., Say, L., Gülmezoglu, A., & Van Look, P. (2016). WHO analysis of causes of maternal death: a systematic review. *Lancet*, 367(9516):1066–74.

Khosravi,et al., 2016. (n.d.). Predictive factors for preeclampsia in pregnant women: a unvariate and multivariate logistic regression analysis. *Acta Biochim Pol*, 59(4):674.

Kimbally, K., Barassoumbi, H., Buambo, S., Gombet, T., Kibeke, P., & Monabeka, H. (2017). Arterial hypertension: epidemiological aspects and risk factors on pregnant and delivered woman. *Dakar Med*, 52(2):148–52.

Kiondo, P., Tumwesigye, N., Wandabwa, J., Wamuyu-maina, G., Bimenya, G., & Okong, P. (2014). Supplement article Adverse neonatal out-comes in women with pre-eclampsia in Mulago Hospital , Kampala , Uganda : a cross-sectional study. 17:1–5.

Klungsøyr, K., Morken, H., Irgens, L., Vollset, S., Skjærven, R., Morken, N., & Vollset, S. (2012). Secular trends in the epidemiology of pre-eclampsia throughout 40 years in Norway: prevalence, risk factors and perinatal survival. *Paediatr Perinat Epidemiol*, 26(3):190–8.

Kuklina, E., Kuklina, V., Ayala, C., Callaghan, W., Ayling, M., & Michael, C. (2019). Hypertensive disorders and severe obstetric morbidity in the United States. *Obstet Gynecol.*, 113(6):1299-1306.

Lakew, Y., Reda, A., Tamene, H., Benedict, S., Deribe, K., Taylor, M., & Barnes, M. (2013). Geographical variation and factors influencing modern contraceptive use among married women in Ethiopia: evidence from a national population based survey. *Reprod Health*, 10(1):52.

Lamminpää, et al. (2016). Preeclampsia complicated by advanced maternal age: a registry-based study on primiparous women in Finland 1997–2008. *BMC Pregnancy and Childbirt*, 12:47.

Landsbergis, P., & Hatch, M. (2016). Psychological work stress and pregnancy induced hypertension. *Journal of Epidemiology*, 7, (4): 346-351.

Langenveld, J., Jansen, S., van der Post, J., Wolf, H., Mol, B., & Ganzevoort, W. (2010). Recurrence risk of a delivery before 34 weeks of pregnancy due to an early onset hypertensive disorder: A systematic review. *Am J Perinatol*, 27:565–571.

Liona, C., Shennan, A., Jonathan, A., Anil, K., von Dadelszen, P., Harold, D., . . . Moshe, H. (2019). The International Federation of Gynecology and Obstetrics (FIGO) initiative on pre-eclampsia:pragmatic guide for first-trimester. *Int J Gynecol Obstet*, 145 (Suppl. 1): 1–33.

Luciano, E., Mignini, Pallavi, M., Latthe, Jose, & Villar. (2005). Mapping the theories of preeclampsia: The role of homocysteine. *Obstetrics and Gynecology. Vol. 105, No. 2*, 411-425.

Lyall, F., Robson, S., & Bulmer, J. (2013). Spiral artery remodeling and trophoblast invasion in preeclampsia and fetal growth restriction: relationship to clinical outcome. *Hypertension*, 62:1046–1054.

Masoura, S., Kalogiannidis, I., Margioula-Siarkou, C., Diamanti, E., Papouli, M., & Drossou-Agakidou, V. (2016). Neonatal outcomes of late preterm deliveries with pre-eclampsia. *Minerva Ginecol.*, 64(2):109-115.

McClure, E., McArthur, M., Saleem, S., Pasha, O., Goldenberg, R., & Clutterberg, L. (2019). Stillbirth in developing countries: a review of causes, risk factors and prevention strategies. *Journal of Maternal-Fetal and Neonatal Medicine*, 22(3):183–190.

Ministry of Health [Rwanda]. (2018). *National Community Health Policy 2008.* Kigali: Republic of Rwanda.

MoH (Ethiopia). (2018). *Ethiopia - Demographic and Health Survey 2016.* Addis Abbaba: Ministry of Health.

MoH (Rwanda). (2014). *Rwanda Demographic and Health Survey 2014-2015.* Kigali: MINISANTE.

Moussa et al. (2014). Management of hypertensive disorders in pregnancy. *Womens Health*, 10, 385–404.

Mudd,et al.,2018. (n.d.). Health benefits of physical activity during pregnancy: An international perspective. *Med Sci Sports Exerc*, 45:268–277.

Mutabazi, L., Bazzett-Matabele, L., Small, M., Ntasumbumuyange, D., Rulisa, S., & Magriples, U. (2020). Seasonal variation in preeclampsia and eclampsia in Kigali. *Rwanda Medical Journal*, Vol. 77, No. 1, pp. 1-5.

Mwashamba, et al.,2020. (n.d.). Prevalence and risk factors associated with severe pre-eclampsia among postpartum women in Zanzibar: a cross-sectional study. *BMC Public Health*, 20:1347.

Nakimuli, A., Chazara, O., Byamugisha, J., Elliott, A., Kaleebu, P., & Mirembe, F. (2014). Pregnancy, parturition and preeclampsia in women of African ancestry. *Am J Obstet Gynecol*, 210(6):510–520.

Naljayan,et al.,2015. (n.d.). New developments in the pathogenesis of preeclampsia. *Adv Chronic Kidney Dis.*, 20:265–270.

Nathan, H., Paul, T., Greeff, A., Conti, F., Anthony, J., & Steyn, W. (2018). Maternal and perinatal adverse outcomes in women with pre-eclampsia cared for at facility-level in South Africa : a prospective cohort study. 8.

Ndayambaje,et al. (2017). Human Resources for Health (HRH) midwives mentoring program and episiotomy rates at muhima hospital, Rwanda: A retrospective cross-sectional study. *Rwanda Medical Journal Vol.74 (2)*, 1:5.

NISR. (2020). *Rwanda Demographic and Health Survey 2015.* Kigali: National Institute of Statistics of Rwanda, Rwandan Ministry of Health ICF International.

NISR, & ICF. (2020). *Rwanda Demographic and Health Survey 2019-20 Key Indicators Report.* Kigali, Rwanda, and Rockville, Maryland, USA: National Institute of Statistics of Rwanda (NISR) [Rwanda], Ministry of Health (MOH) [Rwanda], and ICF.

Nyamtema, A., Urassa, D., & van Roosmalen, J. (2011). Maternal health interventions in resource limited countries: a systematic review of packages, impacts and factors for change. *BMC Pregnancy Childbirth*, 11(1):30.

Odegard, e. a. (2019). Risk factors and clinical manifestations of pre-eclampsia. *BJOG*, 107:1410–1416.

Ogawa, K., Urayama, K., Tanigaki, S., Sago, H., Sato, S., & Saito, S. (2017). Association between very advanced maternal age and adverse pregnancy outcomes: a cross sectional Japanese study. *BMC Pregnancy and Childbirth*, 17:349.

Onakewhor, J., & Gharoro, E. (2018). Changing trends in maternal mortality in a developing country. *Nigerian Journal of Clinical Practice*, 11(2):111–120.

Onuh, S., & Aisien, A. (2016). Maternal and fetal outcome in eclamptic patients in Benin City, Nigeria. *Journal of Obstetrics and Gynaecology*, 24(7):765–768.

Ozimek, J., & Kilpatrick, S. (2018). Maternal mortality in the twenty-first century. *Obstet Gynecol Clin N Am.*, vol.45, no. 2, p.175–86.

PATH. (2014). *Proteinuria measurement and urine-based markers for preeclampsia diagnosis Technology Opportunity Assessment*. Retrieved from https://www.semanticscholar.org/paper/Proteinuria-measurement-and-urine-based-markers-for/c9f76e6c7d30b05373e89688962ab23333e824db/figure/1

Rawlins, B., Marya, P., Rakotovao, J. P., Ashebir, G., Maria, V., Jim, R., . . . Patricia, G. (2018). Screening and management of pre-eclampsia and eclampsia in antenatal and labor and delivery services: findings from cross-sectional observation studies in six sub-Saharan African countries. *BMC Pregnancy and Childbirth*, 18:346.

Rizzo, et al., 2015. (n.d.). Uterine artery Doppler velocity waveforms in twin pregnancies. *Obstet Gynecol.*, 82:978–983.

Roberts & Hubel. (2009). The two stage model of preeclampsia: variations on the theme. *Placenta*, 30(Suppl. A):S32–S37.

Roberts, J. M., & Himes, K. P. (2017). Pre-eclampsia: Screening and aspirin therapy for prevention of pre-eclampsia. *Nat Rev Nephrol 13*, 602–604.

Roberts, J., & Hubel, C. (2004). Oxidative stress in preeclampsia. *Am. J. Obstet. Gynecol.*, 190:1177–78.

Say, L. C. (2014). Global causes of maternal death: a WHO systematic analysis. *Lancet Glob Health*, vol. 2, no. 6, p. e323-33.

Schneider, et al. (2012). Gestational diabetes and preeclampsia–similar risk factor profiles? *Early Hum Dev*, 88:179–184.

Schneider, S., Freerksen, N., Maul, H., Roehrig, S., Fischer, B., & Hoeft, B. (2014). Risk groups and maternal-neonatal complications of preeclampsia–current results from the national German perinatal quality registry. *J Perinat Med*, 39(3):257–65.

Schneider, S., Freerksen, N., Röhrig, S., Hoeft, B., Maul, H., Schneider, S., & Freerksen, N. (2016). Gestational diabetes and preeclampsia–similar risk factor profiles? . *Early Hum Dev*, 88(3):179–84.

Semasaka, S. J. (2018). *Pregnancy and delivery-related complications in Rwanda: prevalence, associated risk factors, health economic impact, and maternal experiences.* Kigali: College of Medicine and Health Sciences, University of Rwanda.

Shah, A., Fawole, B., M'Imunya, J., Naomy, M., Kingsley, M., & Arjen, R. (2019). Cesarean delivery outcomes from the WHO global survey on maternal and perinatal health in Africa. *International Journal of Gynecology and Obstetrics*, 107(3):191–197.

Subki, A., Algethami, M., Baabdullah, W., Alnefaie, M., Alzanbagi, M., & Alsolami, R. (2018). Prevalence, risk factors, and fetal and maternal outcomes of hypertensive disor-ders of pregnancy: A retrospective study in Western Saudi Arabia. Oman Med J [Inter-net]. *Oman Med J*, 33:409–15.

Tesfaye, at al., 2019. (n.d.). Pregnancy Induced Hypertension and Associated Factors among Women Attending Delivery Service at Mizan-Tepi University Teaching Hospital, Tepi

General Hospital and Gebretsadik Shawo Hospital, Southwest, Ethiopia. *Ethiop J Health Sci*, 29(1):831-840.

Tessema, et al., 2015. (n.d.). Preeclampsia and associated factors among pregnant women attending antenatal care in Dessie referral hospital, Northeast Ethiopia: a hospital-based study. *BMC Pregnancy Childbirth*, 15(1):73.

Thaddeus, S., & Maine, D. (2014). Too far to walk: maternal mortality in context. *Soc Sci Med,* 38(8):1091–110.

Thornton, C., & Hennessy, A. (2017). The incidence of preeclampsia and eclampsia and associated maternal mortalityin Australia from population-linked datasets: 2000-2008. *Am J Obstet Gynecol*, 208, 476.e471–475.

Tranquilli, A., Dekker, G., Magee, L., Roberts, J., Sibai, B., & Steyn, W. (2014). The classification, diagnosis and management of the hypertensive disorders of pregnancy: A revised statement from the ISSHP. *Pregnancy hypertension*, 4(2):97-104.

Tubbergen, P., Lachmeijer, A., Althuisius, S., Vlak, M., van Geijn, H., & Dekker, G. (2014). Immune maladaptation on the fetal maternal interface could be an underlying mechanism. *J Reprod Immunol.*, 45(1):81-8.

UNFPA. (2015). *Emergency obstetric care: checklist for planners.* New York: United Nations Population Fund.

United Nations Economic Commission of Africa. (2015). *MDG Report 2015: Assessing Progress in Africa toward the Millennium Development Goals.* UNECA.

USAID. (2020). *Ending Eclampsia project: Prevention and treatment of preeclempsia and eclempsia.* The Population Council, Inc.

Uwizeyimana, P., Musabyemariya, E., Tengera, O., Collins, A., Collins, C., & Thomas, M. (2020). Neonatal Outcomes from Mothers with Hypertension Disorders of Pregnancy: A Retrospective Study at a Referral Hospital in Rwanda. *Rwanda J Med Health Sci*, 3(2):193-203.

van der Tuuk, K., van Pampus, M., Koopmans, C., Aarnoudse, J., van den Berg, P., & van Beek, J. (2015). Prediction of cesarean section risk in women with gestational hypertension or mild preeclampsia at term. *Eur J Obstet Gynecol Reprod Bio*, 191:23-27.

Vata, K., Chauhan, M., Nallathambi, A., Hussein, F., Vata, P., & Chauhan, N. (2015). Assessment of prevalence of preeclampsia from Dilla region of Ethiopia. *BMC Res Notes*, 8(1):816.

Velauthar, L., Plana, M., Kalidindi, M., Zamora, J., Thilaganathan, B., & Illanes, S. (2014). First-trimester uterine artery Doppler and adverse pregnancy outcome: a meta-analysis involving 55,974 women. *Ultrasound Obstet Gynecol.* , 43:500–507.

WHO. (2011). *WHO recommendations for prevention and treatment of pre-eclampsia and eclampsia.* Geneva: WHO.

WHO. (2011). *WHO recommendations for prevention and treatment of pre-eclampsia and eclampsia.* Geneva: World Health Organization.

WHO. (2011). *WHO recommendations for Prevention and treatment of pre-eclampsia and eclampsia.* Geneva, Switzerland: World Health Organization.

WHO. (2018). Geographic variation in the incidence of hypertension in pregnancy. *Am J Obst Gynecol 1988;158(1):80–3*, 158(1):80–3.

WHO. (2018, May 17). *WHO Recommendations for Prevention and Treatment of Pre-Eclampsia and Eclampsia.* Retrieved from World Health Organization: http://apps.who.int/iris/bitstream/handle/10665/44703/9789241548335_eng.pdf;jsessionid=7FCF88AEE7FCD29C75BD56AF69D2574C?sequence=1

WHO. (2019). *Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division: executive summary.* Geneva: WHO.

WHO. (2019). *WHO recommendations for prevention and treatment of pre-eclampsia and eclampsia.* Geneva: World Health Organization.

WHO, UNICEF & UNFPA. (2000). *Managing Complications in Pregnancy and Childbirth: a guide for midwives and doctors.*

Wikström, A. K., Gunnarsdóttir, J., & Cnattingius, S. (2012). The paternal role in pre-eclampsia and giving birth to a small for gestational age infant; a population-based cohort study. *BMJ Open*, 2:e001178. doi: 10.1136/bmjopen-2012-001178.

Wikstrom, A.-K., Stephansson, O., & Cnattingius, S. (2010). Tobacco Use During Pregnancy and Preeclampsia Risk: Effects of Cigarette Smoking and Snuff. *Hypertension*, 55(5):1254–1259.

Williams, P., & Broughton, P. (2017). The genetics of pre-eclampsia hypertensive disorders of pregnancy. *Best Pract Res Clin Obstet Gynaecol*, 25:405–417.

Williams,et,al.,2017. (n.d.). The genetics of pre-eclampsia hypertensive disorders of pregnancy. *Best Pract Res Clin Obstet Gynaecol*, 25:405–417.

World Bank Report. (2018). *Ethiopia - Demographic and Health Survey 2016 [ it appeared on 15 Oct2018 10:26:16 GMT]; Available from: http://microdata.worldbank.org/index. php/catalog/2886.* Addis Ababa: World Bank.

Yogev, Y., & Catalano, P. (2019). Pregnancy and obesity. *Obstet Gynecol Clin North Am.*, 36(2):285–300. viii.

Yusra, L. (2018). Pre-eclampsia: Maternal Risk Factors & Perinatal Outcomes. *Pediatr Pract Res*, 6(2): 10-15.

Zibaeenezhad, et al., 2017. (n.d.). The prevalence of hypertensive disorders of pregnancy in Shiraz, Southern Iran; 2010.

# APPENDICES

**Appendix 1. Introduction and consent**

Hello. My name is _____. I am currently a student at Mount Kenya University Rwanda (MKUR) in Master of Public Health Program, (Global Health) Option. I am conducting a research about **"*Prevalence, factors associated and outcomes of pre-eclampsia among pregnant women attending Muhima district hospital, Rwanda"***. The information provided in this research will be used for academic purposes. You have been selected to take part in the survey. All of the answers you give will be confidential and will not be shared with anyone other than research investigators. Your views are important. If I ask you any question you do not want to answer, just let me know and I will go on to the next question or you can stop the interview at any time. In case you need more information about the survey, you may ask the interviewer**.**

Do you have any questions? Yes ☐ No ☐

May I begin the interview now? Yes ☐ No ☐

Respondent agrees to be interviewed ⬇ Respondent does not agree ➡ END

Name of the interviewer: ……

Phone number of the interviewer: ……...

**Signature of interviewer_____ Date: _____**

**Appendix 2. Data collection checklist**

| **Respondent code number:** | | **Date: …/…/20…** |
|---|---|---|
| **No** | **Questions** | **Answers** |
| **Section 1: Sociodemographic characteristics** | | |
| **1.** | Residence | 1) Urban<br>2) Rural |
| **2.** | Age | …….. years |
| **4.** | Educational status | 1) No formal education<br>2) Primary education<br>3) Secondary education<br>4) Tertiary education [University] |
| **5.** | Marital status | 1) Single<br>2) Married<br>3) Separated<br>4) Divorced<br>5) Widowed |
| **6.** | Religion | 1) Catholic<br>2) Protestant<br>3) Muslim<br>4) No religion |
| **7.** | Occupational status | 1) Unemployed<br>2) Self-employed<br>3) Employed |
| **8.** | Gravidity | 1) Primigravida<br>2) Multigravida |
| **9.** | Gestational age | ..... weeks |
| **10.** | Lifestyle | 1) Alcohol consumption<br>2) Smoking<br>3) Psychological stress<br>4) Getting a diversified diet<br>5) Performing physical exercise |
| **Section 2: Clinical characteristics** | | |
| **11.** | Woman's BP measurement | 1) Normal<br>2) Abnormal |
| **12.** | Have you ever had history of a chronic disease? | 1) Yes<br>2) No |
| **13.** | If "YES" to the question 12, specify | ..... |

| Section 3: Maternal and perinatal outcomes of pre-eclempsia among pregnant women | | |
|---|---|---|
| **13.** | Maternal complications | 1) Severe pre-eclampsia<br>2) Placental abruption<br>3) Partial/complete HEELP<br>4) Eclempsia<br>5) Disseminated intravascular coagulation(DIC)<br>6) Maternal death<br>7) No maternal complication |
| **14.** | Fetal complications | 1) Stillbirth<br>2) Intrauterine growth restriction(IUGR)<br>3) Preterm birth<br>4) No fetal complication |
| **15.** | Neonatal complications | 1) NICU admission<br>2) Low APGAR score<br>3) Respiratory distress syndrome(RDS)<br>4) Early neonatal death<br>5) No neonatal complication |

**We are coming to the end of our interview. Thank you very much for your valuable contribution in this research**.

**Appendix 3. Observation Checklist: Diagnostic Criteria for Preeclampsia**

❖ **Preeclampsia:**

- Blood pressure: 140 mm Hg or higher systolic or 90 mm Hg or higher diastolic after 20 weeks of gestation in a woman with previously normal blood pressure;
- Proteinuria: 0.3 g or more of protein in a 24-hour urine collection (usually corresponds with 1+ or greater on a urine dipstick test).

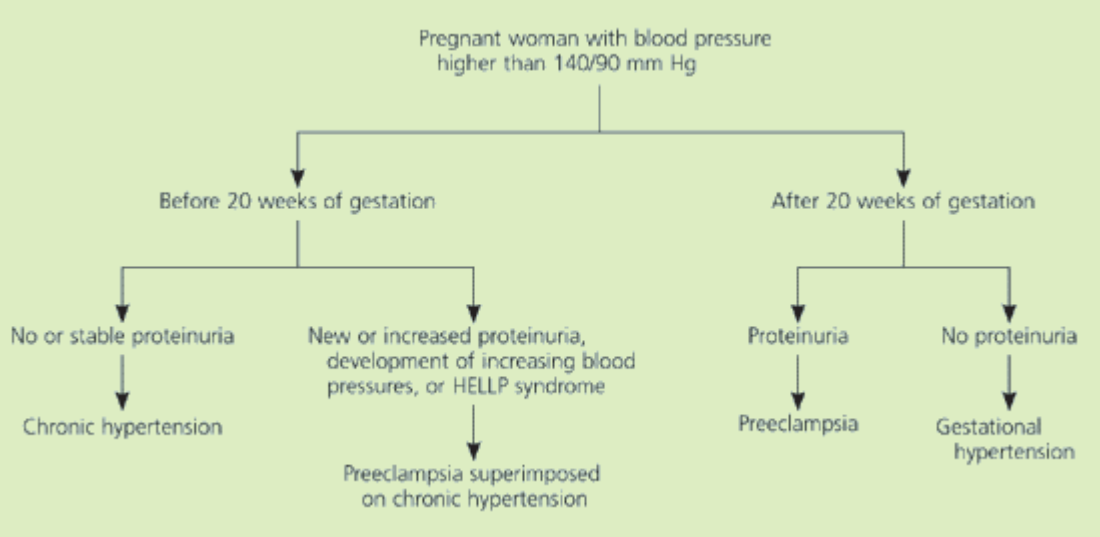
❖ **Severe preeclampsia:**

- Blood pressure: 160 mm Hg or higher systolic or 110 mm Hg or higher diastolic on two occasions at least six hours apart in a woman on bed rest;
- Proteinuria: 5 g or more of protein in a 24-hour urine collection or 3+ or greater on urine dipstick testing of two random urine samples collected at least four hours apart;

- Other features: oliguria (less than 500 mL of urine in 24 hours), cerebral or visual disturbances, pulmonary edema or cyanosis, epigastric or right upper quadrant pain, impaired liver function, thrombocytopenia, intrauterine growth restriction.

**NB:** For the diagnosis of preeclampsia, both hypertension and proteinuria must be present.

**Appendix 4. Algorithm for differentiating among hypertensive disorders in pregnant women**




**Source:** (ACOG Committee on Obstetric Practice, 2002)

**Appendix 5. Protein dipstick grading**

| Designation | Approximate Amount* | |
|---|---|---|
| | Concentration | Daily |
| Trace | 5 mg/dL to 20 mg/dL | |
| 1+ | 30 mg/dL | < 0.5 g/day |
| 2+ | 100 mg/dL | 0.5 g/day to 1 g/day |
| 3+ | 300 mg/dL | 1 g/day to 2 g/day |
| 4+ | > 2,000 mg/dL | > 2 g/day |

*The diagnostic criterion for protein levels in PE is proteinuria of at least 300 mg of protein in a 24-hour urine collection.

**Source:** (PATH, 2014)