PREVALENCE AND DETERMINANTS OF LOW-BIRTH-WEIGHT NEONATES AMONG WOMEN WITH PRE-ECLAMPSIA AT MOI TEACHING AND REFERRAL HOSPITAL, KENYA

BY

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A RESEARCH THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE NURSING (MATERNAL AND NEONATAL HEALTH) DEGREE IN THE DEPARTMENT OF MIDWIFERY AND GENDER, SCHOOL OF NURSING & MIDWIFERY, MOI UNIVERSITY.

DECLARATION

I hereby declare this thesis as my original work and have not been presented to any university or institution for an academic credit or any degree awards. No part of this work may be produced or transmitted in any form without prior permission from the author or Moi University.

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DEDICATION

This thesis is dedicated to all women with pre-eclampsia who took their time to participate in this study.

ABSTRACT

Introduction: Pre-eclampsia contributes to the prevalence of Low neonatal birth weight (LBW) which is a crucial measure of child's vulnerability to risks of illnesses, growth and development, chronic diseases later in life and reduced chances of survival. There is paucity of information about prevalence and determinants of LBW neonates among women with Pre-eclamptic Toxaemia (PET) particularly in sub-Saharan Africa.

Objective: To investigate the prevalence, determinants and immediate birth outcomes of low birth weight neonates born of women with PET at Moi Teaching and Referral Hospital (MTRH).

Methods: A descriptive cross-sectional study involving 355 participants sampled consecutively was carried out at the postnatal ward of MTRH. Data was collected using interviewer administered questionnaires. A descriptive analysis was done for social demographic factors, obstetric factors, prevalence of LBW neonates and immediate birth outcomes. Chi square and Wilcoxon tests were used to determine the association between LBW and maternal factors at bivariate level. Multivariate analysis was done using logistic regression to determine factors associated with LBW. A p-value of < 0.05 was considered significant at 95% confidence level.

Results: Mean age and parity of participants were 27.5 years and 2.25 respectively. Among the participants 277(76.1%) had severe PET while 87(23.9%) had mild to moderate PET. The prevalence of LBW neonates was 180(49.45%). A statistically significant association was observed between LBW and maternal age 15-19 years (OR =2.44, p=0.035), preterm births (aOR = 13.2, 95%C.I. =6.22-27.92, p<0.001), lack of antenatal care attendance (uOR = 5.5, 95%C.I. = 1.47-20.6, p=0.011), Hemolysis, Elevated liver enzymes and low platelets (HELLP) syndrome (aOR = 17.32, 95%C.I. =3.29-91.25 p=0.001) and twin gestation (aOR = 12.63, 95%C.I. =2.09-76.18, p=0.006). Neonatal birth outcomes were: 162(90%) live births, 17(9.44%) Fresh stillbirth and 1(0.56%) macerated. The mean APGAR scores were 6.44 (±2.773 SD) and 7.66 (±3.123 SD) at one and ten minutes respectively. Neonatal morbidities were: 51(28.73%) birth asphyxia, 38(21%) neonatal jaundice, 18(7.9%) hypothermia and 1(0.68%) neonatal sepsis. In 24 hours of birth, 107(59.18%) neonates were admitted to New Born Unit, 53(29.53%) were rooming in with their mothers while 20(11.29%) had died.

Conclusion: The factors associated with the prevalence of LBW neonates among women with pre-eclampsia at MTRH were; preterm birth, HELLP syndrome, twin gestation, lack of antenatal care and teenage. Admission to the newborn unit related to and not limited to birth asphyxia was the commonest neonatal outcome.

Recommendation: Awareness to be created to pregnant women particularly with twin pregnancy and other high risk cases on signs, symptoms and early diagnosis of preeclampsia and importance of prenatal care. Additionally, midwives to offer strict management of women with PET using available guidelines to prevent complications to more severe forms such as HELLP syndrome and prepare women with PET for adverse outcomes of the newborn.

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OPERATIONAL DEFINITION OF TERMS

Birthing: The process of bringing forth a child from the gravid uterus by the women with preeclampsia.

Birth weight: The first weight of the neonate taken within 24 hours of delivery among the neonates born of women with preeclampsia.

Eclampsia: Is the development of grand malseizures in gestational hypertension or preeclampsia.

Education level: It is the highest level of schooling attended by the women with preeclampsia whether completed or not.

Determinants: Are the maternal socio-demographic, obstetric and environmental factors contributing to LBW neonates born of women with preeclampsia.

Immediate Neonatal Birth Outcomes: Occurrence or results in the neonate born of women with preeclampsia 24 hours following the delivery.

Live Birth: Refers to the total expulsion or extraction of a product of conception by the women with preeclampsia, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life.

Low birth weight: Neonatal birth deficit of less than 2500 grams irrespective of gestational age born of women with preeclampsia.

Neonate: A newborn child in its first 28 days of life.

Preeclampsia: a syndrome characterized by the new onset of hypertension and proteinuria after 20 weeks gestation in a previously normotensive woman with or without proteinuria.

Preterm birth: a birth before completion of 37 weeks of gestation.

Prevalence: proportion of low birth weight neonates delivered by the women with preeclampsia during the study period.

ABBREVIATIONS

AARR	Alan Aragon's Research Review
ACOG	American College of Obstetrics and Gynaecology
ANC	Antenatal care
AOR	Adjusted Odds Ratio
BMI	Body Mass Index
EOPE	Early Onset Preeclampsia
IREC	Institutional Research and Ethics Committee
KDHS	Kenya Demographic Health Survey
LBW	Low Birth Weight
LOPE	Late Onset Preeclampsia
LW	Labour Ward
MTRH	Moi Teaching and Referral Hospital
NBU	New Borns Unit
NRFS	Non Reassuring Fetal Status
PET	Pre - Eclamptic Toxaemia
UNICEF	United Nations Children's Fund
WHO	World Health Organization

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CHAPTER ONE

1.0 Introduction

This chapter provides background information on global, regional and national trends of prevalence and determinants of women with pre-eclampsia giving birth to low-birth-weight neonates and immediate neonatal birth outcomes of LBW neonates among preeclampsia mothers, problem statement, study justification and study objectives.

1.1 Background

Low neonatal birth weight (LBW), a weight of below 2500 grams regardless of gestational age taken mostly within the first hour of life, is classified into three; low birth weight (below two thousand, five hundred grams), very low birth weight (below one thousand, five hundred grams) and extremely low birth weight (below one thousand grams), (Usman, Jalil, & Zakaar, 2016 and Cheryl B, 2019). The LBW is a crucial indicator of child's susceptibility to risks of childhood sicknesses, delayed growth as well as development, chronic diseases later in life and reduced chances of survival (Rao et al., 2018). The chances of a neonatal death is increased among LBW neonates as compared to those of normal birth weight owing to increased susceptibility to birth asphyxia, hypothermia, jaundice, hypoglycemia, respiratory disorders, and infection (WHO, 2004). For instance, in South Africa a study done by Tshehla et al., (2019) reported mortality rate of twenty times high among LBW compared to normal birth weight neonates although the study was conducted among both normotensive and hypertensive women.

A study done from the London School of Hygiene & Tropical Medicine by Ekubagewargies, Kassie, & Takele (2019) estimated the prevalence of LBW at 15.5% at a global perspective amounting to 20.5 million LBW neonates in 2015. A

systematic analysis on national, regional, and global estimates of LBW trends from the year 2000 to 2015 reported an estimated 20.5 million (UR 17·4–24·0 million) live births were LBW; 91% were from low and middle income countries, especially southern Asia (48%) and sub-Saharan Africa (24%) with East Africa contributing to 13.5% while that of Kenya stood at 11% (Demelash, Motbainor, Nigatu, Gashaw, & Melese, 2015).

According to Blencowe (2019), prevalence of LBW increased from 6% in the year 2009 to 8% in 2014. In order to achieve the 2·74% Alan Aragon's Research Review (AARR) from 2012 to 2025 aimed to meet the global nutrition goal requires more than doubling progress, including both improved measurement and programme investments that address causes of LBW all over the lifecycle (UNICEF-WHO, 2019).

According to (Mitao et al., 2016), numerous determinants linked with increased risk of LBW are: hypertensive disorders of pregnancy, premature rupture of membrane (PROM), placental abruption, placenta previa, , poor nutrition, low education level and smoking during pregnancy. Other determinants are: high parity, low education level, high maternal age, low maternal Body Mass Index (BMI), inadequate antenatal care attendance, comorbidities like HIV positive status of the mother and maternal anemia, environmental as well as genetic factors.

Preeclampsia, a syndrome characterized by new onset of hypertension and proteinuria after 20 weeks gestation in a previously normotensive woman or within the first 4 - 6 weeks postpartum (Baha M. Sibai, 2009) is said to contribute to prevalence of LBW neonates. Wagnew et al., (2016) found that the worldwide incidence of preeclampsia is between 2% and 10% of pregnancies varying mostly from one nation to another.

The World Health Organization (WHO) estimates the incidence of preeclampsia as seven times higher in low- and middle-income countries (2.8% of live births) as compared to developed countries (0.4%).

A study done in Indonesia by Sirenden et al, (2020) on 256 women with preeclamptic toxaemia (PET) of which 184 (71.9%) had severe preeclampsia and 92 (28.1%) had severe preeclampsia with maternal complications found that LBW neonates were more in the severe preeclampsia with maternal complications group (37.5%). Another study that was done in Ethiopia by Goba et al.,(2019) established that the prevalence of LBW (1500-2499 grams) among preeclampsia accounted for 29.3%, and very LBW (1000-1499 grams) for 6.9%. Low birth weight as well as preterm deliveries were common in the women who had preeclampsia with severity features than in those who were having preeclampsia without severity features.

In 2012, the World Health Assembly Resolution 65.6 endorsed a comprehensive implementation program on maternal, infant and young child nutrition that emphasized six global nutrition targets for 2025 including 30% reduction in LBW. Its target is to heighten attention to investment in action for a set of economical interventions and policies that can assist member states and their partners in reducing rates of LBW neonates.

1.2 Problem Statement

Neonates born with low birth weight have increased chances of dying during infancy as compared to normal weight neonates owing to their increased susceptibility to hypoglycemia, hypothermia, birth asphyxia, trauma, respiratory disorders and neonatal sepsis (Lee, Noh, & Chang, 2019, Laopaiboon et al., 2019). In Kenya the

prevalence of LBW neonates in year 2014 stood at 8%. Notably, in MTRH, the prevalence of LBW in the years 2016, 2017 and 2018 were 9.8%, 10.63% and 8.9 % respectively.

A study done in Howrah, India by Arpita Mandal, (2018) found that the major factors responsible for LBW in newborns were: the age of mother at time of delivery, poor nutritional health of mother, availing inadequate antenatal care and high parity. In addition, prenatal exposure to environmental pollutants for instance phthalates, bisphenols and organophosphate pesticides were significantly associated with LBW in New York city (Dries M. et al, 2021). According to a study done in Ethiopia by Mekie, (2019), women with preeclampsia who were living in urban areas, those with weight loss and inadequate food during pregnancy gave birth to low birth weight neonates.

Wagnew, Dessalegn, Worku, & Nyagero, (2016) found that the worldwide incidence of PET ranges from 2% to 10% varying greatly from one nation to another. The prevalence of pre-eclampsia varies significantly worldwide due to its wide variation in epidemiological studies. World Health Organization (WHO) estimates that the incidence of preeclampsia is seven times more in developing countries at 2.8% compared to developed countries at 0.4%, (Davies et al., 2015). A study done in Ethiopia by (Goba et al, 2019) showed that the prevalence of preeclampsia was at 5%.

While factors associated with LBW are well studied in developed countries, there is paucity of information that has been reported about prevalence of LBW neonates and maternal factors of LBW neonates among women with preeclampsia in sub-Saharan Africa except for the general impression that preeclampsia condition predisposes to low birth weight neonates (Badalyan, 2014). While some women with preeclampsia

deliver normal weight neonates, there is paucity of information as to why other women with preeclampsia give birth to LBW neonates. Cases of LBW among women with preeclampsia delivering at MTRH have been reported and this could be the tip of the iceberg. Therefore, the purpose of study was to investigate the prevalence of low-birth-weight neonates among women with preeclampsia, maternal factors associated with LBW and immediate neonatal birth outcomes among LBW neonates born of women with preeclampsia at Moi Teaching and Referral Hospital, Eldoret.

1.3 Research questions

This study answered the following questions:

1. What is the prevalence of LBW neonates among women with preeclampsia birthing at MTRH?
2. What are the maternal factors associated with LBW neonates among women with preeclampsia birthing at MTRH?
3. What are the immediate neonatal birth outcomes among LBW neonates born of women with preeclampsia at Moi Teaching and Referral Hospital?

1.4 Objectives of the study

1.4.1 Broad objective

To investigate the prevalence of low-birth-weight neonates, maternal factors associated with LBW and immediate neonatal birth outcomes among LBW neonates born of women with preeclampsia at Moi Teaching and Referral Hospital, Eldoret.

1.4.2 Specific objectives

1. To determine the prevalence of LBW neonates among women with preeclampsia birthing at Moi Teaching and Referral Hospital
2. To assess the maternal factors associated with LBW neonates among women with preeclampsia birthing at Moi Teaching and Referral Hospital.

3. To determine the immediate neonatal birth outcomes among LBW neonates born of women with preeclampsia at Moi Teaching and Referral Hospital.

1.5 Significance of the study

This study sought to ascertain the prevalence of LBW neonates, maternal factors associated with LBW as well as immediate neonatal birth outcomes among LBW neonates born of women with preeclampsia at MTRH, Eldoret. The findings from the study will help create awareness in the hospital and community about LBW neonates among women with preeclampsia and contribute in formulating intervention to avert LBW from a localized perspective. The study results will be disseminated to various stakeholders so that prompt focused intervention programs aimed to reduce the burden of the LBW can be put in place and treatment strategies instituted to care for neonates with LBW. Furthermore, the findings can inform other countries experiencing low birth weights among women with preeclampsia thus contributing to existing body of knowledge on neonatal health. Finally, the study findings will eventually help in achieving the Sustainable Development Goal number 3:2 that by 2030; preventable deaths of newborns and children below 5 years of age should cease, with all countries targeting to reduce neonatal mortality to at least as low as 12 per 1000 live births and below 5 mortality to at least as low as 25 per 1000 live births"(Bora & Saikia, 2018).

1.6 Scope of the Study

This study aimed to elucidate the prevalence of LBW neonates among women with preeclampsia, associated maternal determinants and immediate neonatal birth outcomes of the LBW neonates at MTRH. Relevant data was collected cross-sectional during the study period from 21st March 2021 to 20th August 2021.

1.7 Expected Impact

The study findings informs policy makers to develop guidelines to aid reduction of LBW among the women with preeclampsia at MTRH based on already existing statistics and outcomes of the study. The information gap was filled by the study as it aimed to determine prevalence of low birth weight neonates, maternal associated factors with LBW and immediate neonatal birth outcomes among LBW neonates born of women with preeclampsia at Moi Teaching and Referral Hospital, Eldoret.

1.8 Justification

Low birth weight, a common fetal outcome among women with preeclampsia, contributes to global neonatal morbidity and mortality. While the general subject of LBW has been widely researched and published, developing countries have contributed little in this body of knowledge. In line with this only scanty data exist on the prevalence and determinants of low birth weight neonates among women with preeclampsia in Kenya. The patterns of prevalence keep changing over time thus necessitating periodical studies in each region to evaluate the trend. Identifying maternal determinants of LBW neonates among the preeclamptic women birthing at MTRH will provide insight as to which group of PET women are at more risk thus benefit from increased vigilance. The information generated will not only be useful to MTRH in its quest to improve outcomes of neonates born to women with preeclampsia but also contribute to the body of knowledge in managing this common challenging neonatal condition.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

The following areas are highlighted in this chapter: review of literature for prevalence of low birth weight, maternal determinants of pre-eclamptic women delivering LBW neonates and describes immediate neonatal birth outcomes of LBW neonates born of the preeclamptic women. It is basically divided in parts namely: the general literature review, prevalence of LBW, maternal factors contributing to LBW, preeclampsia, diagnosis of preeclampsia, empirical theory of preeclampsia, prevalence of preeclampsia, and pathophysiology of low birth weight among women with preeclampsia and the immediate neonatal birth outcomes of neonates born of preeclampsia women. The literature search has been drawn from the global, regional and local perspective using several search engines like Google scholar, semantic scholar, Microsoft Academic and Scopus. The key terms used to conduct the literature search included: preeclampsia, prevalence, determinants, low birth weight neonates and birth outcomes.

2.1 General overview

Birth weight, a reliable indicator of intrauterine growth helps determine the child's future intellectual as well as physical development (Shiva G. et al, 2018). According to Mitao et al., (2016), low birth weight (LBW) is the newborn weight below 2500 grams irrespective of gestational age. Low birth weight neonates can be categorized into small for Gestational Age (SGA), Intrauterine Growth Retardation (IUGR) or preterm. Developing countries, especially in Africa have been constantly facing the problem of LBW. Globally, 92% of LBW neonates are in developing countries with

70% in Asia and 22% in Africa (Mandal A, 2018). Despite being preventable, complications associated with LBW are the leading cause of neonatal morbidity and mortality in Kenya.

According to Blencowe et al., (2019) , a newborn's weight or size is a relevant indicator of the child's vulnerability to chances of childhood illnesses and risks of survival. LBW is closely related to fetal and neonatal death, morbidity, inhibited growth and cognitive development, and chronic diseases later in life (Chowdhury et al., 2017). The mortality rate of LBW neonates is about twenty times more as compared to heavier infants (Tshehla et al., 2019). A study done in Iraq by Basim & et al, (2017) found that LBW contributed to between 60% to 80% of all neonatal deaths owing to their susceptibility to hypothermia, birth asphyxia, trauma, respiratory disorders, hypoglycemia, and infection

2.2.1 Prevalence of low birth weight Neonates

According to a study done from the London School of Hygiene & Tropical Medicine by Ekubagewargies et al., (2019) the estimated global prevalence of LBW at 15.5%, amounted to 20.5 million neonates in 2015 (approximately 1 in 7 babies). Blencowe et al., (2015) in a systematic analysis on national, regional and global estimates of low birth weight trends from year 2000 to 2015 established that about 20·5 million (UR 17·4–24·0 million) live births were LBW; 91% from low and middle income countries, southern Asia contributing 48%, sub-Saharan Africa 24% and East Africa contributing to 13.5% while that of Kenya stood at 11% (WHO, 2014).

KDHS 2014 reports that 8% of neonates had LBW and this was said to have increased from 6% in the year 2009 to 8% in 2014 (Blencowe et al, 2019).

Table 2.1: Data for global low birth weight neonates

Region [a]	**% of infants with low birth weight** [b]	**% of infants not weighed at birth** [b]
Sub-Saharan Africa	13	54
Eastern and southern Africa	11	46
West and central Africa	14	60
Middle East and north Africa	-	-
South Asia	28	66
East Asia and Pacific	6	22
Latin America and Caribbean	9	10
Least developed countries	13	46
World	**15**	**48** [c]

KEY

a- Classification of countries according to the United Nations Statistical Division (8).

b- Regional aggregates are presented where adequate population coverage is present, based on available data 2008–2012.

c- Excludes China (United Nations Children's Fund [UNICEF] estimate, as of February (2014) (9).

Source: UNICEF data (2014). Nutrition: low birth weight (9).

2.2.2 Prevalence of low birth weight Neonates among women with preeclampsia

Sirenden et al., (2020) did a study in Indonesia by on 256 pregnant preeclampsia women of whom about two thirds (71.9%) had severe preeclampsia and nearly a third (28.1%) had severe preeclampsia with maternal complications found that LBW neonates were more in the severe preeclampsia with maternal complications group at 37.5% than those without maternal complications. At a study done in Ethiopia by Goba et al., (2019), the LBW babies (1500 to 2499 grams) in preeclampsia women was 29.3% and very low birth weight (1000 to 1499 grams) was 6.9%. Low birth weight and preterm deliveries were more likely in women who had preeclampsia with severe features than those with preeclampsia without severe features.

LBW data remain limited or unreliable due to many home and peripheral remote health clinics leading to poor reporting thus resulting in an underestimation of LBW prevalence (WHO, 2014). These estimates show that in order to achieve the 2·74% Alan Aragon's Research Review (A.A.R.R) needed between 2012 and 2025 to meet the worldwide nutrition target requires more than doubling progress both by improving measurement and programme investments aimed in curbing the causes of LBW all around the lifecycle (UNICEF-WHO, 2019). In doing this it will eventually lead to a 30% reduction of LBW newborns by the year 2025 translating into a 3.9% relative reduction per year between 2012 and 2025 (WHO, 2014).

2.3 Maternal factors associated with low birth weight neonates

Several studies show that determinants leading to LBW are multifactorial. According to Raghunath et al., (2016), a neonate's low birth weight could be due to pre-term birth or inhibited intrauterine growth. Globally, Low birth weight constitutes 60% to 80% of neonatal mortalities (Wardlaw, You, Hug, Amouzou, & Newby, 2014). Osward & et al., (2018) at a study among the PET women in Tanzania found that many factors influence gestation at birth and fetal growth, and thus, the birth weight. These factors can be neonatal, maternal or environmental.

A study done in India by Arpita Mandal, (2018) found that the major factors responsible for LBW in neonates were: the age of mother at time of delivery, poor nutritional health of mother, availing inadequate antenatal care and high parity. Prenatal exposure to environmental pollutants for instance phthalates, bisphenols and organophosphate pesticides were significantly associated with LBW in New York city (Dries M. et al, 2021). According to a study in Nigeria by Etuk, (2020), pre-eclampsia exacerbated the risk of delivering low birth weight neonates and preterm

deliveries among the teenage mothers. In Bangladesh, a study done by Yasmeen S & Azim E, (2011) found that the rate of LBW was higher in low income families.

A study done in Baghdad by Zeidan, (2019) found that the women with the lowest level of education attained gave birth to low birth weight neonates as compared to those with higher level of education. According to a study done in Ghana by (Shamsudeen Mohammed & Bonsing Irene (2019), secondary or higher education attending women were 63 % less likely to give birth to LBW neonates as compared to illiterate women. In Tanzania, unmarried women were found to give birth to LBW neonates almost two times more than the married ones (Kamala B. et al, 2018).

Mohamed et al., (2022) and Ekubagewargies et al., (2019) in studies conducted in Malaysia and Ethiopia respectively found that low pre-pregnancy BMI, living in urban areas, weight loss together with inadequate food during pregnancy were significantly associated with low birth weight neonates. Women of urban residence were found to deliver more LBW neonates as compared to their rural dwellers. The study related this to urban social lifestyles like heavy alcohol intake and cigarette smoking. The factors which did not show association included: religion, ethnicity, previous history of a sexually transmitted infection and engaging in heavy work during pregnancy.

Moreover, Mitao et al., (2016) states that numerous determinants linked to heightened risk of LBW are: hypertensive disorders of pregnancy, placental abruption, placenta previa, premature rupture of membrane (PROM), maternal background characteristics like poor nutrition, smoking during pregnancy, maternal illness during pregnancy, high parity, low maternal education, high maternal age, low maternal Body Mass Index (BMI), inadequate antenatal clinic attendance, medical conditions like HIV

positive status of the mother and anemia, environmental as well as genetic factors like history of the mother being born with LBW and previous history of delivering LBW neonates in the last pregnancies. Similarly in the same study, maternal social determinants of health for example income, level of education, housing, addiction, and living place (urban/rural) have a significant role in resulting to LBW neonates.

2.4 Preeclampsia

Preeclampsia, a syndrome characterized by the new onset of hypertension and proteinuria experienced after 20 weeks gestation or within the first 4 - 6 weeks postpartum in a previously normotensive woman; is characterized by high blood pressure, visual disturbances, headaches, swelling, excessive weight gain and abdominal pain (Paidas M et al., 2020). Eclampsia is the development of grand malseizures in gestational hypertension or preeclampsia (Cao et al., 2019). Preeclampsia, a systemic syndrome occurring in about 5–10% of pregnant women is a leading cause of maternal and neonatal morbidity and mortality (Rugolo, Bentlin, & Trindade, 2011).

2.5 Diagnosis of preeclampsia

Mild and severe preeclampsia is diagnosed during the antepartum period based on series of defined criteria occurring after 20 weeks of gestation posing heightened risk of unfavorable maternal and perinatal outcomes (Lai J. et al., 2021). According to guidelines by American College of Obstetrics and Gynaecology (ACOG) (N. Khan et al., 2020), preeclampsia is diagnosed as new-onset hypertension (systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg on 2 occasions at least 4

hours apart) after 20 weeks of gestation with or without proteinuria (≥300 mg per 24-hour urine collection, protein/Creatinine ratio ≥0.3, or dipstick reading of 1+).

Severe preeclampsia is characterized by at least one of the followings: persistent rise in blood pressure (≥ 160/110 mmHg), cerebral or visual disturbances, hepatic or renal failure, epigastric pain, platelet count < 100,000/mm^3, hemolytic elevated liver enzymes and low platelet count (HELLP) syndrome, persistent severe and pulmonary edema (Konar H, 2013). In contrast, mild preeclampsia is described by an elevated blood pressure below 160mmHg (systolic) or 120mmHg (diastolic) including proteinuria greater than 300mg, but less than 5 g daily (Paidas M. et al., 2020).

2.6 Empirical Theory of Preeclampsia

According to Sanjay & Girija, (2014), occurrence of preeclampsia could be at ≥34 weeks of pregnancy and is referred to as a late onset preeclampsia (LOPE). Nevertheless, about 10% of PET cases occur before 34 week of pregnancy thus referred to as early-onset preeclampsia (EOPE). An interrupted placentation process in the early implantation is an essential point that distinguishes between the pathophysiology of EOPE and LOPE. At EOPE disorders results during the early implantation in spiral artery remodelling and trophoblast invasion, while LOPE happens when maternal syndrome appeared in ≥34 weeks gestation as a result of dysfunction and dysregulation of maternal tolerance against inflammation.

The EOPE condition is considered as a disease of the placenta while LOPE as a maternal disease (Jiri Sonek et al., 2018). Several studies done by Sumawan, Purwara & Krisnadi (2013) reported that serum leptin plays a role in the pathogenesis of preeclampsia, whereby an increase in leptin levels can help in the prediction of the

disease and a marker of the severity of PET. In addition, Serum Leptin plays an important role as a biomarker of EOPE and LOPE in connection to the severity of the disease, body mass index (BMI), IUGR as well as LBW.

2.7 Prevalence of Preeclampsia

Wagnew et al., (2016) found that the worldwide incidence of preeclampsia is between 2% and 10% of pregnancies varying greatly among countries. The WHO approximates the incidence of preeclampsia to be seven times more in developing countries (2.8% of live births) as compared to developed countries (0.4%). Studies conducted in Ethiopia by Berhe, Kassa, Fekadu & Muche (2018) found a high prevalence of preeclampsia whereby the condition is rampant among older (> 35 years) pregnant women. The overall pooled prevalence of hypertensive disorders during pregnancy in Ethiopia was 6.07% (95% CI: 4.83%, 7.31%).

According to Al-jameil, Aziz, & Fareed, (2014), predisposing factors to developing preeclampsia were as follows: preexisting hypertension, gestational or preexisting diabetes mellitus, nulliparity, previous history of preeclampsia, renal disease, family history of preeclampsia, advanced maternal age of ≥35 years, multiple gestations, a long inter-pregnancy interval and obesity. A study done in Jordan by (Khader Y. et al., 2018) found the risk of preeclampsia to be 2.3 times higher in first pregnancies as compared to the second or more pregnancies.

2.8 Pathophysiology of low birth weight neonates in preeclamptic mothers

Several maternal, placental and fetal aspects play an interlocking mechanism in the pathophysiology of LBW. Similarly, a number of factors have been proposed as the etiology and pathogenesis of preeclampsia as follows: ischemia of the placenta,

prostacycline (PGI2) and thromboxane (TXA2) involvement, genetic, immune maladaptation, endothelia dysfunction oxidative stress and nutritional factors. Uterine conditions that are not supportive for infant development are said to contribute to LBW (Barker, Osmond, Forsen, Kajantie, & Eriksson, 2007). The Hypertensive disorders of pregnancy like preeclampsia predispose women to acute or chronic utero-placental insufficiency, resulting in intrauterine growth retardation, antenatal as well as intra-partum hypoxia and anoxia which causes fetal death (Hassan et al., 2015). Moreover, maternal nutritional status is said to alter her risk for pre-eclampsia.

2.9 Immediate birth outcomes of neonates born of preeclampsia mothers

According to Ozgen G et al., (2022), preeclampsia, a common complication of pregnancy causes neonatal morbidity and mortality as it results in fetal growth restriction with oligohydramnios, low birth weight, preterm birth, nonreassuring fetal status, severe birth asphyxia and stillbirth. Although the pathophysiology of morbidity and mortality of LBW neonates is not yet known, it is thought to be brought about by placental insufficiency as well as generalized endothelial dysfunction (Afeke, 2017).

One of the largest prospective studies in the United Kingdom done by Lucy Champel, Bramham, Parnell, & Nelson-piercy, (2014), examined the neonatal outcome in preeclampsia and hypertensive pregnant women and displayed the restriction of fetal growth to be 48% and 21%, preterm birth was 51% and 15% while neonatal intensive care admission stood at 35% and 12% respectively. In Zimbabwe, a study done by Ngwenya (2017) found that the highest occurring fetal/neonatal complications of severe preeclampsia included: low birth weight, prematurity, stillbirths, and respiratory distress syndrome. A study conducted in general pediatric

wards at Kenyatta National Hospital in Kenya by Ndwiga et al., (2020) established that 38.5% of the admissions in pediatric ward were due to low birth weight and jaundice.

Intrauterine Growth Restriction (IUGR): According to Esposito et al., (2019), the fetal growth is an important indicator of fetal wellness. Delivering a preterm Small for Gestational Age (SGA) has been reported to be linked to pre-eclampsia (Ota, Ganchimeg, Morisaki, Vogel, & Pileggi, 2014). Preeclampsia, as it is distinguished by reduced uteroplacental blood flow and ischemia, posses a remarkable risk factor in the occurrence of IUGR and represents the commonest cause of IUGR in the non-anomalous infant. Birth weight below the 10^{th} percentile at any gestational age has been reported to significantly increase the risk of mortality (Afeke, 2017). Owing to its crucial importance on child survival, LBW has been adopted as one of a number of health indicators as part of the global strategy for health in the 34^{th} Assembly of WHO in 2000 (WHO, 2017). According to Ødegård, Vatten, Nilsen, Salvesen, & Austgulen, (2000), pregnancies complicated by severe preelampsia had infant birth weights 12% lower than expected, while pregnancies with mild preeclampsia showed no difference in weight gain from expected norms.

Hematologic Effects*:* Maternal preeclampsia is said to predispose to neonatal thrombocytopenia, generally referred to as a platelet count less than 150,000/ul and its severity is greatly variable with a small percentage of infants developing severe or clinically significant thrombocytopenia which could result from fetal hypoxia having direct depressant effect on megakaryocyte proliferation (Kalagiri R. et al, 2016). In preeclampsia, thrombocytopenia is typically manifested at birth or within the first 2–3 days following delivery and mostly resolves by 10 days of life.

Risk of Fetal Demise/Stillbirth: According to Saroj, (2020), stillbirths are deliveries at or after 20 weeks' gestation with APGAR scores of 0 at 1 and 5 minutes and no signs of life on direct observation. A scoring tool was devised by Dr. Virginia Apgar in 1952 that is a rapid method of assessing the clinical status of the newborn infant at 1 minute of age and the need for prompt intervention to initiate breathing (American Academy of Pediatrics, Committee on Fetus and Newborn, 2020). The Apgar score provides an accepted as well as a convenient way for reporting the newborn's status soon after delivery and one commences resuscitation if necessary. The scoring is as illustrated:

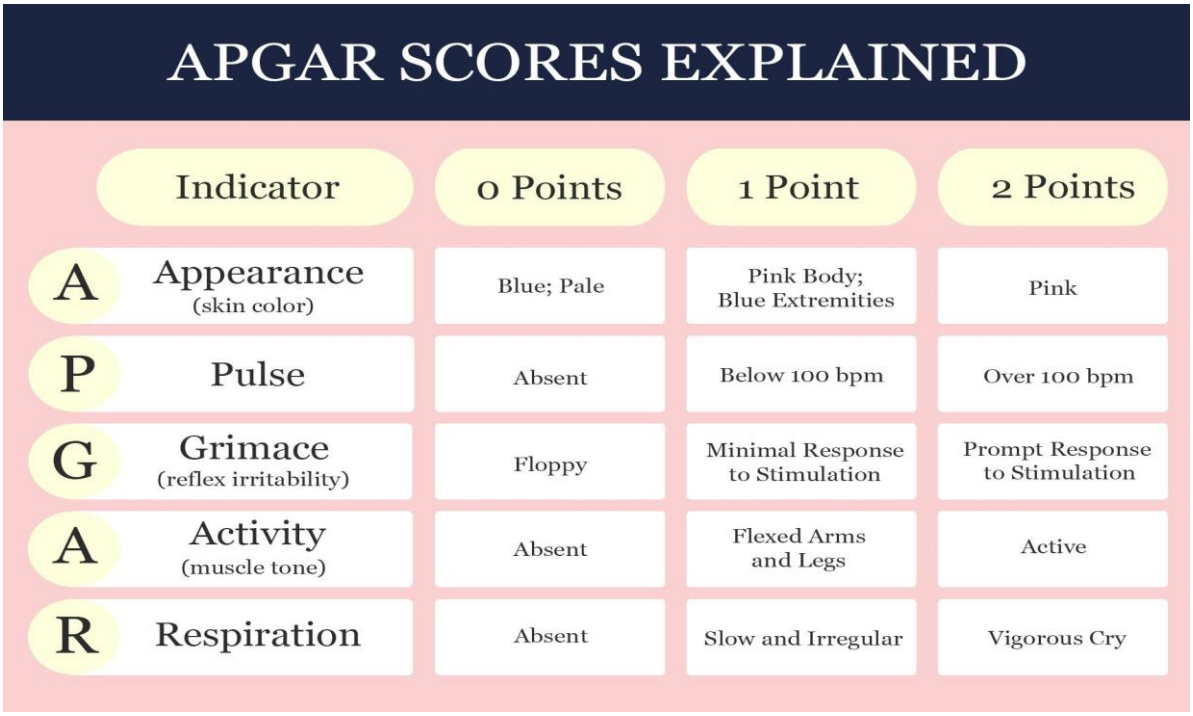

Figure 2. 1: Apgar score - Birth Injury Attorneys (2019).

A study conducted in the USA by Gold J. Katherine, (2010) that investigated births among people of various races and found that the risk of stillbirth was substantially increased by LBW irrespective of their races. Moreover, it is estimated that in every ten seconds, an infant dies as a result of a disease or infection attributed to LBW in a

developing country. According to Vigil-De Gracia & Ludmir, (2020), severe preeclampsia resulted in maternal and perinatal complications with an increased rates of stillbirths. Placental insufficiency is often implicated in stillbirth, more so in preeclampsia. Fleiss et al., (2019) describes placental insufficiency as a condition whereby a maladaptive placenta fails to provide adequate oxygen and nutrients to the growing fetus thus resulting in both adverse obstetric sequelae and fetal programming. LBW infants begin life immediately disadvantaged facing extremely poor survival rates. Additionally, LBW newborns have increased risk of dying in the first 28 days of life (UNICEF-WHO, 2019). A study conducted in Ethiopia by Berhe, Ilesanmi, Aimakhu, & Mulugeta (2019) revealed that perinatal death occurred in 15.0% of women with preeclampsia.

Respiratory distress syndrome: Respiratory distress syndrome (RDS) is among the most common complications of preterm delivery. Preterm RDS is secondary to surfactant insufficiency, whose incidence is usually related inversely to gestational age (GA). Preeclampsia is a common cause of preterm birth and neonatal morbidity, but its relationship with neonatal respiratory distress syndrome (RDS) remains controversial. A study done in Taiwan by Wen, (2019) revealed that maternal preeclampsia slightly increases the risk of severe RDS in VLBW infants by odds ratio (OR) 1.16 (95% CI, 1.02–1.31). According to a study done at Holtz Children's Hospital of the Jackson Memorial/University of Miami Medical Center by Tagliaferro & et al., (2019), it was found that the risk of severe RDS was increased in extremely premature (23–28 gestational weeks) infants exposed to preeclampsia.

2.10: Summary

The maternal health status as well as socio-economic well-being of the community may be mirrored indirectly by the increased prevalence of LBW. Therefore, obtaining accurate patterns and determinants of LBW neonates among women with preeclampsia are crucial measures in adopting relevant strategies for mitigating risk factors and improving neonatal health status that eventually promote public health status. While factors associated with LBW among women with preeclampsia are well studied in developed countries, inadequate evidence prevail in the developing countries (Badalyan, 2014). This study aimed to determine prevalence of LBW neonates, maternal factors associated with LBW and immediate neonatal birth outcomes among LBW neonates born of women with preeclampsia at Moi Teaching and Referral Hospital, Eldoret.

2.11 Conceptual Framework

Diagrammatically, the conceptual framework is illustrated in figure 2. This is researcher's owner adopted framework.

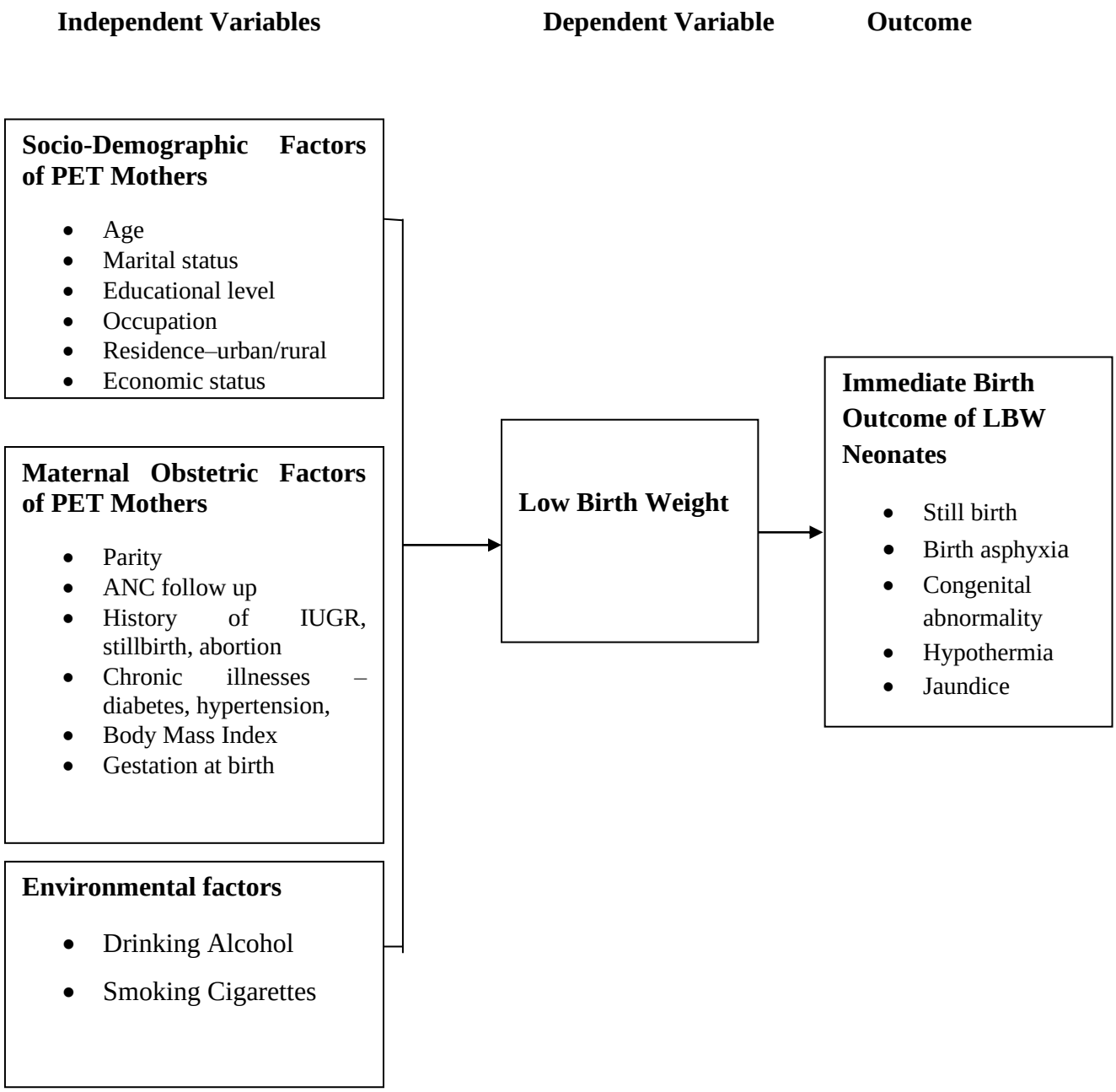

Figure 2.2: Conceptual framework (Researcher's Adopted)

CHAPTER THREE
METHODOLOGY

3.0 Introduction

In this chapter, the researcher describes the methodology employed in the study. The chapter outlines the study site, study design, the target and study population, sample size, sampling technique used, data collection procedures, statistical analysis and the ethical considerations observed.

3.1 Study Area

This study was carried out at Riley Mother and Baby Hospital (RMBH), the maternity wing of MTRH in Eldoret, which is located in Uasin Gishu County in the North Rift region of Western Kenya. The hospital is located about 310 kilometers Northwest of Nairobi, the capital city of Kenya and is the second largest referral hospital after Kenyatta National Hospital. It serves the greater western Kenya region representing about 40% (approximately 16.2 million people) of the country's population. It also serves Eastern Uganda and parts of Southern Sudan. In addition to this, MTRH offers teaching and training opportunities to students from Moi University, Baraton University, Kenya Medical and Training College among other colleges. The study was conducted at the antenatal ward, labour ward, RMBH theatre and nursery. The bed capacity of the Riley Mother and Baby hospital is as follows: antenatal ward = 28 beds, labour ward = 22 beds, postnatal ward = 35 beds, women's Hostel =30 beds and Nursery= 60 cots and 12 resuscitaires. The maternity wing of MTRH also houses the records department where relevant data to the study was collected.

3.2 Study Design

A descriptive cross-sectional study design was used in this study. The justification for using descriptive cross-sectional design is that it enabled the researcher get an in-

depth description of the prevalence of LBW neonates, neonatal birth outcomes and the maternal factors associated to low neonatal birth weight among the women with preeclampsia by answering the 'what' questions of the study in a statistical form. It was a cross-sectional method because data was being collected once from each participant at every given time without further follow up.

3.3 Target population

The target population was all women with preeclampsia who gave birth at Riley Mother Baby Hospital in MTRH during the period of study. On average, about 310 women with preeclampsia are admitted and deliver on monthly basis in Moi Teaching and Referral Hospital.

3.4 Study population

The study population comprised of all women who had a diagnosis of preeclampsia and delivered in MTRH from 21st March, 2021 to 20th August, 2021.

3.5 Inclusion criteria

The women with preeclampsia who delivered at MTRH were enrolled into the study.

3.6 Exclusion criteria

- Women with eclampsia. Once a woman entered into eclampsia the pregnancy had to be terminated irrespective of the gestation thus was considered be a confounding factor to low birth weight.
- Women who had elevated blood pressure levels above 140/90 mmHg at below 20 weeks gestation. They were excluded to rule out chances of pre-existing hypertensive disorders.

3.7 Sample size

One of the objectives of the study was to estimate the prevalence of low birth weight newborns among preeclamptic women delivering at MTRH. A similar study done in Ethiopia by (Goba et al, 2019) found that the prevalence of low birth weight among

preeclamptic mothers was 36.2%. In order to be 95% sure that the proportion was within plus or minus 5% of 36.2% assumed to be the population value, a sample size was calculated using a sample size formula for estimating single population proportion as described by Lemeshow et al, (1990) as follows:

- $n = \frac{Z^2_{1-\alpha/2} P(1-P)}{d^2}$
- Where,
- n= minimum sample size required
- $Z^2_{1-\alpha/2}$= Critical value for standard normal distribution at α-level of significance (α=0.05, $Z_{1-\alpha/2}$=1.96).
- p = proportion of low birth weight among preeclampsia women taken as 36.2% from a study done by (Goba et al, 2019).
- d =Margin of error (d=0.05)
- The calculated minimum sample size, using the formula and defined parameters is 355 women

3.8 Sampling procedure

Consecutive sampling technique was used to recruit the study participants who had a diagnosis of pre-eclampsia and met the inclusion criteria to the study in each of these points; labour ward delivery rooms and theatre where hospital deliveries take place. Collecting data in theatre from women after spinal anaesthesia was anticipated to have no challenges as they were fully awake throughout the delivery process and in the recovery room. Data collection on post general anaesthesia women was only done when they had completely recovered from the anaesthesia. A study participant was selected at a time post delivery, purpose of the study explained to her and an informed consent obtained in written while ensuring confidentiality. Data on socio-demographic characteristics, maternal obstetric history and birth outcomes of the

LBW neonates born of the pre-eclamptic women was then collected and after which the researcher moved on to another participant until the desired sample size of 355 was attained.

3.9 Pre-test for Validity and Reliability of the Research Instrument

Mugenda (1999) states validity as the accuracy and meaningfulness of inferences which are based on research results. According to Saunders, Lewis and Thornhill, (2009), reliability is a measure of the degree to which a research instrument yields consistent results after repeated trials. To fit the definitions, a pilot test was carried out at MTRH, RMBH Maternity Department; a month before the actual study with a pretest sample size of 30. The pre- test study population had similar characteristics with the research study population as they shared the same geographical region and resources only with different periods of study.

The results of the pilot test helped to modify the content and wording of the data collection questionnaire ensuring that it yielded the information required. Establishing face validity evaluated the appearance of the questionnaire in terms of consistency of style and formatting, readability, feasibility and clarity of language used. The completed tools were entered into the SPSS data base correlation to test their reliability. The value of r was higher than 0.5 thus the questionnaire was assumed to yield data that had high reliability and therefore adopted for the study (Lukoye 2014). Cronbach's alpha was also run using SPSS on the 30 pre-test population and got alpha coefficient of 0.73 thus the questionnaire was considered to be sufficient for reliability.

3.10 Data collection procedures

Training of the research assistants was done prior to the data collection process. Research assistants introduced themselves to the ward managers and explained the purpose of the visit. Informed consent was obtained from the study subjects. The pre-eclamptic women's information on socio-demographic characteristics, obstetric history, neonatal birth weight and immediate neonatal birth outcomes of LBW neonates was gathered soon after delivery by research assistants using a structured questionnaire (Appendix 1). The questionnaire was read and elaborated to the illiterate women by the research assistants.

3.11 Quality of Data

3.11.1 Selection of research Assistants

Four research assistants were selected as follows: one staff nurse from NBU, two staff nurses from the labour ward and one staff nurse from the postnatal ward; all of whom were off duty in their work stations during the data collection process. The research assistants were able to read, understand and document research findings in English.

3.11.2 Training of the research assistants

Research assistants were trained on the data collection questionnaire and how to record the relevant findings appropriately.

3.11.3 Supervision

The principal investigator worked closely with the research assistants during data collection ensuring close monitoring and review of the filled questionnaires for data accuracy, consistency and completeness. Data collection and entry mistakes were corrected as they occurred.

3.12 Data Management

Data collected was stored in a flash disk, external and internal hard drive. A password was created to protect the data from un-authorized personnel's access thus ensuring

integrity, security and privacy. A hard copy of the data was produced as a back-up measure incase the storage in the internal and flash disk was lost.

3.13 Statistical Analysis and Presentation

The study's dependent variable was low birth weight while the independent variables included: Social-demographic factors (Age, marital status, education level, residence, occupation and economic status), Maternal obstetric factors (parity, antenatal visit follow up, past obstetric history, intake of PET treatment and gestational age at birth), Social and environmental factors (history of alcohol intake and cigarette smoking).

Data was analyzed using SPSS software version 22. The collected data was cleaned and coded immediately on the basis of the research objectives. Descriptive analysis was done to summarize the social demographic, maternal obstetric and environment characteristics of the women with preeclampsia. Pre-pregnancy Body Mass Index (BMI) was calculated by taking the squares of the woman's pre-pregnancy weight in kilograms divided by her height in meters. Numeric variables like age, parity were summarized as means/median and SD/IQR while categorical variables like education level, history of alcohol intake were summarized as frequencies and percentages.

To answer objectives 1 and 2, descriptive statistics was performed to get the proportion of newborns with low birth weight and immediate outcomes of low birth weight newborns. To answer objective 3, Chi square test and Wilcoxon test were done to check for association at bivariate level and then multivariate analysis was done using logistic regression to determine factors associated with low birth weight. A p-value of 0.05 or less and a confidence level of 95% were considered statistically significant. Variables that exhibited significance in the bivariate logistic regression

were used for the multivariable logistic regression. The resultant data was presented using tables, narratives, frequencies, percentages and charts.

3.14 Dissemination of research findings

The study findings will be disseminated as follows:

1. Copies of the research findings shall be given to MTRH Reproductive Health Department, MTRH management, Moi Library, County Health Department and the Ministry of Health.
2. Presentations on the research findings shall be done during thesis defense and professional scientific forums
3. Continuous Medical Education (CMEs) on the research findings shall be conducted in MTRH labour ward, antenatal ward and Theatre.
4. The study shall be published in international peer reviewed journals.

3.15 Ethical consideration

1. Research proposal was submitted for scrutiny and approval obtained in written from the Institutional Research and Ethics Committee of Moi University (IREC).
2. Permission to conduct the study at MTRH was sought from the hospital management.
3. No patient names or other identifying characteristics were used; unique identifiers like codes were used as a reference.
4. The information gathered was confidential and used for the purpose of the study.
5. All participants were free to withdraw from the study as they wished without any consequences whatsoever for doing so.

6. An informed consent to conduct the study was sought in writing from the participant having been explained the purpose of the study while ensuring confidentiality.
    i. Directly from adult patients above 18 years of age.
    ii. From an adult guardian / parent for clients below 18 years of age together with assent from these clients.
    iii. No risks were anticipated during the study.
7. After the whole data collection, the data extraction tool was locked in and kept confidential throughout the whole process of the research work.
8. The findings of the study were disseminated to the relevant stakeholders appropriately.

3.16: Summary

This was a descriptive cross- sectional study carried out at the maternity wing of MTRH in Eldoret. The study involved a sample size of 355 participants consecutively sampled. A pilot test involving 30 participants was carried out at the study area a month before data collection to ascertain study tool reliability. Permission to conduct the study was sought from the hospital management and IREC. Data was collected using a structured questionnaire; questionnaires were checked for completeness, data entered into SPSS version 22 and coded. Descriptive analysis was done for social demographic factors, obstetric factors, prevalence of LBW neonates and immediate birth outcomes. Chi square test and Wilcoxon test determined association between LBW and maternal factors at bivariate level. Multivariate analysis was done using logistic regression to determine factors associated with LBW.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.0 Introduction

This chapter specifically presents analyzed data pertaining to the three research questions and objectives of the study as follows: the prevalence of LBW neonates among preeclamptic women birthing at MTRH, the maternal factors associated with LBW neonates among the preeclamptic women and the immediate neonatal birth outcomes among LBW neonates born of preeclamptic women birthing at Moi Teaching and Referral Hospital. A total of 355 mother/neonate dyad participated in the study. Nine of these participants gave birth to twins thus leading to 364 data entries for neonatal outcome.

4.1: Prevalence of LBW Neonates among PET women

The study showed that the prevalence of low birth weight neonates among the participants was 180(49.45%) as illustrated in table 4.1 below:

Table 4.1: Prevalence of LBW Neonates *(n=364)*

Variable	Category	Frequency	Percentage
Birth weight	<2500 grams	180	49.45
	≥2500 grams	184	50.55
	Total	**364**	**100**
Very LBW	No	326	89.56
	Yes	38	10.44
	Total	**364**	**100**

4.2: Socio-Demographic characteristics for all women with PET

The participants' age was distributed as follows; 20 to 34 years 263(72.25%), 35 to 49 years 63(17.31%) and 15 to19 years 38(10.44%). It was observed that 267(73.35%) of the participants were married while 97(26.65 %) were unmarried. Regarding highest level of education attained 147(40.38%) had secondary level, 133(36.54%) had tertiary level while 84(23.08%) had primary and below.

On the employment status, about two thirds (65.93%) of participants were unemployed while a third (34.07%) had some employment. Less than a third (24.73%) of the participants was from the first and lowest income quintile while 54(14.84%) were from the fourth income quintile. A majority 334 (91.76 %) of participants had no history of substance use while 30(8.24%) reported to have used substances. Participants' county of residence was distributed as follows; 236(65.19%) Uasin Gishu, 50(13.81%) from Trans-Nzoia, 31(8.56%) from Nandi, 15(4.14%) from Elgeyo Marakwet, 14(3.87%) from West Pokot while 16(4.42 %) were from other counties. Notably, 230(62.98%) of the preeclamptic women were of rural residence while 134(37.02%) were of urban residence as illustrated in table 4.2 below:

Table 4.2: Socio-Demographic characteristics for all PET women (*n=364*)

Variable	Category	Frequency	Percentage
Age	34-49	63	17.31
	20-34	263	72.25
	15-19	38	10.44
	Total	**364**	**100**
Marital status	Not Married	97	26.65
	Married	267	73.35
	Total	**364**	**100**
Education level	Primary	84	23.08
	Secondary	147	40.38
	Tertiary	133	36.54
	Total	**364**	**100**
Employment	Unemployed	240	65.93
	Employed	124	34.07
	Total	**364**	**100**
Substance use	No	334	91.76
	Yes	30	8.24
	Total	**364**	**100**
Residence	Urban	134	36.81
	Rural	230	63.19
	Total	**364**	**100**
Income quintile	Lowest	90	24.73
	Second	66	18.13
	Third	88	24.18
	Fourth	54	14.84
	Highest	66	18.13
	Total	**364**	
County of Residence	Uasin Gishu	236	65.19
	Trans Nzoia	50	13.81
	Nandi	31	8.56
	West Pokot	14	3.87
	Elgeyo Marakwet	15	4.14
	Others	16	4.42
	Total	**364**	**100**

4.3: Socio-Demographic characteristics for participants with LBW Neonates

The age of participants who gave birth to low birth weight neonates was distributed as follows: 20 to 34 years 130(72.23%), 34 to 49 years 26(14.44%) and 15 to19 years 24(13.33%). The mean age of participants was 27.5 years. It was observed that 121(67.22%) of the participants were married while 59(32.78%) were unmarried.

Regarding highest level of education attained, 72(40%) had secondary level, 66(36.67%) had tertiary level while 42(23.33%) had primary and below.

On employment status, about two thirds (68.89%) of participants were unemployed while a third (31.11%) had some employment. Less than a third 47(26.11%) of the participants were from the first and lowest income quintile while 38(18.89%) were from the fourth income quintile. A majority 162(90 %) of participants had no history of substance use while 18(10%) reported to have used substances.

Participants' county of residence was distributed as follows; 115(68.89%) Uasin Gishu, 28(15.56%) from Trans-Nzoia, 11(6.11%) from Nandi, 9(5%) from Elgeyo Marakwet, 9(5%) from West Pokot while 8(4.44%) were from other counties. Notably, 112(62.22%) of the women with preeclampsia were of rural residence while 68(37.78%) were of urban residence as illustrated in table 4.3 below:

Table 4.3: Socio-Demographic characteristics for participants with LBW Neonates (*n=180*)

Variable	Category	Frequency	Percentage
Age	34-49	26	14.44
	20-34	130	72.23
	15-19	24	13.33
	Total	**180**	**100**
Marital status	Not Married	59	32.78
	Married	121	67.22
	Total	**180**	**100**
Education level	Primary	42	23.33
	Secondary	72	40.00
	Tertiary	66	36.67
	Total	**180**	**100**
Employment	Unemployed	124	68.89
	Employed	56	31.11
	Total	**180**	**100**
Substance use	No	162	90
	Yes	18	10
	Total	**180**	**100**
Residence	Urban	68	37.78
	Rural	112	62.22
	Total	**180**	**100**
Income quintile	Lowest	47	26.11
	Second	27	15.00
	Third	35	19.44
	Fourth	37	20.56
	Highest	34	18.89
	Total	**180**	**100**
County of Residence	Uasin Gishu	115	63.89
	Trans Nzoia	28	15.56
	Nandi	11	6.11
	West Pokot	9	5.00
	Elgeyo Marakwet	9	5.00
	Others	8	4.44
	Total	**180**	**100**

4.3.2: Pre-pregnancy BMI of the participants with LBW neonates (*n=180*)

The figure below shows that majority 79(43.9) of the participants with neonatal birth weight deficit had a pre-pregnancy grouped BMI of 23.6-28.5. The mean maternal BMI was 27.88(SD +/-5.003). The minimum BMI was 18.9 while the maximum BMI was 50.43. The findings are summarized in figure 4.1

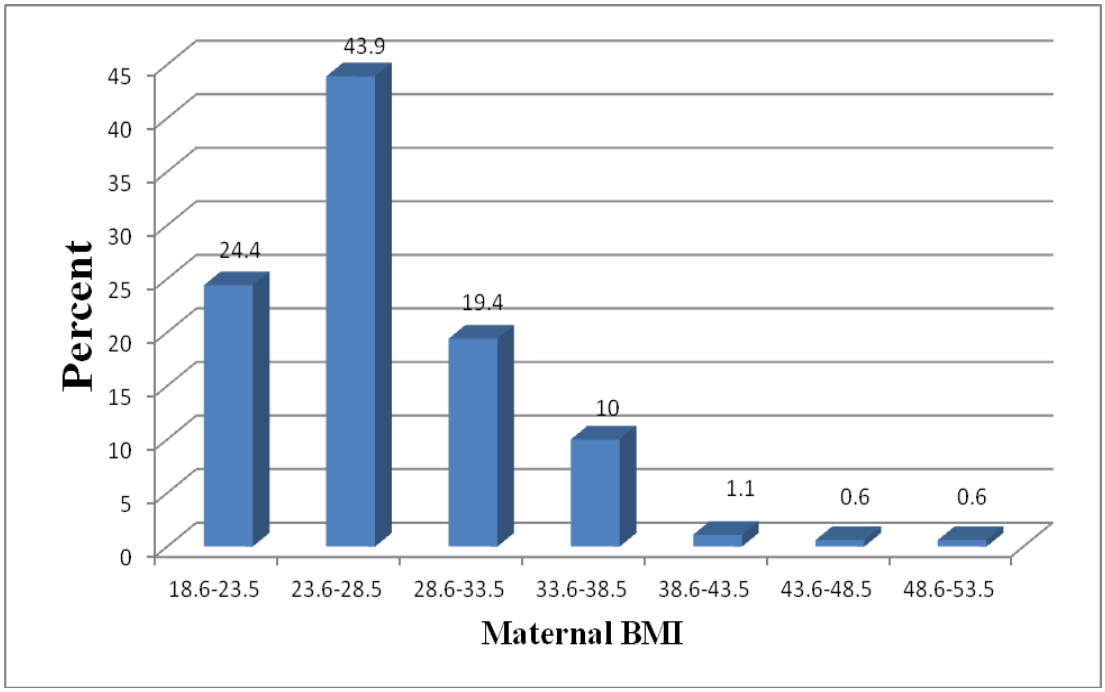

Figure 4.1: Maternal Pre-pregnancy BMI (n=180)

4.4: Maternal Obstetric characteristics for participants with LBW neonates

A majority 168(93.33%) of the women with preeclampsia who gave birth to LBW neonates had proteinuria during the current pregnancy while 12(6.67%) had undetected protein levels in their urine. Participants parity was distributed as follows; 94(52.22%) were primigravidas, 60(33.33%) were para 2 and 3 and 26(14.44%) were para 4 and above. The mean parity of the participants was 2.25. About half 93 (51.67%) of the participants had history of attending ANC clinic 1 to 3 times, 77 (42.78%) reported to have had 4 or more ANC visits while 10 (5.56%) had not attended to any antenatal care.

In terms of previous preeclamptic history, about two thirds (62.78%) of the PET women had no history of PET while 67(37.22%) reported to have had PET in their previous pregnancies. Among the participants with LBW neonates, 150(83.3%) had severe PET while 30(16.7%) had mild to moderate PET. Concerning the use of PET

treatment, about two thirds (67.22%) of the participants reported to have been on treatment for PET.

The study found that 48(26.67%) of the participants with LBW neonates had comorbidities during the current pregnancy. Nearly a quarter 43(23.89%) of the participants who gave birth to LBW neonates had previous still birth history. From the research findings, 39(21.67%) of the preeclamptic women with LBW neonates had HELLP syndrome. Table 4.4 summarizes the findings.

Table 4.4: Maternal Obstetric characteristics for participants with LBW neonates (*n=180*)

Variable	Category	Frequency	Percentage
Protein in urine	Not Detected	12	6.67
	Detected	168	93.33
	Total	**180**	**100**
Parity	Primiparity	94	52.22
	2-3	60	33.33
	4+	26	14.44
	Total	**180**	**100**
ANC attendance	None	10	5.56
	1-3 times	93	51.67
	≥4 times	77	42.78
	Total	**180**	**100**
Previous history of preeclampsia	No	113	62.78
	Yes	67	37.22
	Total	**180**	**100**
Nature of PET	Severe	150	83.30
	Mild-Moderate	30	16.70
	Total	**180**	**100**
On preeclampsia treatment	No	59	32.78
	Yes	121	67.22
	Total	**180**	**100**
Comorbidities	No	132	73.33
	Yes	48	26.67
	Total	**180**	**100**
History of still birth	No	137	76.11
	Yes	43	23.89
	Total	**180**	**100**
Was pregnancy complicated by HELLP syndrome	No	141	78.33
	Yes	39	21.67
	Total	**180**	**100**

4.5: Maternal blood pressure for women with PET and had LBW neonates

The study findings showed that PET women who delivered LBW neonates during the study period had mean maternal systolic BP of 177.33mmHg (±16.07 SD) while mean diastolic BP at birth was 110.60mmHg (±9.425 SD) as demonstrated in table 4.5.

Table 4.5: Maternal blood pressure for PET women with LBW neonates (n=180)

Variable	Minimum	Maximum	Mean	Std Deviation
Systolic BP at birth (mmHg)	141	212	177.33	16.07
Diastolic BP at birth (mmHg)	90	138	110.60	09.425

4.6 Socio-demographic characteristics for the LBW Neonates

The study found that slightly than half 99(55%) of the LBW neonates were born preterm while 81(45%) were of term gestation. LBW male neonates were 102(56.7%) while females were 78(43.3%). Generally, the prevalence of low birth weight twins among the LBW neonates was at 18(10%) as compared to LBW singleton neonates 162(90%). About two thirds 107(59.4%) of the LBW neonates were delivered via caesarean section as shown in table 4.6 below.

Table 4.6: Socio-demographic characteristics of LBW neonates (n=180)

Variable	Category	Frequency	Percentage
Gestation at birth	<37 weeks	99	55.00
	≥37 weeks	81	45.00
Sex	Male	102	56.67
	Female	78	43.33
Child is twin	Yes	18	10.00
	No	162	90.00
Delivery mode	C/S	107	59.44
	Normal	73	40.56

4.7: Neonatal outcomes for the LBW Neonates born of PET women

Among the twins born of women with preeclampsia 18(90%) had LBW as compared to normal weight twins 2(10%). A majority 162(90%) of the LBW neonates were born alive, 17(9.44%) were fresh still births while 1(0.56%) were MSB. More than half 113(63%) of the LBW neonates were not resuscitated soon at birth whereas 67(37%) were resuscitated. In addition, 12(7%) of the low birth weight neonates had congenital abnormalities at birth while 168(93%) were free of congenital abnormalities as shown in table 4.6.1.

Table 4.7: Birth outcomes for the LBW Neonates born of PET women (*n=180*)

Variable	Category	Frequency	Percentage
Gestation at birth	<37 weeks	99	55
	≥37 weeks	81	45
	Total	**180**	**100**
Child is twin	Yes	18	10
	No	162	90
	Total	**180**	**100**
Twin and LBW	Yes	18	90
	No	2	10
	Total	**180**	**100**
Delivery mode	C/S	107	59.44
	Normal	73	40.56
	Total	**180**	**100**
Very LBW	No	142	79
	Yes	38	21
	Total	**180**	**100**
Birth outcome	Born Alive	162	90.00
	FSB	17	9.44
	MSB	1	0.56
	Total	**180**	**100**
Neonatal resuscitation	No	113	63
	Yes	67	37
	Total	**180**	**100**
Congenital malformation	No	168	93
	Yes	12	7
	Total	**180**	**100**

4.8: Neonatal morbidities of LBW neonates at birth

The findings showed that neonatal morbidities among the LBW neonates were as follows: birth asphyxia at 51(28.7%), neonatal jaundice at 38(21%), hypothermia at 18(7.9%), multiple morbidities stood at 3(1.7%), 1(0.7%) had neonatal sepsis while about 69(40%) had no neonatal morbidities at birth as presented in the figure 4.2.

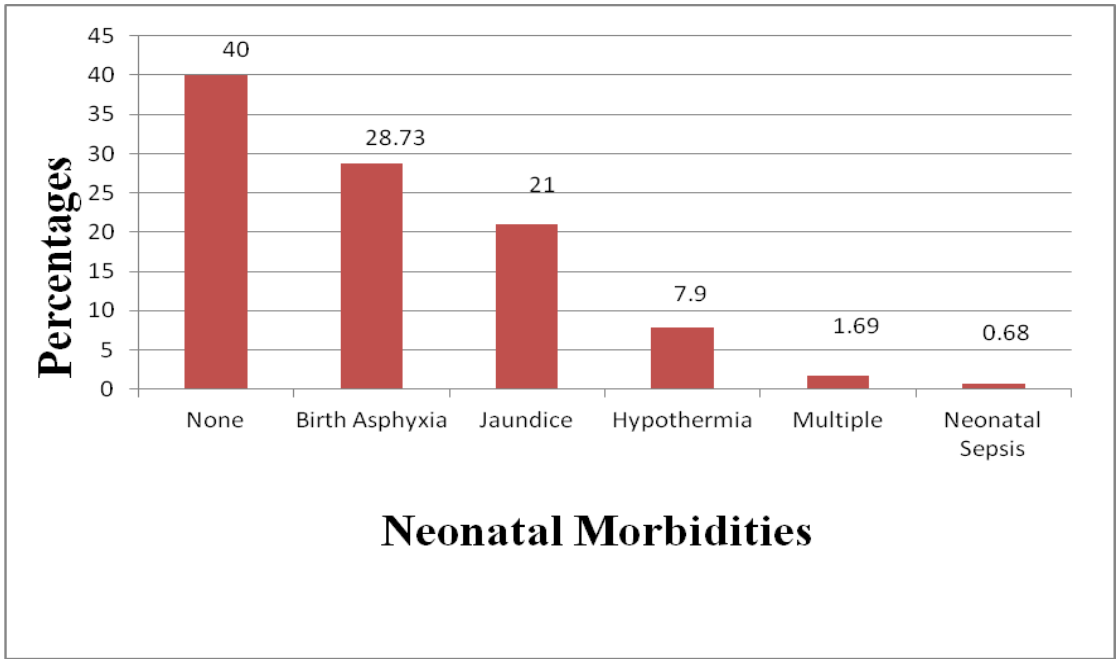

Figure 4.2: Neonatal morbidities of LBW neonates at birth (n=180)

4.9: APGAR Scores for the LBW Neonates

The mean APGAR scores for the low birth weight neonates were as follows: at one minute were 6.44 with a standard deviation of +/- 2.773; at five minutes were 7.23 with a standard deviation of +/- 3.089 and at ten minutes were 7.66 with a standard deviation of +/- 3.123 as illustrated in table 4.5.3.

Table 4.8: APGAR Scores for the LBW Neonates *(n=180)*

Variable	Category	Mean	Standard Deviation
APGAR score	At 1 Minute	6.44	2.773
	At 5 Minute	7.23	3.089
	At 10 Minute	7.66	3.123

4.10: Fate of LBW neonates within 24 hours of birth

During the period of study, 53(29.53%) of the LBW neonates were alive rooming in with their mothers, 107(59.18%) were admitted to NBU while 20(11.29%) of the neonates died within 24 hours of delivery as shown in figure 4.3.

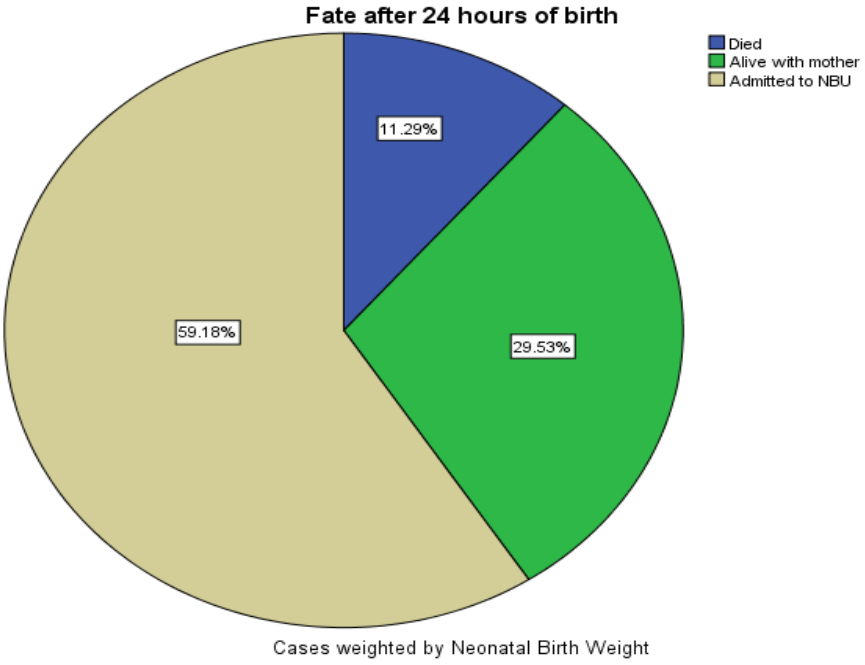

Figure 4.3: Fate of LBW neonates within 24 hours of birth (*n=180*)

4.11: Association between LBW and other variables

The study findings showed that giving birth to LBW neonates was significantly associated with comorbidity p = 0.016, ANC attendance p<0.001, parity p=0.014,

gestation at birth p< 0.001, twin pregnancy p< 0.001, HELLP syndrome p< 0.001, non marital status p= 0.009, no use of preeclampsia treatment p< 0.001 and proteinuria p< 0.001 as illustrated in table 4.6 below.

Table 4.9: Association between LBW and other variables

Variable	Category	LBW		Ch2	P-Value
		NO (%)	YES (%)		
Age	34-49	58.73	41.27	4.5430	0.103
	20-34	50.57	49.43		
	15-19	36.84	63.16		
Marital status	Not in union	39.18	60.82	6.8441	0.009
	In union	54.68	45.32		
Education level	Primary	50	50	0.024	0.988
	Secondary	51	49		
	Tertiary	50.6	49.4		
Occupation	Unemployed	48.33	51.67	1.3842	0.239
	Employed	54.84	45.16		
Residence	Urban	49.25	50.75	0.0890	0.765
	Rural	50.88	49.12		
Income quintile	Lowest	44.71	55.29	4.1610	0.385
	Second	60.29	39.71		
	Middle	46.97	53.03		
	Fourth	50	50		
	Highest	52.11	47.89		
Substance use	No	51.50	48.50	1.4556	0.228
	Yes	40.00	60		
Proteinuria	No Detected	75.00	25.00	13.2235	0.000
	Detected	46.84	53.16		
Parity	Primiparity	41.98	58.02	8.6000	0.014
	2-3	57.14	42.86		
	4+	58.06	41.94		
ANC attendance	None	23.08	76.92	26.3303	0.000
	1-3 times	36.73	63.27		
	≥4 times	62.25	37.75		
Previous history of preeclampsia	No	52.92	47.08	1.5794	0.209
	Yes	45.97	54.03		
On preeclampsia treatment	No	60.67	39.33	10.4475	0.001
	Yes	43.46	56.54		
Maternal Comorbidities	No	53.85	46.15	5.8029	0.016
	Yes	38.46	61.54		
Gestation at birth	Term	67.86	32.14	98.1465	0.000
	Pre-term	11.61	88.39		
Child is twin	No	52.91	47.09	13.9205	0.000
	Yes	10.00	90.00		
Was pregnancy complicated by HELLP syndrome	No	56.35	43.65	38.5553	0.000
	Yes	4.88	95.12		

4.11: Logistic regression analysis of factors associated with LBWT

The table below shows the results of bivariate (presented as unadjusted Odds Ratios-uOR) and multivariate (presented as adjusted Odds Ratios-aOR) logistic regression analysis.

Results from the above bivariate logistic regression analysis revealed a significant association between neonatal low birth weight and maternal aged 15-19 years , p=0.035, marital status (uOR = 0.53, 95%C.I= 0.33-0.86 , p=0.009), parity (uOR = 0.54, 95%CI=0.34-0.86 , p=0.009), preterm gestation at birth (uOR = 16.1, 95%C.I. =8.51-30.4, , p<0.001), no ANC attendance (uOR = 5.5, 95%C.I. = 1.47-20.6, , p=0.011), gestation of PET diagnosis, HELLP syndrome (uOR = 25.2, 95%C.I. =5.98-106.0, , p<0.001), maternal comorbidities (uOR = 1.87, 95%C.I. =1.12-3.11, , p=0.017), proteinuria (95%C.I. =1.71-6.79, , p=0.017)and twin gestation (uOR = 10.1, 95%C.I. =2.31-44.24, , p=0.002).

After considering several confounding factors, results from the multivariate (presented as adjusted Odds Ratios-aOR) logistic regression analysis observed a statistically significant association between LBW and maternal age 15-19 years (OR =2.44, p=0.035), preterm birth (aOR = 13.2, 95% C.I. =6.22-27.92, p<0.001), lack of ANC attendance (uOR = 5.5, 95% C.I. = 1.47-20.6, p=0.011), HELLP syndrome (aOR = 17.32, 95% C.I. =3.29-91.25 p=0.001) and twin gestation (aOR = 12.63, 95% C.I. =2.09-76.18, p=0.006) with low birth weight neonates among the women with preeclampsia during the period of study. Other variables were not statistically significant in this model. The findings are summarized in Table 4.7.

Table 4.10: Logistic regression analysis of factors associated with LBWT

		Low Birth weight					
Variable	**Category**	**uOR**	**95% CI**	**P-Value**	**aOR**	**95% CI**	**P-Value**
Congenital malformation	No (ref)						
	Yes	1.57	0.63-3.94	0.335	0.70	0.21-2.36	0.562
Age	20-34 years	1.39	0.80-2.43	0.245	2.30	0.94-5.67	0.069
	15-19 years	2.44	1.07-5.58	0.035	1.57	0.40-6.26	0.519
Marital status	Married	0.53	0.33-0.86	0.009	0.69	0.33-1.43	0.319
BMI		0.97	0.93- 1.00	0.117	0.96	0.90-1.02	0.213
Employment	Employed	0.77	0.50-1.19	0.240	1.14	0.58-2.25	0.696
Income quintile	2	0.53	0.28-1.02	0.056	0.44	0.18-1.07	0.071
	3	0.91	0.48-1.74	0.782	0.97	0.41-3.31	0.944
	4	0.81	0.43-1.51	0.505	0.55	0.23-1.34	0.190
	5	0.74	0.39-1.40	0.357	0.49	0.18-1.30	0.151
substance	Yes	1.60	0.74-3.40	0.231	1.51	0.52-4.38	0.451
parity	2-3	0.54	0.34-0.86	0.009	0.55	0.27-1.09	0.088
	4+	0.52	0.29-0.95	0.032	0.63	0.23-1.73	0.368
gestation	Pre-term	16.1	8.51-30.4	0.000	13.2	6.22-27.92	0.000
ANC attendance	1-3	2.84	1.83-4.41	0.000	1.99	1.09-3.61	0.024
	None	5.50	1.47-20.60	0.011	2.37	0.35-16.33	0.379
Gestation of PET Diagnosis		0.93	0.89-0.97	0.001	0.97	0.91-1.04	0.414
PET treatment	No	0.50	0.33-0.76	0.001	0.88	0.47-1.63	0.676
HELLP syndrome	Yes	25.2	5.98-106.0	0.000	17.32	3.29-91.25	0.001
Comorbidities	Yes	1.87	1.12-3.11	0.017	1.83	0.84-4.00	0.128
Proteinuria	Yes	3.41	1.71-6.79	0.000	2.52	0.96-6.61	0.061
Twin gestation	Yes	10.1	2.31-44.24	0.002	12.63	2.09-76.18	0.006
County	TransNzoia	1.34	0.72-2.74	0.351	0.75	0.31-1.83	0.530
	Nandi	1.34	0.27-1.26	0.169	0.60	0.21-1.69	0.336
	West Pokot	1.89	0.62-5.82	0.265	3.13	0.70-14.0	0.136
	Elgeyo-M	1.58	0.54-4.57	0.401	1.18	0.28-4.92	0.823
	Others	1.05	0.38-2.90	0.922	2.26	0.59-8.69	0.236

CHAPTER FIVE

DISCUSSION OF THE FINDINGS AND IMPLICATIONS

5.0 Introduction

This chapter presents the discussion, conclusion and recommendations on the research findings in the preceding chapter in relation to the aim and objectives of the study that states: the prevalence of LBW neonates among preeclamptic women birthing at MTRH, the maternal factors associated with LBW neonates among the preeclamptic women and the immediate neonatal birth outcomes among LBW neonates born of preeclamptic women birthing at Moi Teaching and Referral Hospital. The discussion is pegged to the earlier studies conducted on LBW neonates among the preeclamptic women. The similarities and differences between this study and previous studies have been stated. Explanations for the findings have been provided and served as a basis for drawing conclusions and advancing recommendations.

5.1: Prevalence of LBW neonates among women with preeclampsia

The study findings revealed that the prevalence of low birth weight neonates among the women with preeclampsia was 49.45%. These findings are similar to study done in Nigeria by Yilgwan et al., (2020) and found that 19 (42.2%) of newborns was born of women with preeclampsia had LBW compared to 5 (11.1%) of newborns born following normal pregnancy ($p \leq 0.001$). Another study done in Ethiopia by Goba et al., (2019) established the prevalence of low birth weight among preeclamptic mothers to be about 36.2%. Neonatal low birth weight is an essential sequel of preeclampsia due to the occurrence of fetal under-nutrition as a result of utero-placental vascular insufficiency (Afeke, 2017).

5.2: Maternal factors associated with LBW neonates among women with preeclampsia

Concerning maternal age, the study findings revealed that teenage women with preeclampsia (aged between 15-19 years) had 2.44 increased odds of getting LBW neonates with p-value 0.035 thus was statistically significant. The findings are in congruent to several other studies that found that teenage mothers with PET had higher chances of giving birth to LBW neonates (Bugssa, Dimtsu, & Alemayehu, 2014), Fall et al., (2015) and Afeke et al.,(2017). Possibly due to poor socioeconomic status, maternal malnutrition, and inadequate attendance to antenatal care of teenage mothers as these factors have been reported to influence birth weight of babies born to teenage mothers in the developing countries (Govender, Reddy, & Ghuman, 2018). Moreover, immaturity of the teenage biological system and other behavioural factors could have aggravated the heightened risk of LBW among teenage mothers. According to Fall et al., (2015), teenage mothers in the low-and-middle-income countries have a double risk of birthing LBW neonates. However, these study findings are contrary with the findings of a similar study in Makassar by Sirenden, Sunarno, Arsyad, & Idris, (2020) that established that most PET women who gave birth to LBW neonates were in ages 20–35 (69.4%). The reason could be due to differences in the geographic location of the study subjects.

On employment status, majority (68.89%) of preeclamptic women who gave birth to LBW neonates were unemployed while 31.11% had some employment. The study finding is congruent to a similar study in Uganda by Nakimuli et al., (2020) that found preeclamptic women with unskilled or unemployment to be related to delivering LBW neonates ($p \leq 0.001$). This shows that unemployed PET women have greater chance of delivering LBW neonates as collated to their employed counterparts. This could be related to the fact that unemployed women with preeclampsia cannot afford

all their basic needs like adequate food, good shelter, health care for example buying of the prescribed antihypertensive drugs and pregnancy supplements as compared to their financially stable counterparts.

About 26.11% of the women with PET who gave birth to LBW neonates were from the first and lowest income quintile while 18.89% were from the fifth income quintile. This means that PET women in the lowest income quintile have more chances of delivering LBW neonates as compared to their economically rich counterparts. This is analogous to the study findings in India by Zaveri et al., (2020) that found that the prevalence of LBW neonates had a decreasing trend from bottom to upper quintiles of household wealth whereby the percentage of LBW was 5.5% lower in the richest quintile than the poorest household.

The study findings show a statistically significant association between the non marital status of women with preeclampsia and low neonatal birth weight (p=0.009) at bivariate analysis. This is consistent with the findings of a study in Ghana that established that married women were protective for low birth weight neonates (Agorinya et al., 2018).

Notably, 62.22% of the preeclamptic women with LBW neonates at MTRH were from rural residence while 37.78% were of urban residence. This is analogous to the findings of a study in Ethiopia by Bekela et al., (2020) that found that the odds of residing in the rural areas was 3.51 increased chances of birthing low birth weight babies as compared to urban dweller women (AOR = 3:51, 95% CI =1.91-6.45). Possibly, low accessibility to health facilities and maternal health service utilization or strenuous work habit among women in rural areas precipitates the chances of giving

birth to LBW neonates. This finding was consistent with studies conducted in Zimbabwe (Feresu, Harlow, & Woelk, 2015).

From the study findings, maternal education was found to be protective against birthing LBW neonates among the women with preeclampsia. The odds of having LBW neonates decreased with an increasing maternal education level (p= 0.988). This is comparable with several previous studies conducted in Bangladesh as well as other developing countries (J. R. Khan, Islam, Awan, & Muurlink, 2018). Educated women with preeclampsia are thought to have greater health seeking behavior in relation to the uneducated ones thus increasing their chances of giving birth to neonates with less morbidity as compared to the uneducated counterparts.

Women with preeclampsia who delivered LBW neonates during the study period had mean maternal Systolic BP of 177.33mmHg (±16.07 SD) while mean Diastolic BP at Birth was 110.60mmHg (±9.425 SD). The study finding was congruent to the outcomes of a similar study in Uganda by Nakimuli et al., (2020) that found that during delivery, the PET women had an average systolic blood pressure of 168.95 (±19.14 SD) and mean diastolic BP of 116.22 (±15.92 SD).

Regarding prenatal care, women with preeclampsia who did not attend antenatal clinics for prenatal care were 5.5 increased odds (uOR = 5.5, 95%C.I. = 1.47-20.6, p=0.011) of getting LBW neonates in relation to those who had the prenatal care. Congruent to this finding is a study done in Lesotho by (Nwako et al, 2020) that established that mothers who did not attend ANC for that pregnancy were 1.7 (OR 1.4, 2.2) times more likely to have low birth weight. Possibly due to the fact that women with preeclampsia who have timely antenatal care thus having better opportunities for nutritional counseling and iron and folic acid supplementation,

detection as well as treatment of various infections (Bhaskar et al., 2015). As a result, the tendencies of delivering a LBW baby would be reduced as compared to PET women who attend less antenatal care visits; congruent to many other studies, that established that ANC attendance ≥ 4 ANC was found to be greatly protective against LBW (Kumar et al., 2018).

Additionally, the study findings show a statistically significant association between the non use preeclamptic treatment among the women with preeclampsia and low neonatal birth weight (p=0.001). This is similar to the findings of a meta-analysis expert review that state that prophylaxis and other treatment modalities of preeclampsia improves both maternal and neonatal birth outcomes (Rolnik, Nicolaides & Poon, 2022). Those women who were given calcium supplements anti-hypertensive treatment and aspirin had less severe forms of preeclampsia thus giving birth to normal weight neonates as compared to those who did not take any treatment.

From the study findings, preterm gestation at birth had 13.2 increased chances of birthing LBW neonates (aOR = 13.2, 95%C.I. =6.22-27.92, p<0.001) congruent to the study findings among the women with preeclampsia in India conducted by Kumar et al., (2018) and in Ethiopia by Tolu et al., (2020) that established that fetuses gain maximum weight during the third trimester due to increasing body fat, blood and fluids thus if a neonate is born prematurely, there is a likelihood of having low birth weight.

According to the findings of this study, Primiparity was associated with low birth weight neonates among the women with preeclampsia (p=0.014). This is consistent with a similar study done in Uganda among women with preeclampsia that found that

primigravida women gave birth to neonates with lower birth weight as compared to the multiparous counterparts (Nakimuli et al., 2020).

Moreover, preeclamptic women with hemolytic elevated liver enzymes and low platelet count (HELLP) syndrome had increased chances of delivering low birth weight neonates (uOR = 25.2, 95%C.I. =5.98-106.0, p<0.001). These findings are comparable to a study in Germany by Kongwattanakul et al., (2018) that found that preeclamptic women with HELLP syndrome had 35.1% chances; p≤0.001of giving birth to LBW neonates. Another study in Indonesia by Sirenden et al, (2020) on 256 women with preeclamptic toxaemia (PET) of which 184 (71.9%) had severe preeclampsia and 92 (28.1%) had severe preeclampsia with maternal complications found that LBW neonates were more in the severe preeclampsia with maternal complications group (37.5%). This could be as a result of severe utero-placental insufficiency by the severe preeclamptic toxaemia causing intrauterine growth restriction.

PET women with twin gestations had 12.63 increased chances (aOR = 12.63, 95% C.I. =2.09-76.18, p=0.006) of getting low birth weight neonates as compared to singleton gestations. Congruent to these findings are the outcomes of a study in Bulgaria that established a relationship among the multiple pregnancies and LBW whereby 100% of the triplets and 79% of the twin pregnancies had low birth weight neonates while the rate stood at 7% amid monogamous pregnancies (Atanasova et al, 2021). In addition to this, the odd ratio of LBW in multi-fetal pregnancies was reported to be 16.5 times more than single fetuses.

The study findings failed to prove any significant relationship between maternal substance use and neonatal low birth weight. Conversely, previous evidences in a

study done in Tanzania showed that maternal substances use like smoking could predispose to LBW (Mitao et al., 2016). The reason for the disparity in this study finding on the maternal substance use as compared to the study in Tanzania could be due to the fact in this study the number of participants who reported to have used cigarettes were very few (10%) and when analyzing the variable to look for its association with neonatal low birth weight, multivariate logistic regression was not the model of best fit. In my view, if a bigger sample of preeclamptic women with history of smoking could be used in analysis the findings could inform us better on the association with LBW neonates.

According to this study, increasing pre-pregnancy maternal Body Mass Index (BMI) was protective against low-birth-weight neonates among the women with preeclampsia. This study found that for every unit positive change in BMI, it reduced the odds of getting LBW neonates by the women with preeclampsia by 3%. The findings are similar to the study done in Mexico that established that being overweight by the pregnant women prior to their conception was protective against delivering low birth weight neonates (Sámano et al., 2022). This could be as a result of adequate nutrition to the growing fetus.

5.3: The immediate neonatal birth outcomes among LBW neonates born of women with preeclampsia

According to the study, 10% of the LBW neonates were still births. The findings are consistent with a study done in South Africa by Nathan et al., (2018) that found that (17.7%) of deliveries from preeclamptic women were still births. This is in line with a study done by Simpson L, (2002) that states that severe preeclampsia represents significant risk for intrauterine fetal demise, with approximated stillbirth rate of 21

per 1000. Placental insufficiency is often implicated in stillbirth, especially in preeclampsia.

The mean APGAR scores for the low birth weight neonates born of women with preeclampsia at MTRH were as follows: 6.44 (±2.773 SD) at one minute; 7.23 (±3.089 SD) at five minutes and 7.66 (±3.123 SD) at ten minutes. Similarly, a study conducted in Tanzania reported that babies born with LBW had an increased risk of a low Apgar score in the first and fifth minutes (Mitao et al., 2016). Another study in Ghana by Afaya A. et al., (2021) found that neonates with LBW had a higher risk of low Apgar score in the first minute compared to neonates with normal birth weight [AOR = 0.52 (95%CI: 0.37–0.73), p≤0.001]. Therefore, the study findings show that there is an inverse proportion between the incidences of low Apgar scores to birth weight. A study in Qatar by (Bayoumi et al., 2020) found that low Apgar score both at 1 and 5 minutes was significantly more frequent in babies of women with preeclampsia than those of normotensive women. From the study findings, 37% of the LBW neonates were resuscitated soon at birth by ventilation and even intubation appropriately due to low APGAR scores in the attempt to improve the outcomes. In line with our findings is a study in Thailand that found that 42.7% of the LBW neonates born of women with preeclampsia were resuscitated soon at birth (Kongwattanakul et al, 2018).

In addition, 7% of the low birth weight neonates had congenital abnormalities at birth. Consistent to this finding is a study done in South Africa that established that Preeclampsia, being an inflammatory disorder could predispose infants to congenital anomalies including congestive heart disease (Sliwa & Mebazaa, 2014). Another study in Iran found that the commonest causes of neonatal mortality among the

preeclamptic women were congenital abnormalities and respiratory distress syndrome (Saadat, Nejad, Habibi, & Sheikhvatan, 2007).

According to the study findings, the leading neonatal morbidity among the LBW neonates born of PET women was birth asphyxia at 28.73%. A study in Ethiopia by Melese, Badi, & Aynalem, (2019) found that 12.5% of LBW neonates born of severe preeclamptic women had birth asphyxia. Another study in Jordan by (Khader Y. et al., 2018) found that birth asphyxia was more common among the neonates born of women with preeclampsia. These findings show that neonates born of women with preeclampsia have heightened risk of birth asphyxia due to a reduction in the uteroplacental blood supply emanating from placental ischemia due to the increased blood pressure (Barker et al., 2007). However, our findings are contrary to previous findings that preeclampsia is a protective factor against birth asphyxia and respiratory distress syndrome (RDS) among the late preterm deliveries promoting the belief that fetal lung maturation is quickened by maternal preeclampsia (Lin et al., 2021). The heightened fetal lung maturation increases the levels of surfactant factor production that assist in adequate respiration by the neonate soon at birth.

Furthermore, 21% of the LBW neonates born of PET women at MTRH had neonatal jaundice, 7.9% had hypothermia and 0.68% presented with neonatal sepsis. Boskabadi H. et al., (2020) at a study in Iran found that the prevalence of jaundice among LBW neonates was at 30.9%. Similarly, Mitao et al., (2016) did a study in Tanzania and established that LBW neonates had 3 fold more chances of developing jaundice compared to neonates with normal weight . Additionally, an analogous study done in KNH; Kenya by Ndwiga et al., (2020) found that neonates delivered to women with PET were more probable to experience jaundice. This could be due the under nutrition

to the fetus owing to the uteroplacental insufficiency related to the preeclamptic toxaemia.

The study revealed that the fate of LBW neonates within 24 hours of birth was as follows: 29.53% of the LBW neonates were alive rooming in with their mothers, 59.18% were admitted to NBU while 11.29% of the neonates died. The findings are comparable to a study done in Jamaica by McKenzie & Trotman, (2019) that established that 60% of the LBW neonates born of women with preeclampsia were admitted to neonatal unit, 24.2% were alive rooming in with their mothers whereas 15.8% had died within 24 hours of birth. The high rates of admissions to the newborn units in both studies were due to the morbidities and very low birth weight that made the neonates require close monitoring.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1: Introduction

This chapter presents the conclusions and recommendations drawn from the study findings with reference to the study objectives. It also states the limitations encountered during the period of the study.

6.2: Conclusion

Arising from the study findings, the following conclusions are drawn: The prevalence of LBW neonates among women with preeclampsia at MTRH, remains higher than the national (8%) and was influenced by several determinants notably preterm gestation at birth, lack of ANC attendance, HELLP syndrome, maternal age and twin gestation which resulted to adverse neonatal birth outcomes like birth asphyxia, neonatal jaundice and hypothermia.

6.3: Recommendations

The following recommendations are made from the study findings:

1. Practice recommendations:
    a. The MTRH mother and Riley management to create awareness to the women with preeclampsia having twin pregnancies and other high risk cases on signs and early diagnosis, prenatal care and management to prevent severe forms and negative birth outcomes.
    b. Midwives should offer strict management of preeclamptic women using available guidelines to prevent complications such as HELLP syndrome and prepare women with PET for adverse outcomes of the newborn.

c. Newborn units should be well equipped with equipment and personnel to handle neonatal comorbidities soon as neonates are delivered.

2. Policy recommendations:
    a) Inform community-based policy makers to emphasize on socio-economical practices among vulnerable women.
3. Future research:
    a. Comparative studies to be done to investigate whether there are some differences in maternal determinants between PET women delivering LBW neonates and those giving birth to normal weight neonates and compare the neonatal outcomes.

6.4: Study Limitations

The maternal determinants were self-reported by the women thus might have a recall bias. However, to minimize the recall bias, clarity was sought by checking on the mothers' ANC card. Additionally, the study was done in a single national and referral hospital that admits referral women with both normal and high-risk pregnancies from verse counties, therefore the findings may not be representative of all hospitals in Kenya.

In spite of these limitations, crucial insights on maternal factors associated with LBW in neonates born of women with preeclampsia are provided which may inform policy makers in their quest to reduce the incidence of LBW in Kenya.

6.5: Summary

Conclusions, recommendations and limitations of the study have been presented in this chapter.

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APPENDICES

Appendix 1: Questionnaire

Study serial number: …….

Date: …….

SOCIO- DEMOGRAPHIC DATA

1. What is your age? (complete in years)_____
2. What is your marital status? Tick (×) in the boxes provided appropriately
   a) Single ☐
   b) Married ☐
   c) Widowed ☐
   d) Separated/Divorced ☐
3. What is the highest level of education attended? Tick (×) in the boxes provided appropriately
   a) None ☐
   b) Primary ☐
   c) Secondary ☐
   d) Tertiary ☐
4. What is your occupation? Tick (×) in the boxes provided appropriately
   a) Unemployed ☐
   b) Gainful self employment ☐
   c) Student ☐
   d) Salaried employment ☐
   e) Other_____
5. How many members are in your household? _____
6. How much (in shillings) is your household monthly income?
   _____
7. What is your household monthly expenditure (in shillings)?
   _____
8. Pre- pregnancy weight (kgs) _____
9. Height (cm) _____
10. Body Mass Index (kg/m^2)_____

SUBSTANCE USE

11. Is there any history of using the following substances? Tick (×) in the boxes provided appropriately

1. Alcohol YES ☐ NO ☐
2. Cigarettes YES ☐ NO ☐
3. Miraa YES ☐ NO ☐
4. Other substance use (specify)_____

If yes, for how long have you used the substance? _____

OBSTETRIC PARAMETERS AND PRACTICES

12. How many children do you have? Tick (×) in the boxes provided appropriately
    a. One ☐
    b. Two ☐
    c. Three ☐
    d. Four ☐
    e. Other, specify _____
13. Do you have previous history of still birth or early (within 7 days of birth) neonatal death? Tick (×) in the boxes provided appropriately
    a) YES ☐
    b) NO ☐
14. What is the birth order of the current/latest pregnancy? Tick (×) in the boxes provided appropriately
    a) First ☐
    b) Second ☐
    c) Third ☐
    d) Fourth ☐
    e) Other _____
15. What was the gestation of the current delivery? _____
16. Did you attend antenatal clinic? Tick (×) in the boxes provided appropriately
    a) YES ☐
    b) NO ☐

If yes, how many antenatal clinic visits did you attend?

i. One ☐
ii. Two ☐
iii. Three ☐
iv. Four ☐
v. Other_____

17. Have you ever had preeclampsia in the previous pregnancies? Tick (×) in the boxes provided appropriately
    a) YES ☐
    b) NO ☐
18. At what gestation (in weeks) were you diagnosed with pre-eclampsia in the current pregnancy? _____
19. Have you been in any high blood pressure treatment? Tick (×) in the boxes provided appropriately
    a. YES ☐
    b. NO ☐

    If yes, when did you start taking high blood pressure treatment (gestation in weeks)? _____
20. Is there any family history of high blood pressure? Tick (×) in the boxes provided appropriately
    a) YES ☐
    b) NO ☐
21. Was the current pregnancy complicated by the following conditions? Tick (×) in the boxes provided appropriately
    a) Blood Hemolysis YES ☐ NO ☐
    b) Elevated liver enzymes YES ☐ NO ☐
    c) Low platelet count YES ☐ NO ☐
22. Are you suffering from any of the following conditions? Tick (×) all that apply
    a) Diabetes ☐
    b) HIV/AIDS ☐
    c) Asthma ☐
    d) Tuberculosis ☐
    e) Others_____

LABORATORY INVESTIGATIONS

23. Protein in urine during delivery
    a) Detected ☐
    b) Not detected ☐
24. Blood Pressure at birth
- Systolic _____
- Diastolic _____

NEONATAL CHARACTERISTICS

25. Mode of delivery. Tick (×) in the boxes provided appropriately
    a) SVD ☐
    b) SBD ☐
    c) AVD ☐
    d) Emergency C/S ☐
    e) Elective C/S ☐
26. Birth weight in grams_____
27. APGAR score
    i. At one minute_____
    ii. At five minutes_____
    iii. At ten minutes_____
28. Neonatal morbidity. (tick (×) all that applies)
    a) Birth asphyxia ☐
    b) Jaundice ☐
    c) Neonatal sepsis ☐
    d) Hypothermia ☐
    e) Others _____
29. Neonatal outcome (tick (×) in the boxes provided appropriately)
    a) Alive: YES ☐ NO ☐
    b) Still birth: FSB ☐ MSB ☐
30. Death within two hours of birth. Tick (×) in the boxes provided appropriately
    a. YES ☐ NO ☐
    If yes, Specify cause of death_____
    b. Survival (alive with the mother) ☐
    c. Survival (alive but admitted to NBU) ☐

31. Was the neonate resuscitated? Tick (×) in the boxes provided appropriately
    a) YES ☐
    b) NO ☐
32. Does the neonate have congenital malformations? Tick (×) in the boxes provided appropriately
    a) YES ☐
    b) NO ☐

    If yes, specify_____

Thank you for participation.

Appendix II: Consent Form in English

STUDY TITTLE: Low Birth Weight Neonates among Pre-Eclamptic Women Birthing at Moi Teaching and Referral Hospital, Eldoret.

Serial Number: ……. **Study Number**: ……

Dear Participant/ Guardian,

My name is Lina Sigei. I am pursuing masters of Science Nursing Maternal and Neonatal Health at the school of Nursing in Moi University. I am doing a research to find out the Prevalence and Determinants of Pre-eclampsia Women Delivering Low Birth Weight Neonates and describe immediate birth outcomes of LBW neonates born of the preeclampsia women at MTRH.

I would like to include you as a participant so that I can use your data and research findings for the purpose of creating awareness in the hospital and community about LBW among pre-eclampsia women and contribute in formulating interventions to improve management of women with preeclampsia thus enhancing giving birth to normal weight neonates. No name is required and the information gathered shall be used only for the purpose of the study. This will require that I administer you a questionnaire and examine your infant at birth. The investigation is not harmful to you and your child.

Participation in this study is voluntary and your decision on whether to participate or not will not prejudice you or your child's care in any way. Strict confidentiality will be observed at all times. Moreover, there will be no added costs. I hope that you accept to take part in this study. Thank you.

Participant's Consent

I, being a person aged 18 years and over, have read/ been explained to the purpose and processes involved in this study and hereby accept to participate. I understand that my participation is voluntary and I have the right to withdraw from the research at any time, for any reason without penalty or harm.

Signature: …….. Date: …….

Parent's/ Guardian's Consent

I have read/ been explained to the purpose and processes involved in this study and hereby give consent for my child to participate in this study. I understand that the participation is voluntary and my child has the right to withdraw from the research at any time, for any reason without penalty or harm.

Signature: …….. Date: …….

Relationship to the adolescent if not the parent ……..

Adolescent's signature if above 14 years (assent): ……. Date: …….

Witness

Signature: ……Name: ……..…… Date: ……

TAFSIRI: IDHINI YA KUSHIRIKI UTAFITI KWA LUGHA YA KISWAHILI

IDHINI FOMU: ……

Nakuomba Mhusuika,

Jina langu ni Lina Sigei. Ninasoma shahada ya uzamili kama muuguzi katika idara ya akina mama na watoto katika chuo Kikuu cha Moi.

Ninafanya utafiti juu ya maambukizi, vipimo na matokeo ya watoto wa kilo ya chini inayopatikana kwa akina mama wenye ugojwa wa pre-eclampsia. Utafiti huu utatusaidia kuboresha huduma kwa akina mama na watoto wanaoathirika.

Ningependelea uwe mshiriki. Utahitajika kujibu maswali wa kadha na pia mtoto kufanyiwa uchunguzi wa kimwili punde anapozaliwa. Uchunguzi huu hauna madhara yoyote kwako na kwa mtoto wako. Usiri utatunzwa wakati wowote. Ushiriki wako kwa utafiti huu ni kwa hiari na uamuzi wako. Wewe unaruhusa kukataa kujibu maswali ama kutojihusisha na utafiti huu wakati wowote. Uamuzi wako kushiriki au kutoshiriki uatafiti huu hautaathiri huduma kwako au kwa mtoto wako kwa njia yeyote.

Ninaomba idhini yako ya kushiriki.

Asante.

RUHUSA YA MSHIRIKA

Mimi nimeelewa maelezo ya utafiti huu na ninakubali kushiriki.

Sahihi: …… Tarehe: ……

RUHUSA YA MZAZI

Mimi nimeelewa maelezo ya utafiti huu na ninakubali motto wangu kushiriki.

Sahihi: …… Tarehe: ……

MSHUHUDIA

Sahihi: …… Jina: …….Tarehe: ……

Appendix III: IREC Approval

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471//2/3

MOI UNIVERSITY
COLLEGE OF HEALTH SCIENCES
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2020/245
Approval Number: 0003815
11th March, 2021

Lina Chepngeno Sigei ,
Moi University,
School of Nursing,
P.O. Box 4606-30100,
ELDORET-KENYA

Dear Ms. Sigei,

LOW BIRTH WEIGHT NEONATES AMONG PRE-ECLAMPTIC WOMEN BIRTHING AT MOI TEACHING AND REFERRAL HOSPITAL, ELDORET

This is to inform you that ***MTRH/MU-IREC*** has reviewed and approved your above research proposal. Your application approval number is ***FAN: 0003815.*** The approval period is **11th March, *2021 – 10th March, 2022.***

This approval is subject to compliance with the following requirements;

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

Prior to commencing your study; you will be required to obtain a research license from the National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and other relevant clearances. Further, a written approval from the CEO-MTRH is mandatory for studies to be undertaken within the jurisdiction of Moi Teaching & Referral Hospital (MTRH), which includes 22 Counties in the Western half of Kenya.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
11 MAR 2021
APPROVED
P. O. Box 4606 - 30100 ELDORET

Sincerely,

DR. S. NYABERA
DEPUTY-CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc	CEO	-	MTRH		Dean	-	SOP		Dean	-	SOM
	Principal	-	CHS		Dean	-	SON		Dean	-	SOD

Appendix IV: Hospital Approval from Moi Teaching and Referral Hospital (MTRH)

An ISO 9001:2015 Certified Hospital

MOI TEACHING AND REFERRAL HOSPITAL

Telephone :(+254)053-2033471/2/3/4
Mobile: 722-201277/0722-209795/0734-600461/0734-683361
Fax: 053-2061749
Email: ceo@mtrh.go.ke/directorsofficemtrh@gmail.com

Nandi Road
P.O. Box 3 – 30100
ELDORET, KENYA

Ref: ELD/MTRH/R&P/10/2/V.2/2010

12th March, 2021

Linah Chepngeno Sigei,
Moi University,
School of Nursing,
P.O .Box 4606-30100,
ELDORET -KENYA.

LOW BIRTH WEIGHT NEONATES AMONG PRE-ECLAMPTIC WOMEN BIRTHING AT MOI TEACHING AND REFERRAL HOSPITAL, ELDORET

In order to conduct research within the jurisdiction of Moi Teaching and Referral Hospital (MTRH) this includes 22 counties in the Western half of Kenya. You are required to strictly adhere to the regulations stated below in order to safeguard the safety and well-being of staff and patients seen at MTRH involved research studies.

1. The study shall be under Moi Teaching and Referral Hospital regulation.
2. A copy of MU/MTRH-IREC approval shall be provided.
3. Studies dealing with collection, storage and transportation of Human Biological Material (HBM) will not be allowed to export the HBM outside the jurisdiction of **MTRH.**
4. For those tests which are unavailable locally the PI is tasked to ensure sourcing of equipment and subsequent training of staff to build their capacity.
5. No data collection will be allowed without an approved consent form(s) to participants to sign.
6. Take note that **data** collected must be treated with due confidentiality and anonymity.

Permission to conduct research shall only be provided once all the requirements stated above have been met

12/03/2021

DR. WILSON K. ARUASA, *EBS*
CHIEF EXECUTIVE OFFICER
MOI TEACHING AND REFERRAL HOSPITAL

CHIEF EXECUTIVE OFFICER
12 MAR 2021
MOI TEACHING & REFERRAL HOSPITAL

c.c. - Senior Director, Clinical Services
- Director of Nursing Services
- HOD, HRISM

Appendix V: Approval from National Commission for Science Technology and Innovation (NACOSTI)

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 492974

Date of Issue: 06/April/2021

RESEARCH LICENSE

This is to Certify that Ms.. LINA CHEPNGENO SIGEI of Moi University, has been licensed to conduct research in Uasin-Gishu on the topic: LOW BIRTH WEIGHT NEONATES AMONG PRE-ECLAMPTIC WOMEN BIRTHING AT MOI TEACHING AND REFERRAL HOSPITAL, ELDORET, for the period ending : 06/April/2022.

License No: NACOSTI/P/21/9797

492974

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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

Appendix VI: Time lines

	July 2020	**Aug 2020**	**Sept 2020**	**Oct 2020**	**Nov 2020**	**Dec 2020**	**Jan-June 2021**	**July 2021**	**Aug-Sep 2021**	**Oct-Nov 2021**	**Dec 2021**
Developing proposal(introduction, literature review and methodology)											
Presenting proposal to supervisors											
Developing data collection tools											
Proposal submission to IREC											
Piloting data collection tools											
Finalization of data collection tools											
Data collection											
Data entry, coding and cleaning											
Interim analysis											
Final analysis											
Thesis write up(results, discussion)											
Notice of intent to submit											
Mock defense											
Submission of thesis for Examination											
Thesis defense											
Graduation											

Appendix VII: Budget

Project Name: Low Birth Weight Neonates among Pre-Eclamptic Women Birthing at Moi Teaching and Referral Hospital, Eldoret.

Project Period: 1st January 2021 to 30th December 2021.

Items	**quantity**	**Unit price (KSH)**	**Total (KSH)**	
Stationary and equipment				
Laptop	1	56,400.00	56,400.00	
Photocopy papers	10 reams	600.00	6000.00	
Writing pens	5 packets	630.00	3150.00	
Note books	8	130.00	1040.00	
Pocket files	2	100.00	200.00	
Writing Pencils	10	10.00	100.00	
Flash disk	2	1000.00	2000.00	
erasers	6	15.00	90.00	
Stapler	1	400.00	400.00	
staples	1 packet	200.00	200.00	
Printing papers	5 reams	550.00	2500.00	
Research Proposal Development				
Printing draft proposal	300	20.00	6000.00	
Photocopying draft proposal	300	3.00	900.00	
Printing final proposal	7 copies	450.00	3150.00	
Binding final proposal	7 copies	150.00	1050.00	
Personnel				
Biostatistician	1	30000.00	30000.00	
Research Assistants	4	3000.00	12000.00	
Thesis development				
Printing draft thesis	1500	20.00	30000.00	
Photocopying draft thesis	1500	3.00	4500.00	
Binding (hard cover)	7 copies	450.00	3150.00	
Printing questionnaires	4 pages	20.00	80.00	
Photocopying questionnaires	4 ×384 files	3.00	4620.00	
Regulatory bodies				
IREC	1	2000.00	2000.00	
NACOSTI	1	1000.00	1000.00	
Communication				
Phone, internet and email	30 hours	500.00	15000.00	
Dissemination of information	1	25000.00	25000.00	
Consultancy (Biostatistician)	1	5000.00	5000.00	
Miscellaneous(10% of total)	1		21553.00	
TOTAL			**237,083.00**	

Appendix VIII: Plagiarism Certificate

SR073

EDU 999 THESIS WRITING COURSE

PLAGIARISM AWARENESS CERTIFICATE

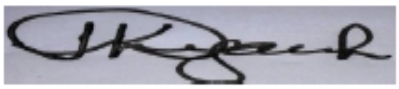
This certificate is awarded to

SIGEI CHEPNGENO LINA

SN/PGMNH/01/18

In recognition for passing the University's plagiarism awareness test with a similarity index of 4 % and striving to maintain academic integrity

Awarded by:



Prof. John Changách, CERM-ESA Project Leader

Date: 27/05/2022