# PERINATAL MORTALITY IN MOTHERS WITH HYPERTENSION IN PREGNANCY ADMITTED AT PUMWANI MATERNITY HOSPITAL, NAIROBI COUNTY, KENYA.

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**Bachelor of Medicine and Surgery (M.B.ch.B)**

**A Thesis Submitted in Partial Fulfilment of the Requirements of the Degree of Master of Public Health (MPH) of the Department of Epidemiology, School of Public Health, Moi University**

**2015**

**Declaration**

This research is my original work and has not been previously presented for a degree in any university or for the purposes of examination. No part of this thesis may be reproduced without the prior permission of the author and /or Moi University.

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**Dedication**

This study is dedicated to women of the less and least developed countries especially the urban poor who form a special reproductive health group with special needs and women who leave their delivery beds with unfavourable perinatal outcomes. Their agony and psychological distress is the price they pay for living in a part of the world they did not choose.

## ABSTRACT

**Title: Perinatal mortality in women with hypertension in pregnancy admitted at Pumwani Maternity Hospital (PMH), Nairobi, Kenya.**

**Background:** Hypertension is the most common medical complication in pregnancy and complicates 6-9% of pregnancies globally. It is associated with an increased risk of maternal and perinatal morbidity and mortality. **Research question:** What are the determinants of perinatal morbidity and mortality among women admitted with hypertension in pregnancy at PMH? **Objectives**: To document perinatal morbidity and mortality in women with hypertension in pregnancy (HIP) and determine risk factors for adverse perinatal outcomes in these women**. Methods**: This was a descriptive cross-sectional study carried out in PMH on women with HIP. Ethical approval was granted from MOI-MTRH IREC and permission granted by the Hospital Research Board. One hundred and fifty seven (157) women were consecutively recruited between November 2011 and May 2012. Data was collected using a structured data abstraction form. The perinatal outcome was recorded during a scheduled postnatal visit, a home visit or through a follow-up phone call to the women. Data was analyzed using IBM SPSS V 19.0. Descriptive statistics were means and frequencies. A Chi-square test was performed on categorical variables and univariate logistic regression performed for continuous variables. A regression model was then developed to identify factors predictive of the perinatal outcomes. A p-value of $< 0.05$ was significant. **Results**: The perinatal mortality rate in women with hypertension in pregnancy was 203 per 1000 births. The incidence of hypertension in pregnancy was 287 per 10000 pregnancies. Half (74) of the neonates were born premature and 71 (47.97%) had low birth weight (weight <2500g). Small for gestational age (SGA) was prevalent in 58 (39.19%). Pre-eclampsia 74 (50.02%) and unclassified hypertension (38.5%) were the most prevalent hypertensive states. Women who were married or had attained post-primary education had better perinatal outcomes, (p values <0.05). A low fifth-minute APGAR score, prematurity at the time of birth, low birth weight, exposure to magnesium sulphate, severe maternal hypertension, presence of labour at admission, pre-eclampsia, proteinuria of more than 2+ on dipstick, a previous pregnancy loss and high parity were associated with increased risk of perinatal mortality, (P values $< 0.05$). **Conclusion/Recommendations**: Hypertension in pregnancy is associated with a high perinatal mortality rate. It is associated with a high rate of prematurity, birth asphyxia and small for gestational age. A low fifth-minute APGAR score, prematurity at time of birth, low birth weight, magnesium sulphate exposure, severe maternal hypertension, presence of labour at admission, pre-eclampsia, dipstick proteinuria >2+, previous pregnancy loss and high parity were identified as risk factors for perinatal mortality. Timely management of pre-term labour followed by appropriate care of premature neonates, proper monitoring during labour and the timely management of severe HIP in PMH are recommended. Clinicians need training on materno-fetal surveillance and timely use of corticosteroids in women with HIP. Studies to evaluate the effect of appropriate use of $MgSO_4$ and the effect of fetal exposure on the perinatal outcome are recommended.

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**List of Abbreviations**

| | |
|---|---|
| ANC | Antenatal Clinic |
| DIC | Disseminated Intravascular Coagulation |
| HELLP | Haemolysis Elevated liver enzymes, Low platelets |
| HIP | Hypertension In Pregnancy |
| HIV | Human Immunodeficiency Virus |
| ICU | Intensive Care Unit |
| IREC | Institutional Research and Ethics Committee |
| IUGR | Intra Uterine Growth Restriction |
| JNC | Joint National Committee |
| KDHS | Kenya Demographic and Health Survey |
| NCAPD | National Coordinating Agency for Population and Development |
| NHBPCG | National High Blood Pressure Education Working Group |
| PMTCT | Prevention of Mother To Child Transmission |
| SGA | Small for Gestational age |
| SOGC | Society of Obstetricians and Gynecologists of Canada |
| SPSS | Statistical Packages For Social Scientist |
| PND | Perinatal Death |
| $MgSO_4$ | Magnesium Sulphate |
| PMH | Pumwani Maternity Hospital |
| GA | Gestational Age |
| END | Early Neonatal Death |
| MU-MTRH IREC | Moi University- Moi Teaching & Referral Hospital Ethics and Review Committee |
| WHO | World Health Organisation |
| FSB | Fresh Stillbirth |
| MSB | Macerated Stillbirth |

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**Operational Terms**

Perinatal period was the period from 28 weeks of pregnancy and up to the end of the first six days after delivery

Perinatal death was defined as any baby born after 28 weeks of gestation either as a still birth or born alive but died within the first 6 days after delivery.

A survival was defined as any baby born after 28 weeks of gestation and survived the first six complete days of life

Pre-eclampsia referred to new onset hypertension and proteinuria after 20 weeks of gestation in a previously normotensive woman.

Mild hypertension was defined as HIP which did not fit the criteria for severe hypertension

Severe hypertension was defined as new onset proteinuric hypertension or non proteinutic hypertension and at least one of the following: Blurred vision, scotomata, altered mental status, severe headache, right upper quadrant or epigastric pain and nausea, vomiting, severe blood pressure i.e. systolic blood pressure 160 mm Hg or diastolic 110 mm Hg on two occasions at least six hours apart, thrombocytopenia: Less than 100,000 platelets per cubic millimeter, proteinuria of 5 or more grams in 24 hours, oliguria, severe fetal growth restriction, pulmonary edema or cyanosis, cerebrovascular accident

Eclampsia was defined as the development of grand mal seizures or coma in a woman with gestational hypertension or preeclampsia in the absence of any other attributable cause of seizures.

Early neonatal death was defined as death occurring within the first 6 days of life

Birth asphyxia was defined as an Apgar score less than 7 at 5 minutes after birth with cardio respiratory and neurological depression

HELLP syndrome was defined as a clinical entity of preeclampsia associated with Haemolysis, Elevated Liver Enzymes and Low Platelets

Preterm delivery was defined as a delivery below 37 completed weeks of pregnancy

A fresh stillbirth was defined as the intrauterine death of a fetus during labor or delivery,

A macerated stillbirth was defined as the intrauterine death of a fetus sometime before the onset of labor, where the fetus showed degenerative changes.

# 1.0 CHAPTER 1: INTRODUCTION

## 1.1 Background Information

Pregnancy losses occurring after twenty eight (28) completed weeks of gestation (stillbirths) plus deaths of live births within the first seven days of life (early neonatal deaths) constitute perinatal deaths, (MacDorman, 2012). Perinatal mortality is an important indicator of obstetric care, health status and socio-economic development, (Yu V., 2003). Perinatal mortality rates are highest in developing countries, particularly in Africa, (WHO., 2006). Several studies conducted in Kenya have documented perinatal mortality rates between 33 - 118 deaths per 1000 births, (KDHS 2003, KDHS 2008-9; Kavoo, 1992; Weiner, 2003). Several approaches have been developed to reduce perinatal deaths, ranging from the risk-based approaches in the 1980s through screening and risk classification of pregnancies based on maternal characteristics to the skilled attendant approaches delivered through safe motherhood projects in the 1990s, (Backet, 1984, Starrs, 1997). Although remarkable improvement has been reported in maternal and fetal care due to these interventions huge disparities exist between women experiencing medical complications and those without during pregnancy because most of the emergencies associated with these conditions are not predictable, (Mohammad, 2011). There are widespread disparities in the implementation of these global initiatives resulting to differences in the quality of care due to limited access to health care facilities, rudimentary transport systems for referral, limited staff capacity building and limited budgetary support to safe motherhood initiatives, (Islam, 2007). The medical complication of pregnancy alone may not explain the high perinatal mortality in these women. One of the main medical complications in pregnancy is hypertension.

Hypertensive disorders of pregnancy complicate 6-15% of pregnancies globally and are associated with increased risks of perinatal morbidity and mortality, (Xiong X., 2007, Roberts C.L., 2005), and contributes 9-25% of maternal mortality, (Andersgaard A. B., 2006). Studies have documented that pregnancies complicated with HIP are associated with 3 times risk of perinatal death compared to normo-tensive pregnancies, (Mamun, et al, 2006, Anath C., 2010, Gezehagn et al, 2014). Studies conducted in Kenya on hypertensive disorders of pregnancy report prevalence rates of HIP ranging from 1.5% to 11%, (Mati, 1982). Hypertensive disease in pregnancy was also found to be the leading cause of complications in pregnancy in a Nairobi survey, (Mati, 1982). While four distinct classes of hypertensive disorders have been described by the National High Blood Pressure Education Working Group, (NHBPCG, 2000), the cause of hypertension in pregnancy still remains elusive. There is hope that continued research regarding screening, improved diagnosis, and management will alleviate the burden HIP contributes to overall perinatal morbidity and mortality.

Further, studies in women with hypertension during pregnancy document higher rates of prematurity and low birth-weight compared to healthy maternal controls, (Ananth C., 1995, Gaugler-Senden I., 2006). The specialized neonatal care that is required for such babies is associated with emotional and financial stress for the parents, third party payers and is associated with long-term infant developmental consequences, (Markestad T., 1997). The quality of early neonatal care may also be a key determinant to the prevention of perinatal deaths. A study by Opondo, et al, (2009) found that clinicians in eight referral hospitals in Kenya were not prepared to support a newborn survival because structural components for providing newborn care were often unavailable. This lack of preparedness and absence of management guidelines

for early neonatal care may explain why perinatal mortality is higher in HIP which is associated with a higher risk of preterm delivery, (Ayaya, 2001).

Primary prevention and early identification of HIP may be viewed as the best interventions to reduce the perinatal complications associated with it. This is because studies in developing and transitional countries have shown positive effects of reduction of pre-term labour, low birth-weight and perinatal death through antenatal care, (Kapoor S.K., 1985). There is evidence that majority of pregnant women in Kenya have access to ANC, with ranges between 76% to 92% between different surveys, (KDHS, 2008-9). However, a tendency towards 'late' attendance for the first ANC and concerns over the specific quality or content of the ANC provided in Sub-Saharan Africa have been raised. The contribution made by delays in decision-making and poor quality of care at the health facility cannot be understated, (Maine, 1994; McCarthy, 1992). Limited access to acceptable management guidelines by clinicians coupled with poor implementation and clinical variation in using internationally accepted management protocols to manage HIP may account for the high perinatal mortality rate and morbidity associated with HIP, (Davis et al, 2002). Finally, maternal pre-conceptual characteristics may also play a vital role in predicting the outcome of pregnancy in women with HIP. Studies have documented that early neonatal outcomes are determined by nutrition, lifestyle and socio-economic status of mothers, (Thompson, 1999).

### 1.2 Problem Statement

Perinatal mortality remains a big challenge in the care of pregnant women worldwide, particularly in low-resource settings, (Jelka Z., 2005). Each year, 8 million perinatal deaths occur throughout the globe; 98% of them in developing countries, (Yu V.,

2003). There is however paucity of data pertaining to characteristics of these perinatal deaths; most of the current data is collected retrospectively and through maternal surveys and most deaths may be unreported due to cultural reasons.

Kenya has a high perinatal mortality rate of 37 deaths per 1,000 pregnancies (KDHS, 2008-9), a marginal decline from the 40 deaths per 1,000 births recorded in the KDHS of 2003. This high perinatal rate calls for urgent studies to evaluate the results of delivery of interventions during the prenatal, natal and postnatal period.

National vital statistics do not reveal what contribution high-risk pregnancies such as those complicated with HIP make to overall perinatal and neonatal death rate as part of total births and live births. Nairobi, headquarter of health administration, had the high perinatal mortality rate in the latest demographic health survey at 66 death per 1000 births and thus of major public health importance, (KDHS, 2008/9).

The global increase in the rates of hypertension in pregnancy over the last decade and the paucity of data regarding the extent of perinatal morbidity and mortality resulting from hypertensive disorders of pregnancy especially in developing countries, (Wallis A.B., 2008) underscores the importance of studies on this subject area. There is also an urgent need to study how sector wide safe motherhood program interventions have impacted the management of pregnancies complicated by hypertension and other high-risk conditions.

### 1.3 Justification of the Study

Improved neonatal and maternal care has been on the global agenda and clearly set targets were defined in the fourth United Nations Millennium Development Goal (MDG, 4). This study prioritizes the fetal/neonatal outcome of pregnancies complicated by HIP.

The global increase in the number of women with hypertension in pregnancy raises an immediate need to assess the impact of this main medical complication of pregnancy on perinatal health. This is even more relevant in low and middle income countries within which most perinatal deaths occur and is in line to a Call to Action to reduce the stillbirth rate to less than 5 per 1000 births by 2020 for all countries and in high-income countries, to eliminate all preventable stillbirths. This study was based in Kenya, a low-income country.

No studies have been done to identify specific factors associated with adverse perinatal outcomes for each of the different complications of pregnancy in comparison with uncomplicated pregnancies. Where such attempts have been made, the factors identified were basic and broad-based and not specific to a particular condition. It is assumed that risk factors for poor perinatal outcomes are the same for all women. This study was meant to identify whether there are unique risk factors for adverse perinatal outcomes in the group of women with HIP. The identified risk factors will provide an opportunity for scientists to conduct further studies to develop priority action areas which will serve as important planning tools for managing women with HIP in developing countries.

Pumwani Maternity Hospital where the study was carried out was most suitable to host such a study as it is the sole referral maternity hospital in Nairobi City and has a diverse population representing multi-cultural groups due to its wide catchment and records a large number of mothers with hypertensive disease in pregnancy. The catchment area served by the hospital represents both the urban poor and lower middle class who have the highest burden of perinatal morbidity and mortality.

Most studies on HIP have not been powered to identify the effect of HIP on perinatal outcomes in the post delivery period and instead have focused on maternal and fetal

mortality. This study was developed to focus on the entire perinatal period. Collecting information related to the perinatal outcome in prospect in this study was aimed at reducing the risk of under-reported perinatal death, early neonatal complications and other adverse perinatal events and eliminated bias associated with collecting information about perinatal outcomes in retrospect.

### 1.4 Research questions

i. What is the magnitude of perinatal morbidity and mortality among women admitted with hypertension in pregnancy in Pumwani Maternity Hospital?
ii. What are the risk factors of perinatal morbidity and mortality among women admitted with hypertension in pregnancy in Pumwani Maternity Hospital?

### 1.5 Research Objectives

#### 1.5.1Broad Objectives

i. To determine the distribution of perinatal outcomes in women with hypertension in pregnancy in Pumwani Maternity Hospital, Nairobi Kenya
ii. To identify risk factors associated with adverse perinatal outcomes in women with hypertension in pregnancy in Pumwani Maternity Hospital, Nairobi Kenya

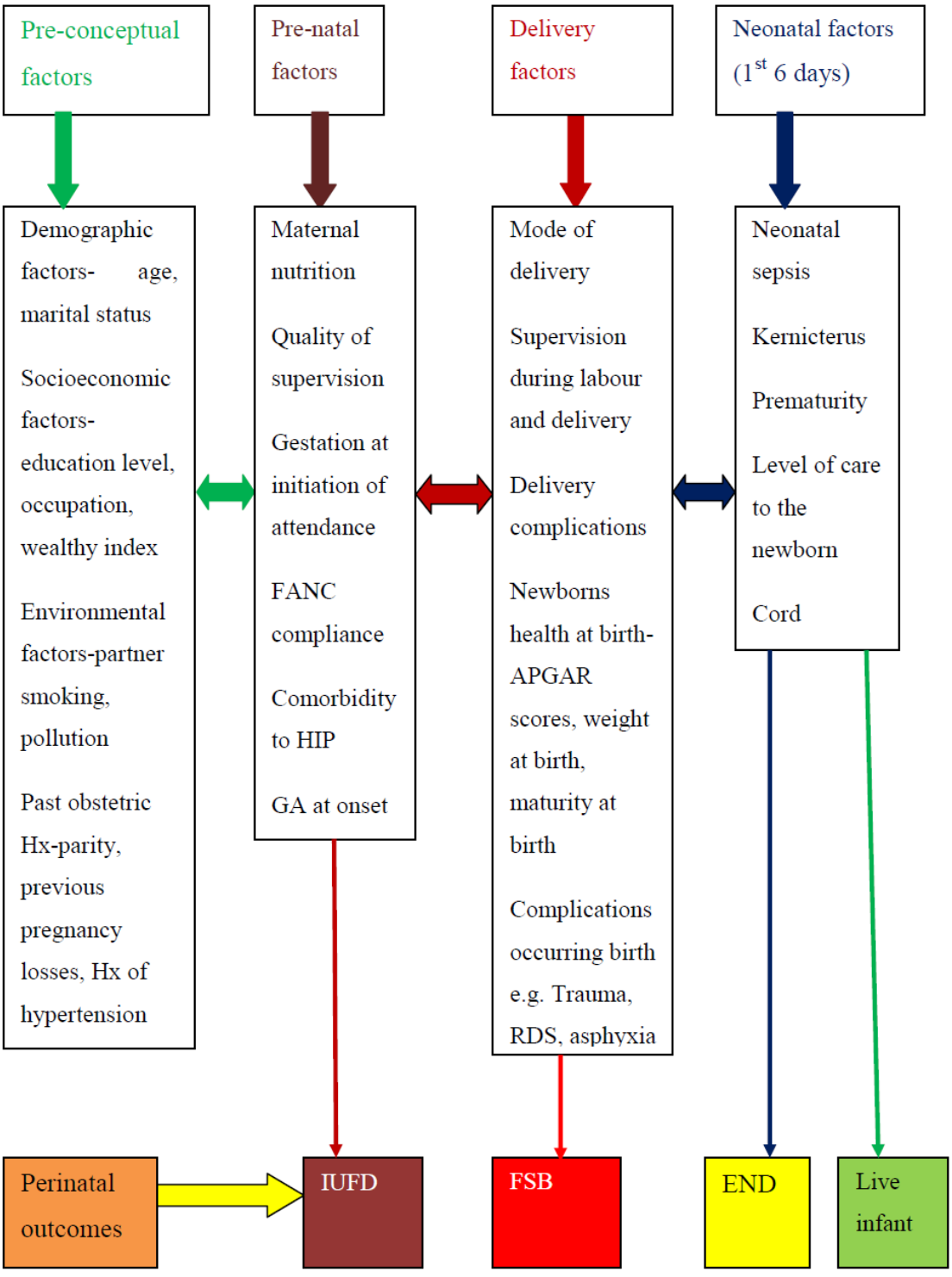
#### 1.5.2 Specific Objectives

i. To determine perinatal morbidity in women with hypertension in pregnancy in Pumwani Maternity Hospital, Nairobi Kenya

ii. To determine perinatal mortality in women with hypertension in pregnancy in Pumwani Maternity Hospital, Nairobi Kenya

iii. To describe the key predictive factors for the perinatal outcomes in women with hypertension in pregnancy

### 1.6 Conceptual framework of the study



Adapted from: Magadi, M., Madise & Diamond. (2001). Factors associated with unfavourable Birth Outcomes in Kenya. *In J. biosocial. Sci. 88*, 199-225

**1.7 Explanatory notes of the conceptual framework**

This study aimed to look at risk factors predictive of the perinatal outcome. These risk factors occurred before and during the current pregnancy, during delivery and related to the neonate and the care the neonate received in the first six days of live. Maternal factors considered before conception included level of education, marital status, employment status, tribe, past obstetric history and residence.

Factors occurring during pregnancy that would influence the perinatal outcome which were considered during the study were the hypertensive state and its characteristics, care given during pregnancy, drugs used during pregnancy and medical conditions that existed parallel to the hypertensive state.

Delivery related factors considered in the study included the labour process including the onset, mode of delivery, the gestation at which delivery occurred, the fetal weight at birth, presence of any congenital malformations, the APGAR score and any other complication occurring during delivery.

Factors which we considered to influence the outcome in the early neonatal period included the presence of any neonatal complications, neonatal weight, maturity and neonatal care factors up to the end of the sixth day

Outcomes were perinatal death, perinatal survival, premature birth, small for gestational age, birth asphyxia, need for resuscitation and prolonged stay in the neonatal intensive care unit.

## 2.0. CHAPTER 2: LITERATURE REVIEW

### 2.1. Introduction

The perinatal period covers the period leading up to birth after 28 weeks and the first week of life according to perinatal death definition 1, preferred for international and state-specific comparisons (Macdoman M.F, 2012). Perinatal mortality is the sum of stillbirths and neonatal deaths before seven days per 1000 total births. Deaths occurring during the first week of life are termed as early neonatal deaths. A death of the fetus that occurs prior to expulsion or extraction from the mother after 28 weeks is termed as a still birth either as a fresh still birth or macerated still birth. Both early neonatal deaths and stillbirths constitute perinatal deaths, (Barfield W D, 2011). Perinatal deaths are largely due to obstetric causes, (WHO: Neonatal and Perinatal mortality: Country, Regional and Global estimates; 2006). For every baby who dies in the first week after birth, a fetus is born dead and in many societies, neonatal deaths and stillbirths are not perceived as a problem, largely because they are very common, (Zupan Jelka, 2005).

Globally, more than 3.3 million stillbirths and over 3 million early neonatal deaths are estimated to occur every year (Neonatal and Perinatal Mortality: Country, Regional and Global Estimates, WHO 2006). These 6.3 million perinatal deaths occur worldwide: almost all of them (98%) occur in developing countries and 27% in the least developed countries, (Zupan Jelka, 2005). In developing countries stillbirths represent half of perinatal deaths, while in developed countries, where interventions have largely eliminated excess early neonatal mortality, over 6 out of 10 perinatal deaths are stillbirths**,** (The European Perinatal Health Report, 2004). Improved maternity services in the community are regarded as a key to the delivery of

preventative and pro-active perinatal care (Martin, J., 2007). Perinatal deaths relate to poor accessibility to and low quality of health care services and therefore the importance of improved accessibility to quality basic and comprehensive emergency obstetrical care, (Hofmeyr G. J., 2009).

Neonatal deaths and stillbirths stem from poor maternal health, obstructed or prolonged labor, hypertensive diseases of pregnancy, syphilis and gram-negative infections, malaria in endemic areas, maternal under-nutrition, poor hygiene during delivery and immediately after birth, and lack of newborn care, (Mohammad Yawar Yakoob, 2010). Several factors such as women's status in society, early childbearing, too many closely spaced pregnancies and harmful practices, such as inadequate cord care, letting the baby stay wet and cold, discarding colostrum and feeding other foods are deeply rooted in the cultural fabric of societies and interact in ways that are not always clearly understood in influencing the outcome of birth, (Michael S. K., 2002).

## 2.2 Hypertension in pregnancy

### 2.2.1 Introduction

Hypertension in pregnancy is defined as a diastolic BP of 90 mmHg or more, based on the average of at least 2 measurements obtained when the patient is seated comfortably for at least 5 minutes with the back supported, feet on the floor, arm supported in the horizontal position, and the BP cuff at heart level, (Schocken D., 2011)

Hypertensive disease in pregnancy can be classified as chronic hypertension, pre eclampsia- eclampsia, preeclampsia superimposed on chronic hypertension and

gestational hypertension, (NHBPCG, 2000). The time since the onset of hypertension before or during pregnancy and when it disappears postpartum and proteinuria or its absence are the key elements used to classify hypertensive disorders. Due to late entry to antenatal clinic and limited postpartum follow-up, most cases of HIP are left without a definite classification and therefore labelled as unclassified hypertension.

Pregnancy induced hypertension is described as hypertension occurring after 20 weeks and disappearing in peurperium without proteinuria. Chronic hypertension denotes documented hypertension before conception or before twenty (20) weeks or that which persists after peurperium usually confirmed through a series of measurements of home and out of office blood pressure measurements, (JNC, 7). Preeclampsia/eclampsia is a syndrome characterized by the new onset of hypertension and proteinuria after 20 weeks of gestation. Severe pre eclampsia is proteinuric hypertension and at least one of blurred vision, scotomata, altered mental status, severe headache, right upper quadrant or epigastric pain, systolic blood pressure >160 mm Hg or diastolic >110 mm Hg on two occasions at least six hours apart, thrombocytopenia (<100,000 platelets/mm3), proteinuria (>5 g in 24 hours), oliguria, severe fetal growth restriction, pulmonary edema or cyanosis and cerebrovascular accident. Patients with proteinuria and hypertension that do not meet the criteria for severe pre eclampsia have mild pre eclampsia. Eclampsia is described as grand mal seizures or coma in a woman with gestational hypertension or preeclampsia in the absence of any other attributable cause after 20 weeks of pregnancy, (Mattar, et al 1990).

Hypertension in pregnancy is prevalent in 6 to 15% of all pregnancies. In a population study involving 255 931 women by Christie L et al, (2005) documented a prevalence

rate of 9.8%. Of these 0.6% had chronic hypertension, 4.2% had pre eclampsia, 0.3% had superimposed preeclampsia on chronic hypertension and 4.3% had pregnancy induced hypertension. According to Bolagoko O., et al (2010) chronic hypertension in Nigeria occurs in 4.6%, pre eclampsia/eclampsia in 39.8% and gestational hypertension in 55.6% of patients with hypertension disease in pregnancy. Studies in Kenya have documented prevalence of hypertension in pregnancy between 2-11%, (Mati J. K., 1983)

Hypertension in pregnancy is a bigger problem in developing countries because illiteracy, lack of health awareness, poverty and superstitious beliefs prevent women from seeking medical advice during pregnancy and is the third major cause of maternal death in Kenya, (NCAPD, 2010).

### 2.2.2 Clinical course of hypertension in pregnancy

The progression from mild to severe hypertensive disease then to eclampsia is a continuous process; patients with severe hypertension who remain untreated may develop eclampsia, (Gabbe, 2007). Other complications that can occur in hypertension in pregnancy are progressive renal failure, disseminated intravascular coagulation (DIC), microangiopathic hemolysis, and liver dysfunction. The clinical course of hypertension in pregnancy often leads to progressive deterioration of both mother and fetus.

### 2.2.3 Fetal effects of hypertension in pregnancy

Fetal manifestations of severe hypertension in pregnancy may occur with, precede, or occur in the absence of maternal manifestations, (von Dadelszen P., 2011). The fetal

syndrome consists of oligohydramnios (i.e., low amniotic fluid), intrauterine fetal growth restriction, abnormal blood flow of the umbilical artery (as measured by pulsatility index or resistance index), decreased resistance to flow in the fetal middle cerebral artery (reflecting redistribution of blood flow to the central nervous system), an abnormal waveform in the ductus venosus, and/or stillbirth.

### 2.2.4 Hypertension in pregnancy and prematurity

Aggressive management of women with hypertension in pregnancy with immediate delivery leads to high perinatal mortality and morbidity resulting from iatrogenic prematurity. Prematurity often occurs due to spontaneous labor or due to obstetric interruption of the pregnancy due to compromised maternal-fetal health. Hypertension in pregnancy contributes to 11.3 to 78.3% of pre-term births (births before 37 completed weeks) and accounts to 57% of the elected premature deliveries, (Kurkinen-Raty M., 2000). Elected deliveries are usually done through a caesarian delivery or through induction of labor. Premature neonates are prone to respiratory distress syndrome, asphyxia neonatorum, pneumothorax, pneumomediastinum, retinopathy of prematurity and intraventricuar haemorrhage. Perinatal mortality and morbidity rates are higher in mothers who get early delivery for maternal reasons. There are higher rates of caesarian delivery in HIP due to failed induction of labor due to poor cervical ripening, (Yücesoy G., 2005). Steroids administered between 24 and 34 weeks can reduce perinatal morbidity and mortality in those with severe hypertension, (Roberts D., 2006). In a clinical based audit in Tanzania, Hussein L Kidanto *et al* (2009) documented that preterm delivery and low birth weight were the major causes of perinatal mortality.

### 2.2.5 Hypertension in pregnancy, fetal growth restriction and intrauterine death

Attempts to prolong pregnancy with expectant management may result in fetal death, asphyxial damage in utero or intra uterine growth restriction (IUGR). Intrauterine growth restriction (IUGR) and asphyxia in HIP occur due to placental insufficiency and resultant erratic placental nutrient and oxygen transfer. Women with any hypertension in pregnancy are also 1.4 (95% CI 1.1–1.8) times more likely to have a stillbirth as compared with normotensive women due to placental insufficiency. IUGR occurs in around 30% of such pregnancies which is twice high compared to normotensive pregnancies, (Friedman, et al 1995). Hypertensive disorders in pregnancy have been associated with small-for-gestational-age infants, with risk differences of 5.1%, 3.5%, and 9.2% for chronic hypertension, pregnancy-induced hypertension, and eclampsia, respectively, (Allen V. M, 2004). Ultrasound assessment of fetal size can be used to assess fetal growth and growth restriction in utero, (Galan H. L., 2002). Severe growth-restricted fetuses are at increased risk of intrauterine death and those born alive have an increased risk of neonatal death and significant morbidity from hypoglycemia, hypocalcemia and polycythemia, (Kramer M. S., 1990)

### 2.2.6 Perinatal effects of proteinuria in hypertension in pregnancy

Proteinuria has usually been associated with increase in maternal and fetal mortality and morbidity, (Magee L.A., 2002). Proteinuria reflects plasma volume reduction and subclinical renal dysfunction. Predictive power of perinatal outcome using proteinuria has been unclear and several studies have suggested a central role of proteinuria either in the definition of severe preeclampsia or as a delivery indication, (von Dadelszen P.,

et al, 2011). Proteinuria alone may not solely predict the perinatal outcome. However, most women with higher proteinuria levels are likely to use magnesium sulphate, received more antihypertensive drugs, have higher diastolic blood pressures and are likely to have deliveries at an earlier gestation which are risk factors for adverse perinatal outcomes, (Thornton E., et al, 2010).

### 2.2.7 Effects of drugs and maternal care for HIP during pregnancy on perinatal outcome

The standard criteria for management of women with hypertension in pregnancy include diagnosis, classification of the hypertensive state, control of hypertension, prevention of convulsions and timely delivery using an appropriate method.

Because the only cure for any fetal complications is delivery, there is universal agreement that patients should be delivered if severe hypertension develops after 34 weeks of gestation or if development of convulsions occurs anytime during the gestational period. Some institutions however consider delivery to be the definitive therapy, regardless of gestational age, whereas others recommend prolonging pregnancy in all severely premature hypertensive gestations until either development of fetal lung maturity, development of fetal or maternal distress, or achievement of gestational age of 34 to 36 week.

A large multicenter study has shown that magnesium sulfate is the ideal anticonvulsant, and is superior to both phenytoin and diazepam in the management of eclampsia, (The Magpie Trial Collaboration Group, 2002). $MgSO_4$ is recommended as the first-line treatment of eclampsia and used for prophylaxis against eclampsia in women with severe preeclampsia, (Magee L. A., 2008).

Maternal health risk in HIP is related to severe hypertension and therefore lowering of severe maternal hypertension is recommended, (Magee, 2001). However, for mild to moderate hypertension, the effectiveness of antihypertensive drug therapy in limiting poor perinatal outcomes is unclear, (Abalos et al, 2001; Magee, 2001). Antihypertensive medication use has been associated with fewer prenatal admissions to hospital, and fewer instances of respiratory distress syndrome in the newborn but has been associated with small-for gestational-age (SGA) infants, (Abalos et al., 2001). Magee, (2001), described a "continuum of risk" in which perinatal mortality and intrauterine growth restriction increases incrementally with increases in maternal blood pressure. This raises concerns about potential fetal risks associated with antihypertensive medication use, suggestions being raised about use of less potentially harmful approaches to blood pressure reduction either alone, or in combination with pharmacological management of hypertension in pregnancy, (Kreitzer M., Snyder M., 2002).

## 2.3 Other determinants for perinatal outcome in normotensive pregnancy which can occur in hypertensive women

Several maternal demographic and obstetric factors may influence the perinatal outcome. Akello B et al, (2008) found that significant risk factors for perinatal deaths in Mulago hospital included living more than 5 kilometres from the hospital, having a transport problem, baby not being resuscitated and being born with low APGAR score.

Illiteracy, women with a birth interval of less than two years, women who delayed their first ANC visit and with irregular antenatal attendance have been associated with increased risk a perinatal death, (Harrison K. A., 1997).

In Botswana, HIV infection with HAART use from before conception was associated with very small for gestational age infants, (Natasha Parekh, 2010). Wang P.D, and Lin R.S., (1999) observed that stillbirths are increased by illicit drug use during pregnancy, unwanted pregnancies and in women with higher body mass (>30kg/m2). They also documented that early neonatal deaths occurred more in teenage mothers, in primigravidae and grand-multiparous women.

The risks of both stillbirth and early neonatal mortality are significantly increased by a history of previous stillbirth, prematurity in the last pregnancy, clinical anemia and congenital malformations. Socioeconomic factors such as low maternal education, agricultural occupation, and lack of a toilet lose significance after adjustment for confounding factors, (Greenwood et al, 1987).

According to Gray R.H., (1991), maternal smoking, bleeding during the first or second trimester, less than 5 prenatal care visits, and congenital malformations are associated with more perinatal deaths. Their study showed weaker associations for pre-pregnancy factors such as single marital status or low maternal body weight and no significant associations were observed with socioeconomic status. Similar findings in a perinatal study in Tanzania by Christentze S., et al (2012) suggested that efforts to reduce early neonatal death should focus on improved maternal care and the prevention of prematurity. According to this study pregnancy-related risks exerted a more substantial effect than maternal characteristics, suggesting the feasibility of a

strategy focused on preventing preterm births through prenatal care rather than a high-risk approach of screening women prior to pregnancy.

## 3.0 CHAPTER 3: METHODOLOGY

### 3.1 Study area: Pumwani Maternity Hospital

This was a hospital-based study conducted in Pumwani Maternity Hospital's labour, neonatal and antenatal wards. The study was conducted between the months of December 2011 and April 2012. Pumwani Maternity Hospital, in Nairobi, Kenya, is the largest maternal hospital in East and Central Africa. It is located close to Mathare, Majengo and Korogocho, three of Nairobi's biggest slums. It also provides other medical services related to pregnancies such as antenatal care, Prevention of Mother to Child Transmission (PMTCT) and comprehensive post-natal clinic services including family planning services and cancer screening.

It has a school of Midwifery within the Hospital which trains Kenya Registered Midwifery Nurses. It had an average annual admission of 18600 in 2011 and 17557 in 2010. Out of the 18600 deliveries 3701 were caesarean deliveries (a caesarean delivery rate of 19.8%). It has a newborn unit with a cot capacity of 150. In 2011 there were 6091 neonatal admissions to the Neonatal Baby Unit with 513 neonatal deaths. Prematurity and birth asphyxia are the main reasons for neonatal admissions to the NBU. There were 330 fresh still births and 253 macerated stillbirths reported in the same year. Eighty eight mothers were referred to Kenyatta National Hospital for specialized care. There were 11 maternal deaths in 2011.

Pumwani Maternity Hospital is a referral hospital and offers comprehensive emergency obstetric care. It serves a population largely composed of the urban poor and young mothers. In 2012, the hospital had a midwife capacity of 180 midwives, several specialist and general medical practitioners. This level of staffing gives a high staff-patient ratio. It has a high-risk antenatal clinic which serves women with hypertension in pregnancy. Magnesium sulphate is the drug of choice in prophylaxis

and treatment of convulsions related to hypertension in pregnancy in the hospital. Hydrallazine, nifedipine and methyldopa are the hypertensive medications used in the hospital. Pumwani maternity hospital did not have locally developed protocols on the criteria for management of hypertension in pregnancy and management depended mainly on previous training of each individual in the clinical team during the time of this study. Women with hypertension on admission are admitted through a central admission area close to the labour wards. Any patient identified to have an elevated blood pressure by the admitting nurse is referred to the medical officer or the obstetrician on duty for clinical consultation. The consulting doctor then formulates a management plan consisting of time and mode of delivery, drugs to use in control of hypertension and decides on whether or not to use magnesium sulphate to prevent or treat convulsions with priority set based on their clinical assessment.

Hypertension in pregnancy in this hospital is defined as a diastolic BP of 90 mmHg or more, based on the average of at least two measurements, taken using the same arm using a regularly calibrated 0124 Riester Diplomat Presameter mercury sphygmomanometer with an appropriate-sized cuff and a rest period of 10 minutes allowed before taking the blood pressure. The woman is normally sitting upright and the cuff positioned at the level of the heart and Korotkoff phase IV used for recording diastolic blood pressure.

Patients attending Pumwani Maternity Hospital are a self-selecting group who consist of a higher proportion of less educated, socioeconomically disadvantaged urban women with a higher proportion of those experiencing complicated deliveries and referrals from surrounding health centres. As such, location of the study in this hospital may have excluded the wealthy and the more educated mothers in the city which reduces the generalisability of the study findings.

### 3.2 Study design

This was a descriptive cross-sectional and quantitative study. This design enabled us to study both the risk factors and the perinatal outcomes at the same time and with minimal resources. The outcome was determined at the end of the sixth day after a live birth and recorded as either a survival or a death. For women admitted with intrauterine fetal demise, verification was done to confirm whether it was a fresh or a macerated stillbirth at delivery and weight for all births recorded from the patient's clinical notes.

### 3.3 Target population

Any pregnant woman who admitted during the time of the study fit the criteria for hypertension in pregnancy was included in the study. The nature of admission was therefore as emergency or as a referral from the surrounding health facilities due to the nature of the condition. These women were either admitted to the antenatal, labour and postnatal wards. Two elevated BP readings done fifteen minutes apart on the patient or two high BP readings recorded on two separate occasions in case of a normal reading at the time of admission to the study were confirmatory of hypertension.

### 3.4 Sampling method

This study used consecutive sampling. Consecutive recruitment of participants was done until the desired sample size was achieved. Researchers visited the hospital on a daily basis to recruit participants to the study and collected any information relating to previously recruited participants. Hypertension was classified in mutually exclusive categories of chronic hypertension, chronic hypertension with superimposed

preeclampsia, pre eclampsia/eclampsia, pregnancy induced hypertension and unclassified hypertension. Where there was inconsistency in the type of hypertensive state, maximizing the likelihood of the accurate diagnosis was done. Eclampsia was defined as coma or one or more convulsions not attributable to other cerebral conditions such as epilepsy or cerebral haemorrhage in a patient with hypertension in pregnancy

**3.5 Sample size and determination**

This was determined based on an estimated perinatal mortality rate of 110.3 per 1000 total births in women with hypertension in pregnancy from a hospital based case-control study in Nigeria in 2005, (University of Benin Teaching Hospital). We used the Kish and Leslie formula to calculate the sample size for this study.

Sample size n was calculated as

$$n = \frac{t^2 \times P(1-P)}{d^2}$$

Where n was the required sample size

t is the standard normal value at the 95% CI level = 1.96

p as the estimated perinatal mortality rate of 110.3 per 1000 births

d as the margin of error at 5%

With the perinatal mortality rate of 110.3 per 1000 births, the z score at 95% being 1.96 and d being 0.05, replacing these values on the formula

$$\text{Sample size } n = \frac{1.96^2 \times 0.11(1-0.11)}{0.05^2}$$

$$\text{Sample size } n = \frac{3.8416 \times 0.089}{0.0025}$$

Sample size (n) for the study was therefore 150 participants. Seven (7) participants were added to this to take care of mothers who would have been lost to follow up or who gave incomplete information assuming a 5% non-response rate. Therefore, the study sample size was approximately 157 participants.

### 3.5.1 Inclusion Criteria

Any woman admitted to Pumwani Maternity Hospital in the antenatal, labour and postnatal wards was eligible to the study if;

i. She was a verified case of hypertension in pregnancy in the antepartum, partum or postpartum period.
ii. A urinalysis report showing proteinuria or its absence was present in the clinical notes
iii. Clinically visible recordings of elevated blood pressure were ascertained from her clinical records
iv. She had given informed consent to participate in the study

### 3.5.2 Exclusion Criteria

i. Women with gestations below twenty eight (28) completed weeks based on the criteria for the minimal gestational age for neonatal survival within or with birth weight less than 500 grams
ii. Women with isolated systolic hypertension were excluded due to its variability and its possibility of over staging the degree of hypertension
iii. Women who met the above criteria and who declined to give consent for the study

### 3.6 Data collection

#### 3.6.1 Data Collection Instrument

Information collected for the purpose of this study was quantitative**.** A pilot-tested, structured data abstraction form was used to collect information from the mother and from the clinical notes of both the woman and the neonate. This data collection tool was developed by the principal researcher. It was administered by a trained research assistant or the principal researcher. It was pilot tested before administration to the participants. It had both maternal and foetal or neonatal variables.

#### 3.6.2 Dependent variable

The dependent variable was the perinatal outcome. This was defined as:-

A perinatal death- which was any death between twenty eight (28) weeks of gestation and six complete days after delivery or

A survival- which was a living neonate at the end of the sixth day after birth whether still admitted to the newborn unit or discharged to the mother either at home or still in the hospital.

Secondary outcomes for this study were premature birth, small for gestational age (SGA), birth asphyxia, neonatal complications and need for admission to the newborn unit.

**Maternal risk factors**

i. Age
ii. Prior obstetric history
iii. Parity
iv. Antenatal history
v. Previous pre-eclampsia
vi. Blood pressure recordings-

during the start of ANC, highest diastolic, Mean Arterial Pressure

vii. Family history of hypertension

viii. Mode of delivery and indications for caesarean delivery

ix. Multiple or singleton pregnancy

x. Hypertensive drugs used before and during the admission period

xi. $MgSO_4$ use

xii. Pre-existing medical conditions (diabetes mellitus, asthma, HIV/AIDS)

xiii. Time between pregnancies

xiv. Blood pressure recordings- during the start of ANC, highest diastolic, Mean Arterial Pressure

xv. Corticosteroid use

xvi. Laboratory results of tests done

### 3.6.3 Independent variables

These were categorized as:-

**Neonatal and fetal risk factors**

i. APGAR score (five minute score

ii. Birth weight of the fetus at birth

iii. Gestational age at birth

iv. Gross fetal anomalies

v. Complications to the neonate (Respiratory distress syndrome, meconium aspiration syndrome, hypothermia, sepsis etc)
vi. Outcome of the birth
vii. Need for admission to the Newborn Unit (NBU)
viii. Need for resuscitation and drugs used

### 3.6.4 Pilot study

A pilot study was conducted to test the application and acceptability of the data collection tool, refine the consenting and recruitment procedures, test the process of collecting data from medical records and to test data entry procedures. This was done on 10 patients in Mbagathi District Hospital before the main study in October 2011. Data from the pilot study was not included in the main study. Relevant amendments to the data collection tools and the recruitment process were made after the pilot study.

Two research assistants were recruited by the principal researcher to assist in this study. They were registered nurses working in the hospital and taking the midwifery course. They were trained on consenting procedure, on ethical principles of dealing with human subjects in research and on recruitment and data collection procedures. This was done before the pilot study.

### 3.6.5 Recruitment procedure

Participants were recruited at the time of admission to the hospital by the research assistants or by the principal researcher using active case finding. Every day the research assistants would report to the admission room and go through the admission

book. They would then trace all the admitted patients in the labour, antenatal and postnatal wards and go through their antenatal and hospital clinical records to check for blood pressure readings elevation. Women with elevated blood pressure readings were then considered for inclusion in the study if they met the case definition criteria for hypertension in pregnancy. Women who met the case definition criteria were requested to participate in the study. Willing participants received an explanation of the goals and significance of the study before consenting to be involved in the study.

Those who consented were then interviewed on demographics, past medical and obstetric history, antenatal history and current medical condition. Clinical data about the current pregnancy was collected from the patient's antenatal booklet and the hospital clinical notes. A recent blood pressure reading was then taken. At least one dipstick urinalysis was done at the time of recruitment and subsequent urinalysis reports noted from the clinical records. The highest level of proteinuria was recorded for the purpose of this study. Where possible and in case of post-natal mothers the outcome of the pregnancy was obtained from the clinical notes at the time of recruitment.

More information about the neonate or the woman was collected on subsequent hospital visits from the postnatal ward or at the neonatal ward. In case the mother was discharged before the end of the perinatal period, a home visit or a follow up phone call was made to confirm the outcome of the birth at the beginning of the seventh day after delivery (end of the perinatal period). Women who were still in the ward or had their neonates admitted in the ward had this information collected at the end of the perinatal period. Women who could not be reached at the end of the perinatal period were treated as lost to follow-up and were not included in the final analysis. Gestational age was determined by calculating from the first day of the last menstrual

period (Naegele's Rule) or calculated from the earliest available obstetric ultrasonographic scan report where the dates of the last menstrual period were not available or using fundal height measurements recorded in the antenatal card compared with the earliest positive pregnancy test and quickening.

Centiles for the birth weight were calculated using customized birth weight centile charts (Gestation Related Optimal Weight-GROW) and Small for gestational age (SGA) defined as birth weight for gestational age less than the sex-specific $10^{th}$ percentile cut-off of a published Canadian fetal growth reference, (Michael S. Kramer, 2001).

### 3.7 Data analysis

Information collected was checked for any errors and omissions. Only abstraction forms with accurately recorded information were considered for data analysis. Collected information was entered into IBM SPSS version 19.0. Double entry was done for each of the information collected on separate fields. This information was then transferred to Microsoft excel to ascertain the uniformity of entries and cleaned up and exported back to SPSS. Of the 157 patients recruited 9 mothers were excluded in the analysis because of incomplete maternal and neonatal datasets. Analysis was done with a confidence level of 95%. The output of the data was described in terms of frequency distributions, means, and figures (proportions, percentages and ratios).

#### 3.7.1 Descriptive and inferential analysis

Descriptive analysis was done on all variables (means, frequency tables and standard deviation) and comparison of categorical variables and the perinatal outcome done by Chi square test with a p value $< 0.05$ being considered significant and $<0.01$ highly

significant. Univariate logistic regression was done on continuous variables to test their predictive capacity on the perinatal outcome. Associations with perinatal mortality were expressed with Odds ratio (OR) with their 95% confidence intervals (CI). Variables that were significant through the Chi square test and univariate logistic regression were considered in a regression model. The independence of each variable and interactions between each of the variables and the perinatal outcome in the model were assessed using the likelihood ratio test. Step-wise multivariate logistic regression was conducted to identify potential confounding socio-demographic, antenatal, intra-partum, fetal or neonatal risk factors. Statistical significance had been set at 0.05 a priori. Hosmer-Lemeshow statistic values <0.05 were significant for testing the model.

### 3.8 Ethical Considerations

Approval No. 000688 from the Institutional Research and Ethics Committee (IREC) of Moi University was obtained before commencing the study. Permission to carry out the study in Pumwani Maternity Hospital was obtained from the Nairobi City Council Research Ethics Committee through the Pumwani Maternity Hospital administration. All participants gave signed consent before inclusion into the study. Women below 18 years and unconscious post-ictal eclamptic patients had a relative or caretaker to give consent on their behalf. Those unable to read and write had the consent details verbally explained to them by the research assistants before giving signed consent. Women were informed that they would be contacted for follow-up prior to giving consent for recruitment. No names of participants were indicated anywhere on the data compilation forms. The right of the respondent to withdraw from the interview or not to participate was informed and respected. Participating

women were notified that they would be identified using numbers assigned to them at the time of recruitment. A right thumb print impression or a signature in the participants own writing on the designated place on the data abstraction form was evidence of informed consent.

**Risks**: The only risk involved in this study was the discomfort participants might have experienced by giving information about obstetric history with unfavorable outcomes. Some of these questions were intrusive. Those who developed emotional disturbance after answering the questions were counseled appropriately by the research team or referred to a hospital counselor.

**Benefits**: Through women giving correct information about their obstetric history this study was going to elicit the effect of some of the previous unfavorable obstetric events and the current pregnancy. Benefits related to this study included being referred for senior urgent review in case a complication requiring urgent attention was noted by the research staff. There was no compensation given to the women for participating in the study

### 3.9 Limitations of the Study

We employed the use of consecutive sampling which is a non-probability sampling method which has inherent challenges of biasness in generalizability of the results to the entire population of mother with HIP.

It was also assumed that because standardized urinalysis sticks were used to test for proteinuria using visual interpretation inter-observer variability of the tests was minimal. We relied on local laboratory quality control procedures for ensuring test reproducibility.

Research assistants were trained on the recruitment procedure, active case identification, administration of the data collection tools and in consenting and other ethical considerations to minimise data collection bias related to inter and intra observer variability.

To estimate for small for gestational age, we used Canadian based birthweight centile charts. Since these charts were developed for a Canadian population, their use in an African population may over or underestimate small for gestational age when used in a different population from where they were developed. At the time of collecting data for this study no locally based centile charts had been developed, and this was a limitation.

## 4.0. CHAPTER 4: RESULTS

The study period was from 4th December 2011 to 28th May 2012. A total of 158 participants were recruited into the study, one did not consent to participate, 9 had incomplete information and results of 148 were analyzed. During this period, 5466 deliveries were conducted in the hospital. The incidence of hypertension in pregnancy in the period was 289 per 10000 pregnancies (2.89%). Perinatal mortality rate in women with hypertension in pregnancy was 203/1000 births. The overall hospital perinatal mortality rate was 63/1000 births (early neonatal death rate of 30 per 1000 live births and still birth rate of 32 per 1000 total births). Premature births constituted 74 (50%) of the births and small for gestational age was in 38.19% of the pregnancies.

### 4.1 Socio-demographic Characteristics

The mean maternal age was 27.5(SD ± 6.08) years with an age range between 17-43 years. Most of the women were married and had post-primary education. Other demographic characteristics are presented on the table below

**Table 1: Distribution of socio-demographic characteristics in the women with HIP**

| Demographic variables | N-148 | Frequency |
|---|---|---|
| **Marital status** | | |
| Married | 128 | 81.8% |
| Single | 21 | 17.6% |
| Widowed | 1 | 0.6% |
| **Maternal level of education** | | |
| No formal education | 3 | 2% |

| | | |
|---|---|---|
| Primary education | 57 | 38.5% |
| Secondary level | 60 | 40.5% |
| Tertiary level | 28 | 18.9% |
| **Maternal age groups** | | |
| <20 years | 24 | 16.2% |
| 21-30 years | 74 | 50% |
| 31-40 years | 48 | 32.4% |
| >40 years | 2 | 1.4% |
| **Where the mother was coming from before admission** | | |
| Home | 75 | 50.7% |
| Public health facility | 45 | 31.4% |
| Private health facility | 28 | 18.9% |
| **Employment status** | | |
| Unemployed | 84 | 56.8% |
| Self-employed | 41 | 27.7% |
| Permanently employed | 18 | 12.2% |
| Temporarily employed | 5 | 3.4% |

### 4.2 Obstetric characteristics

Most of the women were parous (56.1%); the highest parity being seven (7). Average spacing between the current and previous pregnancy was 2.6 years. The maximum number of perinatal deaths recorded in previous pregnancies by a single mother was four. The average gestational age at the time of recruitment was 36 weeks; earliest gestational age at recruitment was 26 and the oldest was 43 weeks. Twenty three

(27.7%) of the 83 parous women had a previous pregnancy with a resultant unfavourable outcome as either an abortion, stillbirth or early neonatal death.

**Table 2: Distribution of obstetric characteristics of the women with HIP**

| **Obstetric variables** | **N=148** | **Percentage** |
|---|---|---|
| Parity | | |
| Primipara | 65 | 43.9% |
| Para 2-4 | 72 | 48.6% |
| Grand multipara | 11 | 7.4% |
| **Previous un-favourable pregnancy outcome** | N=148 | |
| Perinatal death | 21 | 25.3% |
| Abortion | 2 | 2.4% |
| None | 83 | 72.3% |

### 4.3 Medical history before the current pregnancy

Asthma, HIV, permanent disability and chronic hypertension were the only chronic conditions in women in HIP and existed in 11 (7.4%) of the women before the current pregnancy as HIV (37%), asthma (27%), chronic hypertension (27%) and disability (9%). The HIV prevalence rate in this population was 3.38%, one diagnosed during the current pregnancy and on zidovudine (AZT) prophylaxis and the rest on HAART started before the current pregnancy. Only 11 (7.4%) of the women with HIP had a positive family history of hypertension and hypertension in pregnancy was recurrent in 24 (16.2%) of the women. One woman experienced four previous pregnancies complicated by hypertension. Partner smoking was prevalent in 17 (11.5%) of the respondents and none of the mothers had a history of smoking.

### 4.4 Antenatal care in current pregnancy

Nearly all (>99%) of the women had attended at least one antenatal visit before recruitment. The average number of ANC attendances was 3; the highest number of visits was 11. The average gestational age at the first ANC attendance was 22 weeks. Most of the ANC tests were normal except one woman who had a positive VDRL test and 14 (9.5%) who had abnormal urinalysis results at the first ANC visit (11 (7.4%) with bacteriuria, and 3 (2.1%) with proteinuria). Blood group O rhesus positive was the most popular blood group. The mean diastolic blood pressure at the time of starting ANC was 68.9 mmHg. The average mean arterial pressure at the time of admission was 120.78 mmHg

### 4.5 Labour and drugs used in the hypertensive women

Eighty four, 84 (56.8%) women were admitted to the wards with established labour. Corticosteroids had been administered to 28 (18.9%) in the current pregnancy, 37.8% of those with premature births while magnesium sulphate ($MgSO_{4)}$ was used in 28 (18.9%) of the women during the pregnancy, both for treatment and prophylaxis for eclampsia. Seventy three, 73 (49.32%) women had severe hypertension and would have benefitted from magnesium sulphate use. Oral nifedipine, methyldopa and hydralazine were used for blood pressure control. Intravenous hydralazine was used for emergency blood pressure control. Pre-eclampsia and unclassified hypertension were the most prevalent classes of hypertension in this population whereas the caesarean delivery rate was high at 43.32%. Significant proteinuria was prevalent in most of the women as depicted on the table below,

**Table 3: Frequency of drugs used, mode of delivery, type of hypertensive states and highest level of proteinuria**

| Variables | N=148 | Frequency |
|---|---|---|
| **Hypertensive drugs used before admission** | | |
| Methyldopa alone | 36 | 24.5% |
| Methyldopa and nifedipine combination | 25 | 16.9% |
| Nifedipine alone | 7 | 4.7% |
| Not on drugs | 78 | 52.7% |
| **Hypertensive drugs used in the wards** | | |
| Methyldopa alone | 43 | 29.1% |
| Methyldopa + nifedipine combination | 70 | 47.3% |
| Methyldopa + nifedipine +hydralazine combination | 32 | 21.65 |
| Nifedipine alone | 2 | 1.4% |
| **Mode of delivery** | | |
| Spontaneous vertex delivery after induction of labour | 33 | 22.3% |
| Spontaneous vertex delivery after spontaneous labor | 49 | 33.1% |
| Emergency C/S delivery | 61 | 40.52% |
| Elective C/S delivery | 4 | 2.8% |
| Breech delivery | 1 | 0.07% |
| **Type of hypertensive state** | | |
| Chronic hypertension | 2 | 1.4% |
| Pre eclampsia-eclampsia | 75 | 52.2% |
| Gestational hypertension | 9 | 6.1% |
| Superimposed pre eclampsia | 3 | 2.0% |

| | | |
|---|---|---|
| Unclassified hypertension | 59 | 38.5% |
| **Highest level of proteinuria** | | |
| **No proteinuria** | 4 | 2.7% |
| **Trace (+)** | 27 | 18.2% |
| ++ | 62 | 41.9% |
| +++ | 55 | 37.2% |

### 4.6 Maternal complications

Eclampsia complicated 10 (6.76%) of the pregnancies. Three (33.3%) of these cases occurring in the immediate post-partum period. Labour related complications were reported in 45 (31.3%) of the women as either cephalopelvic disproportion (CPD), prolonged labour, delayed second stage and failed trial of scar. A labor related complication was the main reason for emergency caesarian delivery, followed by a non-reassuring fetal condition 27 (18.2%). Other reasons for emergency caesarian deliveries were eclampsia, antepartum haemorrhage and previous C/S scar in labour.

There was one maternal death and 14 (9.5%) women developed post-partum hemorrhage requiring emergency blood transfusion. Other maternal complications including abruption placentae, anaemia in pregnancy, HELLP syndrome, uterine rupture, oligohydramnios and oliguria occurred each in one woman.

### 4.7 Perinatal outcomes

There were 30 (20.3%) perinatal deaths and the rest were live neonates either with the mother or still admitted in the neonatal unit. There were more female births 76 (51.4%) compared to males. The perinatal outcomes noted were survival 118 (79.7%),

macerated stillbirth 17 (11.5%), fresh stillbirth 5 (3.4%) and early neonatal death 8 (5.4%) as shown in the chart below.

**Table 4: Frequency table on the perinatal outcomes (n =148)**

| Outcome | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Early neonatal death | 8 | 5.4 | 5.4 | 5.4 |
| Survival in NBU | 73 | 49.3 | 49.3 | 54.7 |
| Survival with mother | 45 | 30.4 | 30.4 | 85.1 |
| Fresh still birth | 5 | 3.4 | 3.4 | 88.5 |
| Macerated still birth | 17 | 11.5 | 11.5 | 100.0 |
| **Total** | **148** | **100.0** | **100.0** | |

There was need to resuscitate the newborn at birth in 42 (28.4%) of the births and gross congenital malformations were present in only 4 (2.7%) of the births occurring as either absent patella, phimosis, polymelia and spina bifida. Nearly a third, (32.2%) of the live neonates had at least one complication in the early neonatal period. Neonatal complications were reported in 42 (35.3%) of the live births. The main neonatal complications noted were respiratory distress syndrome 8 (5.4%), meconium aspiration syndrome 7 (4.8%), neonatal seizures 5 (3.4%), neonatal sepsis 5 (3.4%),

ischemic encephalopathy 4 (2.7%), transient tachypnoea of the newborn 3 (2.0%) and neonatal jaundice 2 (1.4%).

### 4.7.1 Prematurity

Preterm births (< 37 competed weeks) constituted 74 (50%) of the total births. Perinatal mortality was as high as 310 deaths per 1000 preterm births compared to 81 deaths per 1000 term births. The more severe the preterm births occurred the higher was the perinatal mortality rate. Nearly half 71(47.97%) of all the births were low birth weight (weight <2500g). Low birth weight births occurred as very low birth weight (<1500g) births 17 (11.49%) and low birth weight (1500-2500g) 54 (36.49%). No death occured in neonates or fetuses more than 3000grammes. The table below gives the distribution of birth weight, APGAR scores and gestational ages of the perinatal deaths.

**Table 5: Distribution of birth weight, APGAR score and gestational age among the perinatal outcomes (n=148)**

| | | **Outcome** | | **%** | |
|---|---|---|---|---|---|
| | | | | **of PND** | |
| | | Live birth | Perinatal death | | Test statistic |
| **GA of the fetus at birth** | <31 wks | 1 | 11 | 91.7% | Chi value 1.566 at 2 df p-value 0.457 |
| | 32-34 | 4 | 9 | 69.2% | |

| | | | | | |
|---|---|---|---|---|---|
| | wks | | | | |
| | 35-37 wks | 46 | 3 | 6.1% | |
| | >37 wks | 67 | 7 | 9.5% | |
| **5 minute APGAR score** | <3 | 1 | 23 | 95.8% | Chi value 109.547 at 2 df p value **0.000*** |
| | 4-6 | 16 | 5 | 23.8% | |
| | >7 | 101 | 2 | 1.9% | |
| **Birth weight** | <1500 | 3 | 14 | 82.4% | Chi value 59.916 at 4 df p value **0.000*** |
| | 1501-2500 | 41 | 13 | 24.1% | |
| | 2501-3500 | 62 | 3 | 4.6% | |
| | >3501 | 12 | 0 | 0.0% | |
| | **Total** | **79.7%** | **20.3%** | **100.0%** | |

* significance at <0.05

Small for gestational age (SGA) or intrauterine retardation occurred in 58 (39.19%) of all births. There were more early neonatal deaths in neonates with SGA compared to those without. However stillbirths were the same in both groups. There was no

difference in the five minute APGAR scores in neonates with SGA and those without. SGA was not a good predictor of perinatal outcome, P=0.056. SGA occurred only in pre- eclampsia-eclampsia (47.3%), unclassified hypertension (32.3%) and gestational hypertension (33%) while the other hypertensive states did not.

Magnesium sulphate use was the drug of choice for prophylaxis and treatment of seizures related to severe hypertension as depicted on the table below

**Table 6: Cross tabulation of magnesium sulphate use in the current pregnancy with the perinatal outcome**

| | | **Perinatal outcomes** | | | | | **Test statistic** |
|---|---|---|---|---|---|---|---|
| | | Early neonatal death | Survival | Fresh still birth | Macerated still birth | Total | Chi value 17.476 df=4 P = **0.002*** |
| **$MgSO_4$ use** | Yes | 7 | 34 | 3 | 10 | **54** | |
| | No | 1 | 84 | 2 | 7 | **94** | |
| **Total** | | **8** | **118** | **5** | **17** | **148** | |

A large proportion, 117 (79.05%) of the women with HIP had more than 2+ proteinuria on dipstick urinalysis. All perinatal deaths but one occurred in this population. Proteinuria of more than 2++ were associated with more perinatal deaths as depicted on the cross table below

**Table 7: Cross tabulation of the highest level of proteinuria and perinatal outcome**

| | | Perinatal outcomes | | | | | Test statistic |
|---|---|---|---|---|---|---|---|
| | | Early neonatal death | Survival | Fresh still birth | Macerated still birth | **Total** | Chi value- 27.760 Df= 12 P value **0.006*** |
| **Highest level of proteinuria** | None | 4 | 0 | 0 | 0 | **4** | |
| | Trace | 26 | 0 | 0 | 1 | **27** | |
| | ++ | 52 | 1 | 6 | 2 | **62** | |
| | +++ | 35 | 4 | 11 | 5 | **55** | |
| | **Total** | **8** | **118** | **5** | **17** | **8** | |

Women admitted in established labour were more likely to have a perinatal death than those without as depicted on the table below.

| | | Perinatal Outcomes | | | | | Test statistic |
|---|---|---|---|---|---|---|---|
| | | END | Survival | FSB | MSB | Total | Chi value 17.476 Df=4 P value = **0.002*** |
| **Labour at admission** | Yes | 7 | 34 | 3 | 10 | **54** | |
| | No | 1 | 84 | 2 | 7 | **94** | |
| | Total | **8** | **118** | **5** | **17** | **148** | |

**Table 8: Cross tabulation of presence of established labour at the time of admission and perinatal outcome**

Preeclampsia and unclassified hypertension were associated with higher rates of stillbirths, 200 per 1000 births and 84 per 1000 births respectively compared to the other hypertensive states as depicted on the table below.

**Table 9: Frequency of perinatal outcomes for each type of the hypertensive state in pregnancy**

| **Type of HIP** | **Perinatal outcome** | | | | **Total** |
|---|---|---|---|---|---|
| | **Survival** | **END** | **FSB** | **MSB** | |
| Chronic | 2 | 0 | 0 | 0 | 2 (1.35%) |
| PIH | 9 | 0 | 0 | 0 | 9 (6.08%) |
| PET/ET | 55 | 5 | 4 | 11 | 75 (50.7%) |
| S PE | 1 | 0 | 0 | 2 | 3 (2.1%) |
| Unclassifiable | 51 | 3 | 1 | 4 | 59 (39.9%) |

| | | | | | |
|---|---|---|---|---|---|
| **Total** | **118** | **8** | **5** | **17** | **148** |

Low birth weight occurring as very low birth weight <1500 and low birth weight of less than < 250gms were associated with more perinatal deaths.

**Table 10: Cross tabulation of the weight of the fetus at birth and the perinatal outcome**

| **Determinant** | | **Perinatal outcome** | | | | | **Test Statistic** |
|---|---|---|---|---|---|---|---|
| | | **END** | **Survival** | **FSB** | **MSB** | **Total** | |
| Birth weight | <1500 | 3 | 3 | 0 | 11 | 17 | Chi value |
| | 1501-2500 | 3 | 42 | 5 | 4 | 54 | 169.436 |
| | 2501-3500 | 2 | 61 | 0 | 2 | 65 | Df =8 |
| | >3501 | 0 | 11 | 0 | 0 | 11 | P value = |
| Total | | 8 | 73 | 5 | 17 | 148 | **<0.001*** |

A current birth order of more than the fourth (grand-multiparity) was associated with more perinatal death compared to primigravidae and low parity. A high birth order was associated with an increased risk of perinatal death as depicted in the cross table below

**Table 11: Cross tabulation of order of the current pregnancy and perinatal outcomes**

| | | Perinatal outcome | | | | | |
|---|---|---|---|---|---|---|---|
| | | **END** | **Survival** | **FSB** | **MSB** | **Total** | **Test statistic** |
| Birth order of current pregnancy | 1st | 3 | 58 | 1 | 3 | 65 | Chi value 17.855 P value **0.022*** |
| | 2nd-4th | 3 | 55 | 4 | 10 | 72 | |
| | > 4th | 2 | 5 | 0 | 4 | 11 | |
| Total | | 8 | 118 | 5 | 17 | 148 | |

### 4.8 Inferential statistics

Gestational age at the time of birth and recruitment to the study, marital status and maternal level of education were independent significant predictors of perinatal death, (p values < 0.05). Maternal status of employment, any pre-existing medical diseases, paternal history of smoking, family history of hypertensive disease and attendance to antenatal clinic were not predictors of the outcome of the current pregnancy when regressed against perinatal mortality as tabulated in the p values below

**Table 12: Maternal socio-demographic variables regressed against perinatal death, p values, Odds ratios and 95% Confidence limits**

| Variable | P value | Odds Ratio | 95% CI |
|---|---|---|---|
| Marital status (married) | **0.048*** | 0.128 | 0.017-0.984 |
| Occupation of woman | 0.848 | 1.083 | 0.479-2.452 |

| | | | |
|---|---|---|---|
| Post-primary maternal education | **0.039*** | 7.200 | 1.106-46.888 |
| Pre-existing medical condition | 0.508 | 0.625 | 0.155-2.518 |
| Maternal age | 0.328 | 1.034 | 0.968-1.104 |
| Residence | 0.991 | 0.999 | 0.567-1.703 |
| Referral from another hospital | 0.483 | 0.747 | 0.330-1.688 |

An abnormal urinalysis result at the time of starting ANC was a good predictor of the perinatal outcome. There were more perinatal deaths in mothers who had an abnormal urinalysis (significant proteinuria or infection) when starting ANC compared to those with a normal urinalysis (p value 0.004). Past obstetric and current obstetric factors related with perinatal death as below

**Table 13: Obstetric related factors, odds ratios, confidence limits and significance (P values)**

| **Factor** | **P values** | **Odds ratio** | **95% CI** |
|---|---|---|---|
| Birth order | **0.002*** | 1.533 | 1.167-2.014 |
| Spacing from previous pregnancy | 0.740 | 1.020 | 0.908-1.146 |
| Prior poor outcome | 0.160 | 0.488 | 0.180-1.328 |
| Gestational age at ANC entry | **0.023*** | 0.923 | 0.861-0.989 |
| No. of ANC attendances | 0.052 | 0.738 | 0.543-1.002 |
| Abnormal ANC profile | 0.114 | 0989 | .0785-1.634 |
| HIV test result | 0.262 | 0.349 | 0.056-2.193 |

A diagnosis of preeclampsia/eclampsia, superimposed preeclampsia and unclassified hypertension increased the odds of perinatal death (p- 0.424) but this was only significant for pre eclampsia (P < **0.05**). A perinatal death occurred more than three times higher in mothers with pre-eclampsia/eclampsia and two times higher in unclassified hypertension than in the other hypertensive states.

**Table 14: Pregnancy related factors regressed against perinatal mortality; Odds ratio, p values, 95% Confidence limits**

| Variable | P value | Odds ratio | Confidence Levels |
|---|---|---|---|
| Corticosteroid use | 0.278 | 1.680 | 0.658-4.286 |
| Magnesium sulphate use | **0.007*** | 5.556 | 2.395-14.006 |
| Hypertensive use before admission | 0.130 | 1.889 | 0 .829-4.303 |
| Hypertensive drug used in hospital | 0.080 | 0.396 | 0.141-1.116 |
| Highest diastolic level | **0.001*** | 1.060 | 1.026-1.096 |
| Labour at admission | **0.000*** | 0.200 | 0.082-0.491 |
| Operative delivery | 0.291 | 1.578 | 0.677-3.680 |
| Maternal complication | 0.778 | 0.855 | 0.289-2.535 |
| **Type of hypertensive state** | | | |
| Chronic hypertension | 0.999 | 0.000 | 0.000 |
| Pre-eclampsia | 0.999 | 0.000 | 0.000 |
| Unclassified hypertension | **0.004*** | 2.778 | 0.764-4.222 |
| Superimposed hypertension | **0.158** | 1.885 | 0.782-4.544 |

**Level of proteinuria**

| | | | |
|---|---|---|---|
| Nil proteinuria | **0** | | |
| Trace | **0.999** | 0.000 | 0.000 |
| ++ | **0.011*** | 0.067 | 0.008-0.534 |
| +++ | **0.004*** | 0.259 | 0.103-0.653 |
| Severity of hypertensive state | **0.021*** | 0.361 | 0.152-0.859 |

Neonatal complications occurrence in the immediate postpartum period, multiple gestation, sex of the infant, the need for resuscitation and congenital malformations were not associated with perinatal mortality as shown by the P-values below

**Table 15: Neonatal factors regressed against perinatal mortality: Odds ratios, P-values and Confidence limits**

| Factor | P values | Odds ratio | 95% CI |
|---|---|---|---|
| Five minute APGAR score | **0.000*** | 0.398 | 0.284-0.557 |
| Birth weight | **0.000*** | 0.998 | 0.997-0.999 |
| Gestational age at birth | **0.000*** | 0.638 | 0.453-0.699 |
| Neonatal complication | 0.866 | 1.081 | 0.435-2.690 |
| Need for resuscitation | 0.573 | 1.310 | 0.513-3.344 |
| Sex of the infant | 0.110 | 1.970 | 0.857-4.528 |
| Small for gestational age (SGA) | 0.053 | 0.443 | 0.195-1.009 |

Only the five minute APGAR score, birth weight and gestational age at birth were significant neonatal or fetal predictors of the outcome of birth (P values < 0.05).

# 5.0 CHAPTER 5: DISCUSSION

## 5.1 Perinatal Mortality

Perinatal mortality from hypertension in pregnancy is reported to be 5 - 11.8% in developed countries as compared to developing nations such as Kenya where hypertension in pregnancy related perinatal mortality can be as high as 40%, (Moodley J., 2005). The perinatal mortality rate in this study was 203/1000 births and was much higher than that of the general hospital population 63/1000 births. It was much higher than the national and Nairobi perinatal mortality rates of 37/1000 births and 65/1000 respectively, (KDHS, 2008-9). Studies have demonstrated perinatal mortality rates of women with hypertension in pregnancy to be between 47-370/1000 births (Nusrat N., 2010, Gezehagn, et al 2014) and therefore perinatal mortality in this study was well within the expected range. Although facility based studies demonstrate higher perinatal death rates compared to population based studies, the high perinatal mortality rate demonstrates the role that hypertension in pregnancy contributes to perinatal mortality. The probable causes of perinatal death are chronic placental insufficiency, preterm delivery and placental abruption. The higher rate of perinatal deaths in our study and other similar studies could also be explained by the three delays model, (Maine, 1995).

## 5.2 Prevalence of hypertension in pregnancy

The incidence of hypertension in pregnancy in the studied population was 2.87% and was comparable to other studies; Iran 2.13%, India 2.2% and Tanzania 2-5%, (Zibaeenezhad M. j. et al, 2010, Swain S., 1993 and Urassa D. P., 2006) involving several hospitals. Hypertensive disorders complicate 6 to 15 % of pregnancies globally and therefore the incidence rate was low. This lower incidence could have

been due to potential differences with other populations due to geographical variability, access factors for health care services and quality of care provided for patients, the socioeconomic status and other demographic parameters such as age and parity, (Edgar M. N., 2012). Clinical practice factors including the quality of diagnostic factors and the diagnostic criteria would also have lowered the incidence.

**5.3 Socio-demographic and obstetric factors**

The mean maternal age 27.5 (SD+/- 6.07) years was higher than had been observed in similar studies and most of the perinatal deaths occurred in the ages between 21-35 years. Only 16.21% of the studied population were teenagers. This study did not independently identify extremes of maternal age as a risk factor for perinatal death (p-0.507). There were more perinatal deaths in women who were married and women who were not employed. However, when regressed against perinatal outcome maternal employment status was not significantly a predictor of perinatal death, p value 0.848. Recurrence of HIP (16.2%) was lower than 20-50% in other studies, (ACOG, 2002).

ANC attendance, comorbid medical conditions, paternal smoking and possible nicotine exposure through partner smoking were not identified to influence the perinatal outcome as were nulliparity, referral from another facility and child spacing. Higher birth orders were associated with an increased risk of perinatal death. Women with more than four children had a perinatal mortality rate of 545 per 1000 births. This was converse to what had been found by Mati et al, (1983). Gray RH et al, (1991) indicated that maternal risk factors of body weight under 50 kg and single parent status significantly increased the likelihood of early neonatal mortality, while maternal age, parity, prior reproductive loss, and socioeconomic status did not have a

significant effect on the perinatal outcome. Associations between most of the socio-economic and demographic characteristics with pregnancy outcomes were not statistically significant, possibly due to the relatively small number of pregnancies included in the analysis, and hence, insufficient power to detect some of the important associations. Magadi et al, (2001) did not establish any relationship between socioeconomic factors and perinatal deaths in mothers in Kenya as well. Blood pressure monitoring was carried out for almost all women attending ANC, but this study could not establish whether these measurements are taken properly and, even if properly performed, whether this information then leads to the appropriate case management when hypertensive disease of pregnancy is detected. Maternal post primary education was associated with a better perinatal outcome.

The risk of perinatal mortality in the current pregnancy increased with increase in the number of previous unfavourable pregnancy outcomes (abortions, stillbirths and early neonatal deaths), (p= 0.041). More than four previous unfavourable pregnancy outcomes were related to a 75% chance of either a stillbirth or an early neonatal death. The recurrence rate of hypertension in pregnancy was in 16.2% of the pregnancies which was comparable to other studies, (Prakash et al, 2006). However, this recurrence and a family history of hypertensive disease (7.4%) did not significantly predict perinatal mortality. Recurrent HIP has been associated with increased risk of pre-term delivery, higher rates of abruption placentae and fetal deaths that did not concur with our study, (Hnat M.D., et al, 2002).

### 5.4 Effects of maternal care on perinatal outcome

The high rate of ANC attendance (99.1%) in this population is encouraging. However, antenatal attendance in this study was characterised by delayed onset of attendance

and fewer attendances. The number of attendances and gestation at entry matched that of the KDHS 2008-9 which showed that only 47% of women nationally completed the four FANC visits and late entry to ANC at 5.7 months. Markestad T, et al (1997) identified that late first attendance and fewer attendances reduce the opportunity of clinicians to identify mothers at risk of developing hypertension in pregnancy and delays interventions to improve the perinatal outcome. Brown, C.A, (2008) identified that women attending ANC at least twice were more likely to have a live birth (vs. stillbirth). The number of visits and the gestation at entry in this study did not significantly influence perinatal mortality (P value-0.52). Wolde Z. et al (2011) did not also identify any significant relationship between antenatal care, follow-up and perinatal mortality. The prevalence of abnormal antenatal tests at the first ANC visit was low and the most common derangement was an abnormal urinalysis (9.5%). An abnormal urinalysis (as either indicating proteinuria or showing many pus cells) was also a good predictor of the outcome of the birth, (p value=0.004).

The pattern and distribution of the types of hypertensive states were comparable to other studies. Pre eclampsia (44.4%) and unclassified hypertension (46.3%) were the dominant hypertensive states followed by gestational hypertension (6.1%), superimposed hypertension (2.0%) and chronic hypertension (1.2%), (Prakash J. et al, 2006). Eclampsia complicated a higher number of pregnancies 10 (6.76%) compared to other studies and HELLP syndrome was rare. The small sample size and having undertaken the study at a referral hospital may have contributed to a higher incidence of eclampsia in this study, (Wolde Z., 2011).

Hypertensive disorders in pregnancy are associated with increased need for induction of labour to reduce the risks of severe hypertension, HELLP syndrome and subsequent reduced need for caesarean section on the mother and the fetus,

(Koopmans M.C., 2009). There was considerably a higher need for induction of labour in the study population with a resultant successful vaginal birth of 23.3% after induction of labour.

Studies have demonstrated higher operative rates in HIP (34-79%). The operative rate in this study population was 43.32% and much higher than the overall hospital operative delivery rate 19.8% in 2011 and did not differ with other similar studies, (45.8%- Zibaeenezhad, 2010, 34.3%- Gangly, 2007, 58.8% -Yucesoy G., 2005). The indications for operative delivery were mostly labor related led by non-reassuring foetal status and were similar to another study done in a private hospital in Nairobi city, (Wanyonyi S., 2006). Most of the perinatal deaths were noted in mothers who underwent induction of labour as part of terminating pregnancies in women with intra uterine fetal death (IUFD). Emergency caesarean delivery was associated with a high number of perinatal deaths due to the effects of fetal distress, prolonged labour, delayed referral and severe neonatal morbidity. It is also possible that emergency caesarean deliveries may have been performed too late to prevent perinatal deaths. The mode of delivery was not a significant determinant of the perinatal outcome, p value-0.291.

**5.5 Effect of hypertension in pregnancy on premature births**

Hypertension in pregnancy contributes to 11.3 to 78.3% of pre-term births (births before 37 completed weeks), (Ray J, G., 2001). Preterm births are increased in HIP due to increased risk of spontaneous preterm labor and PROM or due to increased need for early termination of pregnancy as a result of compromised materno-fetal health. Preterm delivery formed 74 (50%) of the total births and was higher than comparable studies, (38.89% - Prakash et al, 2006), 28.8% - Yadav, 1997), 34% -

Wolde Z., 2011, 34.3% - Magee L.A., et al, 2003) with most adverse perinatal outcomes occurring with increased severity of prematurity (p value- 0.000). Our study revealed that majority of early neonatal deaths were associated with severe birth asphyxia and prematurity. Compared to those without, women who had adverse perinatal outcomes had a lower gestational age at the time of birth, (Mavalankar D. V., 1992).

**5.6 Effect of magnesium sulphate, corticosteroids and antihypertensive drugs on outcome**

Use of corticosteroids in pregnancies between 32 weeks and 34 weeks is associated with improved perinatal outcomes. SOGC guidelines recommend consideration of antenatal steroids for women with gestational hypertension without signs or symptoms of preeclampsia who present at less than 34 weeks gestation if delivery is contemplated within the next 7 days based on expert consensus. There was lower than anticipated steroid use in the current study, 28 (18.9%) and though comparable to the Canadian Hypertension in Pregnancy study - 24%, (Magee L.A., 2007), but steroid use did not improve the perinatal outcomes, (Woudstra et al, 2010). This was also noted in a Canadian study on hypertension in which a higher perinatal mortality was strongly associated with steroid use, (Michael E. Helewa, 1995). Steroid use was also strongly associated with increased risk for perinatal death (OR 4.9, 95% CI 1.4 to 17.1) in the MOS: HIP study, (Ray J.G., 2001).

Women who had a perinatal death were six times more likely to have used magnesium sulphate (OR 5.556, 95% CI 2.395 to 14.006, p-0.007). Magnesium sulphate is the drug of choice for use in prophylaxis in severe pre-eclampsia or in treatment of in eclampsia, (The Magpie Trial Collaborative Group, 2002). Increased

occurrence of perinatal deaths with use of $MgSO_4$ may have been due to the severity of the hypertensive state necessitating its use or the untoward effect of the magnesium sulphate on the foetus or neonate. It is logical to argue that it may have been the circumstance leading to the use of the $MgSO_4$ that increased the risk for the perinatal death and not the $MgSO_4$ per se that resulted to higher perinatal mortality amongst this group. However, this leaves room for further studies to evaluate the effect of magnesium sulphate on the fetus. Our study identified proper use of anti-hypertensive drugs. Oral methyldopa, nifedipine, and hydralazine were used for blood pressure control while parenteral hydralazine was used as the drug of choice for emergency blood pressure control in of severe hypertension. However, the type of anti-hypertensive drugs used and the degree of blood pressure control were not identified to influence the perinatal outcome.

**5.7 Neonatal factors**

There is increased need for resuscitation and admission in to a specialized neonatal care unit in neonates born of mothers with HIP due to prematurity and birth asphyxia. The need for resuscitation at birth was 26.2% and need for admission to NICU was 49.32%. These figures were high in our study compared to other studies e.g. 28 % in the CHIP study (Magee L.A., 2007). Need for resuscitation and admission to NICU however did not influence the outcome of birth (P 0.573). The main neonatal complications requiring admission into NICU were not different from those in literature and included birth asphyxia, prematurity, low birth weight, respiratory distress syndrome and meconium aspiration syndrome.

Birth asphyxia has been demonstrated to be higher in HIP than in a normal risk population and occurred in 30.4% of the women in this study and perinatal mortality

with low APGAR (<7 at five minutes) was at 62.22%. In the Canadian HIP study the odds of an abnormal APGAR score were higher in pre eclampsia (42.46%) compared to 4.10% in the normal population. In our study a low 5 minute APGAR scores was associated with a higher risk for a perinatal death, (p value <0.001). Appropriate use of the partograph and tracking fetal heart rate are ways that this burden can be reduced.

Women with any hypertension in pregnancy are 1.6 (95% CI 1.5–1.6) times more likely to have a live birth with SGA, (Galan H.L., 2002). Small for gestational age (SGA) infants were prevalent in 58 (39.19%) in this study. SGA was not identified to significantly influence the perinatal outcome, (p value 0.056). However, a low birth weight irrespective of the gestation at birth was associated with an increased risk of a perinatal death, (OR 0.998, 95% CI 0.997-0.999, p **<0.000****).

**5.8 Effect of proteinuria on perinatal outcome**

Proteinuria occurring in HIP is associated with poor APGAR scores at 5 min and a higher incidence rate of SGA, (Schiff E. et al 1995). The presence of proteinuria in hypertension in pregnancy and the elevation of their levels increase the risks of maternal HELLP syndrome, eclampsia and significantly increases the incidence of premature birth, IUGR, stillbirth and neonatal deaths, (Fairly F. M., 1991). Presence of proteinuria of more than 2+ was associated with an increased risk of perinatal death in this study and much more if proteinuria was more than 3+, (OR 0.259, 95% 0.103 to 0.653, p=**0.004***). Prior studies and this study have shown that proteinuric hypertension has worse perinatal outcomes than non-proteinuric hypertension in pregnancy. Chan P. et al, (2005) demonstrated that with increasing proteinuria there is increased risk of adverse maternal and perinatal outcomes. Results from our study

means that once a threshold of 2+ is achieved then a delivery or an emergency admission is indicated to avert a perinatal death. This raises the question whether use of serial assessment of proteinuria after the diagnosis of pre-eclampsia would influences management because an increase in proteinuria seems to be an important predictor of adverse perinatal outcome. Serial urinalysis can therefore be used to step-up in maternal surveillance based on these findings. However this aggressiveness may result to higher rate of iatrogenic premature and socioeconomic consequences of maintaining the women in admission. Studies have reported that proteinuria measured using spot dipstick analysis as done in this study is cheap, and does not delay diagnosis compared with a 24 hour urine collection which has more sensitivity but cumbersome. Dipstick proteinuria performs as well as other methods of assessing proteinuria for prediction of adverse events, (Payne B. et al, 2011). It was however not possible to do a urinary spot protein:creatinine ratio which has more sensitivity as reported by other studies, (Côté et al, 2008). Although we identified proteinuria as a good predictor of the perinatal outcome, we would recommend that the measured amount of proteinuria should not be used in isolation for decision-making in women with hypertension.

## CHAPTER 6: CONCLUSION

1. All the forms of hypertension in pregnancy were identified in this population and hypertension during pregnancy was associated a high perinatal mortality.

2. This study demonstrated that women with hypertensive disease in pregnancy are significantly complicated by small for gestational age and low birth weight, birth asphyxia, prematurity and a high need for neonatal resuscitation and admission to neonatal intensive care unit.

3. Post-primary maternal education and being married were identified as socio-demographic factors with a significant protective effect on adverse perinatal outcome.

4. There was sub-optimal use of corticosteroids and magnesium sulphate amongst potential beneficiaries in Pumwani Maternity Hospital.

5. The monitoring of labour was not done satisfactorily enough to prevent intra-natal demise and severe neonatal asphyxia.

6. Women who had high birth order pregnancies, who were in a clinical state requiring use of $MgSO_4$ during the current pregnancy, had more than 2+ proteinuria and had previous adverse pregnancy outcomes were more likely to have a perinatal death.

7. This study identified prematurity, low birth weight and poor APGAR scores as fetal and neonatal risk factors of perinatal morbidity and mortality in hypertension in pregnancy

## CHAPTER 7: RECOMMENDATIONS

1. Timely identification and management of hypertension through use of maternal surveillance using laboratory and clinical indicators for instance serial urinalysis in mothers with hypertension to guide decision-making is recommended.

2. A clinical audit of the management of premature labour and appropriateness of the care given to premature neonates is recommended.

3. Proper management of labour through use of the partogram and the use of neonatal resuscitation protocols with an aim of reducing fresh stillbirths and early neonatal deaths related to birth asphyxia.

4. Further studies are recommended to evaluate the appropriateness of use of magnesium sulphate and its effect on the fetus and the neonate particularly in Pumwani Maternity Hospital.

5. Clinicians working in PMH should receive current updates and be sensitised on the appropriateness of use of corticosteroids in anticipation for preterm deliveries in women with hypertension in pregnancy.

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# APPENDICES

## Appendix 1: Explanation and Consent form

My name is Dr. Abednego Musau. I am a medical doctor and currently a 2nd year Master of Philosophy (Public health) student of the Moi University –Africa Medical Research Foundation (AMREF) program. I am are currently carrying out a study to evaluate the factors that affect the outcome of mothers admitted to this hospital with hypertension in pregnancy – a condition in which mothers have a high blood pressure in pregnancy. I anticipate that this study will help establish the factors that can be modified to reduce the deaths that do occur to the fetus or in the first week of delivery.

I wish to collect the information from your clinical notes about your progress in the hospital, as well as that of the fetus and the born baby. I will also ask you some questions regarding the past and the current pregnancy.

This information will be privileged and will not be shared to anyone and will not be used elsewhere. I will only use the information that you give us for the purpose of this study.

I shall not indicate your name on any of the forms that I shall be filling and that i will only assign a random number as your identity. I will only include you in the study if you indicate by signing that you have understood what I am doing and that you are willing to participate.

By accepting to be involved in the study you shall not be offered any extra service and neither will you be denied service if you decline to participate in the study. However if I identify that you can benefit from specialized treatment I shall refer you to the appropriate place for further care. You may withdraw from the study any time of the study without fear of intimidation.

I will require that you leave your phone number and physical address so that I can reach you in a weeks' time to find out how the baby is doing and whether a problem may have occurred since the time you are discharged from hospital.

I will involve you in the study if you allow us by signing or put your right thumb print in the slot below

I can be contacted through **+254 721 246450** or through **abednegomusau@yahoo.co.uk.** For an unconscious, or eclamptic respondent a relative/ caretaker will give consent

Signature/Thump print…… Phone number……..……

**Witnessed by- Person Obtaining Consent,** Name, please print:_____

Signature of witness: _____Date: _____

**Appendix 2: Assent form for participants under 18 years**

I, _____, study number _____ have read the explanation/has been read to me by (write the name of the person who has read for you) on the study named **"Perinatal mortality in mothers with hypertension in pregnancy admitted at Pumwani Maternity Hospital, Nairobi Kenya**"**.** I confirm that I was given the time to ask any questions and that all my questions were satisfactorily answered. On the basis of this, I therefore agree that I will participate in the study and that I reserve the right to withdraw that permission at any time without any loss of benefits.

Signature of the participant_____

Date: _____

**Witnessed by- Person Obtaining Consent**

Name, please print: _____

Signature of witness: _____

Phone number _____

Date: _____

**Appendix 3: Formu ya maelezo na kuomba ruhusa**

Mimi naitwa Dr. Abednego Musau. Mimi ni daktari na ni mwanafunzi wa chuo kikuu cha Moi na ambaye anasomea Masters ya Huduma za Kiafya ya Umma. Niko kwenye gazi ya pili. Ninafanya uchuguzi kuhusu vitu ambavyo husababisha mama waja-wazito wenye ugonjwa wa msisimuko wa roho (hypertension) kutompata mtoto mwenye uhai ama kumfanya apate mtoto mwenye matatizo. Natarajia kuwa utafiti huu utawezesha madaktari kuyatafuta haya mambo na kuyabadilisha hili kuwezesha kila mama kumpata mtoto mwenye afya njema hata kama yuko na ugonjwa wa msisimko wa moyo akiwa mja mzito.

Nitakuuliza maswali kuhusu maisha yako, mimba ulizopata hapo awali na mengi kuhusu mimba uliyonayo kwa sasa. Nitachunguza pia recordi za daktari kubaini mengi kuhusu matibabu unayopata na mtoto utakayepata.

Mambo yote nitakayopata ni busara kwangu na mtu yeyote mwingine hataweza kuyajua, nitayaweka siri na kuyatumia kwa huu utafiti peke yake tu. Sitaandika jina lako kamwe kwenye karatasi ambayo natumia. Nitakuhusisha kwa huu utafiti tu kama utanikubalia baada ya kuelewa vizuri vile nafanya kwa ishara ya kutia alama or sahihi kwenye kijikaratasi hiki. Hautapewa matibabu zaidi kwa sababu ya kukubali kuhusishwa kwenye huu utafiti wala hautakosa huduma bora unayohitaji kwa kukosa kukubali kuhusishwa kwenye huu utafiti. Kama tutapata kuwa hali yako inahitaji huduma muhimu tutamuhusisha daktari wako hili upate huduma kwa dharura.

Umeruhusiwa kujiondoa kwenye huu utafiti wakati wowote na kwa hiari yako bila kuogopa kushtumiwa. Huu utafiti hauna madhara yoyote yanayotarajiwa.

Nitakuomba huache nambari yako ya simu na maelezo kuhusu mahali unapoishi hili tuwasiliane kuhusu vile mtoto anavyoendelea baada ya kuruhusiwa kutoka hospitalini.

Tafadhai weka sahihi au alama ya kidole cha ngumba cha mkono wa kulia kwenye nafasi uliyoachiwa hapo chini.

Naweza kupatikana kupitia nambari ya sumu 0721 246450 au kupitia kwenye mtandao kwa hii arafa **abednegomusau@yahoo.co.uk** wakati wowote kama kuna swali yoyote.

Kama ni mama wa miaka chini ya kumi na nane ama mtu aliyezirai na hasiyeweza kujitambua, mzazi wake ama mtunzi wako anaweza kutupa idhini ya kuendelea.

Sahihi…… Makazi ……..……Nambari ya simu..……

**Nimeshuhudia**

Jina: _____

Sahihi: _____

Tarehe: _____

**Appendix 4: Data abstraction form**

Please include the exact values of each of the numerical data. All parts of the form must be filled unless otherwise specified

Form number: …….. Residential location……

**Section A: Demographic data**

1. Maternal date of birth……
2. Date of the last normal menstrual period……Gestational age at delivery...…….
3. Marital status……
    a. Single ☐
    b. Married ☐
    c. Separated ☐
    d. Divorced ☐
    e. Widowed ☐
4. Occupation…….
    a. Employed ☐
    b. Unemployed ☐
5. If employed as above, nature of employment
    a. Self employed ☐
    b. Permanently employed ☐
    c. Temporarily employed ☐
    d. Casual laborer ☐
6. Estimated current annual household income KSHS……..
7. Education level……..

a. Primary ☐

b. Secondary ☐

c. Tertiary ☐

d. Not educated ☐

8. Maternal history of smoking

a. Yes ☐

b. No ☐

9. Partner history of smoking

a. Yes ☐

b. No ☐

10. History of pre-existing medical condition (State which one/s if yes below)

a. Yes ☐

b. No ☐

**Section B: Obstetric characteristics**

11. Birth order of the current pregnancy……

12. Time since the last delivery (years)…….

13. Does the mother have a prior history of a still birth or early neonatal death or abortion

a. Yes ☐

b. No ☐

14. If yes in the above question, what is the number……

15. Number of prior pregnancies complicated hypertension in pregnancy……

16. Family history of hypertension

a. Yes ☐

b. No ☐

17. ANC attendance

    a. Yes ☐

    b. No ☐

18. Date of the first ANC attendance ……..

19. Number of ANC visits……..

20. ANC profile: VDRL……HB level……Blood group……

21. HIV serology……

22. Type of hypertensive state

    a. Gestational hypertension ☐

    b. Chronic hypertension ☐

    c. Pre-eclampsia/ eclampsia ☐

    d. Superimposed hypertension ☐

    e. Unclassified hypertension ☐

23. Mean arterial pressure on admission…….

24. Were corticosteroids used?

    a. Yes ☐

    b. No ☐

25. Was MGSO4 used during the current pregnancy?

    a. Yes ☐

    b. No ☐

26. Was labor was present during time of admission?

    a. Yes ☐

    b. No ☐

27. If yes as above was the labour induced or spontaneous

    a. Induced ☐

b. Spontaneous ☐

28. What was the mode of delivery?

a. Emergency C/S ☐

b. Elective C/S ☐

c. Spontaneous vertex delivery ☐

d. Breech delivery ☐

e. Vertex delivery after induction ☐

29. Was the pregnancy complicated by HELLP syndrome?

a. Yes ☐

b. No ☐

30. Were antihypertensive drugs used during the time before admission?

a. Yes ☐

b. No ☐

31. Maternal outcome

a. Referral ☐

b. Death ☐

c. Discharge ☐

d. Complication ☐

32. If complication occurred as above state which one……

**Section C: Neonatal/ fetal characteristics**

33. Birth weight (grams)……

34. Five minute APGAR score…….

35. Was the neonate resuscitated?

a. Yes ☐

b. No ☐

36. Gross congenital malformations……..

a. Yes ☐

b. No ☐

37. Gestational age at the time of delivery (completed weeks)……

38. Whether with sepsis or not…….

a. Yes ☐

b. No ☐

39. Neonatal complications……

**Section D: Outcome (Tick where applicable)**

a. Neonatal Death ☐

b. Survival (alive with the mother) ☐

c. Survival (alive but in NBU) ☐

d. Fresh still birth ☐

e. Macerated still birth ☐

**Appendix 5: Classification Of The Hypertensive Disorders Of Pregnancy**

**Gestational hypertension (pregnancy induced hypertension)**

Hypertension detected for the first time after 20 weeks' gestation, in the absence of proteinuria

Hypertension defined as systolic blood pressure ≥ 140 mm Hg or diastolic blood pressure ≥ 90 mm Hg and resolves within three months after the birth

**Pre-eclampsia and eclampsia**

Hypertension and proteinuria detected for the first time after 20 weeks' gestation

Hypertension defined as above

Proteinuria defined as ≥ 300 mg/day or ≥ 30 mg/mmol in a single specimen or ≥ 1+ on dipstick

Eclampsia is the occurrence of seizures superimposed on the syndrome of pre-eclampsia

**Chronic hypertension**

Hypertension known to be present before pregnancy or detected before 20 weeks' gestation

"Essential" hypertension if there is no underlying cause

"Secondary" hypertension if associated with underlying disease

**Pre-eclampsia superimposed on chronic hypertension**

Onset of new signs or symptoms of pre-eclampsia after 20 weeks' gestation in a woman with chronic hypertension

(Reference: Report of the National High Blood Pressure Education Program Working Group on High Blood Pressure in Pregnancy *American Journal of Obstetrics and Gynecology* Jul 2000. 183(1):S1-S22

**Appendix 6: Canadian references for birth weight for gestational age**

**Birth weight (in G) for GA in completed weeks Canadian female singletons**

| Gestational age | 3rd percentile | 5th centile | 10th centile | 50th centile | 90th centile | 95th centile | 97th centile | Mean | SD |
|---|---|---|---|---|---|---|---|---|---|
| 22 | 332 | 347 | 385 | 466 | 552 | 576 | 576 | 472 | 72 |
| 23 | 379 | 403 | 450 | 557 | 669 | 706 | 726 | 564 | 95 |
| 24 | 424 | 456 | 513 | 651 | 790 | 839 | 887 | 656 | 121 |
| 25 | 469 | 508 | 578 | 751 | 918 | 982 | 1,060 | 754 | 152 |
| 26 | 516 | 562 | 645 | 858 | 1,060 | 1,139 | 1,247 | 860 | 186 |
| 27 | 569 | 624 | 717 | 976 | 1,218 | 1,313 | 1,446 | 976 | 222 |
| 28 | 634 | 697 | 802 | 1,109 | 1,390 | 1,499 | 1,657 | 1,107 | 254 |
| 29 | 716 | 787 | 903 | 1,259 | 1,578 | 1,701 | 1,885 | 1,256 | 286 |
| 30 | 814 | 894 | 1,022 | 1,427 | 1,783 | 1,918 | 2,121 | 1,422 | 319 |
| 31 | 938 | 1,026 | 1,168 | 1,613 | 2,004 | 2,150 | 2,347 | 1,604 | 345 |
| 32 | 1,089 | 1,184 | 1,346 | 1,817 | 2,242 | 2,399 | 2,578 | 1,808 | 368 |
| 33 | 1,264 | 1,369 | 1,548 | 2,035 | 2,494 | 2,664 | 2,825 | 2,029 | 389 |
| 34 | 1,467 | 1,581 | 1,768 | 2,266 | 2,761 | 2,948 | 3,097 | 2,266 | 409 |
| 35 | 1,695 | 1,813 | 1,998 | 2,506 | 3,037 | 3,242 | 3,384 | 2,981 | 426 |
| 36 | 1,935 | 2,052 | 2,227 | 2,744 | 3,307 | 3,523 | 3,660 | 3,181 | 439 |
| 37 | 2,177 | 2,286 | 2,452 | 2,968 | 3,543 | 3,752 | 3,886 | 3,350 | 443 |
| 38 | 2,406 | 2,502 | 2,658 | 3,169 | 3,738 | 3,931 | 4,061 | 3,486 | 439 |
| 39 | 2,589 | 2,680 | 2,825 | 3,334 | 3,895 | 4,076 | 4,202 | 3,588 | 434 |
| 40 | 2,722 | 2,814 | 2,955 | 3,470 | 4,034 | 4,212 | 4,331 | 3,656 | 434 |
| 41 | 2,809 | 2,906 | 3,051 | 3,576 | 4,154 | 4,330 | 4,444 | 3,693 | 439 |
| 42 | 2,849 | 2,954 | 3,114 | 3,655 | 4,251 | 4,423 | 4,554 | 2,512 | 448 |
| 43 | 2,862 | 2,975 | 3,159 | 3,717 | 4,333 | 4,495 | 4,685 | 2,754 | 459 |

**Reference**: Michael S. K. 2001. A new and improved population based Canadian reference for birth weight for gestational age, pediatric electronic version. August 2001. http://www.pediatrics.org/cgi/content/full/108/2/e35.

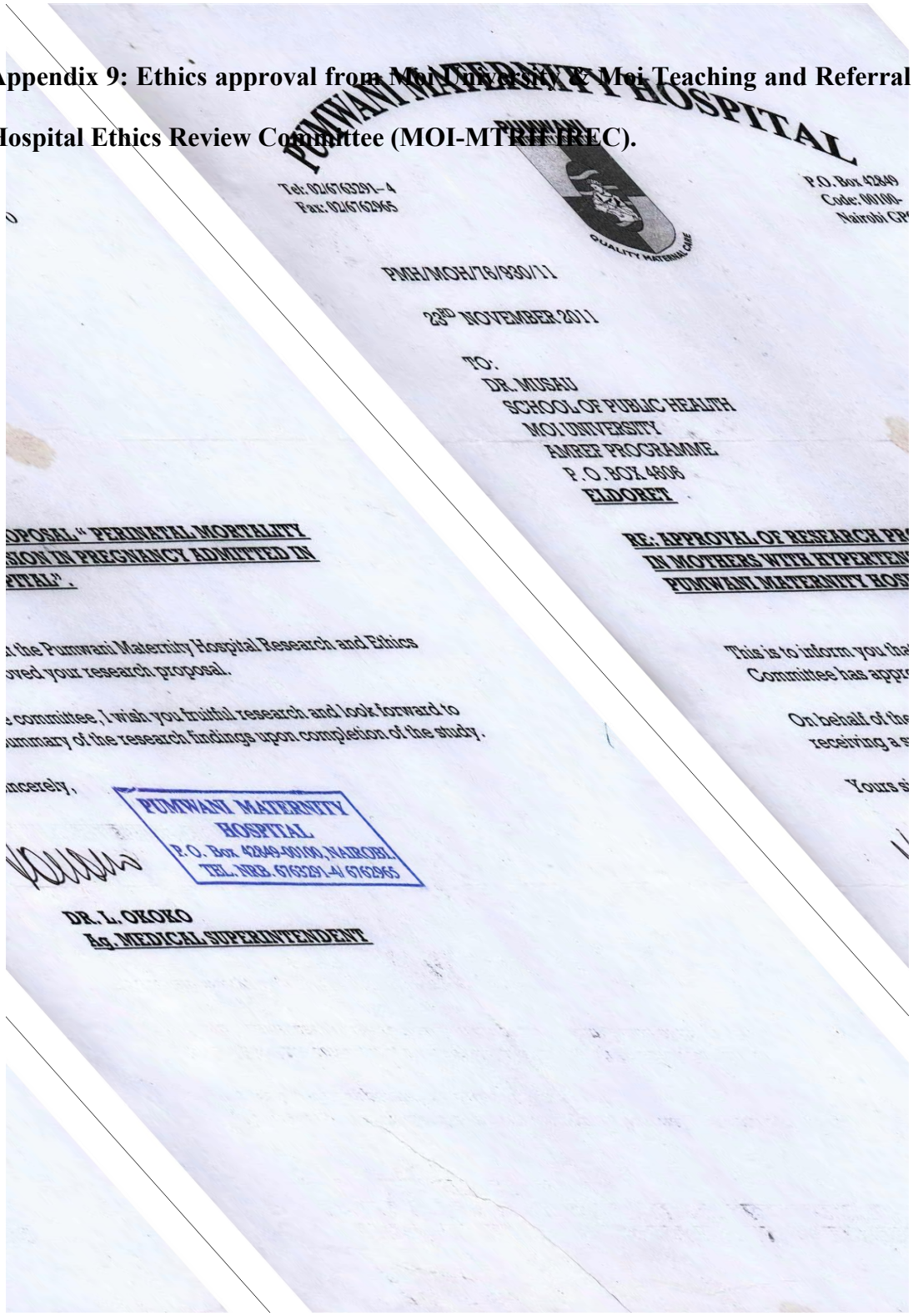
**Appendix 7: Birth weight (in G) for GA in completed weeks Canadian male singletons**

| Gestational | 3rd | 5th | 10th | 50th | 90th | 95th | 97th | Mean | SD |
|---|---|---|---|---|---|---|---|---|---|

| age | centile | centile | centile | centile | centile | centile | centile | | |
|---|---|---|---|---|---|---|---|---|---|
| 22 | 338 | 368 | 401 | 490 | 587 | 627 | 659 | 501 | 111 |
| 23 | 406 | 434 | 475 | 589 | 714 | 762 | 797 | 598 | 114 |
| 24 | 468 | 498 | 547 | 690 | 844 | 902 | 940 | 697 | 125 |
| 25 | 521 | 557 | 617 | 795 | 981 | 1,048 | 1,092 | 800 | 147 |
| 26 | 571 | 614 | 686 | 908 | 1,125 | 1,200 | 1,251 | 909 | 178 |
| 27 | 627 | 677 | 763 | 1,033 | 1,278 | 1,358 | 1,416 | 1,026 | 209 |
| 28 | 694 | 752 | 853 | 1,173 | 1,445 | 1,532 | 1,598 | 1,159 | 241 |
| 29 | 780 | 845 | 964 | 1,332 | 1,629 | 1,729 | 1,809 | 1,312 | 273 |
| 30 | 885 | 959 | 1,099 | 1,507 | 1,837 | 1,955 | 2,053 | 1,487 | 306 |
| 31 | 1,012 | 1,098 | 1,259 | 1,698 | 2,069 | 2,209 | 2,327 | 1,682 | 339 |
| 32 | 1,164 | 1,266 | 1,444 | 1,906 | 2,319 | 2,478 | 2,614 | 1,896 | 369 |
| 33 | 1,344 | 1,460 | 1,648 | 2,127 | 2,580 | 2,750 | 2,897 | 2,123 | 391 |
| 34 | 1,552 | 1,677 | 1,866 | 2,360 | 2,851 | 3,029 | 3,184 | 2,361 | 410 |
| 35 | 1,783 | 1,907 | 2,091 | 2,600 | 3,132 | 3,318 | 3,475 | 2,607 | 428 |
| 36 | 2,024 | 2,144 | 2,321 | 2,845 | 3,411 | 3,604 | 3,759 | 2,855 | 443 |
| 37 | 2,270 | 2,384 | 2,552 | 3,080 | 3,665 | 3,857 | 4,003 | 3,091 | 449 |
| 38 | 2,498 | 2,605 | 2,766 | 3,290 | 3,877 | 4,065 | 4,202 | 3,306 | 448 |
| 39 | 2,684 | 2,786 | 2,942 | 3,465 | 4,049 | 4,232 | 4,361 | 3,489 | 445 |
| 40 | 2,829 | 2,927 | 3,079 | 3,613 | 4,200 | 4,382 | 4,501 | 3,638 | 447 |
| 41 | 2,926 | 3,025 | 3,179 | 3,733 | 4,328 | 4,512 | 4,631 | 3,745 | 459 |
| 42 | 2,960 | 3,070 | 3,233 | 3,815 | 4,433 | 4,631 | 4,773 | 3,800 | 485 |
| 43 | 2,954 | 3,081 | 3,249 | 3,864 | 4,528 | 4,747 | 4,941 | 3,793 | 527 |

**Reference**: Michael S. K. 2001. A new and improved population based Canadian reference for birth weight for gestational age, pediatric electronic version. August 2001. http://www.pediatrics.org/cgi/content/full/108/2/e35.

**Appendix 8: Letter of authority from Pumwani Maternity Hospital Research Review Board**



PUMWANI MATERNITY HOSPITAL

Tel: 0246763291 – 4
Fax: 0246762965

P.O. Box 42849
Code: 00100-
Nairobi GPO

QUALITY MATERNAL CARE

PMH/MOH/76/890/11

23RD NOVEMBER 2011

TO:
DR. MUSAU
SCHOOL OF PUBLIC HEALTH
MOI UNIVERSITY
AMREF PROGRAMME
P.O. BOX 4606
ELDORET

RE: APPROVAL OF RESEARCH PR
IN MOTHERS WITH HYPERTEN
PUMWANI MATERNITY HOS

OPOSAL " PERINATAL MORTALITY
SION IN PREGNANCY ADMITTED IN
PTTAL".

the Pumwani Maternity Hospital Research and Ethics
oved your research proposal.

committee, I wish you fruitful research and look forward to
ummary of the research findings upon completion of the study.

This is to inform you tha
Committee has appro

On behalf of the
receiving a s

Yours si

ncerely,

PUMWANI MATERNITY
HOSPITAL
P.O. Box 42849-00100, NAIROBI.
TEL. NRB. 6763291-4/ 6762965

DR. L. OKORO
Ag. MEDICAL SUPERINTENDENT

**Appendix 9: Ethics approval from Moi University & Moi Teaching and Referral Hospital Ethics Review Committee (MOI-MTRH IREC).**

**INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)**

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

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2010/102

1st September, 2011

***Approval Number: 000688***

Mr. Abednego M. Muema
Moi University
School of Public Health
P. O. Box 3900 - 30100
**ELDORET, KENYA**

Dear Mr. Muema

**RE: FORMAL APPROVAL**

The Institutional Research and Ethics Committee have reviewed your research proposal titled:

***"Determinants of Prenatal outcomes in mothers with pre-eclampsia admitted to Pumwani"***

Your proposal has been granted a Formal Approval Number: **FAN: IREC 000688** on 1st September, 2011. You are therefore permitted to begin your investigations.

Note that this approval is for 1 year; it will thus expire on 31st August, 2012. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

You are required to submit progress report(s) regularly as dictated by your proposal. Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. The Committee expects to receive a final report at the end of the study.

Yours Sincerely,

02/09/2011

**DR. W. ARUASA**
**AG. CHAIRMAN**
**INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE**

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
APPROVED
01 SEP 2011
P.O. Box 4606 ELDORET

cc:
| | | | |
|---|---|---|---|
| | Director | - | MTRH |
| | Dean | - | SOM |
| | Dean | - | SPH |
| | Dean | - | SOD |