Pregnancy Factors Affecting Birth Weight of Babies Born at The Nairobi Hospital, Kenya

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Declaration

I declare that the work presented in this thesis is my original work, has not been presented for any academic purpose in any other university and that this work was supervised by senior members of University of Nairobi School of Tropical and Infectious Diseases, College of Health Sciences, University of Nairobi, Nairobi, Kenya

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Certificate Of Approval

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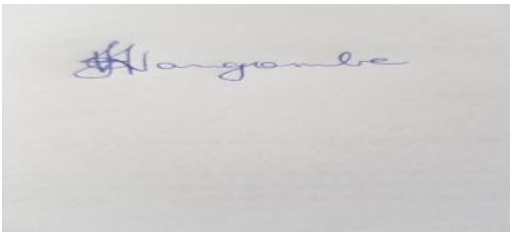
University of Nairobi 

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Dedication

I dedicate this work solely to my late wife Maurine Chepchirchir Koross for her tireless effort and financial support during the entire period of study

Acknowledgement

I wish to express my sincere gratitude to my supervisors Dr. Anne Wang'ombe and Dr. Vincent Otieno for their guidance in the entire preparation of this thesis. I am also grateful to Professor Julius Oyugi for his valuable advice on the concept note that led to actualization of this thesis. My special thanks goes to my data assistants M's Kiiru and Mr. Wanjala for their tireless effort in collection and entry of the research data. Lastly I would like to offer my sincere gratitude to staff in medical records office for facilitating the retrieval of files from the records office.

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List of Abbreviations

ANC: Antenatal Care

BMI: Body Mass Index

CI: Confidence Interval

HIV: Human Immunodeficiency Virus

KDHS: Kenya Demographic and Health Survey

KNBS: Kenya National Birth Survey

KNH: Kenyatta National Hospital

NHIF: National Hospital Insurance Fund

NICU: Neonatal Intensive Care Unit

OR: Odds Ratio

SDGs: Sustainable Development Goals

TNH: The Nairobi Hospital

UN: United Nations

UNICEF: United Nations International Children's Emergency Fund

WHO: World Health Organization

Operational Definitions

BMI: A clinical measure for health status of a person based on weight in kilograms and height in meters. It is used to screen whether a person is underweight, normal healthy weight, overweight or obese.

Diabetes in pregnancy: Fasting blood glucose levels of 7 millimoles or more per litre during routine antenatal assessment in a pregnant woman. Fasting blood glucose levels taken after a she has not eaten for 8 hours.

Low Birth Weight Baby: A neonate whose weight is less than 2500g at birth.

Macrosomia: A baby whose weight at birth is 4000g or more or birth weight above the 90th percentile for gestational age.

Neonate: A baby whose age is less than 28 days since it was born.

Normal Weight Baby: A neonate whose weight at birth is from 2500 to 3999g.

Obesity: Body Mass Index of 30 or more.

Pre-eclampsia: A medical condition unique to pregnancy that occur in late pregnancy characterized a rise in blood pressure equal to blood pressure equal or greater than 140/90 millimeters of mercury presence of protein in urine of equal or more than 300mg in 24 hours and swelling of the feet.

Abstract

Birth weight is a major indicator of neonatal health. Approximately 8% and 4.2% of all babies born in Kenya are classified as low birth weight and macrosomic respectively (UNICEF, 2012; Sanghvi et al., 1989). Bunyoli (2016) found prevalence of macrosomia at KNH to be 5.4%. The primary aim of this study was to identify pregnancy factors significantly affecting birth weight of babies born at TNH. The objective of the study was to model birth weight of babies born at TNH using multinomial logistic regression.

Longitudinal data from obstetric health records for all singleton live births at TNH from 1st of April 2018 to 30th of March 2019 were reviewed retrospectively. The pertinent data was collected using a structured checklist. Frequency tables, Pearson's Chi square and multinomial logistic regression were used to investigate relationship between neonatal birth weight and pregnancy factors.

The results revealed that out of 1573 singleton deliveries studied, the proportion of babies with low birth weight and macrosomia were 6.7% and 5.8% respectively. The adjusted odd ratio results for low birth weight baby versus normal weight baby were as follows; parity of 1≤ 3 (OR= 0.512; 95% CI 0.272 – 0.963,p=0.038), parity>3 (OR= 0.041; 95% CI 0.004 – 0.431,p=0.0078), obesity (OR= 0.418; 95% CI 0.220 – 0.797,p=0.008), preeclampsia (OR= 5.40; 95% CI 2.29-12.74, p=0.00012), term gestation (OR= 0.0073; 95% CI 0.0038 – 0.0143,p≤0.00001) and post term gestation (OR= 0.0016; 95% CI 0.0002 – 0.0128,p≤0.00001) were found significant.

The adjusted odd ratios for macrosomic versus normal weight baby at birth; obesity (OR= 2.428; 95% CI 1.51 - 3.91,p=0.00025), diabetes in pregnancy (OR= 5.085; 95%CI 1.715 - 15.076,0.0034), sex being a boy (OR= 1.860;95% CI 1.191 -2.905,p=0.0064), term baby (OR=

356; 95% CI 196 – 645,p≤0.00001) and post term baby (OR= 569;95% CI 313 – 1037,p≤0.00001) were found significant.

The study concluded that maternal obesity, diabetes in pregnancy, and gestation at birth are significant pregnancy factors affecting both low birth weight and macrosomia at TNH. These findings are in agreement with many local and international studies on neonatal weight.

1.0 CHAPTER ONE: INTRODUCTION

1.1 Background information

Kenya like many other developing countries experience higher neonatal mortality rate compared to global average rate of 18 deaths per 1000 live births (UNICEF, 2017). The neonatal death rate in Kenya stands at 22 deaths per 1000 live births (WHO, 2015). Globally, low birth weight and macrosomia have been associated with significant neonatal morbidity and mortality (WHO, 2015; Mengesha, 2014). Prematurity, birth asphyxia and neonatal sepsis are frequent complications of low birth weight babies. They account for more than two third of all neonatal deaths in Kenya (UNICEF, 2017). About 27% of macrosomic babies develop hypoglycaemia at birth (Bunyoli, 2016). Low birth weight and macrosomic babies increase neonatal vulnerability to complications at birth and after (KDHS, 2014).

Global estimate of low birth weight babies stands at 14% of all live births (WHO, 2015). While in Kenya it is estimated to be 8% (UNICEF, 2012). Muchemi (2015) in a study to determine the prevalence of low birth weight neonates at Olkalau Hospital, Nyandarua County found it to be at 12.3%. On determining the associated factors they identified premature birth, preeclampsia and female new born as significant contributors to low birth weight. Mugambi (2014) in a study at KNH on maternal risk factors of low birth weight found prevalence to be at 9.9%.

Incidence of macrosomia is on the rise in developing countries due to increasing obesity and diabetes in pregnancy (Gaudet et al.,2018; ALSO,2014). Macrosomia is a major cause of birth trauma, increased cases of caesarean delivery and post-partum hemorrhage (Myles,2016). Shoulder dystocia is six times more common in macrosomia than in newborns with normal weight (Koyanagi, 2013; ALSO, 2014).

Despite macrosomia being a major cause of adverse maternal and neonatal outcomes during labour and delivery, few studies have been dedicated to assess for factors contributing to macrosomia in Kenya. The National Birth Survey of 1989 estimated the incidence of macrosomia in Kenya to be 4.2 % (Sanghvi et al., 1989). Bunyoli (2016) in a case-control study at KNH found the prevalence of macrosomia to be 5.4%. Diabetes, post-date pregnancy, maternal age and obesity, weight gain during pregnancy and previous delivery of macrosomia were found to be significant risk factors of macrosomia. WHO classified birth weight into three major categories; Low Birth Weight as neonatal weight at birth less than 2500g, Normal Weight as neonatal weight at birth from 2500g to 3999g and Macrosomia as neonatal birth weight of 4000g or more (WHO,2015).

In 2015 WHO collaborated with member countries in development and implementation of SDGs to accelerate human development through technology and improved governance. Health requirement was prioritized as the third goal of sustainable development whose primary aim was to achieve universal health for all the people by the year 2030. Kenyan government through ministry of health developed strategies to reduce neonatal mortality from current 22 per 1000 to 12 per 1000 live births by the year 2030 (UNICEF, 2017).The identified strategies included family planning, free antenatal care, provision of comprehensive obstetric and neonatal care, early detection and treatment of pregnancy diseases that could have profound effect on neonatal and maternal outcomes (Essential Obstetric Care Manual, 2006).

Through collaboration between MOH, private sector, notable individuals and the local communities, Kenya has registered some noticeable success on reducing neonatal and maternal deaths from pregnancy and birth complications. Various programs were launched and

implemented with remarkable success. The most notable of these include Beyond Zero campaign, an initiative founded by the Kenya's first lady Mrs. Margaret Kenyatta to improve maternal and child health in Kenya through prevention and reduction of maternal and perinatal mortality. Linda Mama Initiative which is a program funded by NHIF to ensure that expectant mothers have free access to quality antenatal, perinatal and postnatal care. In West Pokot, the county government built temporary waiting shelters near hospitals to serve as waiting bays until due date of delivery for pregnant women nearing term from remote areas of the county.

1.2 Statement of the problem

Foetal growth and development is critical to the future of the neonatal life. Conditions which complicate pregnancy affect foetal growth and development. Good antenatal care ensure that majority of babies are born at term have normal birth weight. However a significant proportion are still born either having low birth weight or macrosomia. Both cases have been attributed to underlying health problems experienced during pregnancy period.

TNH is unique in that majority of its clientele are urban residents who reside in Nairobi city and its environs. Pregnant women seeking maternity services at the facility are at risk of becoming overweight or obese as a result of lifestyle characterized limited physical activity common among urban residents. Mkuu et al. (2018) in a prevalence study found that 50% of women whose wealth quintile is rich in Nairobi are obese. Overweight and obesity becomes common as income and wealth levels increase in urban areas of Africa (Koyanagi, 2013). Maternal conditions such as diabetes, preeclampsia and hypertension have been partly associated with obesity.Obesity among other health problems in pregnancy have profound effect on maternal health and consequently affect foetal and neonatal outcomes. In addition, there is no

documented study on neonatal birth weight done at TNH. This study aims to fill this gap by trying to identify those factors that influence birth weight of babies born at TNH.

1.3 Hypotheses

Ho: The neonatal birth weight is not significantly affected by pregnancy factors

Ha: The neonatal birth weight is significantly affected by pregnancy factors

1.4 Research questions

1. What are the proportions of babies born with low birth weight and macrosomia at TNH ?
2. Which pregnancy factors significantly affect the neonatal birth weight at TNH?
3. What is the probability that a baby born at TNH has a low birth weight or normal weight or macrosomia?

1.5 Study Objectives

1.5.1 Broad Objective

To model birth weight of babies born at TNH multinomial logistic regression

1.5.2 Specific Objectives

i. To determine the proportions of babies with low birth weight and macrosomia born at TNH maternity from 1st of April 2018 to 30th of March 2019.

ii. To investigate the relationship between pregnancy factors and neonatal weight at birth using multinomial logistic regression

iii. To predict the probabilities of neonatal weight for each category

1.6 Justification of study

Documented prevalence of low birth weight and macrosomia in Kenya are 8% and 4.2% respectively (UNICEF, 2017; Sanghvi et al., 1989). However facility based studies at KNH and

Olkalou hospital indicate the prevalence of low birth weight in the two institutions is 9.9% and 12.3% respectively (Mugambi, 2014; Muchemi, 2015). This is significant considering that low birth weight and macrosomia adversely contribute to neonatal and maternal outcomes. Low birth weight contributes to more than 60% of all neonatal deaths globally (WHO, 2015). Most eepidemiological review studies revealed that neonates weighing less than 2500g are 20% more likely to die than babies with normal weight (Khan et al., 2014). Babies with low birth weight and macrosomia are at risk of developing respiratory distress syndrome, birth asphyxia and meconium aspiration syndrome (UNICEF, 2017). Macrosomia is a major cause of birth injuries and shoulder dystocia (ALSO, 2014; Gaudet et al.,2018). Foetal macrosomia increase perineal tears by two folds compared to a baby with normal weight (Guanghui et al., 2014). Foetal macrosomia increase the risk of shoulder dystocia by sixfolds (ALSO, 2014).

Neonatal mortality rate in Kenya stands at 22 deaths per 1,000 live births (UNICEF, 2017). The main causes of neonatal deaths in Kenya include birth asphyxia and trauma (31.6%), prematurity (24.6%) and neonatal sepsis (15.8%). These complications are largely feature prominently in low birth weight and macrosomia (UNICEF,2017). The success of achieving vision 2030 in reducing neonatal deaths from current 22/1000 to 12/1000 live births will depend on identifying the significant factors contributing to low birth weight and macrosomia so that appropriate intervening measures are put in place.

Pregnant women seeking maternity services at Nairobi Hospital like many other women living in urban areas and cities in developing countries are at risk of becoming overweight or obese because of life style changes. Obesity has been on an upward trend in most urban areas of Africa where income and wealth levels are higher (Koyanagi et al., 2013). Obesity and advanced maternal age increase the risk of developing pregnancy related complications such as

preeclampsia and gestational diabetes. These conditions directly impact on foetal development (Mengesha et al., 2014).

By studying the association between neonatal birth weight and the risk factors of pregnancy using multinomial logistic regression we will be able to identify those that significantly affect birth weight of babies born at TNH. The findings is hoped to serve as evidence for informing stake holders and policy makers to develop health policy that will address the pertinent health problems contributing to low birth weight and macrosomia.

1.7 Study Limitations

Some files were not available in the records office shelves. Labor induction before term for medical reasons could have increased the proportion of low birth weight babies in the study. This study was done at the Nairobi Hospital and therefore the findings may not reflect national situation.

2.0 CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Birth weight is an important determinant of short and long-term ability of babies to survive, grow and develop mentally (Lao & Cheng, 2014). Risk of birth complications and mortality are higher among babies with low birth weight and macrosomia (Muchemi, 2015; Mengesha et al.,2014). Significant proportion of babies who weigh less than 2500g at birth of have poor Apgar score necessitating special care to be given at neonatal critical care unit. Birth injuries have been associated with foetal macrosomia. Macrosomia is a major indication for instrumental and caesarean deliveries (Bunyoli, 2016).

Approximately 8% and 4.2% of all babies born in Kenya have low birth weight or macrosomia respectively (KDHS, 2009; Sanghvi et al., 1989). Maternal and foetal factors significantly affect neonatal birth weight. Low birth weight and macrosomia are a public health concern worldwide, they are associated with increased morbidity and mortality (UNICEF, 2017).

2.2 Low birth weight neonates.

WHO global report of 2015 indicate that about 20 million babies born annually have low birth weight. This accounts 14.6% of all life births. Majority of low birth weight babies are born at term. Significant proportion of low birth weight babies experience many birth complications. Their health deteriorate quickly necessitating specialized treatment in nurseries equipped with incubators to provide an ambient environment close to that of uterine life. This increase hospitalizations costs thereby putting a lot of financial strain on the affected families and

government. The global proportion of low birth weight babies has been on steady decline however in developing countries it is still quite as high as 30 % (WHO, 2015).

KDHS report of 2009 put the estimate of low birth weight babies born annually in Kenya at 8%. Similar results were obtained by Word Bank as part of its development indicators for official use. UNICEF in 2012 estimated low birth weight to at 8 % (UNICEF, 2012). Mugambi (2014) in a study to assess maternal risk factors associated with low birth weight at KNH estimated the prevalence of low birth weight at 9.9%. Data released by UNICEF in 2016 indicated that about 60% of the low birth weight neonates are term babies while the remaining 40% are preterm. Neonatal deaths contributed to 54.3% of infant deaths and 39% of these deaths occurred during the first day of life. Birth asphyxia and neonatal sepsis are main causes of neonatal deaths among low birth weight babies (UNICEF, 2017).

Donzelli et al. (2000) in a population based prospective study to determine the incidence and risk factors of low birth weight at Nkubu hospital in Meru County, Kenya found that the incidence of low birth weight babies was 7% (5.6% being term and 1.4% being preterm babies). This study demonstrated that 79.6% of the low birth weight babies were term babies who were small for gestational age. Buyongo et al. (2016) in a study at Mulago hospital, Uganda to determine factors associated with low birth weight found the prevalence of low birth weight babies to be at 10.3%. Maternal age below 20 years and preterm delivery were significant risk factors of low birth weight at Mulago hospital (Buyongo, 2016).

Mengesha et al. (2014) in a cross-sectional survey to assess for determinants of low birth weight and macrosomia in Tigray region of Ethiopia found the prevalence of low birth weight and macrosomia to be 10.5% and 6.7% respectively. Maternal age at birth, anemia and baby sex

were found significant. Malachi et al. (2018) in a cross-sectional survey using data sets from demographic health survey of Uganda to assess for survival of a low birth weight neonates. The results from binary logistic regression and Kaplan Meir survival analysis demonstrated that low birth weight neonates were six times more likely to die than a baby with normal weight during the first one month of life.

Low birth weight baby is classified as baby at risk. Low birth weight contribute to between 60 and 80% of all neonatal deaths annually (UNICEF, 2017). Marchant et al. (2012) in a meta-analysis study using data from four regional district projects within East Africa (Kenya, Uganda and Tanzania) estimated that 52% of all neonatal deaths were attributable to low birth weight. Majority of these deaths resulted from birth asphyxia, infections and preterm births. They identified multiple gestation, young maternal age and diseases of pregnancy as well as baby factors such as sex and birth order as significant predictors of low birth weight.

Vazirinejad, Masoodpour & Puyanfar (2012) in a longitudinal study to determine the incidence and survival rates of neonates weighing less than 2500g for the first 28 days of birth in Iranian community hospitals selected randomly. Using neonatal mortality as a clinical end point, they found that newborns weighing less than 1500g had mortality rate of 66.6% and those weighing between 1500g and 2500g had mortality rate of 9.6%. Regression analysis showed that birth weight significantly determines neonatal survival. Shankar et al.(2016) in a study done in India found that low birth weight baby is 11 to 13 times at risk of dying compared to a normal baby and 80% of these deaths occur among preterm.

2.3 Macrosomia

Macrosomia is defined as a weight of a new born of 4,000g or more irrespective of gestational age at birth. Macrosomia globally affects 3 to 15% of pregnancies (Mengesha et al., 2014). Foetal macrosomia significantly contribute to maternal and neonatal morbidity. The maternal effects of macrosomia attested in most studies include prolonged labour, increased likelihood caesarian delivery and post-partum complications such as haemorrhage. Neonatal experiences include increased risks of birth injuries, asphyxiation and shoulder dystocia and in severe cases perinatal mortality (Mengesha, 2014; Bunyoli, 2016; Myles, 2016). Later complications of macrosomia in life to the newborn are obesity, diabetes and cardiovascular diseases (Isaacs, 2018).

The results from KNBS of 1989 indicated the prevalence of macrosomia in Kenya was 4.2% (Sanghvi et al., 1989). A case control study done at KNH to assess for prevalence and risk factors of macrosomia found the prevalence to be 5.4% (Bunyoli, 2016). Maternal age, BMI, diabetes, high parity, late term pregnancy and previous history of macrosomic infants were found to be significant risk factors of macrosomia. Said & Manji (2016) in a case-control study to assess for prevalence and risk factors for macrosomia at Muhimbili National Hospital, Tanzania using data comprising neonates whose birth weight are 4000g or more as cases and neonates weighing 2500–3999g as controls. Matching cases and controls for sex. The study found the prevalence to be 1.3% and gestational diabetes, maternal obesity, maternal weight above 80 kg and previous history of macrosomia as significant predictors of macrosomia.

Global prevalence of macrosomia vary widely from one region to another and from one country to another. Its values range from 0.5 to 15%. Higher prevalence occurs in countries endowed with better resources where obesity tend to be higher and low prevalence in regions

associated with low socioeconomic development (Fuchs, 2016). United States of America National Vital Statistics 2015 report on births put prevalence of macrosomia at 7%. This proportion is distributed in the population as follows; 6% had birth weight equal to or more than 4,000g, 1% had birth weight greater than 4,500g, and 0.1% had birth weight greater than 5,000g (Hamilton et al., 2016).

Guanghui et al. (2014) in a hospital-based cross-sectional survey conducted in 14 provinces of China to obtain prevalence and risk factors of macrosomia using obstetric data of 101,723 singleton term babies born in 39 hospitals in the 2011 found that prevalence of macrosomia to be 7.3%. Maternal age, BMI, gravidity, parity, gestational diabetes and male foetus were significant factors associated with macrosomia.

Complications are more common in babies with macrosomia during and after delivery. A macrosomic baby has large head and broader shoulders relative to a normal baby. This makes it hard to fit into pelvic inlet thus complicating labour and delivery processes. Studies have shown that majority of women giving birth to babies with macrosomia do experience prolonged labour and in most circumstances require instrumental or caesarian delivery (Bunyoli, 2016). Birth injuries such as cervical tears are more common following delivery of macrosomia (Mengesha, 2014). Said & Premji (2016) in a case-control study to assess for outcomes of foetal macrosomia in a tertiary center in Tanzania found that the commonest complications of macrosomia include hypoglycemia (22.7%), respiratory distress (16.5%), birth asphyxia (14.4%) and birth trauma (14.4%).

A retrospective study at the Prince of Wales Hospital, Hong Kong involving 80,953 singleton deliveries on fetal and maternal complications of macrosomia found that macrosomia is significantly associated with birth trauma, shoulder dystocia and perineal tears (Lao & Cheng,

2014). Macrosomia increase perineal tears by 1.5 to 2 folds (Guanghui et al.; Lao & Cheng, 2014).

2.4 Pregnancy factors affecting neonatal birth weight

Many pregnancy, foetal and environmental factors are known to have profound influence on foetal development. The influence on foetal and neonatal outcomes by factors such as maternal nutrition, age, parity, gestational diabetes, pre-eclampsia, obesity and sex of baby as well as gestational age have been well documented in many studies (Hamilton,2016; Guanghui,2014; Mengesha,2014).

To reduce adverse maternal and foetal outcomes form pregnancy, birth and neonatal complications, Safe Motherhood model was initiated by Kenya government in the year 2003 through collaboration with WHO. Family planning, focused antenatal care, prevention, early detection of and treatment of health problems affecting pregnancy became its pillars. This led to improved neonatal and maternal outcomes. A reduction in maternal and neonatal morbidity and mortality from pregnancy, labour and delivery complications became evident (Essential Obstetric Care Manual, 2006).

Maternal age at birth is an important predictor of neonatal birth weight. It is possible for a girl to get pregnant immediately after puberty, however the uterus requires more time to be physiologically and physically ready to accommodate pregnancy. The age between 18 and 35 is regarded as optimal for child bearing. A woman giving birth within this age bracket is likely to have a healthy baby with normal birth weight (Myles, 2016). A woman whose age is below eighteen is more likely to give birth to a low birth weight baby since her uterus and pelvis are yet to fully develop.

Narwade & More (2018) in a cross sectional study in More Nursing Home, Maharashtra observed an increase in the number of babies with low birth weight born to mothers whose ages were less than 20 years. Low birth weight babies have been documented increasingly from women of the age of 45 years and above. This is attributed to shift in hormonal balance as a result of approaching menopause. Advanced maternal age is also associated with increased health risks such as hypertension and diabetes which put the pregnant woman at risk of preterm delivery. It is for this reason older women have increased chance of giving birth to low birth weight babies (Ramdas, 2018).

Donzelli (2000) in a study in rural Kenya at Nkubu Mission Hospital found that low birth weight babies occur among younger mothers aged below 20 years. Tshotetsi et al. (2019) in a case- control study conducted in provincial hospitals of Gauteng province, South Africa found that maternal age was significantly associated with low birth weight. Nirmali (2016) in a prevalence study to determine risk factors of low birth weight among babies in Guwahati Metro, Assam, Northern India found that the prevalence of low birth weight to be at 26.0% and that maternal age below 18 years was significantly associated with low birth weight.

Obesity has been defined as having BMI of equal or greater than 30. Many studies have demonstrated obesity as a significant factor in macrosomia (Bunyoli, 2016). Mkuu et al. (2018) in a cross-sectional study found that obesity is on increase in Kenya. The results of their study indicate that Nairobi had the highest prevalence of overweight and obesity at 47.8%, Central at 47.0% and Coast at 32.4%. They also found that among those whose wealth quintile was rich and richest, obesity prevalence was 41.1% and 50.1% respectively.

Foetal macrosomia is a major cause of adverse neonatal and maternal outcomes at birth. It increases the risk of shoulder dystocia, clavicle fractures, brachial nerve injury and the

frequency of admissions to the neonatal intensive care unit. The risk of cesarean delivery, postpartum hemorrhage and vaginal tears during delivery increase by 1.5 to 2 folds with foetal macrosomia (Mengesha et al., 2014). Babies born with macrosomia are at an increased risk of becoming overweight or obese at a young age and are also at risk of developing type II diabetes later in life (Myles, 2016).

Muthoni et al. (2012) in a systematic review at KNH using 5 cohorts of 400 women to determine the effect of body mass index (BMI) on baby weight at birth. They found that 17.4% and 11.3% of babies from obese and overweight mothers had macrosomia respectively. Macrosomia occurred in only 5.7% of babies from mothers with normal weight. They concluded that maternal weight influence foetal macrosomia and that obesity and overweight contributed significantly to foetal macrosomia.

Guadet et al. (2014) in a systematic review and meta-analysis on influence of maternal obesity on foetal macrosomia using data from 18 retrospective cohort, 8 prospective cohort and one retrospective case-control study in upper and middle income countries. Sixteen of these studies used the definition of macrosomia as birth weight of 4000 grams and over. The results of their study indicated the prevalence of macrosomia among the obese was 15.8% while those born to normal weight women was 9.3% and to underweight women was 1.6%. The odds of delivering macrosomia among obese women increased by 117% when compared to women with normal weight.

Parity is the number of pregnancies reaching viable gestational age of at least 24 weeks a woman has given birth to (Myles, 2016). Parity is a significantt predictor of neonatal birth weight. Low birth weight is observed among neonates born to first time mothers (Ramdas, 2018; Tshotetsi, 2019). Higher birth weight is reported in babies born to multiparous women in

comparison to those born to nulliparous women (Mengesha et al., 2014; Guanghui, 2014). This may be attributed to improve in uterine functioning with subsequent parity (Atuahene, 2015; Bayo, 2016). Donzelli et al. (2000) in a longitudinal study to determine factors associated with low birth weight at Nkubu Hospital in Meru County, Kenya found that odds of low birth weight baby was 43% lower in multiparous when compared to nulliparous woman. This was statistically significant. Narwade & More (2018) in a cross sectional study from April 2012 to June 2014 in More Nursing Home, Maharashtra observed an increase in mean birth weight as the parity increased

Diabetes in pregnancy significantly contributes to pregnancy complications (Myles, 2016). About 3 to 10% of all pregnancies is affected by diabetes. A pregnant woman is classified as diabetic if fasting blood glucose is at least 7 millimoles per liter or 126 milligrams per deciliter. Maternal hyperglycemia causes large quantity of glucose to pass through the placenta into the foetal circulation resulting in foetal hyperglycemia. The foetal pancreatic beta cells respond to this situation by increasing production of insulin to convert much of the excess glucose into glycogen and fat stimulating rapid growth and massive subcutaneous fat (Bunyoli; Myles,2016).

Hyperglycemia in the foetus not only leads to foetal macrosomia but also an important cause of neonatal morbidity and mortality (Bunyoli, 2016). Diabetes in pregnancy has been associated with preterm labour, neonatal and maternal birth complications (Mengesha et al, 2014; Myles, 2016). A prospective study to determine the prevalence and birth outcomes of gestational diabetes in Western Kenya found that the prevalence stood at 2.9 % (Njuguna et al., 2017). Khan & Shakya (2015) in their study on relationship between gestational diabetes and foetal macrosomia found that macrosomia occurs in 12% of newborns of women without

diabetes and 15-45% of newborns for women with gestational diabetes. Gestational diabetes increases the incidence of macrosomia (Mengesha et al., 2014; Guanghui et al., 2016).

Pre-eclampsia is defined as a condition unique to pregnancy that develops after 20 weeks weeks of gestation characterized by elevated blood pressure of at least 140 mm Hg systolic and 90 mm Hg diastolic pressures, presence of proteinuria of equal or more than 300mg in 24 hours or pitting edema of the feet. Preeclampsia is classified as mild, moderate or severe based on the elevation of blood pressure and concentration of proteins in the urine and a variety of clinical symptoms that develop as a result of involvement of body organs and systems. Diagnosis of preeclampsia depend on presence edema although a third of the patients with preeclampsia do not exhibit edema (Myles, 2016).

Preeclampsia compromise utero-placental circulation. This greatly reduce oxygen and nutritional supply to the foetus causing complications such as intrauterine foetal growth retardation or premature labor. The outcome of this is low birth weight baby. Pre-eclampsia affects 5 to 9% of all pregnancies, maternal deaths due to pre-eclampsia is quite high despite it being a preventable condition. Approximately 14% of maternal mortality worldwide is due to hypertensive disorders of pregnancy with sub-Saharan Africa standing at 16 % (Say et al., 2014). Severe pre-eclampsia is significant cause of foetal morbidity and demise (ALSO, 2014).

A case control study carried out at Pumwani maternity hospital in Kenya involving a total of 23,084 deliveries for a period of one year to determine factors affecting birth weight. The study found the incidence of preeclampsia to be 3.7% with higher occurrence among primigravidas of ages between 16 and 21 years. About 23% of the babies born to pre-eclamptic mothers weighed less than 2500g while mothers with uncomplicated pregnancies were about 5%. Still births were seen in 5.2% of the babies born to mothers with preeclampsia. There were no

stillbirths among women with uncomplicated pregnancies. The study also found that the rate of stillbirths was directly proportional to the severity of preeclampsia (Bansal, 1985).

About 40% of low birth weight babies are born pre-term (UNICEF, 2017). Studies have shown that a pre-term baby is at risk of complications during and after birth (ALSO, 2014). Preterm baby is defined as a baby born before 37 completed weeks of gestation (Myles, 2016). The WHO estimates the prevalence of preterm births to range between 5–18% across 184 countries of the world (Essential Obstetric Manual, 2006). Preterm babies have low birth weight and suffer multiple problems at birth necessitating specialized care (Myles; Bayo, 2016). Preeclampsia, gestational diabetes, premature rupture of foetal membranes, antepartum hemorrhages and maternal infections are pregnancy complications contributing to prematurity (Essential Obstetric Manual, 2006).

Post term pregnancy is defined as pregnancy whose gestation has extended beyond 42 weeks. Babies born after 42 weeks of gestation are termed as post term babies or babies with dysmaturity. Globally post term pregnancies make up 3 to 12% of all life births. Risk factors for post term gestation include primigravida, history of post term, sex of the foetus being a boy and genetic factors (McCaughey, 2016). Advanced maternal age and obesity have been associated with post term deliveries as well. At birth post term babies tend to suffer from meconium aspiration and hypoglycaemia (Myles, 2016).

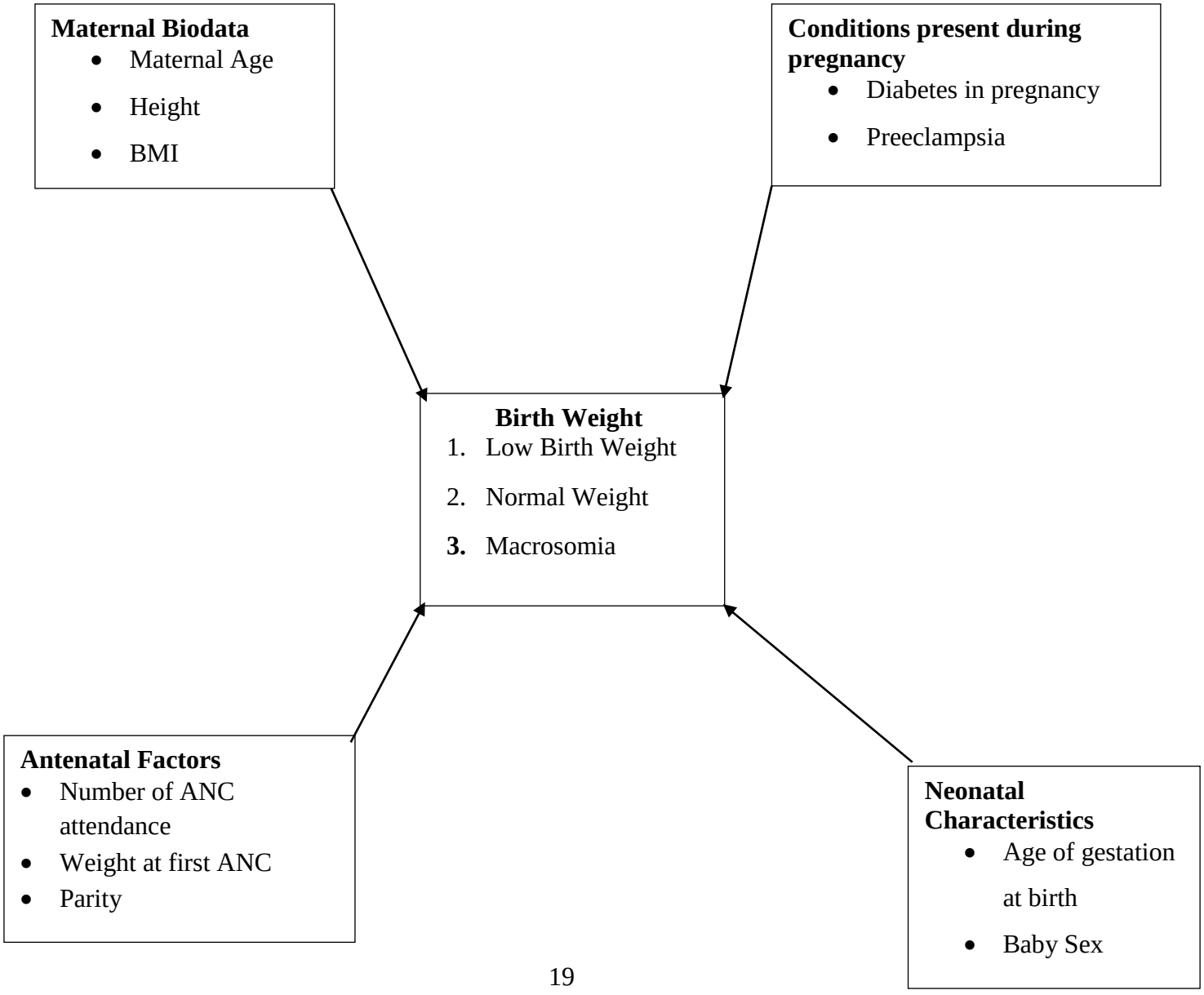
Birth weight has been consistently higher among boys than girls (Said & Manji, 2016; Mengesha et al., 2014). This has largely been attributed to androgen hormone. Vazirinejad et al. (2018) in across-sectional study in Kerman province, Iran to determine causes of low birth weight using data collected from Iranian Maternal and Neonatal Network at public and private

hospitals of live births from March 2014 to March 2015 found that a female neonate is at 41% greater risk of being a low birth weight baby than a male neonate.

Narwade & More (2018) in a cross sectional study involving pregnant women who delivered at More Nursing Home, Maharashtra, India found that the proportions of low birth weight babies were 18.56% and 17.78% for female and male babies respectively. These results were statistically significant.

2.5 Conceptual Frame Work

Conceptual frame work to assess for the pregnancy factors affecting birth weight of babies born at TNH, Kenya. Amodified diagram below was adopted from (Gaudet et al., 2004) to demonstrate how these pregnancy factors are linked to birth weight of a newborn.



3.0 CHAPTER THREE: METHODOLOGY

3.1 Study Design

A retrospective review of longitudinal data from obstetric health records for all live births born at the Nairobi Hospital under care of the hospital team from 1st of April 2018 to 30th of March 2019. The data relevant to the study was obtained from the maternal obstetric and progress notes as well as from individual partographs which contain summary records of labour and delivery. All kept in the maternal files. The data was collected using a modified structured checklist initially developed and pretested by Hailu and Kebede in 2018.

3.2 Study Population and Setting

All babies who were born at TNH maternity from 1st April 2018 to 30th March 2019 under the care of the hospital team were enrolled for the study. The study was carried at TNH Records department office from 2nd to 17th July 2020 after permission to conduct the study was granted by The Nairobi Hospital Bioethics Committee. The records department is involved in cataloguing, storage, safety and retrieval of all patient files following from the hospital.

TNH is a large private hospital offering specialized medical services. The facility has a well-equipped maternity unit comprising of labor and post-natal wards and a nursery with a neonatal intensive care unit. The maternity conducts approximately 4000 deliveries annually of whom about 2000 are under the care of the hospital team and the other 2000 under private consultants.

The maternity is served by a team of competent consultant obstetricians, resident doctors and midwives who provide care to pregnant women during labour, delivery and post-partum as well as care for their babies after delivery. TNH was chosen because of its convenience. Pregnant women seeking maternity services at the facility like many women living in urban

areas and cities in developing countries are at risk of being overweight or obese as a result of lifestyle characterized limited physical activity. Overweight and obesity rises as income and wealth levels increase in urban areas of Africa (Koyanagi, 2013; Gaudet et al.,2014).

3.3 Eligibility and Inclusion and Exclusion Criteria

All babies from singletons pregnancies born at TNH from 1st April 2018 to 30th March 2019 and under the care of the hospital team were eligible for the study. Only the newborns whose maternal obstetric records on pregnancy and birth outcome were complete were included in the study. Those born at The Nairobi Hospital but with incomplete obstetric records or born at the hospital but outside the defined period of study or born elsewhere but admitted to the new born unit for management were excluded from the study. In addition babies from multiple pregnancies were excluded in the study.

3.4 Sampling Method and Determination

Census method was used in this study. Census method was chosen because the population of babies born annually under the care of hospital team at TNH is around 2000. Since we were dealing with a small population a minimum sample size was deemed not feasible considering the prevalence of low birth weight in Kenya is 8% (KDHS, 2009; UNICEF, 2012) and macrosomia at Kenyatta National Hospital and nationally is 5.4 % and 4.2% respectively (Bunyoli, 2016; Sanghvi et al., 1989).

As a step to minimize the likelihood of missing important information on low birth weight and macrosomia and without introducing bias to the study, all the babies from singleton pregnancies under the care of hospital team born at TNH from 1st of April 2018 to 30th of March 2019 were included in the study.

3.5 Study Variables

3.5.1 The Response variable: Neonatal Birth Weight in grams

Neonatal Birth Weight was the birth outcome categorized using an ordinal scale based on weight in grams at birth. Low birth weight is any weight at birth below 2500g, Normal Weight is any weight at birth from 2500g to 3999g and Macrosomia is weight of a baby at birth from 4000g and above.

3.5.2 The Predictors Variables

Are pregnancy factors classified under maternal bio data, pregnancy conditions and neonatal characteristics defined according to the literature review. Based on many studies they have been found to affect foetal development and birth weight. They include;

i. Maternal Biodata

The age of the mother was reported in years. The second variable in this classification was Obesity at first ANC visit was categorized into obese and not obese. Obesity is defined as having body mass index of 30 or more during pregnancy. Maternal obesity has been identified by many studies as a risk factor affecting maternal and neonatal birth weight.

ii. Pregnancy Conditions

Diabetes in pregnancy was categorized into yes when present and no when absent. This was based on the diagnostic criteria for diabetes in pregnancy. A pregnant woman was classified as diabetic if fasting blood glucose is at least 7 millimoles per liter or 126 milligrams per deciliter. Maternal diabetes in pregnancy has been known to adversely affect pregnancy and neonatal weight at birth. The second variable was preeclampsia, it has been categorized into yes when present and no when absent based on standard criteria for diagnosis of preeclampsia as elaborated in operational definitions. Preeclampsia reduces blood supply to the uterus, this

diminishes transfer of oxygen and nutrients to the developing foetus adversely affecting pregnancy and neonatal outcomes.

iii. Neonatal Characteristics

Sex of the neonate was categorized into male when a boy and female when a girl. Many studies have found that boys weigh much more than girls at birth. Age of gestation in weeks at birth was categorized into pre term when the age of gestation at birth was below 37 weeks, term when the gestation at birth was between 37 and 42 weeks and post term when gestation was 43 or more weeks at birth.

Quality control of the data

Two data collection assistants were recruited from nursing division and one records officer in addition to the principal investigator to ensure quality throughout the process of data collection. They were given training on data collection prior to commencement of the study.The training encompassed an introduction to the study, study purpose and objectives. Discussions and sharing of information as well as clarifications were encouraged to ensure that aims of the study were clearly understood. The data management process, use of data collection instruments and techniques were also demonstrated to them using one obstetric file chosen randomly for clarity and understanding. After the demonstration the data assistants were allowed practice data collection using twenty randomly selected files to build understanding of the process, confidence and consistency in use of the data collection tools in information gathering. Confidentiality was stressed throughout the training.

The data collection officers were finally introduced to the records department where the obstetric record files were kept. They were required to wear their uniform and identity cards throughout the period of data collection. The records officer was involved in retrieving the files while the two data collection officers together with the principal investigator gathered the data

from the retrieved files. The data officers are qualified nurses who have good experience in antenatal, perinatal and postnatal management while the records officer has good experience obstetric record filing. All selected from TNH where the research study took place. The training took two days before commencement of the data collection.

3.6 Data Management

3.6.1 Data collection procedures

The data was collected by reviewing obstetrics files retrospectively on maternal bio data, pregnancy, labour and delivery records from maternal delivery files from 1st of April 2018 to 30th March 2019 after approval by the University of Nairobi Review Board and The Nairobi Hospital Ethics Review Committee. Relevant data was extracted using a modified structured checklist initially developed and tested by Lema Deselegn Hailu and Deresse Legesse Kebede in 2018. Information from each file was given a unique identity for confidentiality and to avoid duplication of information. The categorical variables were coded before entered into the Excel, formatted and stored in Excel csv files to enable ease of importation into R software for analysis and long term access.

3.6.2 Data storage and protection

The data pertinent to the study was treated with confidentiality. Prior to storage, information from each file was assigned a number different from the number in the obstetric file to preserve anonymity of the data. The data was stored as soft copy in both hard and flash disk and the information secured with a personal password to ensure data safety. A hard copy was made and kept in a secured locker.

3.6.3 Statistical Analysis

i. Descriptive statistics and test for independence

Frequency tables ideal for multinomial and ordinal data were used to demonstrate counts of babies in each level of birth weight and each pregnancy factor. Mean, median and interquartile range were reported for the continuous variables.

Pearson Chi-Square was used to test for independence between each categorical predictor variable and the levels of the neonatal weight. The proportions of low birth weight, normal weight and macrosomia were reported using frequency tables and pie chart.

ii. Multinomial Logistic Regression Model

Multinomial logistic regression model was used to investigate the relationship between birth weight and the pregnancy factors. It has been widely used in many epidemiologic studies.

This model is based on cumulative probabilities of the response variable and the assumption that there is a linear relationship between the levels of the response variable and a set of independent predictors. Multinomial logistic regression require j-1 equations for j categories giving a cumulative logit function of j-1 times. With respect to this study, since we have three ordered categories hence we require two equations:

$$\ln\left[\frac{p(y=low)}{p(y=normal}\right] = \beta_{0l} + \beta_{1l} + \beta_{2l} + \cdots \beta_{kl}$$

$$\ln\left[\frac{p(y=macrosia)}{p(y=normal)}\right] = \beta_{0m} + \beta_{1m} + \beta_{2m} \cdots \beta_{km}$$

The first equation explains a model for an observation in category of low versus not being in category of normal and the second equation yields a model for an observation being in category of macrosomia versus not being in category of normal.

Likelihood ratio tests

The overall relationship of the model was tested using likelihood ratio tests. This test is based on reduction on the likelihood values for null model and the fitted model. The hypotheses of the test are:

Ho: Null model is a better is a better fit

Ha: Fitted model is a better fit.

The minus twice the difference in the likelihood of the two models was the test statistic which follow Chi square distribution with degrees of freedom equal to the difference in the degrees of freedom between the two models. Significance of the model determined either we accept or reject the null hypothesis and adopt the alternative hypothesis. Mathematically it is expressed as; Likely Ratio Test= -2(log Null- log Fitted model). A significant results indicates that the model is a good fit.

Wald statistics was used to test for individual predictors. The odds ratios and confidence intervals were reported at 95% level of significance. Statistical analyses was conducted using R VERSION 3.6.0 (26-04-2018).

3.7 Ethical Approval

This study was approved by University of Nairobi College of Health Sciences Ethical Review Board and The Nairobi Hospital Research Ethics Committee.

4.0 CHAPTER FOUR: RESULTS

Pregnancy factors affecting neonatal birth weight:**Descriptive results and Pearson's chi test for independence**

4.1 Interpretation of the results

i) Maternal Bio data

Table1A: Distribution of neonatal weight according to parity

Weight Category	Parity			Pearson's Chi
	0	1-3	>3	p= 0.03676
Low	47(8.9%)	57(5.8%)	1(1.8%)	
Normal	455(86.5%)	871(87.9%)	50(89.3%)	
Macrosomia	24(4.6%)	63(6.4%)	5(8.9%)	
Total	526	991	56	

Table 1B: Distribution of neonatal weight according to maternal obesity

Birth Weight	Obesity		Pearson's Chi
	Obese	Not Obese	p≤0.0001
Low	42(5.5%)	63(7.8%)	
Normal	660(86%)	716(88.9%)	
Macrosomia	65(8.5%)	27(3.3%)	
Total	767	806	

Out of a sample of 1573 women who delivered at TNH from 1st of April 2018 to 30th of March 2019.Their median and mean age were 32 and 32.26 years respectively. The minimum age was 19 years and the maximum was 50 years with interquartile rage of 7 years. A total of 526 babies were born to nulliparous women out of whom 8.9% and 4.6% had low birth weight and macrosomia respectively. For women whose parity range from one to three, a total of 991 babies were born out of whom 5.8% and 6.4% had low birth weight and macrosomia respectively. Those whose parity was more than three had a total of 56 babies born out of whom only 1.8% had low birth weight while another 8.9% had macrosomia respectively. As for

obesity, a total of 767 babies were born to obese mothers out of whom 5.5% were classified as low birth weight and another 8.5% as macrosomic. Babies born to mothers who were not obese are 806 out of whom 7.8% and 3.3% were classified as babies with low birth weight and macrosomia respectively. Pearson's Chi-square test for independent association between obesity and parity with neonatal birth weight gave significant results demonstrating that obesity and parity do explain the birth weight of a baby born at TNH.

ii) Pregnancy conditions

Table2A: Distribution of neonatal weight according to maternal diabetes in pregnancy

Weight Category	Diabetes		Pearson's Chi
	Yes	No	p≤0.001
Low	4(16%)	101(6.5%)	
Normal	16(64%)	1360 (87.9%)	
Macrosomia	5(20%)	87(5.6%)	
Total	25	1548	

Table 2B: Distribution of neonatal weight according to maternal preeclampsia

Weight Category	Preeclampsia		Pearson's Chi
	Yes	No	p≤0.0001
Low	23 (28.1%)	82(5.5%)	
Normal	53 (64.6%)	1323(88.7%)	
Macrosomia	6 (7.3%)	86(5.8%)	
Total	82	1491	

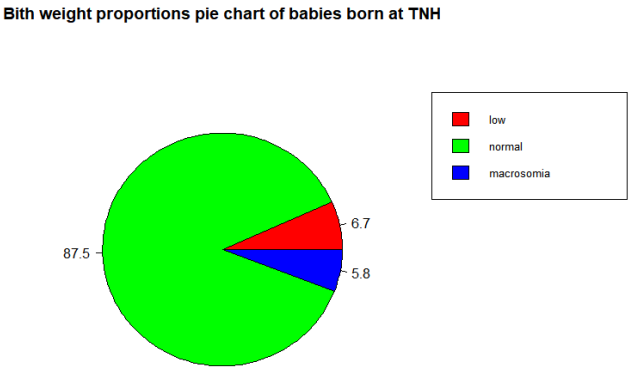
A total of 25 babies were born to diabetic mothers out of whom 16% had low birth weight and another 20% had macrosomia. The number of babies born to non-diabetic mothers were 1458 out of whom 6.9% were classified as low birth weight while another 6.4% as macrosomic. As for mothers with preeclampsia a total of 82 babies were born out of whom 28% had low birth weight and another 7.3% had macrosomia. Mothers without preeclampsia had a total of 1491 babies out of whom 5.5% had low birth weight and another 5.8% had macrosomia. Pearson's Chi-square test for independent association between neonatal birth weight and pregnancy conditions were significant confirming that diabetes and preeclampsia do explain the birth weight of a baby born at TNH.

iii) Neonatal Characteristics

Table 3A: The proportions of babies born at TNH according to neonatal birth weight

Birth weight category	Number	Proportions
low	105	6.7%
normal	1376	87.5%
macrosomua	92	5.8%
Total	1573	100%

Figure 1: A Pie chart on proportions of babies born at TNH with low birth weight, normal weight and macrosomia



Maternity birth register indicated that the number of babies delivered at TNH under the care of hospital team from 1st of April 2018 to 30th of March 2019 were 1785. However files of 212 babies born during the period were not included in the study. They were either unavailable or did not meet the criteria for inclusion in this study. Thus our final sample size was 1573 out of whom

6.7% and 5.8% were low birth weight and macrosomic respectively.The median and mean weight for the babies were 3280g and 3255g respectively. The lowest weight was 1080g and the highest was 5490g with interquartile rage was 580g.

Table 3 C: Distribution of baby sex by levels of weight category

Weight Category	Baby Sex		Pearson's Chi
	Boy	Girl	p≤0.0001
Low	50(6.4%)	55(6.9%)	
Normal	673(86%)	703(88.9%)	
Macrosomia	59(7.5%)	33(4.2%)	
Total	782	791	

Table 3D: Distribution of neonatal weight at birth according to gestation at birth

Weight Category	Gestation at Birth			Pearson's Chi
	Preterm	Term	Post-term	p≤0.0001
Low	73(72.3%)	31(2.4%)	1 (0.5.3%)	
Normal	28(27.7%)	1177(91.7%)	171(91%)	
Macrosomia	0(0%)	76(5.9%)	16(8.5%)	
Total	101	1284	188	

Regarding to sex of the baby, a total of 782 babies born were boys out of whom 6.4% had low birth weight while another 7.5% were macrosomic. The babies born as girls were 791 out of whom 7.0% had low birth weight and another 4.2% were macrosomic. As for gestation, a total of 101 babies were born preterms out of which 72% had low birth weight. Babies who were born at term were 1284 out of whom 2.4% had low birth weight and another 5.9% were macrosomic. There were a total of 188 post-term babies out of which one 0.5% had low birth weight while another 8.5% were macrosomic. Pearson's Chi-square test for independent association between birth weight with baby sex and gestation at birth were significant confirming that both factors do explain the birth weight of a baby born at TNH.

Multinomial Logistic Regression Analysis: Test for significance of predictors

Table 4A. Low birth weight versus normal weight

	coefficients	p-value
Intercept	**1.7199**	
Age	**0.009582**	**0.754**
Parity=(1-3)	**-0.66979**	**0.0380**
Parity=(>3)	**-3.19762**	**0.0078**
Obese	**-0.87178**	**0.0080**
Diabetes	**-0.64974**	**0.4163**
preeclampsia	**1.68693**	**0.00012**
Boy	**-0.35163**	**0.238**
Term	**-4.91476**	**≤0.0001**
Post term	**-6.41025**	**≤0.0001**

Table 4B: Macrosomia versus normal weight

Variable	**coefficients**	**p-value**
Intercept	**-12.04213**	
Age	**-1.48992**	**0.9995**
Parity1	**0.22415**	**0.415**
Parity2	**0.51316**	**0.347**
Obese	**0.88720**	**0.0002**
Diabetes	**1.62626**	**0.0033**
Preeclampsia	**0.40348**	**0.380**
Sex	**0.62058**	**0.0064**
Term	**8.17634**	**≤0.0001**

Post term	**8.64724**	**≤0.0001**

Odds ratios

Table 4C: Low birth weight versus normal weight

Variable	Category	Adjusted O.R	95% C.I	p-value
Age		1.0096	0.951-1.072	0.754
Parity	Ref			
	1-3	0.512	0.272 - 0.963	0.038
	>3	0.041	0.004 - 0.431	0.0078
Obese at 1st ANC	Yes	0.418	0.220 – 0.797	0.008
	No	Ref		
Diabetes	Yes	0.522	0.109 – 2.50	0.416
	No	Ref		
Preeclampsia	Yes	5.40	2.290 – 12.74	0.0001
	No	Ref		
Neonatal sex	Boy	0.704	0.392 – 1.262	0.238
	Girl	Ref		
Age of gestation	Preterm	Ref		
	Term	0.0073	0.0038 -0.0143	≤0.00001
	Post term	0.00164	0.000218 - 0.0129	≤0.00001

Table 4D: Macrosomia versus normal weight

Variable	Category	Adjusted O.R	95% C.I	p-value
Age		0.99998	0.950 – 1.052	0.9995
Parity	0	Ref		
	1-3	1.251	0.730 – 2.146	0.415
	>3	1.671	0.574 – 4.863	0.347
Obese at 1st ANC	Yes	2.43	1.5095 – 3.906	0.0003
	No	Ref		
Diabetes	Yes	5.085	1.715 – 1.508	0.0034
	No	Ref		
Preeclampsia	Yes	1.497	0.086 - 3.682	0.380
	No	Ref		
Neonatal sex	Boy	1.86	1.191 -2.905	0.0064
	Girl	Ref		
Age of gestation	Preterm	Ref		
	Term	355.6	198.5 – 645.4	≤0.00001
	Post term	5.69.4	312.6 -1037.3	≤0.00001

4.2 Likelihood Ratio Test

The model likelihood ratio test p-value <2.2e16*** is less than 0.00001 indicating our model is a good fit. The model has a predictive value of 87.7% thus validating it to be a good predictor for neonatal weight at birth.

4.3 Interpretation of multinomial logistic regression results

4.31 Low birth weight versus normal weight

i) Maternal Bio data

Holding all other variables constant; the odds of a woman delivering at TNH to a baby with low birth weight as opposed to a baby with normal weight increase by 1% for every one year increase in age and at 95% confidence interval the true odds ratio lies between 0.951 and 1.072. This is not statistically significant. As for parity, the odds of a woman whose parity is between one and three delivering at TNH to a low birth weight baby as opposed to a baby with normal weight decline by 49% when compared to a nulliparous woman and at 95% confidence interval the true odds ratio lies between 0.272 and 0.963. This is statistically significant. Likewise the odds of a woman whose parity is more than three delivering at TNH to a low birth weight baby as opposed to a baby with normal weight decline by 96% when compared to a nulliparous woman and at 95% confidence interval the true odds ratio lies between 0.004 and 0.431. This is also statistically significant. At the same time, the odds of an obese woman delivering at TNH to a low birth weight baby as opposed to a baby with normal weight decrease by 58% when compared to a woman who is not obese and at 95% confidence interval the true odds ratio lies between 0.220 and 0.797. This is statistically significant.

ii) Maternal conditions

Holding all other variables constant; the odds of a woman diagnosed with diabetes in pregnancy delivering at TNH to a low birth weight baby as opposed to a baby with normal weight decrease by 48% when compared to a woman who is not diabetic during pregnancy and at 95% confidence interval the true odds ratio lies between 0.109 and 2.50. This is not statistically significant. Similarly the odds of a woman with preeclampsia delivering at TNH to a low birth weight baby as opposed to a baby with normal weight is five times more when compared to a woman without preeclampsia and at 95% confidence interval the true odds ratio lies between 2.29 and 12.74 .This is statistically significant.

iii) Neonatal characteristics

Holding all other variables constant; the odds of a baby boy born at TNH being a low birth weight baby as opposed to a baby with normal weight is 30% less when compared to a baby girl and at 95% confidence interval the true odds ratio lies between 0.392 and 1.262 .This is not statistically significant. As for the status of gestation at birth, the odds of a baby born at TNH whose gestation is term is 99.3% less likely to be a low birth weight baby as opposed to a baby with normal weight when compared to a baby born preterm and at 95% confidence interval the true odd ratio lies between 0.0038 – 0.0143 .This is statistically significant. Similarly, the odds of a baby born at TNH whose gestation is post term is 99.8% less likely to be a low birth weight baby as opposed to a baby with normal weight when compared to a baby born preterm and at 95% confidence interval the true odds ratio lies between 0.000218 – 0.0129 .This is statistically significant.

4.32 Macrosomia versus normal weight

i) Maternal Bio data

Holding all other variables constant; a woman of reproductive age delivering a macrosomia at TNH as opposed to a baby with normal weight is 0.01% less likely for every one year increase of age and at 95% confidence interval the true odds ratio lies between 0.950 – 1.052. This is statistically not significant. Similarly a woman whose parity is between one and three is 25% more likely to deliver a macrosomia at TNH as opposed to a baby with normal weight when compared to a nulliparous woman and at 95% confidence interval the true odds

ratio lies between 0.730 and 2.15. This is not statistically significant. Also a woman whose parity is more than three is 67% more likely to deliver to a baby with macrosomia as opposed to a baby with normal weight when compared to a nulliparous woman at TNH and at 95% confidence interval the true odds ratio lies between 0.574 and 4.863. This is not statistically significant. Likewise, an obese woman at TNH is 43% more likely to deliver to a macrosomia as opposed to a low birth weight baby when compared to a woman who is not obese and at 95% confidence interval the true odds ratio lies between 1.51 and 3.91. This is statistically significant.

ii) Maternal conditions

Holding all other variables constant; the odds of a woman whose diagnosis is diabetes in pregnancy delivering at TNH to a macrosomia as opposed to a baby with normal weight is more than five times when compared to a woman who is not diabetic during pregnancy and at 95% confidence interval the true odds ratio lies between 1.72 and 15.1 .This is statistically significant. Similarly, a woman with preeclampsia is 50% more likely to deliver to a macrosomia as opposed to a baby with normal birth weight at TNH when compared to a woman without preeclampsia and at 95% confidence interval the odds ratio lies between 0.086 and 3.682. This is statistically not significant.

iii) Neonatal characteristics

Holding all other variables constant; a baby boy born at TNH is 86% more likely to be a macrosomic as opposed to being a baby with normal weight when compared to a baby girl and at 95% confidence interval the true odds ratio lies between 1.191 and 2.905. This is statistically significant. Similarly a term baby born at TNH when compared to a preterm baby is 356 times more likely to be a macrosomia as opposed to being a normal weight and at 95% confidence interval the true odds ratio lies between 196 and 645. This results is statistically highly significant. Also a post term baby born at TNH is 569 times more likely to be a macrosomia as opposed to normal weight baby when compared to a preterm and at 95% confidence interval the true odds ratio lies between 313 and 1037.This is statistically highly significant.

4.4 Predicting the probabilities

To predict the probability of birth weight for a term baby whose sex is male delivered at TNH by a 32 year old obese woman with history of preeclampsia and whose previous obstetric history indicate that she has given birth to two babies previously. We use the equations below;

$$\ln\left[\frac{p(y=low)}{p(y=normal)}\right] = \beta_0 + \beta_1 Age + \beta_2 Parity1 + \beta_3 Parity2 + \beta_4 Obese + \beta_5 Diabetes + \beta_6 Preeclampsia + \beta_7 Sex + \beta_8 Term + \beta_9 Posterm$$

$$\ln\left[\frac{p(y=low)}{p(y=normal)}\right] = \beta_0 + \beta_1 Age + \beta_2 Parity1 + \beta_3 Parity2 + \beta_4 Obese + \beta_5 Diabetes + \beta_6 Preeclampsia + \beta_7 Sex + \beta_8 Term + \beta_9 Posterm$$

Where the first equation represent the outcome of a baby with low birth weight relative to a baby with normal weight while the second equation represents the outcome of a baby with macrosomia relative to a baby with normal weight. By applying the above equations the probability that a baby is born with low birth weight or normal weight or macrosomia at TNH is 0.037, 0.818 and 0.145 respectively. This means that there is 82% chance that a baby born at TNH under the given characteristics is likely to be a baby boy with normal birth weight.

5.0 CHAPTER FIVE: DISCUSSION

5.1 Proportions of babies with low birth weight, normal weight and macrosomia at TNH

The proportion of babies with low birth weight, normal weight and macrosomia were 6.7%, 87.5%, and 5.8% respectively. UNICEF (2012) and KDHS (2014) in their survey

estimated the proportion of low birth weight to be 8%. Two studies done separately at KNH gave prevalence of babies born with low birth weight and macrosomia to be 9.9% and 5.4% respectively (Mugambi, 2014; Bunyoli, 2016). A cross-sectional study at Olkalou hospital in Nyandarua County, Kenya estimated the prevalence of low birth weight to be 12.3% (Muchemi, 2015). Muchemi (2015) attributed the high proportion of low birth weight babies to high number of mothers who were below 20 years and malnutrition. In comparison, our study had only 0.4% of the mothers below 20 years of age. The proportion of macrosomia in this study is 5.8% but a study by Bunyoli (2016) at KNH estimated it to be 5.4%. Sanghvi et al. (1989) in a fertility survey study estimated the proportion of macrosomia in Kenya to be 4.2%. Our study at TNH and the study by Bunyoli (2016) at KNH differed by a small margin. However national estimate of macrosomia are lower than the hospital based estimates.

5.2 Low Birth weight versus normal weight

About 73.6% of women who gave birth at TNH during the study period were aged between 20 and 35 years. Those aged 35 years and above were 26%. Only a small proportion of 0.4% were below 20 years. From this study the proportion of low birth weight babies among women below 20 years was 16.7% which is in agreement with studies by (Muchemi,2015;Nirmali,2016; Donzelli et al.,2000).

Several studies have documented maternal age as a significant factor affecting birth weight. Multinomial logistic regression results from our study gave a statistically non-significant results (OR 1.009; 95% CI 0.951 – 1.072, p=0.754). These results are in sharp contrast with studies by (Donzeli et al., 2000; Nirmali et al.; 2016) which demonstrated a significant relationship between maternal age and low birth weight. Donzelli et al.(2000) gave (OR=1.80, 95% CI 1.34=2.43) while Nirmali et al. (2016) gave (OR=3.06 95% CI 1.24 – 3.52). Low proportion (0.38%) of women below 20 years of age could be the reason why maternal age did not significantly influence birth weight in this study.

Obesity has been on the rise in urban areas of Africa (Koyonagi, 2013). This could be attributed to rise in income levels of most families as well as changes in lifestyle patterns owed to increased urbanization. Results from our study indicate that 49% of the women receiving maternity services at TNH were obese. Mkuu (2018) in a prevalence study on obesity in Kenya found the proportion of obese women whose wealth quintile is rich in Nairobi exceed 50%. Our study is in agreement with his finding. The results from multinomial analysis demonstrated a significant association between maternal obesity and low birth weight (OR= 0.418; 95% CI 0.220 – 0.797, p=0.008). However studies by Bunyoli (2016) and Mengesha et al. (2014) reported significant association between maternal obesity and fetal macrosomia. A significant association between maternal obesity and low birth weight baby in our study could be explained by increased delivery of preterm babies as a result of complications associated with obesity such as diabetes and preeclampsia.

Parity has long been known to be an important predictor of baby's birth weight. Low birth weight is observed among neonates born to first time mothers (Koyonagi, 2016; Ramdas, 2018; Tshotetsi, 2019). Many studies have observed that as parity increases there is corresponding increase in weight of newborns (Atuahene, 2015; Bayo, 2016, Bunyoli,2016). This study gave a significant association between low birth weight and parity. Our study demonstrated that mothers whose parity is between one and three had (OR=0.512; 95% CI 0.272 - 0.963, p=0.038) while those whose parity is more than three had (OR= 0.041; 95% CI 0.004 – 0.431, p=0.0078). These results were statistically significant. Donzelli et al. (2000) in longitudinal study to determine factors associated with low birth weight at Nkubu mission hhospital in Meru County, Kenya found that odds of low birth weight baby was 43% lower in multiparous woman when compared to nulliparous woman (OR= 0.57,95% CI 0.42 - 0.77).

The significant finding on parity from this study is in agreement with study by Donszeli et al.(2000) at Nkubu, Kenya. The odds of low birth weight baby as opposed to a baby with normal weight in a woman whose parity between one and three is 49% lower when compared to a nulliparous woman in this study. Similarly, a woman whose parity is more than three is 96% less likely to have a low birth weight baby as opposed to a normal baby. Narwade and More (2018) in a cross sectional study observed significant association between parity and low birth weight. Our study is in agreement with this.

Diabetes has profound effect on pregnancy (Myles, 2016; Mengesha, 2014). Studies have shown that diabetes can complicate pregnancies. Both the mother and the fetus may be affected. Prematurity and fetal macrosomia have been associated with diabetes in pregnancy. Approximately 2.9% of pregnant women receiving antenatal and maternity services in western Kenya had diabetes in pregnancy (Njuguna et al., 2017). Our study found 1.6% of women receiving maternity services at TNH had diabetes in pregnancy. The findings from our study also demonstrated that the odds of a mother with diabetes in pregnancy delivering to a low birth weight baby as opposed to a baby with normal weight is 48% lower when compared to a woman without diabetes in pregnancy (OR=0.522; 95% CI 0.109 – 2.50,p=0.416). This is not statistically significant. It is presumed that antenatal care given to pregnant women at TNH ensures that diabetic mothers achieve optimal control of hyperglycaemia to prevent complications such as preterm labour therefore lowering the chances for low birth weight babies.

Preeclampsia profoundly affect neonatal birth weight. Globally it complicates 3% - 10% of all pregnancies (ALSO, 2014). Many studies have demonstrated significant association between low birth weight and preeclampsia. A significant number of preterm babies are commonly linked to mothers who had preelampsia (Muchemi, 2015). This study found that

preeclampsia affected 5% of all the deliveries at TNH and the proportion of babies with low birth weight born to the mothers with preeclampsia is 28% . Bensal (1985) in a longitudinal study at Pumwani found that prevalence of preeclampsia to be 3.7% and that 23% of babies born to mothers with preeclampsia had low birth weight. The prevalence of preeclampsia in our study is within the WHO global estimates of 2015. The proportion of babies with low birth weight born to mothers with preeclampsia in our study is in agreement with the findings by Bensal (1985) at Pumwani. Multinomial logistic regression results of our study showed that odds of a baby born at TNH to a mother with preeclampsia having low birth weight as opposed to normal weight is 5.4 times higher when compared to a woman without preeclampsia (OR=5.40; 95% CI 2.290 – 12.74; $p \leq 0.00001$). This is statistically significant results.

Birth weight has been consistently higher among boys than girls (Mengesha et al., 2014; Said & Manji, 2016). This is largely attributed this to influence of androgen hormone on foetal body mass. Vazirinejad et al. (2018) in a cross-sectional study in Kerman province, Iran found that a female neonate is at 41% at greater risk of being a low birth weight baby than a male newborn. Muchemi in 2015 in a cross-sectional study at Olkalou hospital, Kenya found female newborn is a significant predictor of low birth weight (OR=2.32; 95% CI 1.15 – 4.70). Donzeli et al. (2000) also found that infant female is a significant factor for low birth weight (OR=1.30; 95% CI 1.12 – 1.53). Our study found that 52% of babies born with low birth weight were girls and 64% of macrosomic babies born were boys. However the odds of low birth weight as opposed to normal weight for a baby boy born at TNH when compared to a baby girl is not statistically significant (OR=0.704;95% CI 0.392 -1.262, p=0.238). The reason behind this could be that boys tend to have higher birth weight than girls.

Preterm babies have been shown consistently to have low birth weight. WHO estimated the prevalence of preterm births to be between 5% and 18% across 184 countries of the world (WHO, 2015). Our study found the proportion of preterm babies delivered at TNH during the study period to be 6.4% which is within the estimates by (WHO, 2015; UNICEF, 2017). Global estimate of low birth weight babies contributed by preterms is 40% (WHO, 2015; UNICEF, 2017). According our study preterms contributed to nearly 70 % of all low birth weight babies born at TNH. This is much higher than WHO global estimates. Our study also demonstrated that the odds of a term baby having low birth weight as opposed to normal weight is 99% less likely when compared to a preterm (OR 0.0073;95% CI 0.0038 – 0.0143, p≤0.0001). Other studies are in agreement with this finding include (Dozeli et al., 2000; Muchemi, 2015; Narwade & More, 2016).

A post term baby is a baby born after gestation at birth has extended beyond 42 weeks. The proportion of low birth weight contributed by post term in this study is 0.53% which is quite low. However post term births contributed to nearly 12% of all births during the period of study at TNH. Post term babies are estimated to be between 3 to 12% of all life births globally (McCaughey, 2016). Our study is in agreement with this. The odds of a post term baby being born with low birth weight at TNH as opposed to normal weight is 99.9% less likely when compared to a preterm (OR 0.000164,95% CI 0.0002 – 0.0128, p≤0.0001). Our finding is in agreement with that of (Mengesha et al., 2014).

5.3 Macrosomia versus normal weight

Maternal age has been documented by many studies to significantly affect neonatal birth weight (Bunyoli, 2016; Koyanagi et al., 2013). However (Mengesha et al., 2014) in a study on factors affecting birth weight in Tigray Ethiopia did not find any statistically significant

association (RRR=0.5; 95% CI 0.48 – 1.20). Our study found (OR=0.999; 95% CI; 0.950 – 1.052, p=0.995). Both studies gave statistically non-significant results.

Parity has been documented by many to be a significant predictor of neonatal weight. However findings from our study did not support this. A study by Bunyoli (2016) at KNH and by Mengesha et al. (2014) in Tigray, Ethiopia found significant association between parity and neonatal birth weight. The odds of a baby being born with macrosomia as opposed to normal weight at TNH by a woman whose parity is between one and three when compared to a nulliparous woman is not significant (OR=1.25,95% CI; 0.730 - 2.15,p=0.415). For a woman whose parity is more than three, the odds of delivering a baby with macrosomia at TNH as opposed to a baby with normal weight is (OR 1.67, 95% CI; 0.574 – 3.91, p=0.347) which is also not statistically significant. This contradicted the study at KNH by Bunyoli (2016) that gave significant results for the two categories of parity (OR 5.04; 95% CI 2.11 – 12.0, $p \leq 0.001$) and (OR= 2.56 95% CI 1.09 – 6.0, p=0.030) respectively. Our study was also not in agreement with studies by Guanghui et al. (2013) and Said and Premji (2016) which found parity of more than three to be a significant factor in macrosomia. A plausible explanation to why our study gave different results from other studies done previously on parity could be that the women receiving maternity care at TNH whose parity was more than three were very few (3.6%) compared to those receiving maternity services at KNH and hospitals in Tigray province of Ethiopia which stood at 23% and 30% respectively (Bunyoli,2016; Mengesha et al.,2014).

About 49% of the women who delivered at TNH in our study were obese. Mkuu et al. (2018) in a prevalence study on obesity found the proportion of women in Nairobi whose wealth quintile is rich was 50%. Our study was in agreement with this. But the proportion of macrosomia at TNH among the obese mothers was 8.5% while non-obese mothers accounted for

only 3.3%. Our study also found that a baby born to an obese mother at TNH is 2.43 times more likely to be a baby with macrosomia as opposed to being a baby with normal weight compared to a woman who is not obese (OR=2.43;CI 1.51,3.91, p≤ 0.001). This is statistically significant. Bunyoli (2016) also found a significant association between obesity and macrosomia (OR=4.04; 95% CI 1.48 – 11.01, p=0.006). A systematic review study in KNH on effects of BMI on baby weight at birth found that 17% of babies with macrosomia were born to obese mothers (Muthoni et al.,2012). They concluded that obesity significantly influenced foetal macrosomia. A study by Gaudet et al. (2014) found significant association between obesity and macrosomia. They also found the prevalence of macrosomia among obese mothers was 15.8%. However this study found that 71% of all the babies with macrosomia were born to obese mothers at TNH. This is much higher compared to studies by Guadet et al. (2014) and Muthoni et al. (2012). The disparity between our study and the two studies could be explained by high proportion of obese women seeking delivery services at TNH which stood at 49%.

About 1.6% of the women who delivered at TNH during the period of study had diabetes in pregnancy. The proportion of macrosomia among babies born to mothers with diabetes in pregnancy was 20%. Women who had no history of diabetes had 5.6% of their babies macrosomic. Khan and Shakya (2015) in their study on relationship between diabetes in pregnancy and foetal macrosomia found that macrosomia occurs in 12% of newborns of women without diabetes and 15-45% of women with diabetes in pregnancy. Our study is in agreement with this. It can be concluded that diabetes in pregnancy increases the incidence of foetal macrosomia.

Multinomial regression analysis results revealed that odds of a woman with diabetes in pregnancy delivering a baby with macrosomia as opposed to a baby with normal weight is five

times higher when compared to a woman without diabetes (OR=5.085; 95% CI 1.715 - 15.08, p=0.003,). Our study findings is in agreement with studies by (Bunyoli, 2016; Gaudet et al; 2014; Koyanagi et al., 2013; Said and Premji, 2016) which also gave statistically significant results on association between diabetes in pregnancy and macrosomia.

Preeclampsia reduces uterine blood supply critically limiting the foetus of oxygen and nutrient supply from the placenta resulting in reduced foetal growth and increased complications. Low birth weight is a significant neonatal outcome in preeclampsia (Mugambi, 2014 ; Say et al., 2014). In our study, about 5.8% of the babies born at TNH were macrosomic out of whom 6.5% were born to mothers with preeclampsia while the majorities (93.5%) were born to mothers without preeclampsia. The proportion of macrosomia among babies born to mothers with preeclampsia was 7.3%. Our study also found the odds of baby with macrosomia as opposed to normal weight delivered by a woman with preeclampsia at TNH is 50% more compared to a woman without preeclampsia (OR=1.497; 95% CI 0.086 – 3.682, p=0.380). This is not statistically significant.

Our study findings are in agreement with the studies by (Mengesha et al., 2014; Hamilton et al., 2016) which also gave non-significant results.

Birth weight has been consistently shown to be higher among boys than girls (Mengesha et al., 2014). Although this study did not consider the mean weight for the boys and girls born during the study period, the number of macrosomic babies belonging to each sex was considered. The proportion of macrosomia among the baby girls and boys were 36% and 64% respectively. Bunyoli (2016) in a case control study at KNH obtained the proportion of macrosomia among girls and boys to be 32.5% and 63.7% respectively. Our study is in agreement with the findings from his study. Our study also found that the odds of a baby boy born at TNH being a

macrosomia as opposed to being a baby with normal birth weight is 1.86 times more compared to a baby girl (OR 1.86; 95% CI 1.19 – 2.90, p=0.006). However the study by Bunyoli (2016) at KNH demonstrated that a male baby was 3.6 times more likely to be macrosomic than female baby (OR 3.6; 95% CI 2.0 - 6.5, $p \leq 0.001$). Both studies gave statistically significant results. The significant results were largely attributed to influence of hormone testosterone on foetal body mass.

The gestation at birth was classified into preterm, term and post term as stated in the variable definition. Preterm baby is a baby born before 37 completed weeks of gestation. A post term baby is defined as a baby whose gestation at birth has extended beyond 42 weeks. Globally, post term babies make up 3 to 12% of all life births (Gaudet et al., 2014). Our study found that the proportion of macrosomia among term and post term babies to 5.9% and 12% respectively. Multinomial analysis revealed that the odds of a term baby born with macrosomia at TNH as opposed to being a normal weight baby was 356 times higher compared to a preterm baby and at 95% confidence interval the true odds ratio lies between 199 - 845 ($p \leq 0.00001$).This is statistically highly significant results.

For a post term baby born at TNH the odds of being a macrosomia as opposed to being a normal weight at birth was 569 times more compared to a preterm baby and at 95% confidence interval the true odds ratio lies between 313 to 1037($p \leq 0.00001$). This is also statistically highly significant results. These very high odds ratios in the two categories of neonatal weight at birth could be attributed to absence of macrosomia among babies born as preterm. Our findings concurred with studies by (Koyanagi et al., 2016; McCaughey, 2016; Said & Manji, 2016; Mengesha, 2014).

5.4 Conclusion

This study found the proportion of babies with low birth weight and macrosomia at TNH to be 6.7% and 5.8% respectively. Previous studies at KNH indicated the proportions of babies born with low birth weight and macrosomia to be at 9.9% and 5.4% respectively (Mugambi, 2014; Bunyoli, 2016). However the national prevalence of low birth weight and macrosomia stood at 8% and 4.2% respectively (KDHS, 2014; Sanghvi et al., 1989). By comparison, the proportion of low birth weight babies at TNH was lower than the national average. The proportion of macrosomia at TNH does not differ much from the findings at KNH by Bunyoli et al. (2016). However the proportion of babies born with low birth weight differ widely between the two institutions. The results of our study identified maternal obesity, diabetes in pregnancy, preeclampsia, gestation at birth and neonatal sex as significant pregnancy factors affecting both low birth weight and macrosomia at TNH. Our findings are in agreement with many local and international studies on neonatal birth weight.

Multinomial logistic regression is a versatile statistical tool that can not only be used to analyze nominal response but also analyze ordinal response if proportional odds model violates the assumption of parallel regression and still give good predictions.

5.5 Recommendations

1. This study found that 49% of mothers who delivered at TNH were obese at their first ANC visit. Obesity adversely affects pregnancy outcomes. Urgent solutions are required to address the problem of obesity among women seeking antenatal and maternity services at TNH and other hospitals within Nairobi.

2. More studies to assess for the magnitude of maternal obesity, diabetes in pregnancy, preeclampsia and gestation at birth on their contribution to low birth weight and macrosomia at hospitals within Nairobi and nationally.
3. MLR is a versatile statistical tool that should be advocated for use in epidemiological studies in health despite its rigors and difficulty in interpretation of its output.

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7.0 APPENDICES

7.1 Appendix 1: Time Lines

Year	2019											2020					
Month	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
Event																	
Proposal Writing																	
Proposal Defense and Corrections																	
Proposal Corrections																	
Presentation to Ethical Committee																	
Data Collection																	
Data Analysis																	
Correction and Project Writing																	

7.2 Appendix 2: Budget

	Component	Quantity	Cost	Total in KSh.
1	Research assistant	3	15,000	30,000
2	Printing	3	2,000	6,000
3	Consent form	1	3,000	3,000
4	Check lists	20	10	200
5	Final Report	1	1,000	1,000
9	Transport & expenses	-	2,000	2,000
	Total			**42,200**

7.3 Appendix 3: Nairobi Hospital Bioethical Request Letter for the Research Proposal Approval

John Chelanga Supra
School of Nursing
P.O. Box 300026-00100
NAIROBI
Mobile: 0728400648
Date: 23-11-2019.

The Chairman,
The Nairobi Hospital Bioethical Committee
P.O. Box 300026-00100
NAIROBI

Dear Sir,

REF: REQUEST FOR RESEARCH PROPOSAL APPROVAL

I hereby request for your permission to carry out research on relationship between neonatal birth weight at birth and a set of pregnancy factors at The Nairobi Hospital Maternity.

I intend to collect data from maternity records on the above from 1st of April 2018 to 30th of April 2019.The data will form the sample frame to draw the study sample.

This study will be a partial requirement for Master's degree in Medical Statistics.

I attach to the letter the research proposal for the study for your interrogation.

I look forward for positive response.

Yours faithfully,
Mr. John Chelanga Supra

7.4 Appendix 4: Nairobi University Bioethical Request Letter for the Research Proposal Approval

John Chelanga Supra
School of Nursing
P.O. Box 300026-00100
NAIROBI
Mobile: 0728 400648
Date: 23-11-2019.

The Chairman
University of Nairobi Bioethical Committee
P.O. Box 19676-00202
NAIROBI

Dear Sir,

REF: REQUEST FOR RESEARCH PROPOSAL APPROVAL

I hereby request for your permission to carry out research on relationship between neonatal birth weight and a set of pregnancy factors at The Nairobi Hospital Maternity.

I intend to collect data from maternity records on the above from 1st of April 2018 to 30th of April 2019.The data will form the sample frame to draw the study sample.

This study will be a partial requirement for Master's degree in Medical Statistics.

I attach to the letter the research proposal for the study for your interrogation. I look forward for positive response.

Yours faithfully,

Mr. John Chelanga Supra

7.5 Appendix 5: Structured Checklist for Data Collection

A modified structured checklist developed and tested previously by Lema Deselegn Hailu and Deresse Legesse Kebede in 2017.

A: Maternal Biodata

ID----------

1: Age of the mother in years ……..

2: Obese at 1st ANC visit

Code	Indicate appropriate category
0	No
1	Obese

3: Parity

Code	Indicate appropriate category
0	0
1	1-3
2	>3

C: Pregnancy Condition

Code		Code	
		Yes	No
1	Diabetes	1	0
2	Preeclampsia	1	0

D: Neonatal Characteristics

1: Sex of the neonate

Code	Sex
0	Girl
1	Boy

2: Birth weight in grams

Code	Indicate the appropriate category
0	<2500
1	2500-<4000
2	4000=<

3: Gestation at birth

Code	Indicate the appropriate category
0	Preterm
1	Term
2	Post Term