GESTATIONAL DIABETES EXPOSURE FACTORS AND ASSOCIATED HEALTH RISKS IN MOTHERS ENROLLED FOR ANTENATAL CLINIC AND NEONATES PAIR IN NAIROBI COUNTY.

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Gestational Diabetes Exposure Factors and Associated Health Risks in Mothers Enrolled for Antenatal Clinics and Neonate Pairs in Nairobi County

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DECLARATION

This thesis is original work and has not been presented for a degree in any other university

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DEDICATION

This work is dedicated to all mothers who have to undergo the life threatening process to bring another life that is important to advance the survival of human race.

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ACRONYMS AND ABBREVIATIONS

ADA	American Diabetes Association
ANC	Ante Natal Clinic
BMI	Body Mass Index
BP	Blood Pressure
CS	Cesaren Section
GDM	Gestational Diabetes Mellitus
CVD	Cardio Vascular Disease
EPH	Essential Package for Health
HAPO	Hyperglycermia and Adverse Pregnancy Outcome
HDL	High Density Lipoprotein
HBP	High Blood Pressure
IDF	International Diabetes Federation
IGT	Intolerance Glucose Test
KG	Kilo gram
KDHS	Kenya Demographic Health Survey
KNH	Kenyatta National Hospital
MCH	Maternal and Child Health
MFL	Master Facility List
MNH	Maternal and Neonatal Health
MoH	Ministry of Health
NCDs	Non- Communicable Diseases
NGOs	Non-Governmental Organizations
OR	Odds Ratio
OGTT	Oral Glucose Tolerance Test
PNC	Post Natal Care
TPF	The Pregnancy Foundation
UNFPA	United Nation Population Fund
UN-HABITAT	United Nations Human Settlements Programme
WHO	World Health Organization

DEFINITION OF OPERATIONAL TERMS

Episiotomy	It is a process of aiding birth process by making a cut on the perineum
Health Outcome	Measures of a patient's symptoms, overall mental state, or the effects of a disease or condition.
Hyperglycemia	A health condition characterised by high sugar in the blood
Incidence	Number of new GDM cases among mothers attending antenatal Clinic
Infant	A new born who is between 0-3 years old
Macrosomal	It is condition in which birth weight of a new born is elevated
Neonate	A new born who is 0- 28days old
Perinatal	This is period between two months before and one month after birth
Pre-eclampsia	A condition during pregnancy when there is a sudden, sharp rise in blood pressure, swelling of the food, hands and face.
Prevalence	All cases of GDM cases (existing and new) over a total projected population of mothers attending Antenatal Clinic
Third Trimester Pregnancy	This a period between 32- 40 weeks of Pregnancy

ABSTRACT

Globally its is estimated that 7% to 9% pregnancies become complicated as result of Gestational Diabetes Mellitus (GDM), this accounts for approximated 200,000 cases reported annually around the world (Terrie, 2009). Kenya continue to report worrying statistics with approximately 1.8 million young population suffering from diabetes and the latest diagnosis in much younger cases of infants creates the need for an investigation to be conducted to identify predisposing factors that need modification for improvement of health outcomes in mothers and neonates. Gestational diabetes may result to serious health consequences for both the mother and infant making it a challenge to reduce maternal and child mortality as stipualted in the Sustanable Development Goals. Thus, the objective of the study was to establish gestational diabetes exposure factors and the associated health risks in mothers and neonates enrolled for antenatal clinics Nairobi County. The study variables were exposure factors, maternal health outcomes and neonatal birth weight in relation to GDM condition. An ambidirectional cohort study was conducted among 238 women attending antenatal clinic in selected health facilities in Nairobi and were on the third trimester of the pregnancy. Data was collected using semi-structured interviewer administered questionnaires, conducted laboratory tests for GDM case ascertainment and anthropometric measurements were taken for BMI estimation. State version 13 was used to derive descriptive statistics for respondents' characteristics. Odds ratio, univariate and multivariate logistic regression was calculated to determine the association of GDM and health outcomes in maternal and neonates. The study findings indicated that mothers who had diabetic history in the family had twice the risk of developing GDM [OR= 2.27; 95% C.I**:**1.23-4.17] compared to those who did not observe diabetic history in the family. The average age for mothers with GDM was high with a mean of 33.06 years compared to a mean of 27.9 years among non-GDM mothers.Mothers with GDM had above normal BMI (overweight and obese) at 54.55% and 24.24% respectively compared to non-GDM with 35.12% and 0.6% in the category of overweight and obese respectively.Further, the results indicated that mothers with GDM are four times likely to experience high frequency of urination [OR = 4.33; 95% C.I**:** 1.14-16.47], three times high volume of urine [OR = 3.65; 95% C.I**:** 1.12-11.93] while episiotomy mode of delivery [OR=0.29; 95% C.I**:**0.10-0.85] and rough skin texture [OR=0.17; 95% C.I**:**0.077-

0.385] showed negative association but significantly common among GDM mothers [P-value <0.05].Lastly,results indicated that neonatal birth weight was high among mothers with GDM 44[66.67%] compared with 59[34.71%] for mothers with no GDM.In conclusion the study suggested that age, weight and diabetic history are risk factors in GDM condition, pregnancy and delivery complications is significanty common among GDM mothers and large- for –age babies phenomena is significantly high among mothers with GDM. To generally improve maternal and child health, there is need to advocate for inclusion of diabetes screening and Nutrition clinics in MCH and Essential Health Services Package for the country to realise Sustainable Development Goals and Vision 2013.

Key Words: Gestational Diabetes Mellitus, Perinatal Health Outcome, Antenatal Clinic, and Nairobi

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Global statistics indicate that at least 285 million people worldwide have diabetes, it is estimated that the figure is likely to be more than double by 2030 (The Pregnancy Foundation, 2014). These facts and figures give an indication of current and future disease burden as a result of diabetes and other emerging non communicable disease that are already threatening the survival and general wellbeing of the population socio-economically.

World Health Organization (WHO) projects that diabetes deaths will increase by more than 50% by the year 2020, if urgent action is not put in place to reverse the trends by addressing nutrition and lifestyles that put populations at risks(World Health Organization & International Diabetes Foundation, 2014). Further, the report indicates that diabetes deaths are projected to increase by over 80% notable in upper-middle income countries between 2006 and 2015 (Zeng,2014)

Approximately 7% of all pregnancies are complicated by Gestational Diabetes Mellitus (GDM); defined as any degree of glucose intolerance with onset or first recognition during pregnancy(Rajput, Yadav, Nanda, & Rajput, 2013).GDM Pregnancy complications have resulted to more than 200,000 cases being reported annually. The prevalence may range from 1 to 14% of all pregnancies, depending on the population studied and the diagnostic tests employed (The Pregnancy Foundation, 2014).

In order to tackle the systemic issue of human race survival, GDM needs to be addressed in integrated and scaled up approach to be able to reverse current trends of disease burden including maternal and neonatal mortalities. Generally, major birth defects are the leading cause of perinatal mortality in pregnancies complicated by pregestational diabetes also known as GDM (Balaji *et al*., 2014)

The presence of fasting hyperglycaemia (>105 mg/dl or >5.8 mmol/l) may be associated with an increase in the risk of intrauterine fetal death during the last 4–8 weeks of gestation(Hartling et al., 2012).The outcome of GDM in population is of greater magnitude touching on maternal and neonatal health both on short and long term basis. Short-term effects of GDM may include; foetal macrosomia, neonatal hypoglycaemia, jaundice, polycythaemia and hypoglycaemia. Other conditions associated with long term effect are;-increased risk for the development of type 2 diabetes after pregnancy while for the Offspring of women with GDM are at increased risk of glucose intolerance, obesity and diabetes in late adolescence and young adulthood(Case, Willoughby, Haley-Zitlin, & Maybee, 2006; Foster *et al*., 2003).

The sudden upsurge of diabetes among Kenya's young population is estimated at about 1.8 million people living with diabetic condition (Obiria, 2012). The souring numbers and the latest diagnosed case in a four-month baby and being the youngest case that has ever been recorded in Kenya, has pushed the bar for an investigation to be conducted to provide information on predisposing factors that need modification that is specific to pregnancy. Reviewed studies also indicate that there is likelihood that future generations have chances of developing obesity and other non-communicable health problems that are mostly determined in the womb hence the interest in studying gestational diabetes and the associated health risks(Chu et al., 2007).

1.2 Problem Statement

Statistics from 2010 WHO report show that an estimated 285 million people have diabetes globally adding to the already high prevalence non-communicable diseases that has increasingly become a public concern due to economic burden posed to households and national development. In relation to health concerns, significant proportions of pregnancies at approximately 7% are complicated by GDM ranging from birth defects to perinatal mortalities across the world(Sattar & Greer, 2002). Studies undertaken using cross-sectional study designs were unclear whether history of GDM increases risk in pregnancy and subsequently metabolic disorders. This

association was not clearly established due to the fact that previous studies lacked biochemical screening for metabolic diseases before and after pregnancy(The HAPO Study Cooperative Research, 2008). Further, systematic review of researches already done in Eastern and Central Africa also indicates that a little is known about GDM and highlights the need for further research(Macaulay, Dunger, & Norris, 2014). Therefore, it is essential that the extent of GDM be understood in Africa and particularly in Kenya to allow for effective intervention programme.

1.3 Justification

Scanty research and little information among health workers, policy makers and population at large about GDM could be the course of "silent deaths" among mothers and neonates. Availability of research information and Knowledge sharing is a driver of GDM Management. More so because GDM is becoming common and clinically important in determining health outcome in mothers and neonates(The Pregnancy Foundation, 2014)

Screening and accurate estimates of GDM prevelence rates is necessary in achieving positive clinical outcomes through evidence based cost effective intervention. Unavailability of GDM related data has been a hindrance in policy enactment especially in routine screening in Maternal and Child Health Clinics(MCH) and Integration of GDM management in Essential Package for Health (EPH), A key aspect needed towards realization of SDG goal 3 targeting to reduce maternal and infant mortalities.

In the developing countries, Kenya included; where little is known about GDM, there is confusion in the management of GDM patients. This challlenge percolates through health system ,lack of guidelines and policies related cases management of emerging NCDs and other infectious conditions. It is no wonder GDM has become a much neglected medical condition in this country despite being the most common metabolic medical disorder in pregnancy.

In addition, the issue of universal versus selective screening still arises based on the fact that the 5th international conference on GDM divided the risk factors into groups

i.e. low, average and high risk group. WHO recommends routine screening for those in the average and high risk group. Patients in Kenya fall into the average risk group by virtue of being African, thus is it prudent to carry out universal screening following WHO recommendations. The recommended directive is far from being actualised considering contextual factors and resource constraints in developing countries.

Previous studies show that in Nairobi, pregnant mothers attend ANC for the first time during second trimester of pregnancy falling between 26-28 weeks . A number of studies elsewhere around the world have established that not all patients with GDM have risk factors. Based on these two facts, it would be convenient to initiate diabetes screening within the same period for all mothers attending ANC. The screening process would then be important for health sector that has an important agenda of meeting the needs of population with consideration of local contextual factors specifc to in Nairobi, with cosmopolitan characteristic as salient feature that represents the general population of Kenya

Most health facilities or hospitals in developing countries around the world , it is noted that screening for GDM is also not part of routine antenatal profile carried out, despite being a good entry point from where health professionals would be able to access future risk of developing diabetes mellitus and complications in pregnancy.There is also no standardization in the process of GDM screening.

American Diabetes Association(ADA) recommends that for high risk population, it is advisable to perform a 100g Oral Glucose Tolerance Test(OGTT) for diagnosis of the disease. This is not applicable in this setting due to the costs involved in doing this to the patients and the associated lower specificity and sensitivity with this is mind then the need to do a study on the usefulness of the Glucose challenge test as a screening test for GDM was noted (Nyakundi & Qureshi 2014).

The results from this study was important in providing information that guides health providers to know as to whether one should still rely on risk factors to screen for GDM or does one change to the alternative method. There are other studies done in Kenya surrounding the issues of appropriate screening technology and

establishment of prevalence of glucose intolerance among population which is estimated at 30% with little information on contextual exposure and health risks in mothers and neonates.

1.4 Objectives

1.4.1 Broad objective:

To establish gestational diabetes exposure factors and associated health risks in mothers and neonates enrolled for antenatal clinics in Nairobi County

1.4.2 Specific Objectives

1) To establish exposure factors associated with GDM among mothers enrolled for ANC in Nairobi County
2) To determine maternal health complications among GDM mothers compared to non GDM mothers
3) To determine the proportion of high birth weight in neonates among mothers with GDM compared to non GDM mothers

1.4 Research Questions

1) What are the exposure factors associated with GDM among mothers enrolled for ANC in Nairobi County?
2) What are the maternal health complications among mothers with GDM in comparison with non-GDM mothers?
3) What is the proportion of high birth weight in neonates among mothers with GDM Condition in comparison with non-GDM mothers?

1.5 Scope of the Study.

The study focused only biological inherent factors as risks factors that lead to development GDM condition. In relation to outcomes associated with GDM in both mothers and neonates, the study was limited to short term complications. For

mothers, the variable under investigation was restricted to symptoms during pregnancy, birth time , delivery mode. On neonates the study was restricted tovariable such as weight and symptoms that presented within 28 days after birth.

The primary target population was wide considering the reproductive age being 15-49 Years, with total fertility rate is 3.9 births per woman(KNBS, 2010). The study used probability-sampling approach to select a representative population. A total of 10 facilities were selected from Master Facility List (MFL) comprising of public and private entity facilities and only women attending ANC were included in the study.

1.6 The Study Limitation

Achieving adequate sample took longer period due to limitations in resources for screening glucose intolerance , in the process refering patients for test significant number did not return to partcipate in the study.

Among those that enrolled for study , some were lost during follow up because either they did not attend Post Natal Care (PNC) in the same facilities they were enrolled for ANC. Others did not respond to phone calls for unknown reason despite several attempts and the last category were those that relocated and could not be reached because of limitation of research resource. At sampling stage, 10% attrition was catered for to compensate for loss to follow up and thus the study finding still considered valid and generalizable.

Standardisation in screening for GDM was another limitation, the research projet banked on facilities/hospital within the study site or outside health facilities laboratiries where pregnant women chose to gor test to ascertain GDM condition. This might have affected precison of test conducted. The researcher, thus recommends that furture studies factors in screening resource to improve results and achieve effeciency in research process.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The 2008 WHO report indicate that 36 million out of the 57 million total deaths that occurred globally are as a result of NCDs encompassing diabetes, cardiovascular, cancers, diabetes and chronic lung diseases(WHO, 2010). Other reports reiterates the fact that the combined burden of these diseases is rising fastest among lower-income countries where the NCD's are also imposing large, avoidable costs for households and national level (Chu *et al*., 2007)**.** Similarly, WHO statistics projects that; NCDs will be responsible for a significantly increased total number of deaths by 15% in the next decade (2010-2020), which is equivalent to 44 million deaths. The greatest increases will be in the WHO regions of Africa, South-East Asia and the Eastern Mediterranean, where they will increase by over 20% (Azevedo & Alla, 2008).

Mortality and morbidity data reveal increased and disproportionate impact of the epidemic specifically in lower- resource settings with approximately over 80% of CDV and diabetes deaths, and near 90% of deaths are as a result of chronic obstructive pulmonary disease, which is confirmed to have occurred in low- and middle-income countries. More than two thirds of all cancer deaths occur in low- and middle-income countries. NCDs are also now causing deaths in much younger population in low- and middle-income countries, where 29% of NCD deaths occur among people under the age of 60, compared to 13% in high-income countries. The estimated percentage rise in cancer incidence by 2030, compared with 2008, will be greater in low by 82% and lower-middle-income countries by 70% compared with the upper-middle at 58% and high-income countries at 40% (WHO, 2010).

Diabetes was essentially unknown in Africa in 1901, yet in 2013 19.8 million people were reportedly living with the condition and this number is predicted to increase to 41.5 million in 2035 equating to a 109% increase (Macaulay *et al*., 2014). In Kenya and other parts of Africa little is known about GDM, prevalence estimates are

unavailable and as such planning and resource allocation remains enormous challenge hence efforts are needed to make data available for evidence based programming and resources allocation that would potentially lead to meaningful gain in the effort to reverse the increasing trend of non-communicable diseases. Globally, it is estimated that 7-9% pregnancies become complicated due to GDM, this accounts for approximately 200,000 cases annually. Gestational diabetes became apparent between 24 to 28 weeks of pregnancy. The GDM condition if left unattended during pregnancy may results to both maternal and perinatal complications(Yvette C. Terrie, 2015)

2.2 Theoretical Review and Conceptual Framework

Several risk factors are associated with the development of GDM. The most common risk factors include a history of macrosomia (birth weight > 4000 g), being a member of an ethnic group with a higher rate of type II diabetes, polycystic ovarian syndrome, essential hypertension or pregnancy-related hypertension, strong family history of diabetes specifically in first-degree relatives, obesity with pregnancy weight > 110% of ideal body weight or body mass index [BMI] > 30), age older than 25 years, persistent glucosuria, and a history of GDM in a previous pregnancy. However, in some cases Upto 50% there are no known risk factors are identified in patients with GDM (Saterre *et al*.,2015)

Complication during pregnancy at birth and after birth may include abruption placenta, preterm labor, postpartum uterine atony depending on health condition of the mother when GDM or Non GDM. Congenital anomalies do not occur at an increased rate in patients with GDM. In some cases stillbirth can occur when glucose control is poor.

Macrosomia, if it occurs, typically becomes evident at 26 to 28 weeks gestation. Complications associated with Macrosomia include fetopelvic disproportion leading to operative delivery, shoulder dystocia, and neonatal hypoglycemia. Others conditions although uncommon that may be experienced in GDM condition include

hyperbilirubinemia, hypocalcaemia, respiratory distress syndrome, and polycythemia in the neonate. (TPF, 2014)

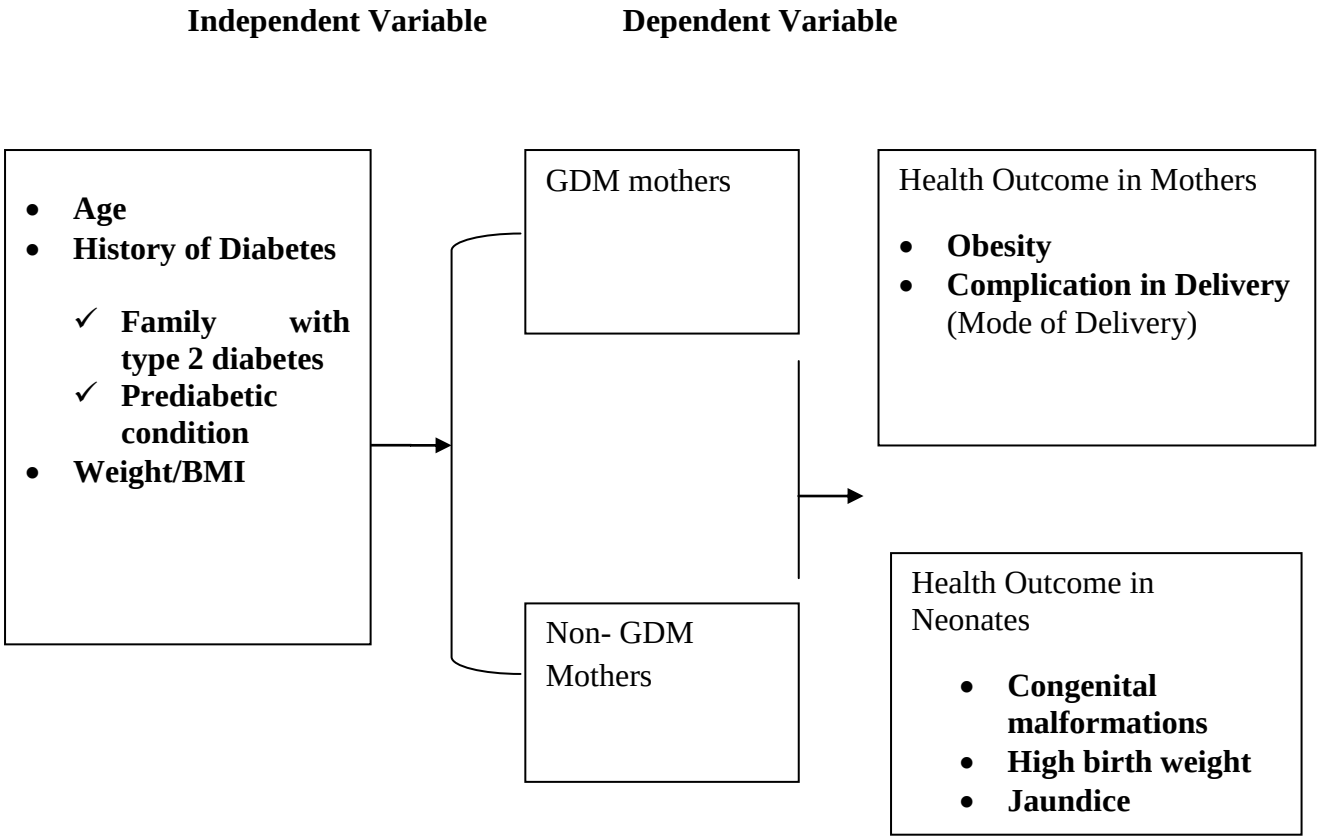

Figure 2. 1: Conceptual Framework

2.4 Prevalence of Gestational Diabetes

Year 2007 data show that gestational diabetes mellitus (GDM) prevalence has increased by approximately 10-100% in the past 20 years. A true increase in the prevalence of GDM, aside from its adverse consequences in new-borns might also reflect or contribute to the current patterns of increasing diabetes and obesity, especially in the offspring. The frequency of GDM is a usually reflection of type two

(2) diabetes in the underlying population. The risk factors associated with GDM are advanced maternal age, obesity, and family history of diabetes(Ferrara, 2007).

Most studies expressed difficulties in assessing trends in GDM prevalence important issues raised in studying trends in GDM included issues such as definition of GDM, which has been described as carbohydrate intolerance of varying degree of severity with onset or first recognition during pregnancy(Case *et al.*, 2006). The definition in itself makes it difficult when it comes to distinguishing between undiagnosed diabetes existing before pregnancy and hyperglycaemia induced by pregnancy. The other reasons for this difficulty are the facts that women in childbearing age are usually not screened for diabetes and therefore tests done at pregnancy could not establish the onset of glucose intolerance. However, this was ruled as studies indicated that unrecognized diabetes before pregnancy could be ruled out in women with abnormal glucose tolerance during pregnancy if glucose tolerance was shown to return to normal at postpartum after tests were conducted (Ferrara, 2007).

Evidence from several studies show that GDM is a problem that affects a significant number of women during pregnancy. GDM can pose a lasting health impacts on both the mother and the fetus. In order to reverse and minimize potential complications to both mother and child, screening, diagnosis, and management of hyperglycemia are critical. There is still work to be done to gain a better sense of what screening protocols are most efficacious and cost effective, and when they should be administered (Bird, Gilmartin, Ural, & Repke, 2008).

2.5 Predisposing risk in diabetic condition

In Africa, the movement from a rural lifestyle to a more industrial urbanized way of life is largely responsible for the evolving problem of chronic diseases such as diabetes and other NCDs (Macaulay *et al.*, 2014).

A number of factors are associated with development of GDM. Most commonly known risk factors include; ethnic group of origin who are likely to be victims of type II diabetes, history of macrosomia (birth weight above 4kg, polycystic ovarian

syndrome, essential or pregnancy related hypertension, history of spontaneous abortion and unexplained still births, strong family history of diabetes specifically at first degree relatives(Bird *et al*., 2008).

A prospective cohort study indicate that women with low risk lifestyle before pregnancy such as health body weight/BMI, consumers of healthy diet, active lifestyle and not smoking had lower risk of gestational diabetes The population attributable risk percentage for smoking, inactivity, overweight or obese, and poor diet in combination was 48%. A similar population attributable risk percentage was observed when we derived it based on distributions of the four low risk (Zhang, Cuilin, Deirdre K Tobias, Jorge E Chavarro Wei Bao Dong Wang research, Sylvia H Ley, 2014)

According to Mayo Clinic (http://www.mayoclinic.org/), any woman is at risk of developing gestational diabetes but some have a higher risk than others. Women older than 25 years have increased risks, other factors such as family or personal history is also a determining factor to the development of GDM condition. A pregnant woman has increased risk if she has pre-diabetes condition; a precursor to type II diabetes or if a close family member, such as a parent or sibling, has type II diabetes. Being overweight before pregnancy and having delivered a very large baby or had a stillbirth is also thought to be a factor that increases risk of developing gestational diabetes. (Alexander, 2015).

Another prospective cohort study concluded that although the overall intake of pre pregnancy dietary fat was not associated with risk of GDM, intakes of dietary cholesterol and animal fat were related to elevated risk in- dependent of other major dietary and non dietary risk factors of GDM. Other researches need to be done to confirm these findings and to discern underlying molecular mechanisms. Of more importance, these findings underline the potential importance of considering the fatty acid content of diet in dietary recommendations for the prevention of GDM (Bowers, Tobias, Yeung, Hu, & Zhang, 2012).

2.6 GDM associated maternal health outcomes

Research done in the United States show that over 8 million women have pregestational diabetes. In this population, it is estimated that approximately 1% of all pregnancies are complicated by GDM resulting to injuries and major birth defects, which is the leading cause of perinatal mortality in pregnancies values (The Pregnancy Foundation, 2014). In review of population welbeing, a key factor underlying cardiovascular disease and, in particular, coronary heart disease, is the metabolic syndrome. The metabolic syndrome is a spectrum of metabolic abnormalities associated with insulin resistance manifesting itself as relative hyperglycemia, hyperlipidemia, and disturbance of coagulation. The normal physiological response to pregnancy represents a transient excursion into a metabolic syndrome in which several components are acquired: a relative degree of insulin resistance, definite hyperlipidemia, and an increase in coagulation factors. Metabolic changes of pregnancy, which is likely to be as a result of hormonal changes, either direct or indirect, through regulation of early, fat acquisition and its rapid mobilization in the second half of pregnancy. Such metabolic responses could be considered as "stress" tests of maternal carbohydrate and lipid pathways and vascular function. In this way, adverse pregnancy outcome may be an indicator of increased risk of metabolic and vascular diseases in later life(Chasan-Taber, 2015).

GDM has both short and long term adverse effect on health outcome. Generally, women with history of GDM have elevated Cardio Vascular Disease (CVD) including high blood pressure, triglyceride level and lower HDL.A Systematic Review reveal that type 2 diabetes develop within 5years after GDM pregnancy including rapid changes in CVD risk factors (Chasan-Taber, 2015).

Women with GDM experience twice the number of urinary tract infection compared to women without GDM condition; this is attributed to increased amount of glucose in the urine above the normal glycosuria. Other complication may include an increased risk of pyelonephritis, asymptomatic bacteriuria and preeclampsia. GDM may further complicate pregnancy and birth process such as increased risks of polyhydramnios that may result in increased risk of abruption of placentae, preterm labor and postpartum uterine atony (Bird et al., 2008)

2.7 GDM Health Outcomes in neonates

GDM condition in pregnant women increased risk level of birth defects of up to 20% or more. Diabetic ketoacidosis occurs in 5-10% of pregnant women with type I diabetes, and stillbirth can occur in up to 10% of cases when this occurs. Further, there is strong evidence that women with GDM are more likely to give birth to macrocosmic or large-for-gestational-age infants this gives evidence of a positive correlation between maternal blood glucose levels and increased birth weight, and treating glucose levels during pregnancy can reduce the risk of macrosomia(The Pregnancy Foundation, 2014.)

GDM may result fetopelvic disproportion leading to caesarian delivery and shoulder dysticia leading to injuries of both the mother and baby. In some circumstances, neonates have increased risk of hypoglycemia, increased incidence of hyperbilirubinemia, respiratory distress syndrome and polycythemia. Moreover, infants of women with GDM have a higher prevalence of overweight and obesity, impaired motor functions and higher rates of inattention, hyperactivityand higher risk of developing type II diabetes later in life(Bird *et al*., 2008; Dempsey *et al*., 2004).

Perinatal death risk associated with GDM is mostly attributable to undiagnosed type two (2) diabetes, which is common among mothers with obesity condition (WHO, 2010). The risk of congenital malformations is slightly increased in infants of mothers with GDM compared to the general population. Thus, increased risk is of congenital malformations is associated with the presence of undiagnosed type 2 diabetes among women with GDM(Xiang et al., 2015).A relationship exists between the risk of congenital malformations, maternal blood glucose levels, gestational age at diagnosis of diabetes and maternal obesity, all of which are found in type 2 diabetes. The pattern of congenital malformations is similar to those reported in pre-existing diabetes(Bao *et al*., 2015)(Bao *et al*., 2015)

2.8 Knowledge Gap.

Similar studies conducted on Gestational Diabetes Mellitus have not been able to establish the actual prevelence of GDM. Besides, there is no clear distinction

between diabetes that existed before pregnancy and hyperglycemia induced by pregnancy more so because most mothers are unaware of their diabetic condition and where routine medical screening is not a routine in developing countries (Ferrara, 2007). Generally, studies in Africa related to GDM are few and scanty in information. Thus, further research is needed to explore risk factors that Lead to GDM and possible health outcome in mothers and children related to GDM condition in the context of developing Countries(Jones, 2013).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Site

The study was conducted in Nairobi County, which comprises of six sub-counties and has a total of 92 maternity facilities put into different categories of: local Authority, Ministries of Health, Non-Governmental and Private enterprise based on institution ownership. See location of Nairobi in Kenya **(See Figure 3.2)**

Figure 3. 2: Map of Kenya

Key: location of Nairobi in green

Located in between Kampala and Mombasa, Nairobi stretches itself across 684 square kilometers of land. It lies adjacent to the eastern edge of the rift valley and is situated 5450 ft (1661 metres) above the sea level. The Ngong hills occupy the western part of the city. Mount Kenya is located to the North of the city and Mount Kilimanjaro lies towards south-east of Nairobi.Nairobi City is considered being the most populous city in Eastern Africa with population estimate of 3 million people according to the 2009 Census.

Nairobi is a cosmopolitant with wide variety of mix in popultation characteristics such as culture,race,etnicity as well as wealth status. Urbanization is considered a key driver to the evolution of NCD epidemic in developing countries(Shawar, 2014).Since 2008, and for the first time in human history, the majority of the world's population has lived in urban areas (Lahariya, 2008). In Kenya while 22.3% of the population is urban, the urban population growth rate is 4.2% almost double the national population growth rate of 2.4% (Statistics, 2009).In Nairobi a majority (60%) of the population live in slums with much of the migrant population settling in slums. Further 75% of the urban population growth is absorbed by informal settlements. It is estimated that the number of urban population living in slums will double in the next 10 years.Yet three quarters of the urban slum dwellers are deprived poor, living under impoverished conditions(UN-HABITAT, 2006).

Despite this large and growing proportion of the population, there is a paucity of documentation on their burden of NCD. Our objective in this survey of the largest Nairobi slum was to determine the incidence of diabetes mellitus and correlates such as physical activity, tobacco consumption; alcohol intake and metabolic risk factors such as hypertension and obesity.

3.2 Study Design

A cohort study design that was ambi-directional in nature was employed, the study design allowed the researcher to obtain outcome data that were collected both retrospectively and prospectively since the study was interested in both exposure and

outcome of the exposure in a comparison group of study subjects i,e. Mothers with GDM and mothers with Non GDM with their baby pair (EpiConcept, 2012).

3.3 Study Population

In the first phase of study, participants comprised of mothers attending ANC in the selected six maternity facilities within Nairobi County and were third trimester of their pregnancy; phase two the study participants included neonates and their mothers recruited and had fully participated in the first phase of the study.

3.3.1 Inclusion Criteria

3.3.1.1 Inclusion Criteria for GDM

- Mothers enrolled for ANC in selected maternity facilities.
- Mothers who were in third trimester of pregnancy
- Mothers who were residents of Nairobi or had plans stay to within Nairobi for at least six months after enrolment into the study.
- Tested positive for Glucose intolerant test
- Mothers who were willing to participate in the study by signing the consent form

3.3.1.2 Inclusion Criteria for Non-GDM

- Mothers enrolled for ANC in selected maternity facilities.
- Mothers who were in third trimester of pregnancy
- Mothers who were residents of Nairobi or have plans stay to within Nairobi for at least six months after enrolment to the study.
- Mothers who tested negative for glucose intolerant test
- Mothers who were willing to participate in the study by signing the consent form

3.3.2.1 Exclusion Criteria for GDM

- Mothers with known pre-existing diabetic condition
- Mothers with other medical condition/ on medication that would have altered glucose tolerance.
- Very sick pregnant mothers
- Mothers who were not attending ANC in selected maternity facilities
- Mothers who were below the third trimester of the pregnancy
- Mothers who were not residents of Nairobi or have no plans to stay within Nairobi County for at least six months after the point of first contact.
- Mothers who were negative for Glucose intolerant test
- Mothers who were not willing to participate or sign a consent form

3.3.2.2 Exclusion Criteria for Non GDM

- Mothers with known pre-existing diabetic condition
- Mothers with other medical condition/ on medication that would have altered glucose tolerance.
- Very sick pregnant mothers
- Mothers not enrolled for ANC in selected maternity facilities
- Mothers below the third trimester of the pregnancy
- Mothers who were not permanent residents of Nairobi or have no plans to stay within Nairobi County for at least six months after the point of first contact.
- Mothers who tested positive for GDM
- Mothers who were not willing to participate or sign a consent form

3.4 Sampling Procedure

3.4.1 Sample Size Determination

Since the study was interested in making a comparison between mothers with GDM and without GDM. The sample size was determined in the two groups with the effect size to be within 10% point of true difference, and 95% Confidence. 13% was used

as a reasonable estimate of proportion of high birth weight among mothers with GDM(Stanley Lemeshow, David W Hosmer Jr, Janelle Klar, 2009). Factoring in the effect size, the estimate of proportion of high birth weight among mothers without GDM was assumed to be 23%.

$$n = \frac{\{Z_{1-\alpha/2}\sqrt{[2P(1-P)]} + Z_{1-\beta}\sqrt{[P_1(1-P_1)+P_2(1-P_2)]}\}^2}{(P_1-P_2)^2}$$

Where;

n=Minimum required sample size

α = Type I error (0.05)

β= Type II error (0.10)

At 95% confidence, $\alpha_{1-\alpha/2} = 1.96$

At 80% power, $z_{1-\beta} = 0.842$

P_1= 13% Estimated proportion of babies with High birth weight among mothers without GDM (Ferrara, 2007)

P_2= 23% Estimated proportion of babies with High birth weight among mothers with GDM

P_1-P_2= Effect size (10%)

$$P = \frac{P_1 + P_2}{2}$$

The minimum required sample size was estimated at 231. The sample was then adjusted by 10% to allow for attrition; hence the final sample adjusted upwards was 254 baby mother pair with each comparison group having sample size 127.

3.4.2 Sampling Techniques

The focus of the study is to establish cause- effect relationship of GDM and health outcomes in perinatal rather than using the study findings for generalization hence sampling techniques used is purely for purposes of ensuring internal validity that might otherwise arise due to confounders if selection is not done in procedurally and in a scientific manner(Halperin, Pyne, & Martin, 2015).

3.4.2.1 multistage sampling of facilities

In considering sample size determination described by Kothari (2004), 10-30% of population size was considered adequate sample size for facilities listed in the Master Facility List (MFL) see **(Appendix I)**. Out the 97 listed facilities 10% gave rise to 10 those facilities, which were spread, within six sub counties of Nairobi County.

Simple random sampling technique was used to pick the 10 facilities from a listing of 97.Facilities codes were recorded on sheets of papers, folded carefully, mixed in a container and hand picked randomly from the container. Each code was then matched with the Maternity Facility List (MFL). see **Table 3.1** for facilities selected for inclusion for the study

Preliminary survey was conducted to establish the number of mothers enrolled for MCH clinic in a month thereafter-proportionate sampling was done to identify respondents from facility level.

Table 3.1:List of Health Facilities Sampled

Maternity facility	Monthly ANC projection(X)	% Proportion of ANC N2(X/N1)*100	Sampled	Actual sample
Kibera Community Health Center	200	8.88	23	39
Pumwani Maternity Hospital	390	17.31	44	53
Coptic hospital	170	7.54	19	37
Marie Stopes Nursing Home	260	11.54	29	16
St Marys Hospitals Lang'ata	183	8.12	21	34
MP. Shah Westlands	126	5.59	14	13
Aga Khan Hospital	188	8.34	21	8
Nairobi Hospital	292	12.96	33	0
Melchezedeck Hospital	130	5.77	15	12
Mama Lucy Kibaki hospital	313	13.89	35	26
Total	**N1 2052**	**100**	**N2 254**	**238**

3.5. Data Collection Methods and Tools

In order to collect data to answer research question that was focusing on determining the risk factor that leads to the development of GDM, the researcher sought to collect

data retrospectively that employed retrospective cohort study design, also known as historical design in which exposure occurred before the onset of data collection. To obtain data that was relevant to determine health outcomes for mother and child in relation to GDM the researcher employed Prospective Cohort study design in which exposure (GDM) is establish before the occurrence of outcomes related to pregnancy and birth complications(*[Leon Gordis] Epidemiology (4Th Edition)*.2007)

3.5.1. Questionnaire

Data collection was done using quantitative methods in which a structured questionnaire was used. The two research assistants with qualification in Nursing, Laboratory technology and Clinical Medicine at Diploma level administered semi-structured questionnaire in three phases;-

Phase One: Research assistant administered consent form to potential study participants and only those who consented were screened for eligibility for the subsequent phase of the study. The initial consent form and questionnaires were in English language and translated into Kiswahili to acceptable levels by a professional translator see Certificate of translation, consent form and questionnaire both in English and Kiswahili Language **(Appendix II,III and IV**).

Interviewers were required to ask participants the language they were conversant with before commencement of interview.

Phase Two: In the phase, the researcher sought to answer questions related historical background after laboratory test to GDM condition and participant categorized in into two study groups (GDM and Non- GDM).

3.5.2. Laboratory Test for Glucose Intolerance

Laboratory tests were carried out to ascertain cases of GDM condition as well as categorization of study participants into study group of GDM condition and those without GDM condition.

Oral Glucose Tolerance Test (OGIT) was recommended and used because of efficiency; ease of administration, lower cost and high sensitivity especially for women who are 24 and above weeks of pregnancy (Sattar, 2002)

3.5.3 Weight and Height Measurements

At the beginning of mothers were asked to provide weight before pregnancy and height. The same measurements were also taken during follow interview to reconcile the accurate BMI. When taking height using the height rod, the participant are required to remove shoes and should stand on a flat surface by the scale with feet parallel to each other while heels, buttocks, shoulders and back of head need to be in contact with the rod in upright position. The head should be held comfortably erect, with the lower border of the orbit of the eye in the same horizontal plane as the external canal of the ear. The arms should be hanging loosely at the sides. The presence of unusually thick hair requires to be taken into account. The measuring scale will be 175 cm high and capable of measuring to an accuracy of 0.1cm.

Salter scale with adjustments of 100g was used to take weight of mother after birth. The BMI was calculated and estimates then paired with BMI estimation table (**Appendix VII**).

Phase Three: The third phase of the interview was a follow up questionnaire that sought to find information about perinatal health outcomes. Measurements of weight and height were taken at the postnatal clinics or home-based arrangements using portable anthropometric kits where needed.

The follow up was done between 3 to 6 weeks after child birth, based on updated records which made it possible to make follow up phone calls to book appointment with participants in advance. **Figure 3.2** below show summarised data collection procedure undertaken during the study.

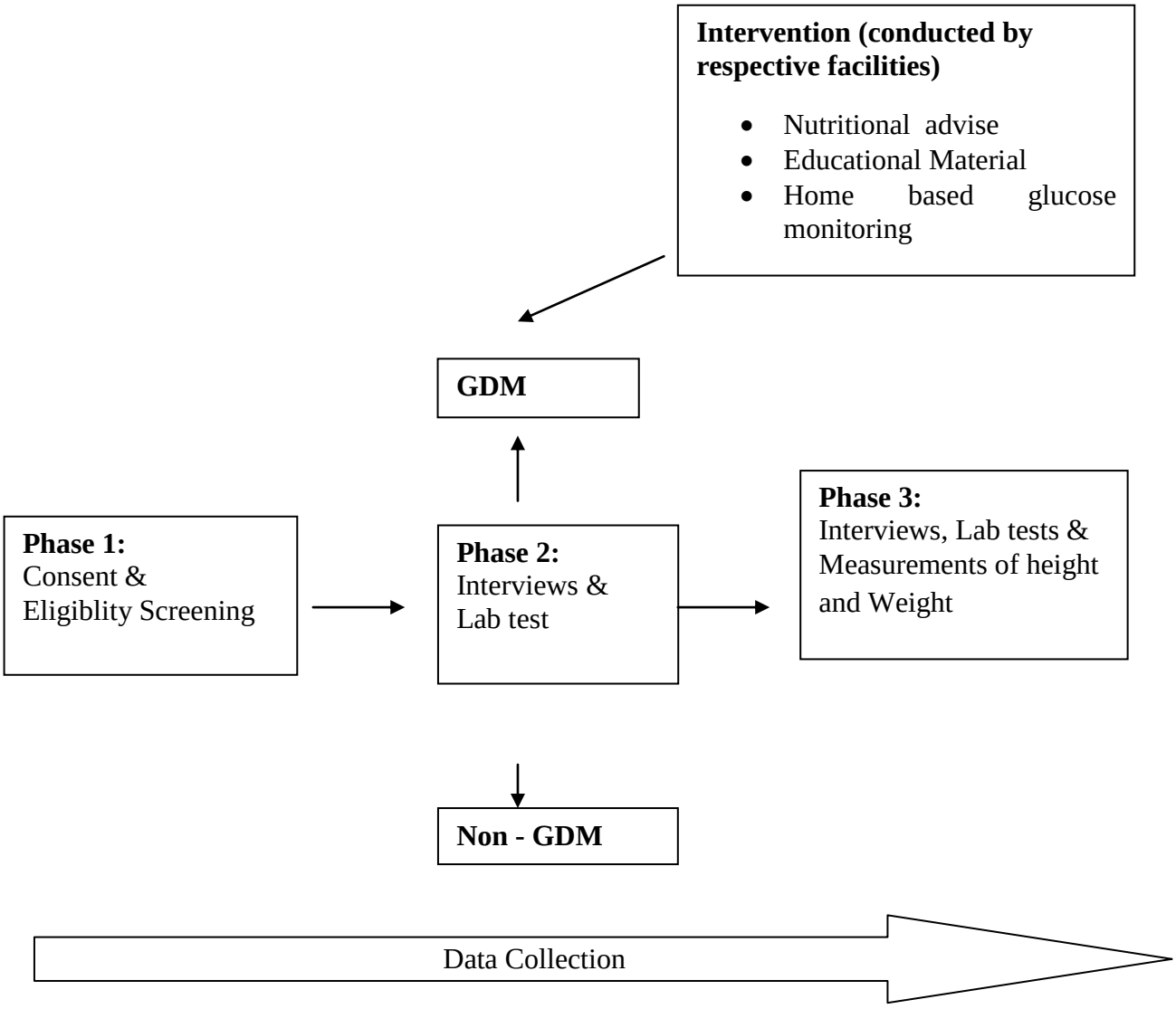

Figure 3.3: Flow Chart of Data Collection, Intervention and Follow up

3.6 Data Management

3.6.1 Reliability and validity of study instruments

To ensure that study instruments and data collection tools produces stable and consistent results; the questionnaire were pilot tested on participants meeting

inclusion criteria drawn from Mbagathi District Hospital which had been not selected as a study facility.

The weighing scale was adjusted to 100g before taking weight measurement of participants, this was done to ensure that the measurements consistent.

To ascertain GDM cases the gold standard test OGT was done on to ensure consistency and criterion related validity concerned with prediction of results with outcome of interest was achieved.

3.6.2 Data analysis and Presentation

Data collected was checked for completeness thereafter coded data was entered into excel sheet, which was exported for analysis onto stata version 13. Risk factors were analysed as Odds Ratio using Univariate logistic regression and multilevel logistic regression to account for confounding variable. Background information of respondents was presented as frequency and percentages.

3.6 Ethical Considerations

Ethical Clearance was obtained from Ethical Review Committee of Kenyatta National Hospital in Conjunction with the University of Nairobi who verified that the research conforms to ethical requirements specific to human subjects and collection of samples and provided a letter of approval for the study to be conducted**(Appendix IX)**

A written permission to conduct the study was obtained from Nairobi local authorities and management of the selected Maternity facilities before commencement of the study **(Appendix X).**

Study participant were consented before enrolment to participate in the study, confidentiality was also maintained through assigning of unique codes to individual respondents instead of using identifiable personal information.

Information that resulted from this study was intended solely for the purpose of this study and to give recommendation on changes need on Maternal and Child Health Intervention Programmes and policies for the benefit of the population with Kenya and the rest of Developing Countries.

Publication and any material generated from the study were shared with all the facilities selected for the study including County's and Nation Ministries of Health.

The investigator was responsible for handling logistical issues including printing of questionnaires and checklists and facilitating the research assistants to deliver questionnaires to the respondents.

All investigators involved in the study were certified by ethically certified scientific body and have obtained CITI certificates **(Appendix VIII).**

3.7 Expected Benefits of the Study

The study recommendation was expected to inform policy on diagnosis and management of high-risk pregnancy conditions and advocate for integration of wellbeing programmes in ANCs. In addition the outcome of the study demonstrated prevailing risk factors that lead to the development of GDM and how they could be manipulated for promotion of healthy lifestyle among pregnant women. The incidence figures including knowledge on established GDM health outcomes produced key information important in public health policy on Maternal and Child health as well proving information to National Government for planning and budgeting for health.

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CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the study findings conducted to establish gestational diabetes among women attending ANC clinic in Nairobi County. The study was curried between February and August 2015.

4.2 Background characteristics of study respondents

4.2.1: Gestational Diabetes Mellitus condition status of respondents

The findings in **Figure 4.1** indicates that out of 238 respondents 172[72.27%] had no GDM condition while 66[27.73%] had GDM condition.

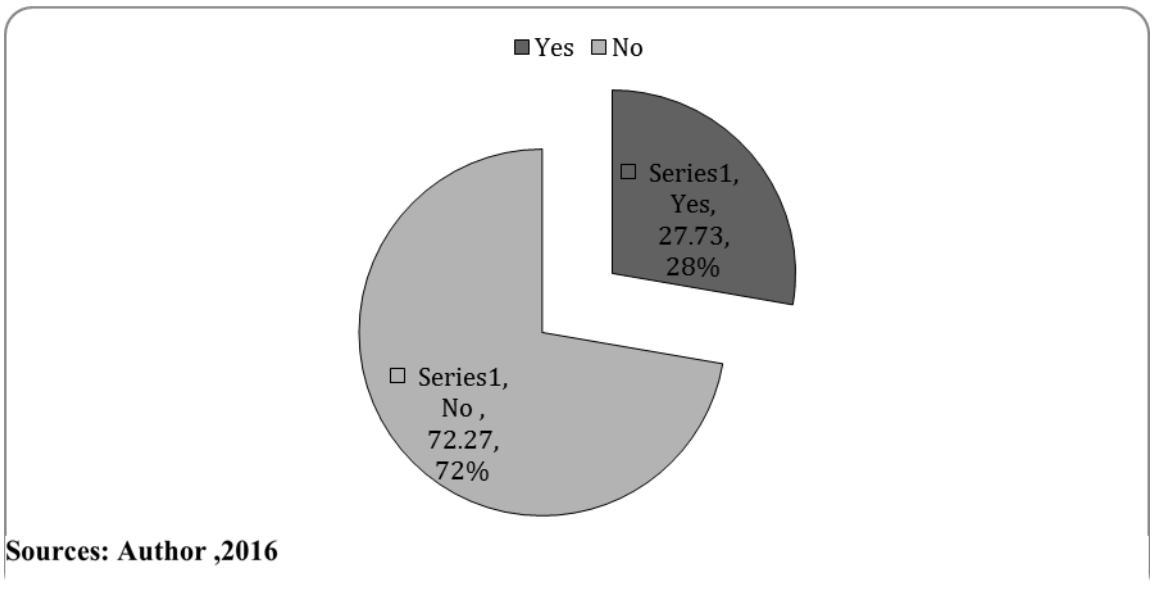
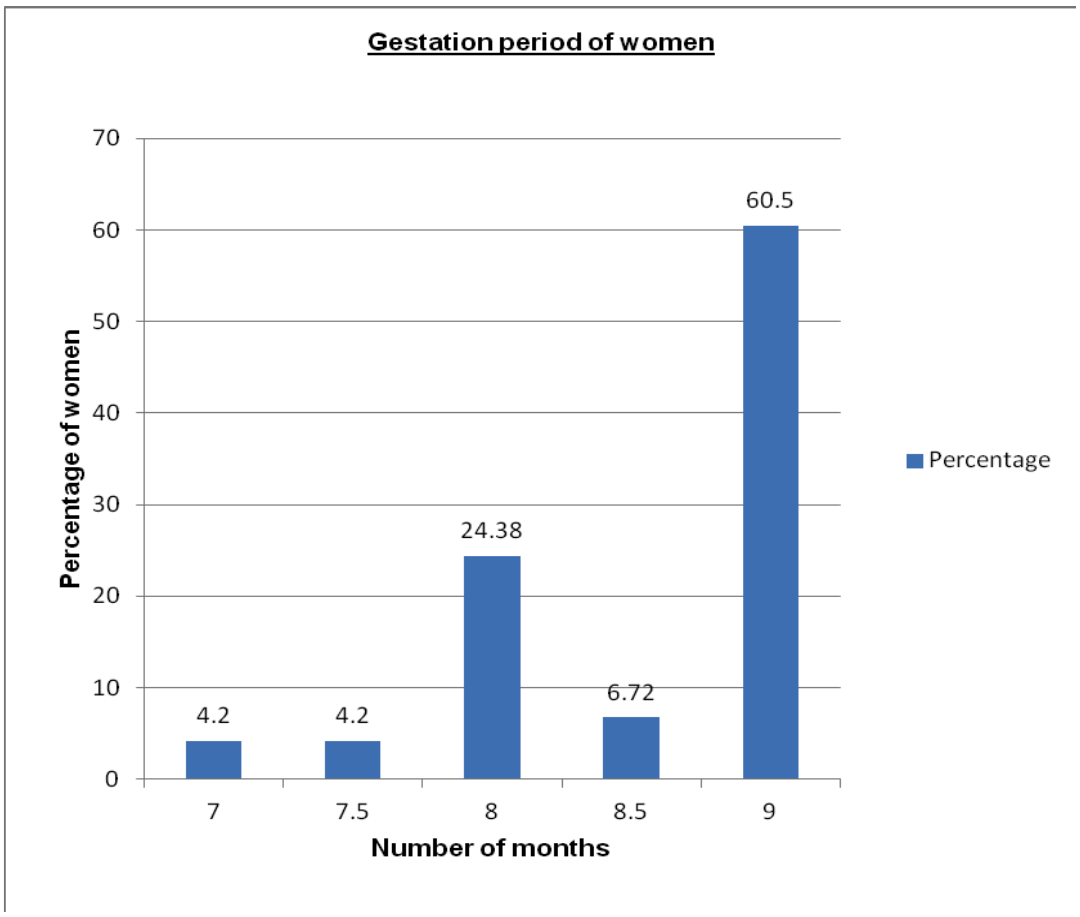


Figure 4.4: Pie Chart Showing Percentage Frequency Distribution of GDM and Non GDM Cases

4.2.2: Enrolment Based on Gestational Period

The findings in **Figure 4.5** shows that majority(61%) of women enrolled for the study were on the 9th month of pregnancy , 31% were on the eighth month and a smaller percentage of 9% were on seventh month of pregnancy.

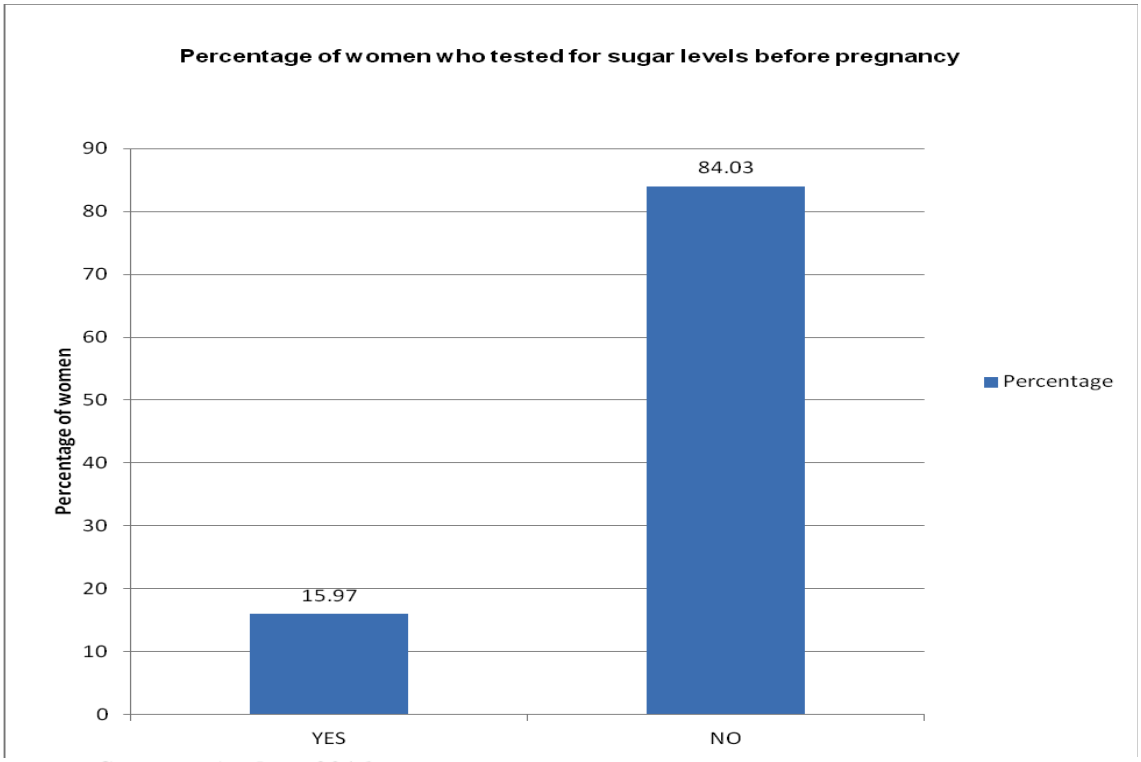


Sources: Author ,2016

Figure 4.5: Graphical Distribution of Gestational Period of mothers enrolled for the study

4.2.3: Blood sugar condition awareness before pregnancy.

In order to check whether mothers were aware of their blood sugar condition by testing for sugar levels before pregnancy, findings in **Figure 4.6** below showed that only 16% of the mothers were aware of their blood sugar levels condition compared to larger population of approximately 84% who had never tested for glucose intolerence thus unware of their diabetic condition before pregnancy.



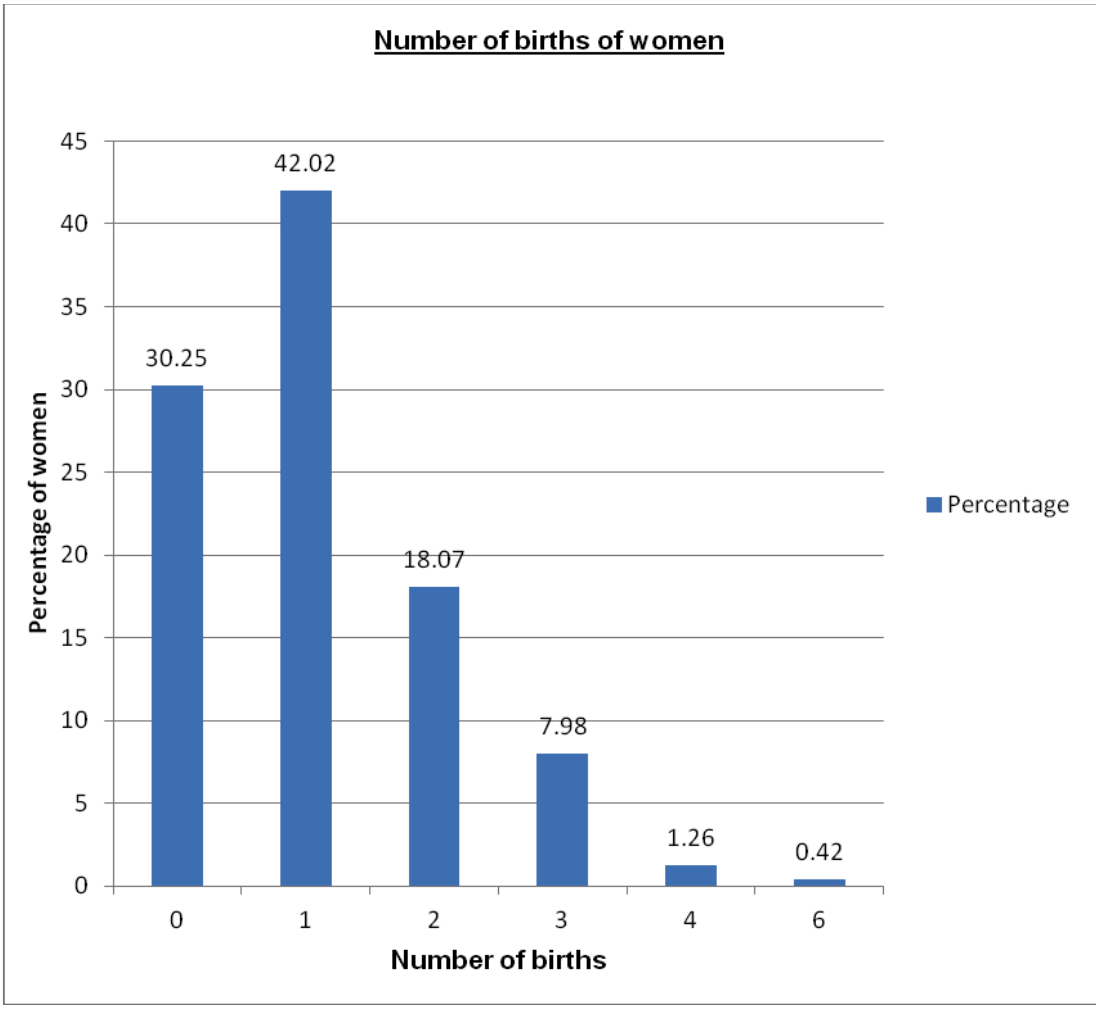
Sources: Author ,2016

Figure 4.6: Graph Showing Percentage of Women who Tested for Sugar Level before pregnancy

4.2.4 Number of Births by Enrolled Mothers

Findings in **Figure 4.7**below showed that majority (42%) of mothers enrolled had given birth once before the current pregnancy, followed by 30% who were pregnant

for the first time, 18% had given birth twice, 8% had given birth three times and less than 1% had given birth six times before the current pregnancy.

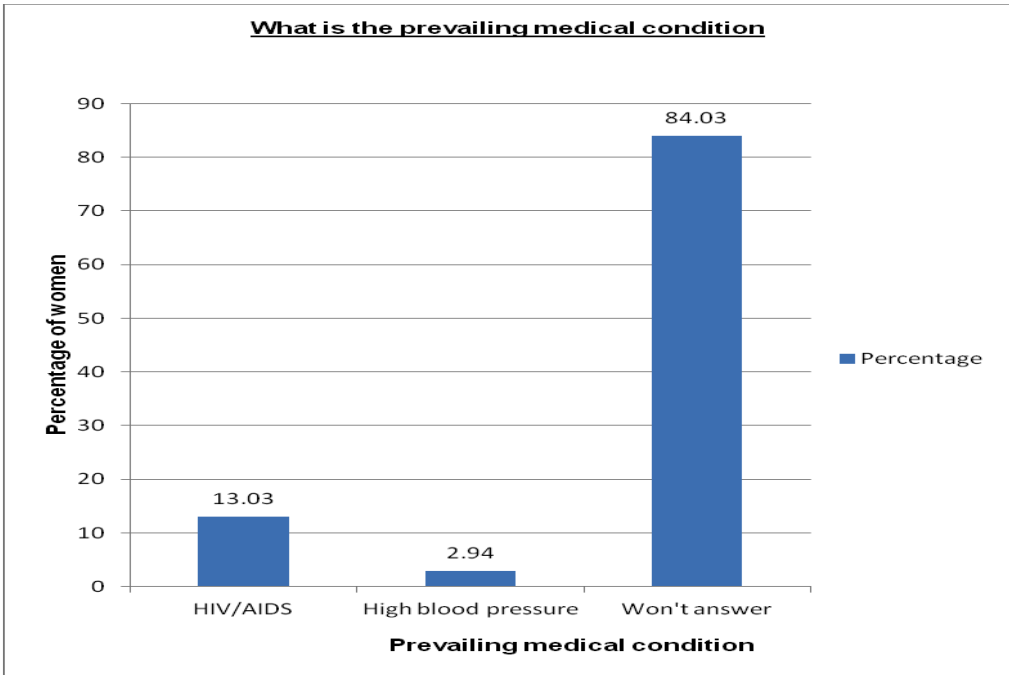


Sources: Author ,2016

Figure 4.7: Graph Showing Number of Births given by Respondents

4.2.5 Prevailing Medical Conditions in Respondents.

The findings showed that 13.03 % of women had HIV/AIDs ,2.94% had high blood Pressure as prevailing medical condition while majority (84.03%) were unsure or did not what to answer question about medical condition as they were in the process of taking other test recommended at the MCH clinic**(See Figure 4.8)**



Sources: Author ,2016

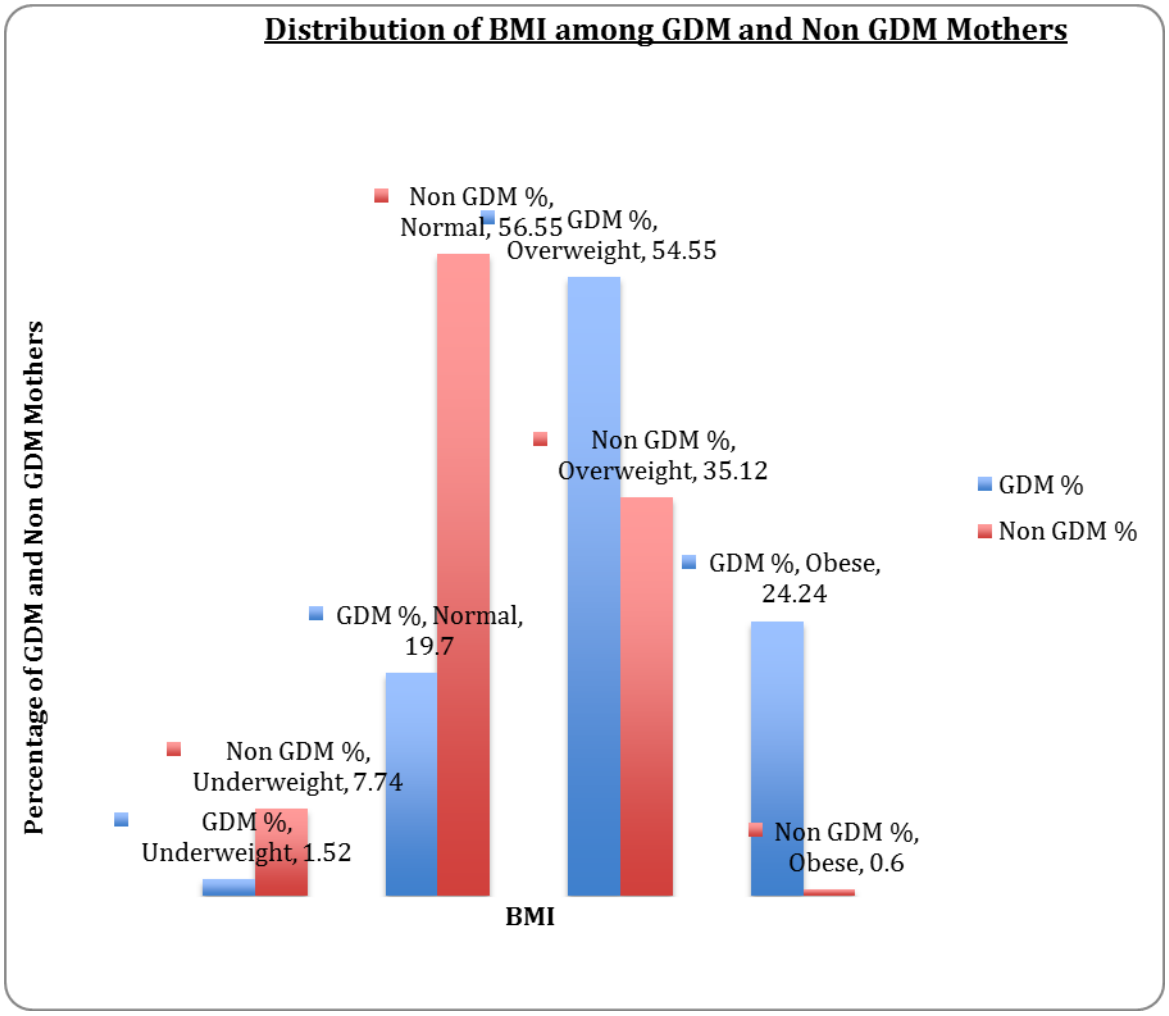
Figure 4.8: **Graph Showing Prevailing Medical Condition of Respondents**

4.3: Exposure factors to Gestational Diabetes Condition

4.3.1 Body Mass Index and Gestational Diabetes

Results for BMI among mothers determined by weight before pregnancy indicates that mothers with GDM had above normal BMI (Overweight and Obese) at 54.55%

and 24.24% respectively compared to non-GDM with 35.12% and 0.6% in the category of Overweight and Obese respectively(**See Figure 4.9).**



Sources: Author ,2016

Figure 4.9: Graph Showing Distribution of BMI among GDM and Non-GDM Mothers

4.3.2 Family Diabetic History, Age and Obesity

Results indicated in **Tables 4.2** shows Univariate relationship between biological factors and GDM condition. Mothers who had diabetic history in the family had

twice the risk of developing GDM [OR= 2.27; 95% C.**I:**1.23-4.17] compared to those who did not observe diabetic history in the family .

BMI status had positive association with GDM, findings indicates that obese mothers had twenty eight folds increased risk of developing GDM condition [OR= 28; 95% C.**I:** 11.83-36.7].

Age and weight of the mother before pregnancy similarly had positive association with GDM [OR = 1.15; 95 % C.**I:**1.089-1.206] and [OR =1.10; 95 % C.**I:**1.07-1.13] respectively.

Table 4.2: Univariate Logistic Regression model for factors associated GDM

Variable[n = 238].	**OR**	**95%CI**	**P-value**
Diabetic history			
No diabetic history [Reference]	1		
Had diabetic history*	2.27	[1.23- 4.17]	0.008
BMI before pregnancy			
Underweight [Reference]	1		
Normal	1.78	[0.214-14.74]	0.593
Overweight	7.93	[0.99-63.22]	0.051
Obese*	20.8	[11.83-3656.7]	0.000
Age of respondent*	1.15	[1.089-1.206]	0.000
Weight before pregnancy*	1.10	[1.07-1.13]	0.000

*** Significant at 5% significance level**

4.4 Maternal Health Outcomes in GDM mothers

In analysing the health condition of mothers two monthsbefore and one month after birth in relation to GDM condition, Univariate Regression analysis was conducted to establish significance of association between health Outcome and GDM. Multi Level Regression analysis was done to control for confounding factors age and prevailing medical conditions

The results in **Table 4.3 and 4.4** indicated that mothers with GDM were four times likely to have high frequency in urination [OR = 4.43; 95% C.I**:**1.63-12.05] and three times likely to experience high volume of urine [OR = 3.53; 95%C.I**:** 1.50-8.33] ,while feeling thirsty had a low significance [OR = 1.35; 95% C.I**:** 0.600-3.05]. Episiotomy delivery [OR=0.29; 95% C.I**:**0.10-0.85] and skin texture [OR=0.17; 95% C.I**:**0.077- 0.385] showed negative association but significantly common among GDM mothers [P-value <0.05]

Table 4.3:Univariate Logistic Regression model for Association between maternal health outcomes and GDM

Variable [n = 238]	**OR**	**95%CI**	**P-value**
Do you feel thirsty			
No [Reference]	1		
Yes*	1.35	[0.600-3.05]	0.465
Blood pressure			
Normal [Reference]	1		
High*	2.53	[1.29-4.94]	0.007
Delivery mode			
C-section [Reference]	1		
Normal*	0.37	[0.19- 0.69]	0.002
Episiotomy	0.47	[0.19 - 1.14]	0.093
Do you have any swelling			
No [Reference]	1		
Yes	1.64	[0.91-2.96]	0.103
Urine Frequency			
Occasionally [Reference]	1		
Often	1.14	[0.48-2.72]	0.763
Quite a lot*	4.43	[1.63-12.05]	0.004
Urine frequency per day			
<= 2 hours [Reference]	1		
3-4 hours	0.99	[0.53-1.87]	0.983
>= 4 hours	1.90	[0.81-4.46]	0.141
Volume of urine per day			
Little	1		
Normal*	2.07	[1.02-4.19]	0.043
A lot*	3.53	[1.50-8.33]	0.004
Skin texture			
Soft and glowing [Reference]	1		
Dry and rough*	0.37	[0.19-0.69]	0.002

*** Significant at 5% significance level**

Table 4.4: Multivariate Logistic Regression model for association between maternal health outcomes and GDM.

Variable**[n = 238]**	**OR**	**95%CI**	**P-value**
Blood pressure			
Normal [Reference]	1		
High	1.13	[0.48-2.66]	0.778
Delivery mode			
C-section [Reference]	1		
Normal	0.56	[0.25- 1.29]	0.175
Episiotomy*	0.29	[0.10-0.85]	0.024
Urine Frequency			
Occasionally [Reference]	1		
Often	2.00	[0.66-6.09]	0.219
Quite a lot*	4.33	[1.14-16.47]	0.031
Volume of urine per day			
Little	1		
Normal*	3.49	[1.37- 8.93]	0.009
A lot*	3.65	[1.12-11.93]	0.032
Skin texture			
Soft and glowing [Reference]	1		
Dry and rough*	0.17	[0.077- 0.385]	0.000

Significant at 5% significance level

4.4: Incidence of high birth weight in neonates among GDM mothers compared to non GDM mothers

Results in **Table 4.5** indicates higher frequency in neonatal birth weight among GDM mothers 44[66.67%] compared to 59[34.71%] for non-GDM mothers.

Table 4.5:Frequency and Percentage Distribution of Neonate's birth weight

	GDM mothers [n=66]		**Non GDM mothers [n=172]**	
Neonates birth weight	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Underweight <2.5kg	1	1.52	13	7.65
Small 2.6kg-3.5kg	21	31.82	98	57.65
High birth weight	**44**	**66.67**	**59**	**34.71**

Results in **Table 4.6** indicates that mothers with GDM are nine times likely to have high neonatal birth weight [OR = 9.69; 95% C.I**:** 0.01 - 0.59]. The association of GDM and high neonatal birth weight is also high significance [P- value=0.013].

Table 4.6: Univariate Logistic Regression model for the analysis of the association between GDM and neonates birth weight

Variable [n = 238]	**OR**	**95%CI**	**P-value**
Neonates birth weight			
Underweight <2.5kg [Reference]	1		
Small 2.6kg-3.5kg	2.78	[0.35- 22.47]	0.336
High birth weight*	9.69	[0.01- 0.59]	0.013

*** Significant at 5% significance level**

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction.

This chapter summarizes the research findings, presents discussion on study findings, conclusion and recommendations.

5.2 Discussion

The analyses in this study suggest that individual biological factors are independently associated with GDM; these biological factors include age, weight of the mother before pregnancy and history of diabetes among family members. The study further suggested that GDM was common among women who are advanced in age with reported mean age of 33.06 years among GDM mothers while non-GDM mothers had a mean age of 27.9 years. These findings are consistent with evidence that any woman above age of 25 years has increased risk of GDM (Chasan-Taber, 2015; Chu *et al*., 2007)

High BMI, which corresponds with high weight, was associated with GDM condition. Study findings indicated that nearly half (47.86%) of the study population under study was considered to be either overweight or obese. Obesity condition was highly significant among mothers with GDM condition (OR=28; 95% C.I**:** 11.83-36.7). Macaulay *et. al* 2014 suggests that diabetes and overweight condition is largely associated with sedentary life style as population shift from rural way of life to urban life lifestyle to a more industrial urbanized. Obesity condition as one of the lifestyle diseases associated with sedentary lifestyle has serious health consequences such Type II diabetes and complications during pregnancy and dire health complication in subsequent generations.

Mothers who had a close family members sibling or parent with diabetes are likely to develop gestational diabetes this was evident by the fact that mothers with GDM condition reported 62.3% observation in diabetes in family tree while mothers with

non GDM condition reported low 42.11% observation in family members who had diabetes. This informs the rejection of alternate hypothesis that there are no risk factors that lead to development of GDM among mothers attending antenatal clinic in Nairobi.

Studies done by Chance Ferrara, (2007) and American Diabetes Association (2003) indicating that frequency of GDM usually reflects of type 2 diabetes in the underlying population with more that 50% developing type 2 diabetes with 5-10years after delivery. Results from this study show that mothers with GDM condition had symptoms such feeling thirsty, high frequency and large volume of urine during pregnancy, which was persistent weeks after delivery, this signifies presence or onset of Type II diabetes. This study could not establish whether the condition was existence before pregnancy specifically for mothers who were unware of the sugar levels before the first test conducted during pregnancy.

Complications at delivery were high among mothers with GDM with majority [61.67%] having delivered through Caesarean Section. The results were way above the study Sattar *et.al* (2002) in which pregnancy complication was reported at 7%. The resulting difference in percentage figures, could have resulted to the fact that the complication in reference was not specific to mode of delivery but rather combined results of all complication related to pregnancy.

Finally, high neonatal birth weight was found to be positively associated with GDM condition in mothers,which was estimated to be 44[66.67%] compared to neonates delivered by non-GDM mothers 59[34.71%].These high birth weight phenomena also referred as macrosomia was observed in a web Report of diabetes magazine http://diapedia.org which showed a positive correlation between maternal blood glucose levels and increased birth weight. American Diabetes Association (2013) report is also in support of the fact that women with GDM are more likely to give birth to macrosomic or large-for-gestational-age infants the report further indicates that macrosomia common among mothers with GDM who experiences complications such as obstructed labour, the death of the mother and the baby and birth injury for the infants.Through this finding thes study thus rejects the null hypothesis that there

is no difference in incidence of baby's high birth weight between women with GDM and those without GDM.

5.3 Conclusions

Gestational diabetes cases is relatively high in the population, lifestyle including other individual biological characteristics such as advanced age in pregnancy, high weight and diabetic history in family are determining factors for development of diabetes among pregnant women. Mothers with GDM condition are at higher risk in developing complications during and after pregnancy. Complications at pregnancy are related to obstracted labor leading to cesarian section and birth related injuries to both mother and child. Later in life with estimate of 5-10 years GDM mother is likely to develop type 2 diabetes.Elevated blood glucose condition in pregnant mothers, similarly known as GDM is a precursor factor to having a large for gestational weight neonates or infants which could results to other health complication that is associated with overweight/obese conditions in present life or future.

5.4 Recommendations

1) Pregnant mothers are not aware of their diabetic status, which is also a reflection of the larger population. Ministry of Health (MOH) and other agencies allied to Maternal and Child Health (MCH) programmes should intensify awareness campaigns and blood sugar testing to be able to manage and reverse life threatening health outcome related to diabetes.
2) Health education needs to encompass lifestyle modification information specific to good nutrition weight management in order to lower risk chance of diabetes and other NCDs.
3) Management of diabetic condition in pregnant women needs to be included in Essential Package for Health for Kenya to realize improvement in MCH health outcomes, which is part of Millennium Development Goals (MDGs) as well as Vision 2030.

5.5 Area for further research

1. To establish association of birth weight of previous pregnancy and risk chance of developing GDM.
2. Comparative study of GDM prevalence among women in rural and urban areas.
3. Prospective Cohort Study to investigate health outcomes of children delivered by GDM mothers

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APPENDICES

Appendix I MFL 2014, Nairobi County

Dagoretti

	Name	District	Type	Owner
1	Mbagathi District Hospital	Dagoretti	District Hospital	Ministry of Health
2	Kenyatta National Hospital	Dagoretti	National Referral Hospital	Ministry of Health
3	Melchezedek Hospital	Dagoretti	Other Hospital	Private Enterprise (Institution)
4	Waithaka Health Centre	Dagoretti	Health Centre	Local Authority
5	Mutuini Sub-District Hospital	Dagoretti	Dispensary	Ministry of Health
6	Riruta Health Centre	Dagoretti	Dispensary	Local Authority

Embakasi

		District	Type	Owner
7	Mama Lucy Kibaki Hospital - Embakasi	Embakasi	District Hospital	Ministry of Health
8	Embakasi Health Centre	Embakasi	Health Centre	Local Authority
9	Kayole I Health Centre	Embakasi	Health Centre	Local Authority
10	Kayole II Sub-District Hospital	Embakasi	Health Centre	Local Authority
11	Mukuru Health Centre	Embakasi	Health	Local Authority

			Centre	
12	Provide International Clinic (Kayole)	Embakasi	Health Centre	Non-Governmental Organizations
13	St Patrick Health Care Centre	Embakasi	Health Centre	Private Enterprise (Institution)
14	Emmaus Nursing Home	Embakasi	Maternity Home	Private Enterprise (Institution)
15	Maria Maternity and Nursing Home	Embakasi	Maternity Home	Private Practice - General Practitioner
16	Arrow Web Maternity and Nursing Home	Embakasi	Nursing Home	Non-Governmental Organizations
17	Alice Nursing Home	Embakasi	Nursing Home	Private Enterprise (Institution)
18	Patanisho Maternity and Nursing Home	Embakasi	Nursing Home	Private Enterprise (Institution)
19	Pipeline Nursing Home	Embakasi	Nursing Home	Private Enterprise (Institution)
20	Kayole Hospital	Embakasi	Other Hospital	Private Enterprise (Institution)
21	Umoja Hospital	Embakasi	Other Hospital	Private Enterprise (Institution)
22	Victory Hospital	Embakasi	Other Hospital	Private Enterprise (Institution)
23	Wentworth Hospital	Embakasi	Other Hospital	Private Enterprise (Institution)

Makadara

	Name	District	Type	Owner
24	Bahati Health Centre	Kamukunji	Health Centre	Local Authority
25	Eastleigh Health Centre	Kamukunji	Health Centre	Local Authority
26	Nairobi Women Hospital Eastleigh	Kamukunji	Health Centre	Private Enterprise (Institution)
27	Edna Maternity	Kamukunji	Maternity Home	Private Enterprise (Institution)
28	Marie Stopes Nursing Home (Eastleigh)	Kamukunji	Nursing Home	Non-Governmental Organizations
29	Afwan Medical Centre	Kamukunji	Nursing Home	Private Enterprise (Institution)
30	Dorkcare Nursing Home	Kamukunji	Nursing Home	Private Enterprise (Institution)
31	Kilimanjaro Nursing Home	Kamukunji	Nursing Home	Private Enterprise (Institution)
32	Shaam Nursing Home	Kamukunji	Nursing Home	Private Enterprise (Institution)
33	Woodstreet Nursing Home	Kamukunji	Nursing Home	Private Enterprise (Institution)
34	Joy Nursing Home and Maternity	Kamukunji	Nursing Home	Private Practice - General Practitioner
35	Nairobi East Hospital Ltd	Kamukunji	Nursing Home	Private Practice - Medical Specialist
36	Pumwani Maternity Hospital	Kamukunji	Other Hospital	Local Authority
37	Pumwani Majengo Dispensary	Kamukunji	Dispensary	Local Authority

38	Madina Nursing Home	Kamukunji	Dispensary	Private Enterprise (Institution)
39	Mother and Child Hospital	Kamukunji	Dispensary	Private Enterprise (Institution)

Kasarani

	Name	District	Type	Owner
40	Kahawa West Health Centre	Kasarani	Health Centre	Local Authority
41	Mathare North Health Centre	Kasarani	Health Centre	Local Authority
42	Kasarani Maternity	Kasarani	Maternity Home	Private Practice - Nurse / Midwife
43	Marura Nursing Home	Kasarani	Nursing Home	Private Enterprise (Institution)
44	St Francis Community Hospital (Kasarani)	Kasarani	Other Hospital	Kenya Episcopal Conference-Catholic Secretariat
45	Huruma Maternity Hospital	Kasarani	Other Hospital	Private Enterprise (Institution)

Langata

	Name	District	Type	Owner
46	Langata Health Centre	Langata	Health Centre	Local Authority
47	Kibera Community Health Centre - Amref	Langata	Health Centre	Non-Governmental Organizations
48	MercillinAfya Centre	Langata	Maternity Home	Community
49	Family Care Medical Center	Langata	Maternity Home	Non-Governmental Organizations

50	Frepals Community Nursing Home	Langata	Maternity Home	Non-Governmental Organizations
51	Saola Maternity and Nursing Home	Langata	Maternity Home	Private Enterprise (Institution)
52	Senye Medical Clinic	Langata	Maternity Home	Private Enterprise (Institution)
53	St Mary's Medical Clinic	Langata	Maternity Home	Private Enterprise (Institution)
54	Huduma Health Centre	Langata	Maternity Home	Private Practice - Clinical Officer
55	Wema Medical Clinic	Langata	Maternity Home	Private Practice - Nurse / Midwife
56	St Mary's Mission Hospital	Langata	Other Hospital	Kenya Episcopal Conference-Catholic Secretariat
57	Langata Hospital	Langata	Other Hospital	Private Enterprise (Institution)
58	Meridian Equator Hospital	Langata	Other Hospital	Private Enterprise (Institution)
59	Nairobi South Hospital	Langata	Other Hospital	Private Enterprise (Institution)
60	Nairobi West Hospital	Langata	Other Hospital	Private Enterprise (Institution)
61	The Karen Hospital	Langata	Other Hospital	Private Enterprise (Institution)

Makadara

	Name	District	Type	Owner
62	Cana Family Life Clinic	Makadara	Maternity Home	Non-Governmental Organizations
63	Mariakani Cottage Hospital Ltd	Makadara	Nursing Home	Private Enterprise (Institution)
64	South B Hospital Ltd	Makadara	Nursing Home	Private Practice - General Practitioner
65	Makadara Health Centre	Makadara	Health Centre	Local Authority
66	The Mater Hospital Mukuru	Makadara	Other Hospital	Kenya Episcopal Conference-Catholic Secretariat
67	Metropolitan Hospital Nairobi	Makadara	Other Hospital	Private Enterprise (Institution)
68	Dandora II Health Centre	Njiru	Health Centre	Local Authority

	Name	District	Type	Owner
69	Ngara Health Centre (City Council of Nairobi)	Starehe	Health Centre	Local Authority
70	Huruma Nursing Home Maternity	Starehe	Nursing Home	Private Enterprise (Institution)
71	Parkroad Nursing Home (Nairobi)	Starehe	Nursing Home	Private Enterprise (Institution)
72	Mundika Maternity &Nursing Home	Starehe	Nursing Home	Private Practice - Unspecified
73	Guru Nanak	Starehe	Other Hospital	Private Enterprise

	Hospital			(Institution)
74	Juja Road Hospital (Nairobi)	Starehe	Other Hospital	Private Enterprise (Institution)
75	Lad Nan Hospital	Starehe	Other Hospital	Private Enterprise (Institution)
76	Radiant Pangani Hospital	Starehe	Other Hospital	Private Enterprise (Institution)

Parklands

	Name	District	Type	Owner
77	Kangemi Health Centre	Westlands	Health Centre	Local Authority
78	Karura Health Center Kiambu Rd	Westlands	Health Centre	Local Authority
79	Westlans Health Center	Westlands	Health Centre	Local Authority
80	Abraham Memorial Nursing Home (Westland's)	Westlands	Maternity Home	Private Enterprise (Institution)
81	Coptic Hospital (Ngong Road)	Westlands	Other Hospital	Christian Health Association of Kenya
82	Aga Khan Hospital	Westlands	Other Hospital	Private Enterprise (Institution)
83	Avenue Hospital	Westlands	Other Hospital	Private Enterprise (Institution)
84	MP Shah Hospital (Westlands)	Westlands	Other Hospital	Private Enterprise (Institution)
85	Nairobi Hospital	Westlands	Other Hospital	Private Enterprise (Institution)
86	Nairobi Women's Hospital (Hurlingham)	Westlands	Other Hospital	Private Enterprise (Institution)
87	Nairobi Women's Hospital	Westlands	Other	Private Enterprise

	Adams		Hospital	(Institution)

Others whose location I have not confirmed:

88. Muteithania Nursing and Maternity Home

89. Jacaranda Health Maternity Home

90. Unity Maternity and Nursing Home

91. Pipeline Maternity and Nursing Home

92. Mkunga Maternity and Nursing Home

AppendixII: Introduction And Consent Form English Version

Good morning/Good afternoon

My name is _____, and I am a Research Assistant working on MSc. Research Project titled "**Gestational Diabetes Mellitus among Mothers Attending Antenatal Clinics In Nairobi County and the Associated Health Risks in Mothers and Neonates**. The Research Project is anchored under Jomo Kenyatta University of Agriculture and Technology (JKUAT) in collaboration with Kenya Medical Research Institute (KEMRI).

Purpose

The purpose of the research is to find out risks factors to development of Gestational Diabetes, possible perinatal health outcomes and incidences of gestational diabetes among mothers attending Antenatal Clinic in Nairobi County. You are a potential participant for this study because you are an expectant woman attending antenatal clinic in the selected maternity facility.

Procedures

If you agree to participate in this research, and sign this consent form, the research assistant will describe the procedure including their purpose. We shall also ask you questions related to your pregnancy in three phases each taking 20-30 minutes of your time; Phase one will be after you have given us a go ahead to interview you; Second phase will be a small laboratory procedure to test for blood sugar and lastly, a follow up interview within 28days after your child birth. We shall therefore request that you provide us with contact information and residential address

Risks and Benefit

The benefit of taking part in the study is that the information will be used to improve the

health of mothers and babies in Kenya through development of programs and relevant policies.

Voluntary nature of study

Your decision whether or not to participate will not prejudice your future relations with the health facility, Kenyatta National Hospital, Kenya Medical Research Institute, Jomo Kenyatta University of Agriculture and Technology and staff. If you do not wish to take part or you do not want to answer some of the questions, you do not have to give us a reason. Even though you have signed the consent form, you are free to stop at any time. You do not need to complete it if you feel uncomfortable doing it

Confidentiality

The information you give us is private and the information will be stored in code form and not names. Your personal details (name and Contact) shall not appear in any discussion of project findings.

Contact

The researchers conducting this study are Maureen A. Adoyo and her assistant. You may contact the researchers at any time. You may also direct any questions regarding the rights of research subjects to the Ethical Committee at the Kenyatta National Hospital

In case of any queries or concerns, please contact the chief researcher Principal investigator or Kenyatta National Hospital Ethical Committee with details below:

Maureen Atieno Adoyo

P.O. Box 1998-00502

NAIROBI-KENYA

Cell phone Number: +254 723509359

Email: oam.adoyo@hotmail.com

OR

The Director;

Institute of Tropical Medicine and Infectious Diseases

Jomo Kenyatta University of Agriculture and Technology

P.O. Box 62200-00200;

NAIROBI -KENYA

Tel: 067-52711

Email: itromid@kemri.org

OR

The Chairperson;

Kenyatta National Hospital Ethical Review Committee

P.O. Box 20723-00200;

NAIROBI -KENYA

Tel: 020 2726300

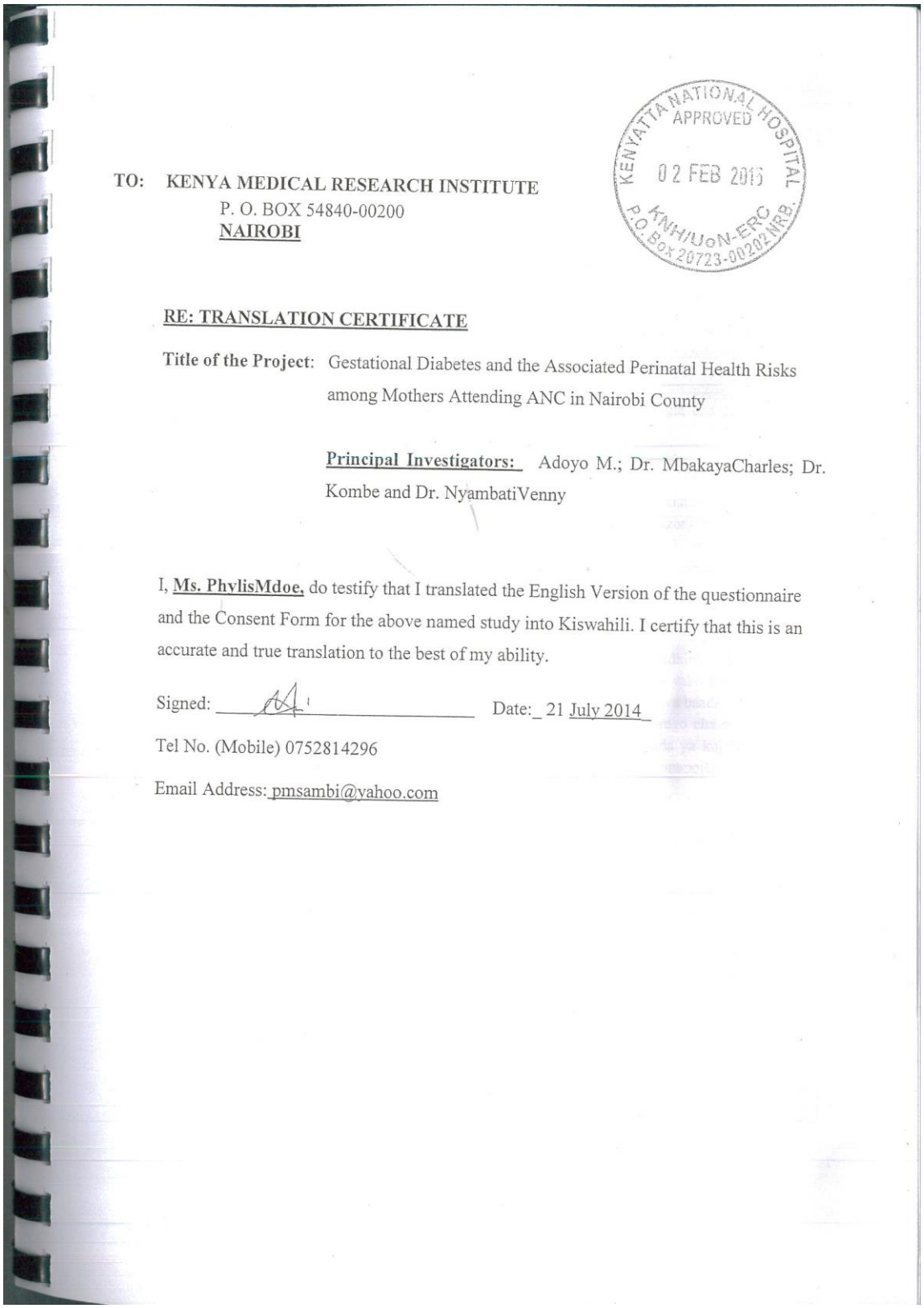
Consent

At this time, do you want to ask me anything about the research? May I begin the interview now?

Signature of interviewer: _____ Date: _____

RESPONDENT AGREES TO BE INTERVIEWED .....1 **Name.....** **Signature..... Date.....**	**RESPONDENT DOES NOT AGREE TO BE INTERVIEWED .....**

Appendix III: Certificate Of Translation From English To Kiswahili



KENYATTA NATIONAL HOSPITAL APPROVED 02 FEB 2015 KNH/UoN-ERC P.O. Box 20723-00202 NRB.

TO: KENYA MEDICAL RESEARCH INSTITUTE
P. O. BOX 54840-00200
NAIROBI

RE: TRANSLATION CERTIFICATE

Title of the Project: Gestational Diabetes and the Associated Perinatal Health Risks among Mothers Attending ANC in Nairobi County

Principal Investigators: Adoyo M.; Dr. MbakayaCharles; Dr. Kombe and Dr. NyambatiVenny

I, **Ms. PhylisMdoe,** do testify that I translated the English Version of the questionnaire and the Consent Form for the above named study into Kiswahili. I certify that this is an accurate and true translation to the best of my ability.

Signed: _____ Date: 21 July 2014

Tel No. (Mobile) 0752814296

Email Address: pmsambi@yahoo.com

Appendix IV: Kitambulisho Na Fomu Ya Ridhaa

HABARI YA ASUBUHI/ HABARI YA KUSHINDA

Jina langu ni……, na mimi ni mtafiti msaidizi ninafanya mradi wa utafiti wa shahada ya MA (sayansi) wenye anwani "Mimba za kisukari miongoni mwa akina mama wanaohudhuria Kliniki za wajawazito katika kaunti ya Nairobia na hatari zinazohusiana nazo kwa mama na mtoto mchanga.

Mradi huu wa utafiti unasimamiwa na chuo kikuu cha kilimo na Teknologia cha Jomo Kenyatta (JKUAT) kwa ushirikiano na Taasisi ya utafiti wa Afya (KEMRI).

NIA

Nia ya utafiti huu ni kutaka kujua hali za hatari kwa maendeleo ya mimba za kisukari, uwezekano wa matokeo ya kiafya ya nje ya uzazi na matukio ya mimba za kisukari miongoni mwa akina mama wajawazito wanaohudhuria kliniki za wajawazito katika kaunti ya Nairobi. Wewe unaweza kuwa mshiriki katika utafiti huu kwa sababu wewe ni mwanamke mjamzito unayehudhuria kliniki za wajawazito katika kituo cha akina mama wajawazito kilichochaguliwa.

MBINU

Ukikubali kushiriki katika utafiti huu, na kutia saini kwenye fomu hii ya idhini, mtafiti msaidizi ataeleza mbinu vilevile nia yao. Tutakuuliza maswali yanayohusiana na mimba yako kwa sehemutatu, kila sehemuitachukua dakika 20 hadi 30 za muda wako;sehemuya kwanza itakuwa baada ya kuturuhusu tukuhoji. sehemu ya pili itakuwa shughuli ndogo ya maabara ya kupima kiwango cha sukari kwenye damu na mwisho, ni mahojiano ya kufuatilia katika kipindi cha siku 28 baada ya kujifungua mtoto wako. Hivyo basi tutakuomba utupatie nambari zako za mawasiliano na mahali unapoishi.

HATARI NA FAIDA

Faida ya kushiriki katika utafiti huu ni kuwa habari hizi zitatumiwa kuboresha afya ya akina mama na watoto nchini Kenya kupitia utayarishaji wa mipango na sera zifaazo.

HIARI YA UTAFITI

Uamuzi wako wa kushiriki au kutoshiriki katika utafiti huu hautaathiri uhusiano wako wa baadaye na kituo hicho cha afya, Taasisi ya utafiti ya afya, chuo kikuu cha kilimo na Teknologia cha Kenyatta na wafanyikazi wake. Ikiwa hutaki kushiriki au hutaki kujibu maswali mengine, hulazimiki kutupa sababu. Hata ingawa umetia sahihi kwenye fomu ya idhini, una uhuru kuacha wakati wowote, hulazimishwi kuijaza ikiwa una shaka unapofanya hivyo.

USIRI

Habari unazotupa ni za faragha na habari hizo zitahifadhiwa kwa njia ya vitambuisho wala sio majina. Maelezo yakoo ya kibinafsi (Jina na nambari ya mawasiliano) hayataonyeshwa katika maelezo yoyote ya matokeo ya utafiti.

MAWASILIANO

Watafiti wanaofanya utafiti huu ni Maureen A. Adoyo na msaidizi wake. Unaweza kuwasiliana nao wakati wowote. Unaweza pia kuelekeza maswali yoyote kuhusu haki za wanaotumiwa kwa utafiti kwa kamati ya kimaadili ya hospitali Kuu ya Kenyatta(KNH).

Ikiwa kuna maswali yeyote au shaka, tafadhali wasiliana na mtafiti mkuu, mchunguzi mkuu au kamati ya kimaadili ya hospitali Kuu ya Kenyatta kuihusu.

Maureen Atieno Adoyo
S.L.P. 1998 – 00502
NAIROBI – KENYA
Numbari ya rununu: +254 723509359

Barua pepe:oam.adoyo@hotmail.com

Au

Mkurugenzi,
Taasisi ya Dawa za Tropikali na Magonjwa Ambukizi,
Chuo Kikuu cha Jomo Kenyatta cha Kilimo na Teknolojia
S.L.P. 62200- 00200
NAIROBI KENYA
Simu: 067 – 52711
Barua pepe:itromid@kemri.org

Au

Mwenyekiti;
Hospitali Kuu ya Kitaifa Kitengo cha Ukaguzi wa Kimaadili.
S.L.P. 20723-00200;
NAIROBI –KENYA
Simu :020 2726300

Idhini

Kwa wakati huu, unataka kuniuliza chochote kuhusu utafiti huu? Naweza kuanza mahojiano sasa?

Sahihi ya anayehoji……..
Tarehe……...

MHOJIWA ANAKUBALIKUHOJIWA**1** **Jina.....** **Sahihi..... Tarehe.....** **ENDELEA**	MUHOJIWA HAKUBALI KUHOJIWA…….2 MWISHO.

Appendix v : Questionnaires /Maojaji

PHASE ONE : SCREENING QUESTIONNAIRE (1)

Interviewer Code.....

Date.....

Sub county (Code).....

Facility Code.....

Interviewer Name..... Assign code.....

Section A: Selection Questions

	QUESTIONS AND INSTRUCTIONS	**RESPONSE AND CODING CATEGORIES**	**SKIP**
101.	What is your Age?	…….	
102.	What month is your pregnancy? **NB: Check clinic card/records for EDD**	-------- ……	Below 32 Weeks
103.	How long have you lived in Nairobi?	……..	
104	What is your residence status here in Nairobi?	Permanent.....1 Visitor.....2	to 106 to 105
105	How long do you plan to be in Nairobi?	Less than 3 months.....1 6 months or more .....2 Others(specify).....3 Don't Know.....98	Stop to 106
106	Where do you plan to take your baby for vaccination or check ups	……	
107	Would you allow us to visit you, If the study team deem it necessary?	Yes……1 No……2	 to 108
108	What is your residential physical		

	address?	……	
109	What are your contact cell number • Personal contact • Next of Kin (Name or relationship) contacts?	1..... 2.....	
110	What was your body weight before pregnancy?	..... Can't remember.....98	

Section B: Laboratory Glucose Intolerance Test

Negative=1 Positive =2

		Results
111	Glucose Intolerance Test 1	
112	Glucose Intolerance Test 2 (confirmatory Test)	

Section C: Measurement (Interviewer only)

NB: Interviewer to interpret results for section

113	What is the BMI (height/weight) based on weight before pregnancy **NB: interviewer convert Kg to pounds**		
114	BMI conversion by Interviewer	Under weight .....1 Normal……...2 Overweight…….3 Obese……..4 Extreme Obese……5	

HOJAJI YA KUCHUJA (1)

Kitambulisho cha anayehoji……

Tarehe……

Kitambulisho cha kauni ndogo……

Jina la kituo……

Kitambulisho……..

Jina la mhojiwa……

kitambulisho kinachotumiwa……..

SEHEMU A: MASWALI YA KUCHAGUA

	MASWALI NA MAAGIZO	**MAJIBU NA KATEGORIA ZA VITAMBULISHO**	**RUKA**
101.	Una umri gani?	……	
102.	Mimba yako iko mwezi wa ngapi? Angalia kadi / rekodi za kliniki uone tarehe ya EDD.	…… ……..	Chini ya wiki 32
103.	Umeishi Nairobi muda gani?	…….	
104.	Hali yako ya kuishi Nairobi ni ipi?	Kudumu……..1 Mgeni …….2	Hadi 106 Hadi 105
105.	Umepanga kuwa Nairobi kwa muda gani?	Chini ya miezi 3……1 Miezi 6 au zaidi…….2 Mengine(eleza)……..3 Sijui…….4	Acha hadi 106
106.	Unapanga kumpeleka mtoto wako wapi kwa chanjo au uchunguzi	…….. …….	
107.	Unaweza kuturuhusu tukutembelee ikiwa itahitajika?	Ndio……..1 La……2	Hadi 108

108.	Unaishi wapi	……..	
109.	Nambari yako ya simu 1. Yako binafsi 2. Ya jamaa wa karibu (jina lake au uhusiano)	1…… 2……	
110.	Uzani wako kabla ya mimba ulikuwaje?	Sikumbuki ……98	

SEHEMU B: UCHUNGUZI WA MAABARA

		Matokeo	Wastani
111.	Kipimo chasukari 1		
112.	Kipimo chasukari 2		

SEHEMU YA C: VIPIMO (Anayehoji Pekee)

113.	BMI (urefu/uzani) kutegemea uzai kable ya mimba ikoje? **Kumbuka:Anayehoji kubadilisha kilo hadi paundi**.	Matokeo	Wastani
114	Hali ya BMI ikoje?	Chini ya uzanu.....1 Kawaida …….2 Uzani uliozidi…….....3 Unene……4 Unene kupindukia……....5	

PHASE TWO :QUESTIONNAIRE (2)

Interviewer Code.....

Date.....

Sub County (Code) .....

Facility Code.....

Interviewer Code.....

Assigned code.....

MEDICAL HISTORY

	QUESTIONS AND INSTRUCTIONS	**RESPONSE AND CODING CATEGORIES**	**SKIP**
201	Is this your first Pregnancy?	Yes……..…1 No…….…..2	To 216
202	Number of births		
203	Are all the children alive?	Yes……1 No…. 2(record cause and age)	
204	Do you remember birth weight of your children?	Yes……..…1 Others No……..2	to 210
205	Weight of Children 206…….. 207…… 208……. 209…….	Small……..1 Large…….....2 Very large…….....3 Specific weigh if known... Won't remember…….98	
210	What was the mode of delivery? 211	C-section…….1	

	212 213 214	Normal…….2 Episiotomy……....3 Refused……. 98	
215	What is the level of blood pressure (BP) **NB: interviewer check and interpret current record from clinic record**	Normal……1 High……....2 Low…….3	
216	How frequent do you urinate?	Occasionally……1 Often…….2 Quite a lot…….3	
217	How frequent do you urinate per day	≤2 hours……1 3-4hours……..…2 ≥4hours……..3	
218	What is the volume of urine per day	Little……1 Normal……..2 Alot …….3	
219	Do you feel thirsty or experience dryness in the mouth?	Yes……..…1 No……...2	
220	How can you describe your skin texture **NB: Interviewer to make observation**	Soft and glowing…… .1 Dry and rough……2	
221	When did occurrence of observed symptoms start? 216- 221 response is not normal	Start of pregnancy…….....1 Before pregnancy……...2 Can't remember……....3	
222	Did you test for sugar levels before pregnancy?	Yes……..1 No…….2 Won't remember……..98	to 225

223	What were the result of the test	Positive……1 Negative……2 Don't know……...98	
224	Do you have any diabetic history/ illness in your family	Yes……..1 No……...2	
225	Who in family tree has diabetic condition?	Father……1 Mother……...2 Grandparents……..3 Uncle/Aunty……..4 ……..	
226	Do you have any swelling experienced on your body? **NB: Interviewer to make observation**	Yes……..1 No……2	Go to 228
226	Any body part with swelling	Hands……..1 Foot ……2 Face……3	
227	Do have any other prevailing medical condition or chronic illness?	Yes……1 No……...2	
228	What is the Medical Condition?	HIV/AIDS……..1 High Blood Pressure……...2 Cancer……3 Other (specify) Won't answer……98	

HOJAJI YA KIWANGO CHA (2)

Kitambulisho cha anayehoji……

Tarehe……

Kitambulisho cha kauni ndogo ……

Jina la kituo ……

Kitambulisho……..

Jinal la mhojiwa……

Kitambulisho kinachotumiwa……..

HISTORIA YA AFYA

	MASWALI NA MAAGIZO	**MAJIBU NA KATEGORIA ZA VITAMBULISHO**	**RUKA**
201.	Hii ni mimba yako ya kwanza?	Ndio …….1 La ……..2	Hadi 216
202.	Umejifungua mara ngapi?		
203.	Watoto wako wote wako hai?	Ndio …….1 La …….2	
204.	Unakumbuka uzito wa watoto wako walipozaliwa?	Ndio ……...1 La …….….2	Hadi 40
205.	Uzito wa watoto 206……. 207…… 208…… 209……..	Wadogo ……1 Wakubwa …….2 Wakubwa sana…….3 Uzito maalum, kama Unaujua.....…….4 Sikumbuki ……..98	
210.	Ulijufungua kwa njia ipi? 211 212 213 214	Upasuaji……1 Kawaida …….2 Kuongezwa kwa njia uzazi.....3 Sitajibu ……98	

215.	Hali ya shirikizo la damu ikoje?	Kawaida ……..1 Juu.……2 Chini …….3	Hadi 108
216.	Unakojoa mara ngapi/	Mara moja moja…….1 Mara kwa mara……2. Mara nyingi…….….3	
217.	Unakojoa kila baada ya muda gani kwa siku?	Saa mbili au chini yake……1 saa 3 hadi 4…..2 Saa 4 au zaidi……..…3	
218.	Ni kiasi gani cha mkojo kwa siku?	Kidogo ……..…1 Kawaida…….2 Mwingi……3	
219.	Unaona kiu au kuhisi ukavu kinywani?	Ndio……1 La…….2	
220.	Hali ya mguso na ngozi iko je?	Kawaida…….1 Kavu na yenye kuparara.2	
221.	Je, dalili zinazoonekana zilianza lini? 216 hadi 221 sio kawaida	Mimba inapoanza…….1 Kabla ya mimba……2 Sikumbuki……..3	
222.	Je, ulipima kiwango cha sukari mwilini kabla ya mimba?	Ndio ……1 La …….2 Sikumbuki ……..3	
223.	Matokeo yalikuwa yapi?	Chanya (+ve)…….1 Hasi (-ve)……2 Sijui……...98	
224.	J e, kuna historia ya ugonjwa wa sukari kwenye familia yenu?	Ndio……1 La……..	
225.	Ni nani kwenye familia yenu aliy na yugonjwa wa sukari	Baba ……1 Mama……..2	

		Baba / nyanya……...3 Mjomba / shangazi…..4	
226.	Ulifura sehemu yeyote ya mwili wako?	Ndio……1 La ……2	(mwisho)
227.	Ni sehemu ipi ya mwili wako imefura/ ina uvimbe	Mkono ……...1 Mguu……..2 Uso……..3	
228.	Hali ya matibabu ikoje?	ukimwi.....1 shiriizo wa damu.....2 saratani.....3 mengine(taja) hutajibu.....98	

PHASE THREE QUESTIONNAIRE: FOLLOW -UP (20-28) WEEKS AFTER BIRTH)

Interviewer Code. .....

Date.....

Sub county (Code) .....

Facility Code.....

Interviewer Code.....

Assigned code.....

SECTION A: MATERNAL HEALTH OUTCOME

	QUESTIONS AND INSTRUCTIONS	**RESPONSE AND CODING CATEGORIES**	**SKIP**
301	State of mother	1=alive 2=dead	Continue to Section B
302	Was your delivery time as prescribed to at the ANC?	Yes……...1 No…….2 Don't Know……..3	
303	What type of labor did you experience	Preterm labor……..1 On term labor……..2 Post term(delayed) labor……3	
304	What was mode of delivery	C-section……..1 Normal…….…2 Episiotomy…….....3 Refused……. 98	
305	What is the level of blood pressure (BP) **NB: interviewer check and interpret current record from clinic record**	Normal……1 High……....2 Low…….3	

306	Urination frequency	Occasionally……..……1 Often……..……2 Quite a lot……..……3 Don't know…….…….98	
307	Current urination frequency	≤2 hours……1 3-4hours……..…2 ≥4hours……..3	
308	Volume of urine per day	Little……1 Normal…….....2 A lot.....3 Don't know……98	
309	Do you experience thirst or dryness in the mouth?	Yes…….……..…1 No…….…2	
310	How can you describe the skin texture **NB: Interviewer to make observation**	Normal…….....1 Dry and rough……..2	
311	Did you experience any complication during and after birth	Yes ……1(specify) No…….…2 Don't Know……...……98	to 312
312	Describe complication experienced during or after birth	……	

MATERNAL MEASUREMENTS I

	Measurements	Observer 1(records)	Observer 2 (Interviewer	Average
313	Weight(In Kg)			
314	Height(Meters)			

MATERNAL MEASUREMENTS II: MEASUREMENT (INTERVIEWER ONLY)

NB: Interviewer to interpret results for section

315	What is the BMI (height/weight) based on weight current weight		
316	What is the BMI status	Under weight .....1 Normal……...2 Overweight…….3 Obese……..4 Extreme Obese……..... 5	

SECTION B :NEONTAL HEALTH OUTCOME

	QUESTIONS AND INSTRUCTIONS	**RESPONSE AND CODING CATEGORIES**	**SKIP**
317	Is your Baby alive	Yes…….. No……..	Continue Stop (empathize)
318	How much did the baby weigh at birth	……	
319	What is the height at birth	…….	
320	What is the BMI (height/weight) based on	……..	

	weight current weight		
321	What is the BMI status	Under weight.....1 Normal……..2 Overweight……... 3 Obese…… 4 Extreme Obese……5	
322	Did the baby experience any difficulties in breathing after birth	Yes……1 No ……2	
323	Describe, in your words the difficulties experienced by the baby	……	
324	Did you observe any yellow coloration in the eyes or babies urine?	Yes……1 No……2	To 325
325	Describe the condition you experienced in the coloration of the baby's eye and urine	…….	

NEONATE MEASUREMENTS I

	Measurements	Observer 1(records)	Observer 2 (Interviewer)	Average
326	Weight(In Kg)			
327	Height(Meters)			

NEONATE MEASUREMENTS II: (INTERVIEWER ONLY)

NB: Interviewer to interpret results for section

328	What is the BMI (height/weight) based on		

	weight current weight		
329	What is the BMI status according to age	Under weight.....1 Normal……...2 Overweight…….3 Obese……..4 Extreme Obese……...5	

HOJAJI YA KIWANGO CHA PILI

KUFUATILIA (WIKI 20-28 BAADA YA KUJIFUNGUA)

Kitambulisho cha anayehoji……

Tarehe……

Kitambulisho cha kauni ndogo ……

Jina la kituo……

Kitambulisho……..

Jinal la mhojiwa……

kitambulisho kinachotumiwa ……..

SEHEMU YA A: MATOKEO YA AFYA YA MAMA

	MASWALI NA MAAGIZO	**MAJIBU NA KATEGORIA ZA VITAMBULISHO**	**RUKA**
301.	Je mama yuko hai?	Ndio …….1 La …….2	Endelea hadi sehemu ya B.
302.	Wakati wako wa kujifungua uliambatana na ule uliambiwa katika kliniki.	Ndio …….1 La ……..2 Sijui……3	
303.	Unaweza kuelezaje uchungu wako wa kujifungua?	Uchungu kabla ya wakati…1 Uchungu kwa wakati .....2 Uchungu uliopita wakati (uliochelewa)..... 3	
304.	Ulijifunguaje mimba yako ya mwisho?	Upasuaji ……...1 Kawaida …….….2 Kwa kuongezwa njia ya uzazi…….3 Sitajibu……98	

305.	Kiwango cha shirikizo la damu ikoje?	kawaida ……1 Juu…….……2 Chini …….3	
306.	Unakojoa mara ngapi?	Mara moja moja……1 Mara kwa mara…….2 Mara nyingi……..3 Sijui…. …….98	
307.	Kwa wakati huu unakojoa baada ya muda gani?	Saa 2 au zaidi……..1 Saa 3 hadi 4……2 Saa 4 au Chini …….3	
308.	Ni kiasi gani cha mkojo?	Kidogo……..…….1 Kawaida……2. Mwingi …...…….….3 Sijui ……..98	
309.	Unaona kiu au kuhisi ukavu kinywani?	Ndio……1 La……2	
310.	Hali ya mguso wa ngozi ikoje?	Kawaida……1 Kavu iliyo parara…….2	
311	Je ulipata shida yeyote wakati wa kujifungua au baada?	Ndio……1 La……2 Sijui……..3	Hadi 312
312	Tafadhali eleza shida uliyopata wakati wa kujifungua au baada ya kujifungua	……..	

VIPIMO VYA II VYA MAMA: KIPIMO (MAHOJI PEKEE)

Anayehoji atafsiri matokeo katika sehemu hii

313	BMI (urefu/uzani) kutegemea uzani wa sasa		
314	Hali ya BMI ni ipi?	Chini ya uzanu.....1 Kawaida …….2	

		Uzani uliozidi……...3 Unene…….4 Unene kupindukia…….....5	

SEHEMU YA B: MATOKEO YA KIAFYA ya MTOTO MCHANGA

	MASWALI NA MAAGIZO	**MAJIBU NA KATEGORIA YA VITAMBULISHO**	**RUKA**
315	Mtoto wako yuko hai?	Ndio …….……..1 La……..……..2	Elezea acha. (Tilia mkazo)
316	Alikuwa na uzani gani alipozaliwa	……..	
317	BMI(urefu / uzito) kutegemea uzito wa sasa	…….	
318	Je hali ya BMI ni ipi?	Chini ya uzani……..1 Kawaida……..….2 Uzani uliozidi……..3 Unene kupidukia…….4	
319	Je mtoto alikubwa na shida ya kupumua baada ya kuzaliwa?	Ndio …….……..1 La……..……..2	
321	Eleza kwa maneno yako shida zilizonimkumba mtoto	……..	
322	Je, uliona rangi ya manjano ndani ya macho ya mtoto au kwenye mkojo wake?	Ndio …….……..1 La……..……..2	Hadi 325
323	Eleza hali uliyoishuhudia katika rangi ya macho na mkojo wa mtoto	…….	

VIPIMO 1 VYA MTOTO MCHANGA

	VIPIMO	MCHUNGUZI 1	MCHUNGUZI 2	WASTANI
325	**Uzani(kwa Kg)**			
327	**Urefu(Mita)**			

VIPIMO VYA II VYA MTOTO MCHANGA (ANAYEHOJI PEKEE)

Anayehoji atafsiri matokeo katika sehemu hii

328	BMI (urefu/ uzani) kutegemea uzani wa sasa ni ipi		
329	Hali ya BMI kutegemea umri	Chini ya uzani.....1 Kawaida……..……2 Uzani uliozidi ……..…..3 Unene ……..…4 Unene kupindukia……4	

APPENDIX VII: BMI Estimation Table

Body Mass Index (BMI) Chart for Adults

Obese (>30) | Overweight (25-30) | Normal (18.5-25) | Underweight (<18.5)

HEIGHT in feet/inches and centimeters

WEIGHT		4'8"	4'9"	4'10"	4'11"	5'0"	5'1"	5'2"	5'3"	5'4"	5'5"	5'6"	5'7"	5'8"	5'9"	5'10"	5'11"	6'0"	6'1"	6'2"	6'3"	6'4"	6'5"
lbs	(kg)	142cm		147	150	152	155	157	160	163	165	168	170	173	175	178	180	183	185	188	191	193	196
260	**(117.9)**	**58**	**56**	**54**	**53**	**51**	**49**	**48**	**46**	**45**	**43**	**42**	**41**	**40**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**32**	**31**
255	(115.7)	57	55	53	51	50	48	47	45	44	42	41	40	39	38	37	36	35	34	33	32	31	30
250	**(113.4)**	**56**	**54**	**52**	**50**	**49**	**47**	**46**	**44**	**43**	**42**	**40**	**39**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**30**
245	(111.1)	55	53	51	49	48	46	45	43	42	41	40	38	37	36	35	34	33	32	31	31	30	29
240	**(108.9)**	**54**	**52**	**50**	**48**	**47**	**45**	**44**	**43**	**41**	**40**	**39**	**38**	**36**	**35**	**34**	**33**	**33**	**32**	**31**	**30**	**29**	**28**
235	(106.6)	53	51	49	47	46	44	43	42	40	39	38	37	36	35	34	33	32	31	30	29	29	28
230	**(104.3)**	**52**	**50**	**48**	**46**	**45**	**43**	**42**	**41**	**39**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**30**	**29**	**28**	**27**
225	(102.1)	50	49	47	45	44	43	41	40	39	37	36	35	34	33	32	31	31	30	29	28	27	27
220	**(99.8)**	**49**	**48**	**46**	**44**	**43**	**42**	**40**	**39**	**38**	**37**	**36**	**34**	**33**	**32**	**32**	**31**	**30**	**29**	**28**	**27**	**27**	**26**
215	(97.5)	48	47	45	43	42	41	39	38	37	36	35	34	33	32	31	30	29	28	28	27	26	25
210	**(95.3)**	**47**	**45**	**44**	**42**	**41**	**40**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**28**	**27**	**26**	**26**	**25**
205	(93.0)	46	44	43	41	40	39	37	36	35	34	33	32	31	30	29	29	28	27	26	26	25	24
200	**(90.7)**	**45**	**43**	**42**	**40**	**39**	**38**	**37**	**35**	**34**	**33**	**32**	**31**	**30**	**30**	**29**	**28**	**27**	**26**	**26**	**25**	**24**	**24**
195	(88.5)	44	42	41	39	38	37	36	35	33	32	31	31	30	29	28	27	26	26	25	24	24	23
190	**(86.2)**	**43**	**41**	**40**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**26**	**26**	**25**	**24**	**24**	**23**	**23**
185	(83.9)	41	40	39	37	36	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23	23	22
180	**(81.6)**	**40**	**39**	**38**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**27**	**26**	**25**	**24**	**24**	**23**	**22**	**22**	**21**
175	(79.4)	39	38	37	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23	22	22	21	21
170	**(77.1)**	**38**	**37**	**36**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**27**	**26**	**25**	**24**	**24**	**23**	**22**	**22**	**21**	**21**	**20**
165	(74.8)	37	36	34	33	32	31	30	29	28	27	27	26	25	24	24	23	22	22	21	21	20	20
160	**(72.6)**	**36**	**35**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**27**	**26**	**25**	**24**	**24**	**23**	**22**	**22**	**21**	**21**	**20**	**19**	**19**
155	(70.3)	35	34	32	31	30	29	28	27	27	26	25	24	24	23	22	22	21	20	20	19	19	18
150	**(68.0)**	**34**	**32**	**31**	**30**	**29**	**28**	**27**	**27**	**26**	**25**	**24**	**23**	**23**	**22**	**22**	**21**	**20**	**20**	**19**	**19**	**18**	**18**
145	(65.8)	33	31	30	29	28	27	27	26	25	24	23	23	22	21	21	20	20	19	19	18	18	17
140	**(63.5)**	**31**	**30**	**29**	**28**	**27**	**26**	**26**	**25**	**24**	**23**	**23**	**22**	**21**	**21**	**20**	**20**	**19**	**18**	**18**	**17**	**17**	**17**
135	(61.2)	30	29	28	27	26	26	25	24	23	22	22	21	21	20	19	19	18	18	17	17	16	16
130	**(59.0)**	**29**	**28**	**27**	**26**	**25**	**25**	**24**	**23**	**22**	**22**	**21**	**20**	**20**	**19**	**19**	**18**	**18**	**17**	**17**	**16**	**16**	**15**
125	(56.7)	28	27	26	25	24	24	23	22	21	21	20	20	19	18	18	17	17	16	16	16	15	15
120	**(54.4)**	**27**	**26**	**25**	**24**	**23**	**23**	**22**	**21**	**21**	**20**	**19**	**19**	**18**	**18**	**17**	**17**	**16**	**16**	**15**	**15**	**15**	**14**
115	(52.2)	26	25	24	23	22	22	21	20	20	19	19	18	17	17	16	16	16	15	15	14	14	14
110	**(49.9)**	**25**	**24**	**23**	**22**	**21**	**21**	**20**	**19**	**19**	**18**	**18**	**17**	**17**	**16**	**16**	**15**	**15**	**15**	**14**	**14**	**13**	**13**
105	(47.6)	24	23	22	21	21	20	19	19	18	17	17	16	16	16	15	15	14	14	13	13	13	12
100	**(45.4)**	**22**	**22**	**21**	**20**	**20**	**19**	**18**	**18**	**17**	**17**	**16**	**16**	**15**	**15**	**14**	**14**	**14**	**13**	**13**	**12**	**12**	**12**
95	(43.1)	21	21	20	19	19	18	17	17	16	16	15	15	14	14	14	13	13	13	12	12	12	11
90	**(40.8)**	**20**	**19**	**19**	**18**	**18**	**17**	**16**	**16**	**15**	**15**	**15**	**14**	**14**	**13**	**13**	**13**	**12**	**12**	**12**	**11**	**11**	**11**
85	(38.6)	19	18	18	17	17	16	16	15	15	14	14	13	13	13	12	12	12	11	11	11	10	10
80	**(36.3)**	**18**	**17**	**17**	**16**	**16**	**15**	**15**	**14**	**14**	**13**	**13**	**13**	**12**	**12**	**11**	**11**	**11**	**11**	**10**	**10**	**10**	**9**

Note: BMI values rounded to the nearest whole number. BMI categories based on CDC (Centers for Disease Control and Prevention) criteria.

www.vertex42.com BMI = Weight[kg] / (Height[m] x Height[m]) = 703 x Weight[lb] / (Height[in] x Height[in])

APPENDIX VIII:Citi Certification Of The Investigator

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI)

STUDENTS CONDUCTING NO MORE THAN MINIMAL RISK RESEARCH CURRICULUM COMPLETION REPORT

Printed on 07/31/2014

LEARNER	Maureen Adoyo (ID: 3680526) kenya
DEPARTMENT	itromid
EMAIL	itromid2010@gmail.com
INSTITUTION	Kenya Medical Research Institute
EXPIRATION DATE	07/31/2015

STUDENTS - CLASS PROJECTS : This course is appropriate for students doing class projects that qualify as "No More Than Minimal Risk" human subjects research.

COURSE/STAGE:	Basic Course/1
PASSED ON:	07/31/2014
REFERENCE ID:	13615230

REQUIRED MODULES	DATE COMPLETED	SCORE
Belmont Report and CITI Course Introduction	07/31/14	2/3 (67%)
Students in Research	07/31/14	10/10 (100%)
Kenya Medical Research Institute	07/31/14	No Quiz

For this Completion Report to be valid, the learner listed above must be affiliated with a CITI Program participating institution or be a paid Independent Learner. Falsified information and unauthorized use of the CITI Program course site is unethical, and may be considered research misconduct by your institution.

Paul Braunschweiger Ph.D.
Professor, University of Miami
Director Office of Research Education
CITI Program Course Coordinator

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Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/42

2nd February, 2015

Maureen A. Adoyo
TM 306-1094/2013
JKUAT

Dear Adoyo

Research Proposal: Gestational diabetes among mothers attending antenatal Clinic in Nairobi County and the Associated Health risks in Maternal and Neonates (P671/11/2014)

This is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and approved your above proposal. The approval periods are 2nd February 2015 to 2nd February 2016.

This approval is subject to compliance with the following requirements:

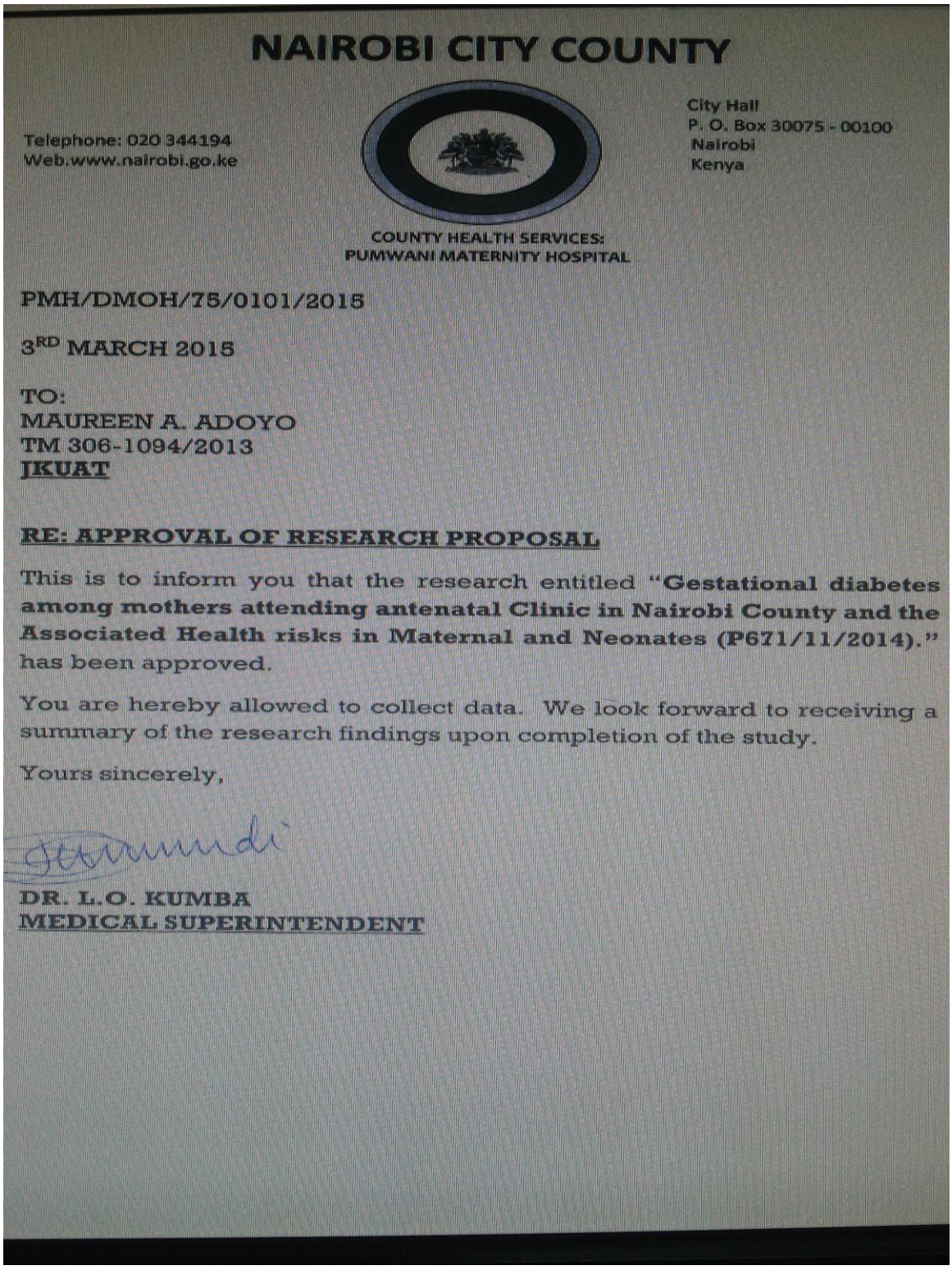
a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
c) Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
g) Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

For more details consult the KNH/UoN ERC website **www.erc.uonbi.ac.ke**

Protect to discover

Appendix ix: Approval from County Council of Nairobi

Appendix x: Ethical Approval



NAIROBI CITY COUNTY

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COUNTY HEALTH SERVICES:
PUMWANI MATERNITY HOSPITAL

PMH/DMOH/75/0101/2015

3RD MARCH 2015

TO:
MAUREEN A. ADOYO
TM 306-1094/2013
JKUAT

RE: APPROVAL OF RESEARCH PROPOSAL

This is to inform you that the research entitled "**Gestational diabetes among mothers attending antenatal Clinic in Nairobi County and the Associated Health risks in Maternal and Neonates (P671/11/2014).**" has been approved.

You are hereby allowed to collect data. We look forward to receiving a summary of the research findings upon completion of the study.

Yours sincerely,

DR. L.O. KUMBA
MEDICAL SUPERINTENDENT