PREVALENCE AND FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT AMONG NEONATES BORN AT OLKALOU DISTRICT HOSPITAL, KENYA

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Prevalence and factors associated with low birth weight among neonates born at Olkalou District Hospital, Kenya

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DECLARATION

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

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This Thesis has been submitted for examination with our approval as university supervisors.

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DEDICATION

To my grandmother, Elizabeth Wanjiru for the many days you carried me on your back since my third month of life until I made my first day in nursery school.

To my mother, Agnes Wanjira for your encouragement that if I worked hard in school, I would know Nairobi like the palm of my hand.

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ABBREVIATIONS AND ACRONYNYMS

AIDS- Acquired Immunodeficiency Syndrome

ANC- Antenatal Care

BMI- Body Mass Index

HIV- Human Immunodeficiency Virus

KDHS- Kenya Demographic Health Survey

KNBS- Kenya National Bureau of Statistics

LBW- Low Birth Weight

LNMP- Last Normal Menstrual Period

MDG- Millennium Development Goal

MUAC- Mid Upper Arm Circumference

SGA- Small for Gestational Age

UNICEF- United Nations Children's Fund

VDRL- Venereal Diseases Research Laboratory

WHO- World Health Organization

ABSTRACT

Ninety two percent of Low Birth Weight (LBW) babies are born in developing countries with 70 percent born in Asia and 22 percent in Africa. WHO and UNICEF estimate LBW in Kenya to be 11 percent, while the estimate was 6 percent according to Kenya Demographic Health Survey of 2008-09. This is probably an underestimate. The same survey estimated Central region to have a low birth weight prevalence of 5.5 percent. Despite being preventable, LBW is a major cause of morbidity and mortality in Kenya. Hospital data in the study setting indicated that the prevalence of LBW was 16.8%. However, the factors giving rise to this high prevalence remained unknown. This formed the basis of this study, which sought to estimate the prevalence and investigate the factors associated with low birth weight in Olkalou hospital. This was a cross-sectional study. The study population involved all women delivering at Olkalou hospital between 28th October 2013 and 28th January 2014. Data was collected using a semi-structured interview tool and data abstraction form to collect reproductive and obstetric information from delivery records, labor notes and mother and child health booklet. The weight, height and mid-upper arm circumference of the mother and the weight of the neonate were measured immediately upon delivery. Three hundred and twenty seven women were randomly selected from a sampling frame of five hundred clients and examined during the study. This represented a 94.5% response rate. The prevalence of low birth weight was 12.3% (n=40). The mean age of the respondents was 25.6±6.2 years and mean birth weight was 2928±533 grams. There were 51.1% (n=165) male neonates and 48.9% (n=158) were females. On bivariate analysis the following factors were found to be significantly associated with low birth weight; LBW delivery in a previous birth (OR=4.7, 95%C.I.=1.53-14.24, p-value=0.01), premature rapture of membranes (OR=2.95, 95%C.I.=1.14-7.62, p-value=0.04), premature birth (OR=3.65, 95%C.I.=1.31-10.38, p-value=0.02), and female newborn (OR=2.32, 95%C.I.=1.15-4.70, p-value=0.03). However, on logistic regression only delivery of LBW baby in a previous birth (OR=5.07, 95%C.I.=1.59-16.21, p-value<0.01) and female neonate

(OR=3.37, 95%C.I.=1.14-10.00, p-value=0.03) were independently associated with LBW in the hospital. Findings from this study confirm that LBW is prevalent in Olkalou district hospital. This was largely influenced by maternal factors such as LBW of a previous delivery, premature rapture of membranes, premature birth and the sex of the newborn. There is therefore need to institute focused local and cost-effective interventions to reduce the prevalence of LBW through retraining on focused antenatal care and adopting simple strategies for the care of LBW babies. The findings will also contribute to the body of knowledge regarding low birth weight

CHAPTER ONE

INTRODUCTION

1.1. Background

Low birth weight is birth of a live infant weighing less than 2500g (up to and including 2499g) irrespective of gestational age. It is often expressed as percentage of live born infants in a given time period. It can be subdivided into very low birth weight (less than 1500g) and extremely low birth weight (less than 1000g). Birth weight should be measured within the first hour of life before significant postnatal weight loss has occurred (UNICEF&WHO, 2004). LBW is mainly as a result preterm birth (before 37 weeks gestation) or due to restricted intrauterine growth (Kramer, 1987).

The global prevalence of LBW is 15.5 percent, which amounts to about 20 million LBW infants born each year, 96.5 percent of them in developing countries. Half of all low birth weight babies are born in South-central Asia where 27 percent are below 2500g at birth while LBW levels in sub-Saharan Africa are estimated at 14 percent (UNICEF&WHO, 2004). This amounts to about 4.3 million of the babies born every year. However, this varies from country to country. The commonest causes of low birth weight in sub-Saharan Africa are Malaria and malnutrition in pregnancy. Malaria also leads to premature delivery (WHO-AFRO, 2008). Most of the babies in Africa are at risk of being born preterm. The situation is different for South Asia where the rate of LBW is almost twice that of Africa but majority of the LBW babies are term babies who are small for gestational age. Preterm babies have a higher risk of death compared to full term babies (Lawn & Kerber , 2006).

The fourth Millennium Development Goal (MDG)is to reduce child mortality by two-thirds from 1990 to 2015. Under-five mortality and infant mortality rates are two of the indicators used to monitor the fourth millennium development goal. The global under five mortality dropped by 41 percent from an estimated 87 to 51 deaths per 1000 live

births between 1990 and 2011. The infant mortality rate decreased from 61 deaths per 1000 live births in 1990 to 37 deaths per 1000 live births in 2011.Neonatal mortality declined from 32 per 1000 to 22 per 1000 live births over the same period. Although these indicators have shown a declining trend, the highest burden and the least improvement was observed in Sub-Saharan Africa compared to other regions of the world (UN Inter-Agency group for child mortality, 2013).

Globally, neonatal mortality accounts for 40 percent of all deaths among children less than five years. Seventy-five percent of neonatal deaths occur during the first week of life, and between 25 to 45 percent occur within the first 24 hours. Preterm birth is the most common direct cause of newborn mortality. Preterm birth and Small for Gestational Age (SGA) which are the reasons for low birth weight (LBW) are important indirect causes of neonatal deaths, contributing 60 to 80 percent of all neonatal deaths globally (UNICEF&WHO, 2004).Worldwide, the main causes of neonatal deaths are infections 35 percent, preterm birth 28 percent and asphyxia 23 percent(Lawn Katarzyna, & Cousens, 2006). There is substantial variation among regions on these three main causes. In Africa infections contributes 39 percent, prematurity 25 percent and asphyxia 24 percent. Low birth weight underlies majority of these deaths and links to maternal health, nutrition and infections such as Malaria and HIV. Similarly, in Kenya infections 25 percent, asphyxia 29 percent and prematurity 34 percent are the leading causes(The partnership for maternal, neonatal and child health, 2006).

The current trends of infant and under five mortality rates in Kenya are declining. Under five mortality has declined by 36 percent from 115 per 1000 in 2003 to 74 deaths per 1000 in the 2008-09, while infant mortality has declined by 32 percent from 77 deaths per 1000 in the 2003 survey to 52 deaths per 1000 (CBS and ORC Macro, 2004; KNBS ,2010). Neonatal mortality changed from 33 deaths per 1000 reported in the 2003 survey to 31 deaths per 1000 reported in the 2008-09 survey. This was a marginal reduction compared to the other child health indicators. The decline of the infant and under five

mortality is an indicator of progress in achieving the fourth millennium development goal(KNBS, 2010).

Addressing challenges associated with newborn deaths in Kenya has the greatest potential of contributing to this progress.

1.2. Statement of the problem

Babies born low birth weight are 37 percent more likely to die during infancy compared to those of normal weight if other factors are held constant. Therefore low birth weight is strongly negatively associated with infant survival (Uthman, 2007). In a study conducted in East Africa, preterm babies and babies with low birth weight were found to account for 52 percent of newborn deaths in East Africa (Marchant *et al*, 2012).

The contribution of low birth weight in neonatal morbidity and mortality in Kenya cannot be ignored. In a study conducted in general pediatric wards in Kenyatta National Hospital, 38.5% of the admissions in pediatric ward were due to low birth weight. In this study low birth weight, apneic attacks, hypothermia and dehydration were documented as significant determinants of mortality (Simiyu, 2003).

Several studies in Kenyan hospitals indicate that majority of babies admitted in new born units are low birth weight (Ayaya, 2001). Neonatal intensive care is not readily available because of its initial and running costs and where available the bed capacity is extremely low (Wasunna, 2005). Even reasonably large rural district hospitals including those with pediatricians are poorly equipped to provide essential services to sick newborns and hence the need to implement simple, cost-effective and sustainable interventions to care for the special needs of newborns (Opondo *et al*, 2009). The need to focus on how to increase access to cost effective interventions that include control of the quality of infants born so as to decrease the burden and adopting simple strategies for the management of the high risk new born have been proposed (Were *et al*, 2002). Providing local solutions to public health problems have been found to be more acceptable and more likely to be implemented. The first steps entail identifying the

problem. Although several studies had been conducted in other settings, no such studies had been conducted in Olkalou hospital to estimate the burden and to provide information on the factors contributing to the high burden of low birth weight infants in the hospital.

1.3. Justification

The prevalence of LBW in central region was 5.5 percent (KNBS, 2010). Neonatal mortality had remained high in central region despite various interventions. A comparative analysis of the Kenya Demographic Health Surveys of 2003 and 2008-09 showed that there was an increase of neonatal mortality in central region by 15 percent from 27 to 31 per 1000 live births. The cause of this increase remained unknown, and the main causes of neonatal mortality were similarly unknown.

Analysis of performance on Annual Operation Plan 6 (July 2010- June 2011) in central region revealed that Kiambu east and Nyandarua north districts had high proportions of low birth weight infants at 13.1% and 8.6% respectively. This was higher than the national and the provincial estimates. Nyahururu and Olkalou hospitals are the main referral hospitals in Nyandarua north district. Further analysis showed that Olkalou hospital contributed the highest burden in the district. Maternity records indicated that 126 out of 752 live births in the hospital between January 2013 and June 2013 constituted of LBW babies. This was approximately 16.8 percent prevalence.

Few studies had been conducted on this important public health problem. Similarly, the prevalence and the factors contributing to the problem in Olkalou district hospital were not documented. This study sought to ascertain the prevalence of low birth weight, describe the socio-demographic characteristics of women attending delivery and to investigate the factors contributing to LBW in Olkalou district hospital. The findings will create awareness in the community about the problem and contribute towards formulating locally appropriate interventions to prevent low birth weight. The findings will be shared among various stakeholders to stimulate focused intervention programs.

1.4. Research questions

i) What is the prevalence of low birth weight among neonates born at Olkalou district hospital?
ii) What are the socio-demographic characteristics of women delivering at Olkalou district hospital?
iii) What factors are associated with low birth weight among neonates born at Olkalou district hospital?

1.5. Objectives

1.5.1. Main objective

To assess the factors contributing to low birth weights among neonates born at Olkalou district hospital.

1.5.2. Specific objectives

i) To determine the prevalence of low birth weight among neonates born at Olkalou district
i) Hospital during the study period
ii) To determine the socio-demographic characteristics of women delivering at Olkalou district Hospital during the study period
iii) To determine the factors associated with low birth weight among neonates born at Olkalou district hospital during the study period

CHAPTER TWO

LITERATURE REVIEW

2.1. Prevalence of low birth weight

The prevalence of low birth weight in Kenya was estimated to be 11 percent (UNICEF&WHO, 2004). A Kenya Demographic Health Survey report in 2008-09 estimated the prevalence at 6 percent. The same survey estimated the prevalence of LBW in central region at 5.5 percent (KNBS, 2010). Different prevalence levels have been reported in a number of hospital settings in Kenya, Tanzania and Ethiopia.

A prospective study in Machakos provincial hospital, Kenya, in 1983 identified a low birth weight prevalence of 9.3 percent (Njuki, 1983). A study in 1994 at Nyanza provincial general hospital documented a prevalence of 15 percent (Were *et al*, 1994). In another study in 2012 at Narok district hospital a prevalence of 16.4 percent was reported (Migwi, 2012). Similarly, a prevalence of 32.8% was documented in Pumwani maternity hospital (Mogire, 2013).

In a study at Jimma zone, south west Ethiopia, a prevalence of 22.5 percent was reported (Tema, 2006) while in Gondar University Hospital of North West Ethiopia a prevalence of 17.1 percent was documented (Berihun *et al*, 2012).In Northern Tanzania at Kilimanjaro Christian Medical Centre (KCMC) referral Hospital in Moshi, a prevalence of 13.6 percent was found (Siza, 2008) while in a facility based retrospective study conducted in MCH clinics in three facilities in Korogwe district, Tanzania, a prevalence of 9.1 percent was documented (Mmbando *et al*, 2008).

2.2. Socio-demographic characteristics of mothers giving birth in hospitals

In a number of studies in Kenya, Tanzania and Ethiopia, women delivering in hospitals have been reported to have various socio-demographic characteristics. A study in

Korogwe, Tanzania found that over 70 percent of the mothers were 20-35 years of age (Mmbando, 2008). Similar findings have been documented in a study in Northern Tanzania, where 76 percent of the women were aged 20-35 years (Siza, 2008). A study in Gondar University hospital documented 80.3 percent of the women to have been aged 20-34 years (Berihun *et al*, 2012). Similarly, a study in Jimma zone, south west Ethiopia found that 74.3 percent of the mothers were 20-34 years old (Tema, 2006).A study in a Kenyan setting in 2004found that 70 percent of the mothers were aged 20-34 years (Magadi *et al*, 2004).

A study in Jimma zone, south west Ethiopia found 65 percent of the mothers attending the maternity facilities to be of rural residence (Tema, 2006). However, a study in Gondar University hospital revealed that 79 percent of the women were urban dwellers (Berihun et al, 2012).The study in Kenya documented that 89.2 percent of the women were of rural residence (Magadi *et al*, 2004).

The study in Jimma zone, south west Ethiopia identified that 79.5 percent of women giving birth in the facilities had either no formal education or had acquired a primary education (Tema, 2006).In contrary, the study in Gondar referral hospital found that 57.8 percent had either acquired a secondary or tertiary education (Berihun *et al*, 2012). Similar to the study in Jimma zone, Ethiopia, the Kenyan study by Magadi found that 79.5 percent of the mothers either had no formal education or had acquired primary education (Magadi *et al*, 2004).

In all studies reviewed, majority of the women were married. In the Jimma zone study, south west Ethiopia, 87.9 percent of the women were married (Tema, 2006) and 93.8 percent of the mothers in the Gondar university study were married (Berihun *et al*, 2012). A slightly similar picture was observed in the Kenya study where 87.9 percent of the women were married (Magadi *et al*, 2004). While the study in the Jimma zone study found 50.4 percent of the mothers were Christians and 49 percent were Muslim (Tema,

2006), the study in Gondar university hospital found that 85.2 percent of the women were of Orthodox faith (Berihun *et al*, 2012)

2.3. Link between antenatal care and low birth weight

Occurrence of low birth weight is highly linked to the quality of antenatal care. In an Ethiopia study that assessed the link between contents and perceived quality of antenatal care with low birth weight among term neonates in public health facilities, among the contents of antenatal care, dietary advice and iron intake of equal or greater than 30 days, were significantly associated with birth weight at term. Similarly less than 4 ANC visits and poor nutritional status of the mothers were significantly associated with low birth weight at term. However, in this study client satisfaction during antenatal care was not found to be significantly associated with birth weight (Mitiku, 2015).

In a multi-level analysis study of the link between antenatal care and birth weight, the study documented that adequate use of antenatal care during pregnancy leads to higher birth weights among infants and by extension better health for infants (Awiti, 2014).

2.4. Socio-demographic, obstetric, co-morbidity and other potential risk factors

A number of factors have been identified to influence LBW. They include religious background, mother's education, gestational age, mother's weight, anemia, severe physical work, and tobacco chewing. In a study carried out at a tertiary care hospital in Uttar Pradesh, India, where 40% of mothers delivered low birth weight babies, Muslim mothers, mothers with no education, gestational age less than 37 weeks, mother's weighing less than 50kg, hemoglobin less than 10gm/dl, severe physical work and tobacco chewing and history of abortion were found to be significant determinants of low birth weight (Agarwal*et al*,2012). Anemia was similarly found to be a significant predictor of low birth weight in a study done in Benin (Bodeau-Livinec *et al*, 2011).

Exposure to environmental pollutants including organophosphate pesticides has also been significantly associated with LBW deliveries. This was evident among Hispanic and African American pregnant women studied in New York City (Perera*et al*,2003).A

study in Jimma zone South West Ethiopia found the following factors to be significantly associated with low birth weight. Mothers living in urban areas were found to be more likely to deliver low birth weights compared to their rural counterparts. The study related the association with urban residence to social lifestyles like heavy cigarette smoking and alcohol intake. Mothers who had experienced weight loss and those who had not had additional food during pregnancy had a significant increased risk of delivering low birth weight babies. Other factors including religion, ethnicity, history of a sexually transmitted infection, engaging in heavy work during pregnancy and history of chronic illness did not show any association (Tema, 2006).

The study by Siza 2008 found that mothers without formal education were 4 times more likely to deliver low weight babies compared to those with formal education, whereas the father's level of education significantly influenced the occurrence of low birth weight. In the same study unmarried mothers were found to be more likely to give birth to low birth weights compared to their married counterparts. Pregnancy and labor complications and illness during pregnancy were also significantly associated with LBW infants. These included hypertension, pre-Eclampsia and Eclampsia disease complex, bleeding, placenta praevia, abruption placenta, premature rupture of membranes, anemia, Tuberculosis and Malaria in pregnancy. HIV positive women were twice more likely to give birth to low birth weight babies than HIV negative ones (Siza, 2008). The HIV positive status also concurred with findings in a referral hospital in North West Ethiopia where HIV positive women were 3 times more likely to give birth to low birth weight infants than HIV negative ones (Berihun *et al*,2012).

In a study which compared the outcomes of perinatally HIV-unexposed infants with HIV-exposed infants, higher occurrence of low birth weight was found among HIV-exposed infected infants and HIV-exposed uninfected infants compared to infants not exposed to HIV (Sofeu *et al*, 2014).Similarly, in a cohort study that analyzed the correlates and the outcomes of preterm birth, low birth weight and small for gestational age in HIV exposed uninfected infants; preterm birth, low birth weight and small for

gestational age were found to be associated with increased neonatal and infant mortality among HIV-exposed uninfected infants. The study similarly found that genital infection, inflammation or vaginal discharge were significantly associated with low birth weight (Slyker *et al*, 2014). A similar study in Malawi which assessed the trends of birth weight and gestational age for infants born of HIV infected mothers who had not received ARV prophylaxis during pregnancy, identified that lower maternal age, female infant, lower maternal education, low birth intervals were significantly associated with higher odds of low birth weight and preterm births (Taha *et al*, 2012).

Religion, marital status, economic status and desirability of the pregnancy are important predictors of low birth weight. In a study involving logistical analysis by Atitwa which analyzed KDHS 2003 data, association between low birth weight and religion, marital status, socio-economic status and desirability of the pregnancy was found to be significant. In this study, respondents who conceived unexpectedly, those who were never married or had been divorced, respondents living in the slums and respondents who were Roman Catholic by faith recorded higher levels of low birth weight baby (Atitwa, 2015).

In a multinomial logistic regression study, mothers who had not attended antenatal care were found to have more than a double likelihood of delivering low birth weights compared to those attended a minimum of four antenatal visits. In addition, mothers who had not had formal education, those of rural residence, those of low socio-economic status, those who gave birth to a male infant and multiple births were more likely to deliver a low birth weight baby (Omedi *et al*, 2015).

2.5. Factors contributing to low birth weight in Kenya

In Kenya, factors documented to have significant influence on LBW can be summarized in two broad categories. These are premature births and poor maternal nutrition. The main factor associated with premature delivery is quality of antenatal care measured by timing, frequency of antenatal visits and tetanus injections. In addition, type of birth,

birth order, region of residence and ethnicity influence premature delivery. Maternal nutritional status influences birth of small babies for gestational age. Other factors include maternal height and sex of the child. As a result shorter mothers tend to give birth to smaller babies, female babies are born smaller and multiple births are more likely to be smaller compared to single births. Maternal age and birth order as risk factors of LBW have been identified in a number of population and hospital studies. In a cross-sectional analytic study that analyzed the 1993 Kenya Demographic Health Survey data, mothers aged below 20 years were found to have the smallest babies at birth. In the same study mothers aged 35 years and older had higher low birth weight babies compared to those aged 20-34 years. The distribution of low birth weights by birth order appeared to follow a similar pattern to maternal age. The highest proportion was identified among first order births with the smallest proportions reported among birth order two to five. However, after multilevel logistic regression analysis, only birth order showed significant influence on low birth weight (Magadi*et al*,2000a). Quality antenatal and delivery care have been identified as important in preventing adverse pregnancy outcomes that include premature delivery, low birth weight, perinatal and maternal death. Although a strong association has been identified between premature deliveries and the baby's size at birth, the two seem to be influenced by different sets of factors. Whereas the baby's size at birth is influenced predominantly by maternal nutrition, premature delivery is predominantly influenced by the quality of antenatal care (Magadi*et al*, 2000b).

In a study that explored the pathways of the determinants of unfavorable birth outcomes, a number of factors were demonstrated to influence low birth weight indirectly through intermediate factors. Marital status, the desirability of pregnancy, use of family planning, and access to health services were demonstrated to be linked to LBW through antenatal care. The findings showed that antenatal care constituted the central link between many of the socio-demographic factors as well as reproductive factors with low birth weight. This may be an important explanation on the inconsistencies observed from

previous studies regarding the relationship between these factors and low birth weight (Magadi*et al*,2004)

2.6. Conceptual framework

In order to determine the association between various factors and LBW in Olkalou hospital, a conceptual framework similar to that described by Magadi was adopted (Magadi*et al*, 2004). Under this framework, we hypothesized that low birth weight was likely to be contributed by the following categories of factors, namely; socio-demographic factors, reproductive behavior and service accessibility, maternal health care and general health care behavior, maternal health status including the mother's nutritional status, and newborn factors. Other factors that include woman's health behavior e.g. cigarette smoking and exposure to environmental contaminants were similarly examined on the basis of findings from previous studies.

These factors may influence LBW either directly or indirectly. A number of factors which do not show direct associations with unfavourable birth outcomes contribute to these outcomes indirectly through intermediate factors. Socio-demographic, reproductive behaviour and service accessibility do not have direct association but are linked to unfavourable outcomes through antenatal care. Antenatal care is the central link between various socio-demographic and reproductive factors and birth outcomes.

The socio-demographic factors are also likely to influence pregnancy outcomes through maternal health care and maternal health status. Appropriate maternal health care has been found to prevent adverse pregnancy outcomes for the mother and the baby and the woman's health has a dramatic impact on the quality of life and productivity, and the life of the newborn, the most important being her nutritional status (Magadi*et al*, 2000a). The inter-relationship among various variables is shown in the flow chart below.

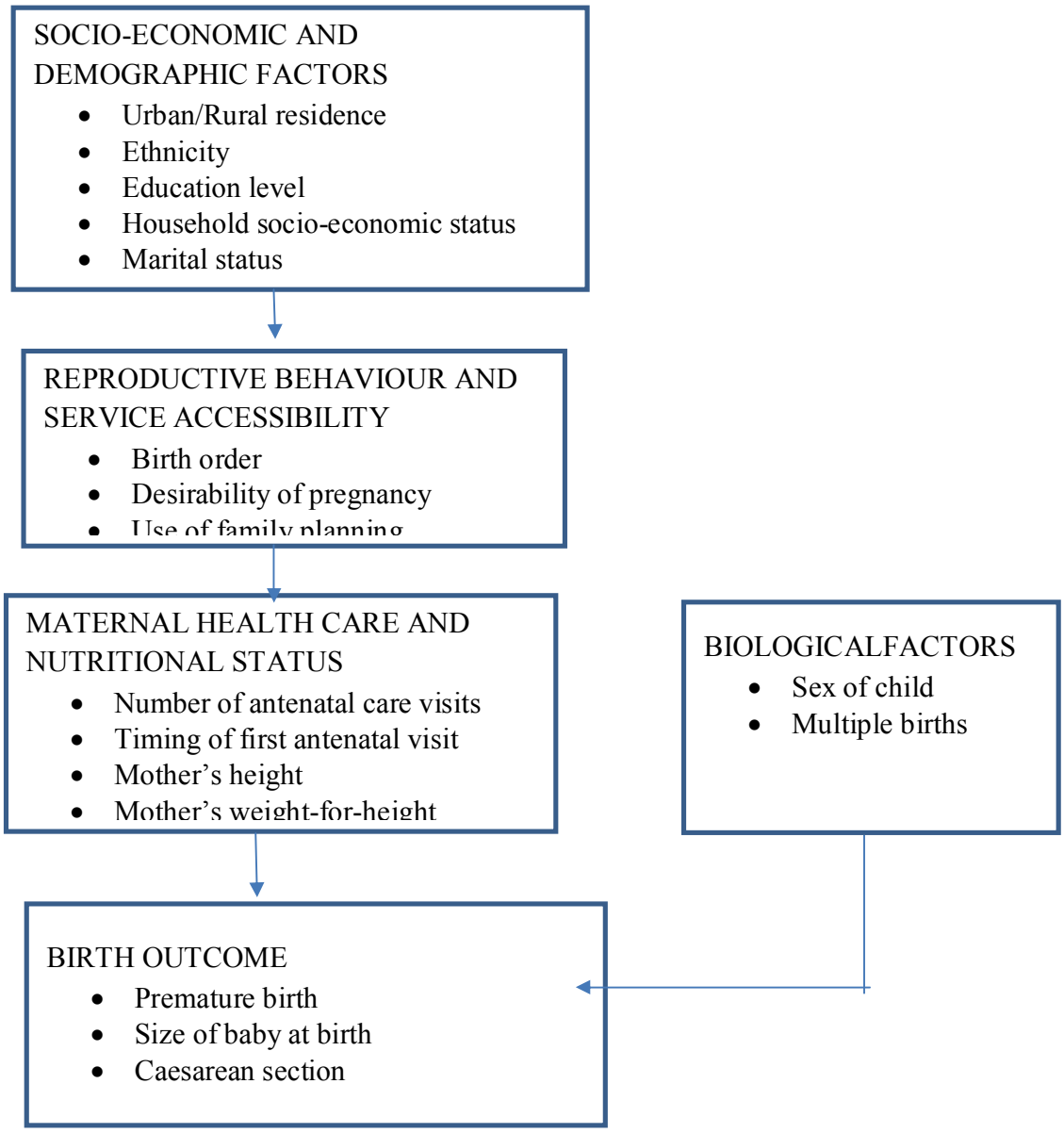

Figure 2.1:the inter-relationships between potential risk factors and unfavorable birth outcomes (Magadi et al, 2004)

CHAPTER THREE

MATERIALS AND METHODS

3.1. Study design

A facility based cross-sectional study was conducted at Olkalou district hospital from 28th October 2013 to 28th January 2014 among women delivering neonates during the study period.

3.2. Study site

The study took place in the maternity ward of Olkalou district hospital, Central province, Kenya. The hospital is a 142 bed public health facility situated in Nyandarua central district of Nyandarua county on the highlands to the west of Aberdare ranges approximately 187 kilometers north of Nairobi (the capital city of Kenya). The hospital is a referral facility serving neighboring health institutions; 2 health centers, 2 dispensaries, clinics, and six community units. The catchment population is 70,273. The hospital delivery services are provided 24 hours, seven days a week. The hospital had one gynecologist, seven medical officers, fourteen nurses and intern clinical officers providing services in maternity.

The hospital is located in Olkalou town which lies on high altitude. It lies within Olkalou constituency which consists of approximately 261,000 people and 2,100 internally displaced families at Mawingu camp. The main economic activity is dairy and crop production. These include potatoes, vegetables, wheat and maize farming. There are five large flower farms in the area. Pesticide and herbicide use is common in the farms.

3.3. Study population

The research study involved pregnant women presenting for labor and delivery at Olkalou district hospital during the study period.

3.4. Sample size

Since this was a hospital based study, an assumed proportion (p) of 16.4 percent from the prevalence of LBW in a previous study conducted in Narok district hospital in 2011 (Migwi, 2012) was used. The Cochran (1963) formula was used to determine sample size (Israel, 1992); $n_0 = Z^2pq/e^2$, where n_o= desired sample size; z= the standard normal deviate, 1.96, which corresponded to the 95% confidence level; p= (0.164), the proportion in the target population estimated to have LBW; 1-p= 0.836; e= degree of accuracy desired to get a 95% CI for a two-sided tails was 2.5%. The sample size equaled 843.

The average number of deliveries per month was estimated as 167 (established in the facility). Three months were spent on the site, giving a total sampling frame of 500. Finite correction was done as appropriate using the following formula: $n=n_0/ (1+ (n_0-1)/N)$, where n =sample size and N is the population size. Therefore the adjusted sample size was n= 843/1+ (843-1)/500 = 314.

A 10% contingency sample was added to cater for non-response giving a total sample size of 314+32= 346. The sample size for the study was therefore 346.

3.5. Sampling method

A simple random method was used to draw a sample of 346respondents from the sampling frame of 500. Computer generated random numbers from Open Epi (Dean*et al*, 2010) were used. From day one of the study period, the clients were allocated positions consecutively as registration was done in the delivery register from position 1 to 500. The positions generated randomly by use of computer were arranged in ascending order by use of Microsoft Excel. Thus, every mother in the randomly selected

position was recruited for the study. In situations where a respondent did not assent or consent, the respondent was replaced by the respondent in the consecutive position, after which the next random position was considered. This continued until the final sample size was obtained in the three months data collection period.

3.6. Inclusion criteria

A mother who had given birth to a singleton live neonate at the hospital and willing to consent during the study was considered for the study.

3.7. Exclusion criteria

A mother with multiple birth or still birth, maternal death following delivery, serious illness in which the mother was unable to respond and for situations where the mother was referred immediately after delivery.

3.8. Independent variables

i) Socio-demographic factors: Age, residence, mother's education level, partner's education level, employment status of mother and spouse, place of employment, religious background, marital status.

ii) Reproductive behavior: age at first birth, number of previous births, number of pregnancies, preceding birth interval, family size, desired family size, desirability of the pregnancy, family planning practice, last baby weight, bad obstetric history, previous history of low birth weight or prematurity, previous history of neonatal death, previous surgery on uterus and cervix.

iii) Service accessibility: Time to maternal health facility

iv) Maternal health care: Antenatal care (timing of first ANC visit, number of ANC visits, tetanus injection).

v) General health care behavior: History of tobacco/marijuana, history of alcohol consumption, history of exposure to agricultural spraying**,** source of water**.**

vi) Mother's health status: Sexually transmitted infection, malaria, HIV/AIDS, Syphilis, and Tuberculosis, chronic conditions e.g. Diabetes Mellitus, hypertension, heart disease, respiratory disease and renal disease.

vii) Maternal nutritional status: anemia, stunting, underweight (maternal weight and height, body-mass index, mid-upper arm circumference), additional food during pregnancy, nutrient deficiency e.g. Iron and Folate supplementation, harmful traditional practices e.g. avoidance of food in pregnancy

viii) Newborn factors: gestational age at delivery, sex of newborn and congenital malformation.

3.9. Recruitment and enrollment

We allocated serial numbers consecutively upon delivery to the mothers delivering in the hospital within the study period from 1 to 500, the sampling frame within the period. Guided by the list of random numbers on the excel sheet, we identified and selected the respondent corresponding to the random number. A private room was provided for further assessment and interview. The eligibility of the client was assessed with regard to whether they met the inclusion criteria. Once the criteria were met, the client was introduced to the research, the title, the purpose, the risks and benefits of participating in the study. We further explained to the respondent the expectations during participation in the study that the client would be granted privacy and records and information would be kept confidential throughout the study, and that the respondent would have the freedom to agree or decline to participate in the study at any stage. Once the subject had fully understood and agreed to participate in the study, the respondent was requested to sign or mark with a left thumb print so as to give consent to participate in the study. Finally, we engaged the respondent in the interview and the anthropometric measurements. Information regarding caring for the baby and targeted post-natal care was provided and any follow-up care was planned. We then thanked the client for agreeing to participate in the study.

3.10. Data collection

3.10.1. Structured interview tool

We used a semi-structured interviewer administered questionnaire to collect data. The tool was prepared prior to the study. Subsequently, it was pretested among ten conveniently selected subjects in Karatina district hospital postnatal ward before using on the study population to check for relevance of questions and to detect obvious errors before engaging on the main study. The questionnaire was coded before data collection to make it easy for entry into the computer. We designed the questionnaire in English, but we administered to the respondent in *Kikuyu* (local language), *Kiswahili*, or English subject to the choice of the client.

Once the client was selected, she was interviewed in a private room in the maternity unit so as to ensure privacy. The room was positioned further from the busy side to avoid interruption. A note was fixed on the outside to indicate that an interview was in progress. Review of records and anthropometric measurements were similarly done in the same room. The respondent mothers were interviewed regarding their socio-demographic characteristics, reproductive health and access to health facility, antenatal care, social lifestyle, health and nutrition.

Gestational age was determined using the mother's recorded or reported Last Normal Menstrual Period and the expected date of delivery in relation to the date of delivery. Where unknown, any ultrasound report was used to confirm gestation, otherwise gestation was regarded as unknown.

Previous history of LBW and premature births was assessed by asking the mother if she had delivered 'small' or 'very small baby' or had given birth to a baby before term. A confirmation was made by checking the mother and child health booklet. The dietary history was assessed by asking the mother to describe the food she had eaten the previous day before admission to hospital. Other questions included whether she had had additional food during pregnancy, any nutritional problems or if any health worker had counseled her on the importance of good nutrition during pregnancy.

3.10.2. Review of medical records

Labor and delivery records and the mother and child health booklet were used to assess obstetric and gynecologic history, antenatal care, health issues during pregnancy, labor, delivery, clinical care and the outcome of birth. The records review took place during the postnatal period after other essential procedures to the client had been completed or just before discharge to minimize interruption.

3.10.3. Anthropometric measurements

We measured neonatal weight using a standard beam balance (Crown), within one hour upon delivery. A baby weighing less than 2500 grams was considered a low birth weight. The mother was weighed using a standard weighing machine (Seca).We requested the respondent to remove extra clothes, remove their shoes and step on a zeroed weighing scale. Weight was recorded to the nearest 0.1kg. The height was measured using a Height board. We asked the participant to stand without shoes in front of the height board, with the head erect and the arms hanging naturally at the sides. Height was recorded to the nearest 0.1cm. The weight and height was used to calculate the body mass index (BMI). A BMI of less than 18.5kg/m^2 was considered malnutrition and therefore a risk factor to a low birth weight birth. The mid-upper arm circumference (MUAC)was measured using a flexible non-stretchable standard tape measure. The circumference was located and measured at the mid-point between the tip of the acromion process of the scapula and olecranon process of the ulna. For right-handed women the circumference of the left upper arm was measured while for left-handed women, the right arm was used instead. We measured the arm while hanging down at the side and relaxed. The MUAC was recorded to the nearest 0.1cm. We considered a MUAC of 23cm as the cut-off point.

Two midwives experienced in delivery care were recruited to assist in accurate weighing of the newborns and measuring the weights and heights of mothers and the mid-upper arm circumference. Consequently, they were trained by the investigator for eight hours

on the purpose and objectives of the study, the standard procedures of weight measurement, height measurement, the mid upper-arm circumference and the interviewing technique. They were further trained on the importance of maintaining confidentiality and obtaining consent before interviewing or obtaining anthropometric measurements, being patient, understanding, respectful and genuine when handling the respondents. The investigator interviewed the mothers and supervised the midwives while taking the anthropometric measurements.

3.11. Data analysis

Data captured in the questionnaire was entered into the computer. Epi Info statistical software version 3.3.2was used for management and analysis of data. Information derived from the study was presented using tables and figures in proportions, odds ratio, and confidence interval and p values.

3.11.1. Validation and data cleaning

We examined the dataset for unexpected and obvious errors and the corrections were made.

3.11.2. Descriptive analysis

The prevalence of low birth weight was determined using the following formula:

$$\text{Low Birth weight Prevalence} = \frac{\text{number of infants <2500 grams born during the study period}}{\text{Total live births during the same study period}}$$

Mothers were analyzed on their socio-demographic characteristics to include age, residence, and mother's level of education, partner's level of education, employment status of mother and partner, place of employment, occupation of mother and partner, religious background and marital status.

In addition measures of central tendency and measures of dispersion were calculated for the following continuous variables: age, age at first birth, pregnancy interval, number of

previous births, number of pregnancies, pregnancy interval, desired number of children, birth weight of previous baby, time taken to reach facility, number of antenatal visits, hemoglobin level, maternal height, maternal weight, BMI, MUAC, Apgar score and birth weight.

3.11.3. Bivariate analysis

The analysis involved comparison between respondents with low birth weight newborns and those with normal birth weight newborns against each of the independent variables. A LBW baby was defined as a live infant less than 2500g (up to 2499g) born of a randomly selected respondent who had delivered at Olkalou district hospital during the study period. A Comparison respondent was defined as a randomly selected client who had delivered a live infant 2500g or more at Olkalou district hospital during the study period.

In this comparison we calculated the odds ratio to determine the relationship between the exposure factor and low birth weight. The strength of the relationship, the upper and lower confidence intervals and level of significance were documented.

3.11.4. Test of significance

A two-tailed test of significance was used. Two tests were used, chi-square corrected (Yates) and Fisher exact test for situations where the value in the cells of the two- by-two table was less than 5. Since Epi-Info reports Fisher exact p-value as one-tailed, the p-value was multiplied by two to make it two-tailed.

The measures of association were reported with a 95% confidence interval. The Taylor series method was used to report the confidence intervals for cross-product odds ratio, while Fisher exact confidence intervals was considered where cells in the two-by-two table were less than 5. A summary of all significant factors was made so as to include them in multivariate analysis.

3.11.5. Stratified analysis

Stratification was done to test for potential confounding and effect modification. The potential confounders and effect modifiers were age of the mother, residence and sex of the newborn. Other potential confounders that were biologically plausible were similarly tested.

After stratification, the chi-square for differing Odds Ratios by stratum was determined to confirm whether the odds ratios differed significantly by stratum. A p-value of less than 0.05 was regarded as statistically significant. A significant difference between the odds ratios among the strata indicated presence of effect modification and the stratum specific odds ratios was reported. In absence of effect modification, the Mantel-Haenszel Odds Ratio was reported as the true measure of association.

To test for presence of confounding, the stratum-specific measures of association were compared with the crude Odds Ratio. Where the crude Odds Ratio fell outside the range of the stratum, confounding was regarded as probable.

The crude Odds Ratio was compared with the adjusted Mantel Haenszel Odds Ratio. A difference of 10% or more was used to confirm the presence of confounding. In the presence of confounding the adjusted Odds Ratio was reported as the true measure of association.

A summary of all identified effect modifiers and confounders were made so as to include them in the model during the multivariate analysis.

3.11.6. Multivariate analysis

All factors significant at level 0.1 were taken to logistic regression. We similarly included the effect modifiers and confounding factors. We used a significant level of 0.1 to minimize the effect of type 2 error which was likely to occur when using Yates corrected chi-square formula in determining the level of significance.

We selected the final model using a stepwise backward elimination procedure. We started with all the factors present and then we eliminated the non-significant factors one at a time, removing the least significant factor first until only the significant factors were left in the model. We summarized the independent factors associated with low birth weight. We then classified the independent factors in terms of whether the factor was modifiable or non-modifiable. Modifiable factors are alterable and important in public health interventions.

3.12. Human subjects (ethical considerations)

We obtained ethical clearance (ref: KNH-ERC/A/325) to use human subjects for the research from the Kenyatta National Hospital research and ethics committee **(Appendix 4).** The protocol was presented to the Jomo Kenyatta University board of postgraduate studies for review and approval. We also obtained permission from the County Health Services Director and a letter was obtained from the Medical Superintendent of the hospital to undertake the study.

We explained to all women participating in the study the objectives of the study and subsequently obtained consent or assent to participate in the study. Participants signed a consent form to affirm their willingness to participate in the study. We considered any woman 18 years of age and above as able to give full informed consent. Young mothers under 18 who were married and parents were considered 'mature minors' capable of giving consent. However, a thorough assessment of the minor's maturity was done. Those under 15 were interviewed with the knowledge and participation of parents and guardians. We further explained that information obtained from them would be used strictly for the purpose of the study. It was similarly clarified to them that they were free to discontinue with the study at any time and stage.

We observed confidentiality and anonymity throughout the study. We interviewed the respondent mothers in a private room with limited interruption by maternity staff and other patients. No name was recorded on the questionnaire or any other identifier

relating to the respondent. A study subject number representing the randomly selected position of the subject was used as the unique identifier. We kept the filled questionnaires under lock and key in the office of the nursing officer in charge prior to analysis to prevent any losses and only the principle investigator had access to them. After entry in the computer, we stored the data folder under password and data backup was maintained during the entire analysis and report writing period.

The mothers with low birth weight babies were counseled regarding feeding and care of the baby and education to prevent future occurrence. Mothers with babies of normal weight were educated regarding targeted post-natal care. Information regarding the findings was given back to the relevant stakeholders for public health action.

CHAPTER FOUR

RESULTS

4.1. Low birth weight prevalence

A total of 327 neonate/mother pairs participated in the study constituting a response rate of 94.5%. A total of 19 clients were excluded due to having delivered a still birth, or having had a multiple delivery. The prevalence of low birth weight was 12.3% (n=40).

4.2. Socio-demographic characteristics

The mean age of the respondents was 25.6±6.2 years. Thirty seven (11.3%) of the sampled women were urban or peri-urban. One hundred and forty one (48.1%), the majority had completed secondary education while 134 (45.7%) were of primary education, 14(4.8%) were of tertiary education, while 4(1.5%) had had no formal education. Similarly, among their partners, 53.9% (n=132) had completed secondary education, 35.5% (n=87) were of primary education, while 10.6% (n=26) were in tertiary level of education. Majority (46.4%, n=135) were self-employed followed by those unemployed (39.2%, n=114). In contrast, majority (64.1%, n=157) of their male partners were self-employed, 77(31.4%) were employed, 10(4.1%) were unemployed, while only 1(0.4%) was a student. Two hundred and twenty nine (79.5%) were protestant, 55 (19.1%) were Catholic, while 4(1.4%) could not identify with a religious background. Two hundred and sixty forty (81.2%) of the mothers were married, 51(15.7%) were single, 5 (1.5%) had either separated or divorced, while a similar proportion were widowed**.**

Table 4.1: **Socio-demographic characteristics of women delivering at Olkalou hospital**

Demographic characteristics	**Variable**	**n**	**(%)**
Age in years	<20yrs	5	(15.6)
	20-35yrs	243	(90.2)
	>35yrs	32	(9.8)
Residence/village/estate	Urban	37	(11.3)
	Rural	290	(88.7)
Level of education of mother	No formal education	4	(1.4)
	Primary education	134	(45.7)
	Secondary education	141	(48.1)
	Tertiary education	14	(4.8)
Partner's education level	No formal education	0	(0)
	Primary education	87	(35.5)
	Secondary education	132	(53.9)
	Tertiary education	26	(10.6)
Mother's employment status	Employed	31	(10.7)
	Self-employed	135	(46.4)
	Student	11	(3.8)
	Unemployed	114	(39.2)
Partner's employment status	Employed	77	(31.4)
	Self-employed	157	(64.1)
	Student	1	(0.4)
	Unemployed	10	(4.1)
Religion	Protestant	229	(79.5)
	Catholic	55	(19.1)
	Muslim	0	(0)
	Unknown	4	(1.4)
Marital status	Single	51	(15.7)
	Separated/divorced	5	(1.5)
	Married/cohabiting	264	(81.2)
	Widowed	5	(1.5)

4.3. Reproductive characteristics

The sampled mothers had the following reproductive characteristics. The mean age at first birth was 20.2±3.2. The mean gravidity was 2.5±1.6. Majority (59.2%, n=189) were less or equal to gravida 2. The mean birth interval was 2.8±2.4 years. Those with a birth interval greater than 2 years were more (53.2%, n=125).The sampled respondents had a mean parity of 2.3±1.5, with majority (62.5%, n=196) having had one or two living children. The mean desired family size was 3.4±1.2. Majority (58.4%, n=170) desired a family size of three or more number of children. Most (81.8%, n=239) of the mothers had intended to have their current pregnancy. However it is important to note that 53(18.2%) had either desired to have the pregnancy later or did not intend to have the pregnancy at all. The mean weight of the previous baby was 2932±531, with 18(10.5%) reporting having had a low birth weight baby in their previous pregnancy. Twenty four (8%) clients reported having had a previous abortion, 20(6.8%) reported a history of low birth weight or prematurity, 9(3.1%) reported history of neonatal death, while 22(7.5%) reported having had a previous surgery of the uterus or the cervix. Majority of the mothers (42.9%, n=133) had attended 3 antenatal visits, the average being 3±1.1. Most mothers (71.3%, n=21) had attended more than 2 antenatal visits. Two hundred and fifty five (87%) had received anti-tetanus immunisation during the pregnancy.

Table 4.2: Reproductive characteristics of women delivering at Olkalou district hospital

Reproductive characteristic	Variable	n	%
Age at first birth	<15yrs	5	(1.7)
	15-19yrs	124	(41.6)
	≥20yrs	169	(56.7)
Number of previous births	<2	180	(57.0)
	2-4	118	(37.3)
	>4	18	(5.7)
Number of pregnancies/gravidity	1	122	(38.2)
	2-4	162	(50.7)
	>4	35	(10.9)
Pregnancy interval of previous birth	<2yrs	12	(6.6)
	2-4	123	(67.6)
	>4	47	(25.8)
Family size (living children)	2 or less	192	(62.6)
	3 or more	117	(37.4)
Desired family size	2 or less	49	(16.8)
	3 or more	242	(83.2)
Desirability of current pregnancy	Yes	239	(81.8)
	Later	49	(16.8)
	No more	4	(1.4)
Family planning practice	Never used any method	128	(44.0)
	Traditional methods	5	(1.7)
	Used modern methods	158	(54.3)
Last baby birth weight	<2500g	18	(10.4)
	>2500g	155	(89.6)
Bad Obstetric History	Present	33	(11.0)
	Absent	268	(89.0)
History of low birth weight/prematurity	Yes	20	(6.8)
	No	275	(93.2)
Previous history of neonatal death	Yes	9	(3.1)
	No	286	(96.9)
Previous surgery on uterus and cervix	Yes	22	(7.5)
	No	272	(92.5)
Timing of 1st ANC visit	1st trimester (≤12weeks)	1	(0.4)
	2nd trimester (12-24)	184	(64.8)
	3rd trimester(≥24weeks)	99	(34.9)
Number of ANC visits	2 or less	82	(27.1)
	3 or more	221	(72.9)
Tetanus immunization	Yes	255	(87.0)
	No	38	(13.0)

4.4. Maternal health status

On average the mothers took approximately 1 hour to reach a maternity health facility (mean 63.2±51.9 minutes). In general, slightly more than half the mothers (52.6%, n=154) obtained domestic water from a well or borehole followed by tap water (29.4%, n=86). Approximately a fifth (19.8%, n=58) reported having been exposed to agricultural spraying during pregnancy. None reported having smoked or taken illegal drugs. Only 1(0.3%) had consumed alcohol. Maternal obstetric and medical illnesses were assessed. Among women with medical and obstetric problems, 1(0.3%) had had a sexually transmitted infection, 3(1.0%) had been treated of malaria, 9(3%) were HIV positive, 2(0.7%) had been tested VDRL positive and none (0%) had been diagnosed of Tuberculosis. Thirteen (4.4%) had a chronic disease, 6(2%) had pre-Eclampsia or Eclampsia, 5(1.7%) had experienced vaginal bleeding during pregnancy and 26(8.9%) had ruptured membranes prematurely**.**

Table 4.3: Health characteristics of women delivering at Olkalou district hospital

Health Status	Variable	n	(%)
Time to maternity facility	< 1 hour	147	(37.7)
	≥ 1 hour	150	(52.3)
Source of water	River	27	(9.2)
	Tap water	86	(29.4)
	Well/borehole	154	(52.6)
	Harvested water	26	(8.9)
History of exposure to agricultural spraying	Yes	58	(19.8)
	No	235	(80.2)
History of tobacco use	Yes	0	(0)
	No	293	(100)
Bang/ Marijuana	Yes	0	(0)
	No	293	(100)
History of alcohol consumption	Yes	1	(0.3)
	No	292	(99.7)
Sexually transmitted infection	Yes	1	(0.3)
	No	299	(99.7)
Malaria in pregnancy	Yes	3	(1.0)
	No	291	(99.0)
HIV positive	Yes	9	(3.0)
	No	295	(97.0)
VDRL positive	Yes	2	(0.7)
	No	302	(99.3)
History of Tuberculosis	Yes	0	(0)
	No	293	(100)
Chronic disease	Yes	13	(4.4)
	No	280	(95.6)
Hyperemesis during pregnancy	Yes	13	(4.4)
	No	280	(95.6)
Pre- Eclampsia/Eclampsia	Yes	6	(2.0)
	No	287	(98.0)
Vaginal bleeding	Yes	5	(1.7)
	No	288	(98.3)
Premature rapture of membranes	Yes	26	(8.9)
	No	267	(91.1)

4.5. Labour and delivery

The onset of labour was mainly spontaneous, constituting 94.0% (n=283). Twelve (4%) had been induced while 6(2%) had not established labour at the time of delivery. The main mode of delivery was spontaneous vertex delivery (88.3%, n=288). The deliveries were mainly conducted by a nurse midwife (82.8%, n=265), followed by the medical officers (11.3%, n=36). Majority of the mothers (82%, n=219) were 37-42weeks gestation at the time of delivery. For those who had caesarean section performed, the main reason was obstructed labour and cephalo-pelvic disproportion (27.3%, n=9).The mean Apgar score was 8±1.2 while the mean birth weight was 2928±533 grams. There were 51.1% (n=165) male neonates and 48.9% (n=158) were females. Ten (3.1%) of the new-borns had a birth defect**.**

Table 4.4: Labor and delivery characteristics of women delivering at Olkalou district hospital

Characteristic	Variable	n	(%)
Referral from other facility	Yes	31	(10.5)
	No	263	(89.5)
Referring facility	Faith based facility	2	(6.9)
	Health Centre	23	(79.3)
	Dispensary	4	(13.8)
Onset of labor	Spontaneous	283	(94.0)
	Induced	12	(4.0)
	No labor	6	(2.0)
Assistance during delivery	Midwife	265	(82.8)
	Medical officer	36	(11.3)
	Clinical officer	16	(5.0)
	Others	2	(0.9)
Gestation	<37weeks	21	(7.9)
	37-42	219	(82.0)
	>42	27	(10.1)
Mode of delivery	Spontaneous	288	(88.3)
	Caesarian section	35	(10.7)
	Assisted breech	3	(0.9)
Indication for C-section	Fetal distress	7	(21.2)
	Previous scar	9	(27.3)
	CPD	4	(12.1)
	Big baby	3	(9.1)
	Poor progress in labor	3	(9.1)
	Obstructed labor	2	(6.1)
	Others	5	(15.0)
Apgar score	<6 (asphyxia)	11	(3.5)
	≥6 (normal)	302	(96.5)
Birth weight	<2500g	40	(12.3)
	≥2500g	285	(87.7)
Infant sex	Male	165	(51.1)
	Female	158	(48.9)
Congenital malformation	Yes	10	(3.1)
	No	314	(96.9)

4.6. Maternal nutrition

The following were the means of the nutritional parameters that were measured: haemoglobin level 12.6±1.2g/dl, height 178±0.8cm, and weight 62.8±8kg. Thirty nine (11.9%) of the women were undernourished (MUAC<23cm). Only 46(15.8%) reported taking additional food during pregnancy. The main source of food was garden (62.1%, n=203). Close to two-thirds of the women (62.5%, n=177) had received nutritional counselling, while 253(77.4%) had received iron and folic acid supplements. The main nutritional problems were nausea and vomiting (36.7%, n=120), heart burn (27.8%, n=91) and poor appetite (19.3%, n=63). Sixty three (21.7%) reported having avoided certain foods during pregnancy. The main reason for this avoidance was nausea and vomiting (58.1%, n=36), heart burn (16.1%, n=10) and poor appetite (11.3%, n=7). Only 3(4.8%) reported avoidance of eggs due to myth of giving birth to a big baby.

Table 4.5: Nutritional characteristics of women delivering at Olkalou district hospital

Nutritional parameter	Variable	n	(%)
Hemoglobin level	Normal(≥10)	259	(97.0)
	Mild (8.1-9.9g/dl)	8	(3.0)
Height of woman	<150cm	1	(0.3)
	≥150cm	290	(99.7)
Maternal weight	<50kg	13	(4.5)
	≥50kg	278	(95.5)
BMI	<18.5	46	(15.9)
	≥18.5	244	(84.1)
Mid-upper arm circumference	<23cm	39	(14.0)
	≥23cm	240	(86.0)
Additional food during pregnancy	Yes	46	(15.8)
	No	246	(84.2)
Food source	Garden	203	(62.1)
	Market	98	(30.0)
	Donation	1	(0.3)
Nutritional counseling	Yes	177	(62.5)
	No	106	(37.5)
Iron and Folate supplementation	Yes	253	(77.4)
	No	74	(22.6)
Nutritional problems	Poor appetite	63	(19.3)
	Constipation	30	(9.2)
	Heartburn	91	(27.8)
	Muscle cramps	3	(0.9)
	Nausea and vomiting	120	(36.7)
	Pica	11	(3.4)
	None	47	(14.4)
Avoidance of food during pregnancy	Yes	63	(21.7)
	No	227	(78.3)

4.7. Food intake during pregnancy

Food intake history revealed that he most common beverage taken for breakfast was tea with milk (64.5%, n=211) accompanied with bread (16.5%, n=54). Majority (26.6%, n=87) took rice for lunch followed by *Ugali* (thick porridge) at 22.3%(n=73), eighteen percent (n=59) ate potatoes while 10.1% (n=33) ate *Mukimo* (mixture of mashed potatoes, maize and beans). These meals were accompanied by side dishes mainly green vegetables (11.3%, n=37) followed by cabbages (12.2%, n=40) and meat (7.0%, n=23). Only 0.6% (n=2) ate fruits for lunch. The main meal taken during supper was *Ugali* (30.3%, n=99) followed by rice (17.4%, n=57), 13.5% (n=44) *Githeri* (cooked mixture of maize and beans) while 11.9% (n=39) ate *Mukimo*. These meals were accompanied by mainly green vegetables (11.9%, n=39), cabbages (12.2%, n=40) and beans (9.5%, n=31). No mother reported having taken fruits during supper. Fruits were the main meal for snack (11.6%, n=38) followed by plain porridge (7.3%, n=24) and milk (7.3%, n=24).

Table 4.6: Food intake the previous day before admission to Olkalou district hospital

Food item	Breakfast n (%)	Lunch n (%)	Supper n (%)	Snack n (%)
Tea with milk	211(64.5)	3(0.9)	2(0.6)	5(1.5)
Tea without milk	9(2.8)			
Enriched porridge	6(1.8)			
Plain porridge	12(3.7)			24(7.3)
Milk	11(3.4)	8(2.4)	8(2.4)	24(7.3)
Yoghurt				7(2.1)
Juice				2(0.6)
Bread	54(16.5)		1(0.3)	1(0.3)
Beans	3(0.9)		31(9.5)	
Peas			3(0.9)	
Mukimo	8(2.4)	33(10.1)	39(11.9)	
Chapati	15(4.6)	10(3.1)	12(3.7)	3(0.9)
Mandazi	7(2.1)			8(2.4)
Eggs	2(0.6)	1(0.3)	1(0.3)	
Ugali	16(4.9)	73(22.3)	99(30.3)	
Fruits	4(1.2)	2(0.6)		38(11.6)
Green grams	2(0.6)	9(2.8)	3(0.9)	
Green vegetables	3(0.9)	37(11.3)	39(11.9)	
Sweet potatoes	6(1.8)	0(0)	1(0.3)	2(0.6)
Bananas	1(0.3)			
Egg pancake	2(0.6)	1(0.3)		
Rice	6(1.8)	87(26.6)	57(17.4)	
Potatoes	1(0.3)	59(18.0)	32(9.8)	0(0)
Githeri	2(0.6)	30(9.2)	44(13.5)	
Roast potatoes	2(0.6)			
Cake	4(1.2)	1(0.3)		1(0.3)
Pan cake	2(0.6)	1(0.3)		
Matoke		4(1.2)	2(0.6)	
None	14(4.3)	27(8.3)	24(7.3)	164(50.2)
Meat		23(7.0)	9(2.8)	
Fish		1(0.3)	0(0)	
Chicken		0(0)	2(0.6)	
Boiled/roasted maize		2(0.6)		2(0.6)
Pork		0(0)	0(0)	
Cabbages		40(12.2)	40(12.2)	
Bone soup		1(0.3)		
Vegetable soup		1(0.3)	1(0.3)	
Sausage				2(0.6)

4.8. Food type consumed during pregnancy

The respondents reported having consumed animal proteins mainly thrice weekly (34.3%, n=99).

Majority (41.7%, n=121) consumed plant proteins daily. Slightly more than half (56.7, n=154) consumed fruits daily, while 56.9% (n=165) consumed dark green vegetables daily. Ninety percent (n=260) ate carbohydrates daily, while slightly less than half (46.2%, n=134) similarly consumed milk and dairy products daily. Majority (85.5%, n=247) reported having consumed cooking oils daily.

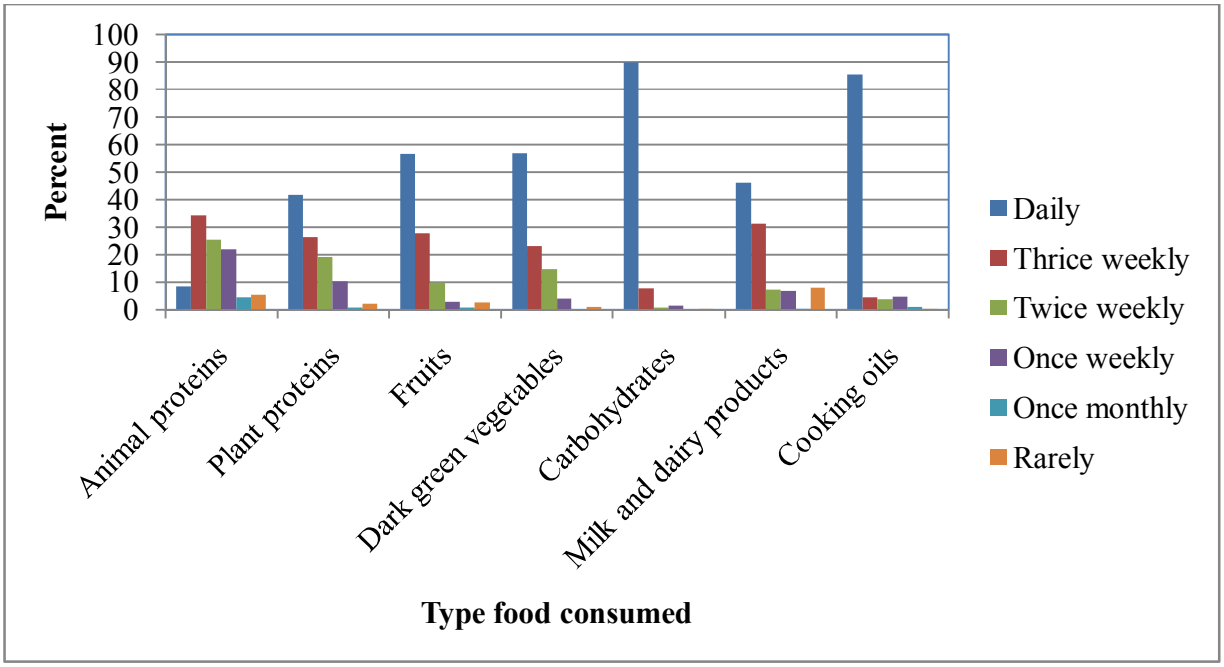

Figure 4.1: Food type consumed during pregnancy by women admitted in Olkalou district hospital

4.9. Bivariate analysis

The results of bivariate analysis indicated a significant association between birth weight of previous baby, premature rapture of membranes, premature birth, Apgar score of the newborn, female infant and low birth weight. Mothers who had delivered a low birth weight baby in their previous pregnancy were almost 5 times more likely (OR=4.7, 95%C.I.= 1.53-14.24,p-value=0.01) to give birth to a LBW baby compared to those who had given birth to a normal weight baby. Additionally, premature rapture of membranes was also one of the risk factors (OR=2.95, 95%C.I=1.14-7.62, p-value=0.04).

There was a statistically significant difference in the birth weights between mothers who gave birth in less than 37 weeks gestation (OR=3.68, 95%C.I.= 1.31-10.38, p-value=0.02) and those that delivered at 37 or more weeks gestation. Newborns with an Apgar score of less than six (asphyxia) had sevenfold (OR=7.03, 95%C.I.=2.03-24.35, p-value=0.00) likelihood of having been born LBW when compared to those that were born with a score of 6 or more on Apgar. Female newborns had a higher proportion of LBW birth compared to male infants (16.6% vs 7.9%). The association between female neonate and LBW was statistically significant in the bivariate analysis (OR= 2.32, p-value=0.03).

Below is summary table of the factors that were identified to be borderline (p-value <0.25 or significantly associated with low birth weight**.**

Table 4.8: Risk factors associated with LBW among neonates born at Olkalou District Hospital

Risk factor	Variable	Odds ratio	95% C.I.	P-value
Birth weight of previous baby	<2500g	4.7	1.53-14.24	0.01
	≥2500g			
Premature rapture of membranes	Yes	2.95	1.14- 7.62	0.04
	No			
Premature birth	<37weeks	3.68	1.31- 10.38	0.02
	≥37 weeks			
Apgar score	<6	7.03	2.03- 24.35	<0.001
	≥6			
Infant sex	Female	2.32	1.15- 4.70	0.03
	Male			

4.10. Confounding and effect modification

Results from stratified analysis showed that infant sex and residence were confounders while maternal age was found to be an effect modifier.

4.11. Multivariate analysis

All variables which had a p-value less than 0.1 were included in the model using a backward strategy. These included birth weight of previous baby, premature rapture of membranes, premature birth and Apgar score. Infant sex and residence were added as confounders while maternal age was included as an effect modifier. The final model showed that only two factors were independently associated with low birth weight at Olkalou District Hospital; low birth weight of previous baby and female infant (Table 4.11). The steps of this analysis are outlined at the Appendix 5.

Table 4.9: Independent factors associated with low birth weight among neonates born at Olkalou District Hospital

Term	AOR	95%	C.I.	Coefficient	S. E.	Z-Statistic	P-Value
Female infant (Yes/No)	3.3724	1.1378	9.9954	1.2156	0.5544	2.1928	0.0283
Previousbaby<2500g(Yes/No)	5.0733	1.5882	16.2063	1.6240	0.5926	2.7406	0.0061
CONSTANT	*	*	*	-3.0569	0.4959	-6.1649	0.0000

CHAPTER FIVE

DISCUSSION

5.1. Prevalence of low birth weight

The prevalence of LBW was 12.3 percent. Having had a LBW baby in the previous birth, premature birth, premature rapture of membranes and female infant were risk factors for LBW in the hospital. Having given birth to a LBW baby in the previous birth and female infant was independently associated with LBW in Olkalou district hospital.

The prevalence of 12.3 percent was double the national 2009 KDHS value of 6.0 percent and 5.5 percent value for Central region (KNBS, 2010). This can be explained by the fact that the national and regional estimates are pooled estimates whereas the 12.3 percent is from a selected population attending Olkalou hospital. The prevalence was lower than the 16.4 percent prevalence documented in Narok District Hospital of Rift Valley region of Kenya (Migwi, 2012).A study in Nyanza Provincial General Hospital recorded a prevalence of 15.0 percent (Were*et al*, 1994). Similarly, a high prevalence of 32.8 percent was documented in Pumwani maternity hospital (Mogire, 2013). In addition, lower than the prevalence of 17.1 percent documented in Gondar University Hospital of North West Ethiopia (Berihun*et al*, 2012) and 22.5 percent in Jimma zone, South West Ethiopia (Tema, 2006). A higher Low birth weight prevalence of 13.6 percent was also recorded in Kilimanjaro Christian Medical Centre (KCMC) referral Hospital in Moshi, northern Tanzania (Siza, 2008).

However, the prevalence was higher than the 9.1 percent documented in facility based retrospective study conducted in MCH clinics in three facilities in Korogwe district, Tanzania (Mmbando*et al*, 2008). This difference in prevalence may be explained by variation in biological and environmental factors. Although there is no documented cut-off values of public health significance for low birth weight in Kenya or internationally, using the WHO interpretation guide for malnutrition for underweight children would

estimate a low birth weight prevalence of 12.3 percent as medium prevalence (WHO interpretation guide, 2010).

5.2. Socio-demographic characteristics

The present study reveals that majority of the women delivering in Olkalou district hospital during the study period were aged 20-35 years. This finding was consistent with findings documented elsewhere (Berihun *et al*, 2012; Magadi *et al* 2004; Tema, 2006; Mmbando, 2008; Siza, 2008). This is the recommended reproductive age group. Majority of the mothers were of rural residence. This was expected as it was predominantly a rural setting. Same findings were documented in Jimma Zone, South West Ethiopia (Tema, 2006). Most sampled women had acquired secondary and primary education in almost equal proportion. This was different with the findings in Gondar University hospital study, Ethiopia where respondents with secondary and tertiary education were equal in proportion (Berihun *et al*, 2012). The difference could have been due to the fact that the sampled population in Ethiopia was predominantly urban and therefore likely to have had a higher education status. However, findings from other studies found majority of the respondent mothers to have been of primary education (Tema, 2006; Magadi *et al*, 2004).In this study, the women were mainly self-employed similar to their partners. This was expected due to the fact that the main economic activity in the area was farming. The respondents were mostly married similar to findings in other settings (Magadi *et al*, 2004; Tema 2006; Berihun *et al*, 2012). The presented study documented that the women attending Olkalou district hospital for maternity services are mainly of protestant faith. A study in North West Ethiopia found majority of the women to be of Orthodox faith (Berihun*et al*, 2012).The difference can be explained by their geographical and ideological settings.

5.3. Factors associated with low birth weight

In this study several factors were found to be significantly associated with low birth weight on bivariate analysis. They included having delivered a LBW baby in the previous birth, premature rapture of membranes, premature birth, Apgar score of less

than 6 and female infant. This was similar to other studies (Berihun*et al*, 2012; Siza,2008; Agarwal*et al*, 2011).The following study also found that when all factors were held constant, male infants were recorded to have a higher birth weight compared to female infants (Awiti, 2014).

5.3.1. Relationship between low birth weight and socio-demographic characteristics

This study did not find any significant association between low birth weight and socio-demographic factors including maternal age, residence, mother's education level, partner's education level, employment status of mother and spouse, place of employment, religious background and marital status. Several studies have shown that socio-demographic factors can either influence low birth weight either directly or indirectly through intermediate factors, for example antenatal care or maternal health care (Magadi*et al*, 2000a). This could be the explanation to this finding.

5.3.2. Relationship between low birth weight and reproductive characteristics

None of the following reproductive factors were found to significantly influence the occurrence of low birth weight. These included age at first birth, number of previous births, number of pregnancies, preceding birth interval, family size, desired family size, desirability of the pregnancy, family planning practice, bad obstetric history, previous history of neonatal death, previous surgery on uterus and cervix. Similar to socio-demographic factors, this lack of association could be explained by the fact that reproductive factors have been documented to influence low birth weight through antenatal care (Magadi *et al*, 2000a; Magadi *et al*, 2004).

5.3.3. Relationship between low birth weight and access to health services

The relationship between the mother's access to health facility and the occurrence of low birth weight was not found to be statistically significant. This factor is similarly indirectly linked to unfavorable birth outcomes through antenatal care (Magadi *et al*, 2004). This could be the explanation to the lack of statistical significance in this finding.

5.3.4. Relationship between low birth weight and antenatal care utilization

This study showed no significant association between timing of first ANC visit, the number of ANC visits, having received tetanus injection during pregnancy and occurrence of low birth weight. The timing of first ANC visit, the number of ANC visits and administration of tetanus toxoid during pregnancy are regarded as important indicators of antenatal care utilization.

5.3.5. Relationship between low birth weight and maternal lifestyle

In this study maternal lifestyle factors were not found to be significant contributors of low birth weight. Very few mothers were found to have taken alcohol or smoked cigarettes during pregnancy. None of the mothers gave a history of having taken marijuana or hard drugs.

5.3.6. Relationship between low birth weight and maternal illness

None of the maternal illnesses was found to be significantly associated with low birth weight. These included sexually transmitted infections, malaria, HIV/AIDS, Syphilis, and Tuberculosis; chronic conditions e.g. Diabetes Mellitus, hypertension, heart disease, respiratory disease and renal disease. The possible explanation could be because very few of the study participants were detected to have suffered these illnesses.

5.3.7. Relationship between low birth weight and maternal nutritional status

A number of maternal nutritional factors were assessed and none were found to be statistically significant. These included anemia, stunting, underweight, additional food during pregnancy, nutrient deficiency e.g. Iron and Folate supplementation and harmful traditional practices. A possible explanation could be that in this setting nutrition is not an important predictor of low birth weight.

5.4. Independent predictors of low birth weight

However, unlike other studies only low birth weight of previous birth and female infant were independently and significantly associated with LBW after unconditional logistic regression. Since being female is non-modifiable, it implies that having delivered a low

birth weight baby in a previous pregnancy is a single most important predictor of low birth weight in the hospital.

5.5. Study limitations

This study encountered a number of limitations. Being a cross-sectional study, it was not possible to show seasonal variation in low birth weight. The study is hospital based, and therefore it was not possible to generalize the results to a particular population as compared to population based studies. The hemoglobin level used to assess anemia as a risk factor in this study was what was available in record. Owing to the fact that mothers attend ANC clinic at different gestation in pregnancy, it would have been more scientifically logical to follow the pattern of hemoglobin level from antenatal period to delivery in estimating the association of anemia and low birth weight. The Last Normal Menstrual Period (LNMP) was obtained from the mother child booklet, the delivery register or asking the mother. The LNMP was then used to calculate gestational age. For those mothers whose LNMP was recorded unknown or could not recall and no ultrasound record was available, gestation age could not be determined and was therefore regarded as non-response. However, an association was calculated to determine if there was a relationship between those with unknown gestation age and low birth weight.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

The prevalence of low birth weight in Olkalou district hospital was 12.3 percent. There are no documented public health thresholds for low birth weight in Kenya or internationally. However, 12.3 percent prevalence represents a substantial risk to neonatal death among newborns in this hospital. It is important therefore that the newborn unit is well equipped to provide essential services to newborns at risk, including low birth weight.

The women that gave birth at Olkalou hospital were mainly within the reproductive age of 20-35 years and predominantly rural. They had had a primary or secondary education, were self-employed, married and of protestant faith.

In this study, low birth weight births were more likely to occur among women who had delivered a low birth weight baby in the previous birth, among those who had ruptured membranes prematurely, those who had given birth before 37 weeks gestation, and among those who gave birth to female infants. Asphyxia was more likely to occur among the low birth weight infants. Although the indicators of quality antenatal care, such as timing of first antenatal visit, number of antenatal visits and tetanus injections were not significantly associated with low birth weight, it is important to note that the association between low birth weight of previous birth, premature rapture of membranes and premature delivery are predominantly linked to the quality of antenatal care.

6.2. Recommendations

6.2.1. Recommendation for action

With regard to the moderately high low birth weight prevalence, there is need for health care providers in Olkalou hospital to put more emphasis on focused antenatal care to

ensure risk of low birth weight is detected early and treated appropriately, especially among mothers with history of previous birth of a low birth weight baby, those who rapture membranes prematurely or give birth prematurely.

Since low birth weight newborns are at risk of asphyxia at birth, it is similarly important for the hospital to ensure availability of equipment and skilled staff for newborn resuscitation.

6.2.2. Recommendation for research

We recommend a population based study to ascertain the prevalence of low birth weight and associated risk factors in Nyandarua County.

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APPENDICES

Appendix 1: Questionnaire

Date of interview

Day		Month		Year	

IDENTIFICATION

Questionnaire number

Study subject number

A)SOCIO-DEMOGRAPHIC DATA

1. How old are you? (years)

2. Residence/Village/estate

3. Your Level of education

1= No formal education, 2= Primary education, 3= secondary education, 4= Tertiary education, 5= Others specify……

4. Partner's level of education **(if not applicable, leave blank)**

1= No formal education, 2= Primary education, 3= secondary education, 4= Tertiary education, 5= Others specify…….

5. Your status of employment

1= employed, 2= self-employed, 3= student, 4= unemployed, 5=Others

specify……...

6. Partner's status of employment **(if not applicable, leave blank)**

1= employed, 2= self-employed, 3= student, 4= unemployed, 5= Others

specify……

7. Your place of employment **(if not applicable, leave blank)**

8. Religion

9. Marital status

1= single, 2= Separated/divorced, 3= Married/cohabiting, 4= widower/other

B) REPRODUCTIVE BEHAVIOR

10. How old were you when you gave birth to the first child? (years)

11. Number of previous births whether the child was alive or dead (include term and premature deliveries)

12. How many times have been pregnant? (Including current pregnancy, abortions and miscarriages)

13. What is the pregnancy interval of the previous birth? (years)

14. How many living children do you have?

15. What is your desired number of children?

16. Did you intend to have the current pregnancy? 1=Yes, 2=later, 3=No more ☐

17. Which method of family planning did you use before the pregnancy? 1=Never used,

2 =traditional/natural, 3=modern methods ☐

18. What is the birth weight of your previous baby? (grams) **(If not applicable, leave blank)** ☐☐☐☐

19. Bad Obstetric History: 1= Previous history of abortion,

2= Previous history of stillbirth, 3=previous retained placenta/PPH, 4=none ☐

For question 20 to 22, please answer 1= Yes, 0= No (If not applicable, leave blank)

20. Previous history of low birth weight/prematurity ☐

21. Previous history of neonatal death ☐

22. Previous surgery on uterus and cervix

(Myomectomy, removal of septum, cone biopsy, caesarian section) ☐

C) SERVICE ACCESSIBILITY

23. How long does it take for you to reach a maternal health facility (hours) ☐

D) MATERNAL HEALTH CARE

24. Which month of pregnancy did you start antenatal visits? (record in weeks) ☐

25. Number of ANC visits attended ☐

26. Did you receive tetanus immunization? 1=Yes, 0=No ☐

E) GENERAL HEALTH CARE BEHAVIOR

27. Where do you obtain water for domestic use? 1=river, 2=tap, 3=well/borehole, 4=harvested water, 5=other, specify…… ☐

For question 28 to 31, answer 1=Yes, 0=No

28. Did your work involve exposure to agricultural spraying during the current pregnancy? ☐

29. Were you smoking cigarettes during the current pregnancy? ☐

30. Were you taking illegal drugs during the current pregnancy? E.g. Bang/marijuana ☐

31. Were you taking alcohol during the current pregnancy? ☐

F) MOTHER'S HEALTH STATUS

During the current pregnancy or in labor, did you have any of the following conditions? (Confirm from records)

Answer 1= Yes, 0= No

32. Sexually transmitted infection ☐

33. Malaria ☐

34. Diagnosed as HIV positive? ☐

35. VDRL positive

36. Tuberculosis?

37. Chronic diseases (hypertension, cardiac/renal disease, Diabetes mellitus, respiratory disease)

38. Hyperemesis (heavy vomiting) during pregnancy?

39. Pre- Eclampsia/Eclampsia

40. Vaginal bleeding

41. Premature rapture of membranes

G) MATERNAL NUTRITIONAL STATUS

42. Hemoglobin level (g/dl) **(check from records)**

43. Height of woman (cm) **(take measurements)**

44. Maternal weight (kg) **(take measurements)**

45. Mid-upper arm circumference (cm) **(Take left hand if right- handed, and right hand if left- handed)**

46. How many meals were you taking in a day (24hours) during pregnancy?

1=One, 2=Two, 3=Three, 4= >Three, 5=None ☐

47. Where do you obtain food? 1=garden, 2= market, 3=donations, 4= others,

specify…… ☐

48. Did you receive nutritional counseling in the clinic during pregnancy? 1=Yes, 0=No ☐

49. Did you receive any of the following food supplements during pregnancy? 1=Iron

and Folic acid, 2=Calcium, 3=Multivitamin, 4= others, specify……

5=None ☐

50 What nutritional problems did you experience during pregnancy? 1=Nausea and vomiting, 2= Poor appetite, 3=Constipation, 4= Muscle cramps, 5=Pica, 6= Heartburn, 7= Others, specify……, 8=None ☐

51. Which meals did you take the previous day before admission to hospital?

i) ***Breakfast***: 1= Tea/coffee with milk, 2=Tea/coffee without milk, 3=Enriched porridge, 4= Plain porridge, 5=Milk, 6=Bread, 7=Chapati, 8=Mandazi, 9=eggs, 10=Ugali, 11=Fruits, 12=sweet potatoes, 13=Mukimo, 14=Roast

ii) potatoes, 15=Others, specify……, 16=None ☐

iii) ***Lunch***: 1=Matoke, 2=Rice, 3=Ugali, 4= Mukimo, 5= Githeri, 6= Meat, 7= Fish, 8= Chicken, 9=Pork, 10= Potatoes, 11= Sweet potatoes, 12= Milk, 13= Cabbages, 14=Green vegetables, 15= Rice, 16= Beans, 17=Chapati, 18=Green grams, 19=Eggs, 20=Others, specify……., 21=None ☐

iv) ***Supper*** : 1=Matoke, 2=Rice, 3=Ugali, 4= Mukimo, 5= Githeri, 6= Meat, 7= Fish, 8= Chicken, 9=Pork, 10= Potatoes, 11= Sweet potatoes, 12= Milk, 13= Cabbages, 14=Green vegetables, 15= Rice, 16= Beans, 17=Chapati, 18=Green grams, 19=Eggs, 20=Others, specify……., 21=None ☐

v) ***Snacks***: 1= Porridge, 2= Milk, 3= fruits, 4= Yoghurt, 5= Sweet potato, 6= Potatoes, 7=Chapati, 8=Mandazi, 9=Bread, 10=Soda, 11= Others, specify…..... 12=None ☐

52. How often did you consume the following foods during pregnancy?

Type of food	**1=Daily**	**2=Thrice a week**	**3=Twice a week**	**4=Once a week**	**5=Once a month**	**6=Rarely**
i) Animal proteins						
i) Plant proteins						
ii) Fruits						
iii) Dark green vegetables						
iv) Carbohydrates						
v) Milk and dairy products						
vi) o Oils						

53. Are there foods that you don't eat during pregnancy? 1=Yes, 0=No

If yes, give reasons……. ☐

H) LABOUR AND DELIVERY

54. Were you referred here for delivery? 1= Yes, 0= No ☐

55. If yes, from where or by whom? ☐

1= district hospital, 2= Faith based facility, 3= Health Centre, 4= Dispensary, 5= Community Health Worker (CHW), 6= Private hospital, 7= Private clinic, 8= other, specify…… ☐

56. Onset of labor: 1= spontaneous, 2= induced, 3= No labor ☐

57. Who conducted the delivery or performed caesarean section or laparotomy?

1= OBGYN specialist, 2= Resident MD in training (registrar), 3= General practitioner (MO), 4= MO intern, 5= Nurse/Midwife, 6= Clinical officer, 7= Student nurse, 8= others, specify…… ☐

I)NEONATAL DATA

58. Last Menstrual Period (first day of last menstrual period)

Day		Month		Year	

59. Expected Date of Delivery

Day		Month		Year	

60. Date of delivery

Day		Month		Year	

61. Mode for delivery **(confirm from records)**

1= Spontaneous SVD, 2= Assisted (Forceps and extraction), 3= C-section, 4= Assisted breech or breech extraction, 5= Laparotomy for raptured uterus

62. If Caesarean-section, what was the indication for the operation (**confirm from records)**

63. Apgar score at 1 minute **(confirm from records)**

64. Birth weight

65. Infant sex (1=Female, 2=Male)

66.A ny congenital malformation?. (1= Yes ,0= No)

THANK YOU

Data collector's signature……..

Date……...

Appendix 2: Informed consent

Study Title

Prevalence and factors associated with low birth weight among infants born in Olkalou district hospital, Kenya

PART 1: Information

Please read the information in this section or have it read to you carefully before completing the consent form attached. If you have any questions please ask the investigator before signing the consent form.

Introduction

You are requested for participation in this study because low birth weight in a major public health problem in Kenya. Babies born with low weight experience higher rates of illnesses and deaths compared to those born with normal weight. There is need to find out factors associated with this problem in Olkalou so as to implement prevention and treatment measures to reduce the occurrence of the problem.

Freedom of choice

This consent form gives you information about the study, the risks, and benefits in participating in the study. Once you have been explained and understood and agreed to participate in the study, you will be requested to sign or make a mark on the consent form. Before consenting to participate in the study, it is important to understand that your participation is totally voluntary, and that you are free to make inquiries to fully understand the study and you have the freedom to terminate the study at any stage without facing any consequences.

Purpose of the study

The purpose of this study is to determine factors associated with low birth weight among infants born at Olkalou district hospital. This will help to make recommendations for action to reduce the occurrence of the problem.

In case of any questions, please contact:Onesmus Maina Muchemi, Cell phone number:0723 680468, Email: onesmuchemi@yahoo.com

In case you would like to ask someone other than the researcher, you are encouraged to contact the following:

The Director, Institute of Tropical Medicine and Infectious Diseases (ITROMID)
Jomo Kenyatta University of Agriculture and Technology (JKUAT)
P.O. box 62000- 00200 Nairobi
Tel: 067-52711
Email: itromid@nairobi.mimcom.net

Or

Prof. A. N. Guantai

Chairperson, Kenyatta National Hospital/ University of Nairobi- Ethical Review Committee

P.O. box 20723- 00202 Nairobi, Kenya

Tel: +254 20 726300-9 or +254 20 726300 Ext 44355

Email: uonknh_erc@uonbi.ac.ke

Expectations during participation

I will ask you simple questions regarding yourself and your family, your current and previous births and pregnancies. I will also take the weight of your baby as well as your height, weight and mid upper-arm circumference if you agree to participate in the study.

Harm and/ or risks and/ or discomforts

We do not anticipate any risks or discomforts to you during the study. We will protect your privacy and confidentiality during the entire study. You will be interviewed privately, and your name will not be recorded anywhere.

Benefits

It will not cost you anything for participating in the study. The results of this study will be useful in implementing community programs to reduce the occurrence of the problem. By participating in this study you will benefit from free counseling regarding feeding and care of the baby and education to prevent future occurrence and targeted postnatal care.

Privacy of records

All information collected will be kept confidential. You will only be identified by use of a code and personal information from the interview will not be released unless with your written permission. However, absolute confidentiality may not be guaranteed because your records may be reviewed by the Ethics Review Committee at Kenyatta National Hospital.

Appendix 2: Idhini ya kushiriki katika utafiti

KICHWA CHA UTAFITI

Masuala kuhusu nini husabibisha watoto kuzaliwa kwa uzani mdogo katika hospitali ya Olkalou, Kenya.

SEHEMU YA KWANZA: MAAGIZO

Tafadhali soma habari ifuatayo au uhakikishe umesomewa kabla ya kutia sahihi kutoa idhini ya kushiriki katika utafiti huu.Ukiwa na maswali yoyote, uliza kwa mtafiti kabla ya kutia sahihi.

Utangulizi

Unaombwa kushiriki katika utafiti huu kwa sababu uzani mdogo kwa watoto wanaozaliwa ni shida inayodhuru afya ya jamii katika nchi ya Kenya. Watoto wanaozaliwa kwa uzani mdogo hukumbwa na maradhi na hata kufa kwa asilimia kubwa kuliko wale wanaozaliwa kwa uzani wa kawaida. Kuna sababu za kutafuta ni kwa nini watoto huzaliwa kwa uzani mdogo katika hospitali ya Olkalou ili kupendekeza suluhu ya kuzuia na tiba ya shida hii katika jamii.

Uhuru wa kushiriki

Fomu hii inakupa habari kuhusu utafiti huu, umuhimu wake na manufaa ya kushiriki. Unapoelewa na kukubali kushiriki, unaombwa kutia sahihi au kuweka alama ya kidole katika sehemu iliyotengwa kwa minajili hiyo. Kabla ya kukubali kushiriki unajulishwa kuwa ni kwa hiari yako na ikiwa kuna masuala ambayo hujaelewa ni vyema kuuliza kabla ya kukubali. Tena uko na uhuru wa kutoshiriki wakati wowote utakaoamua bila ya wewe kuchukuliwa hatua yoyote.

Madhumuni ya utafiti huu.

Madhumuni ya utafiti huu ni kupeleleza ni nini kinachosababisha watoto kuzaliwa kwa uzani mdogo katika hospitali ya Olkalou, Kenya. Matokeo ya utafiti huu yatasaidia katika kupendekeza sera za kuzuia shida hii katika jamii.

Kwa maswali yoyote uliza: Onesmus Maina Muchemi.

Nambari ya simu ya rununu: 0723 680468, Email: onesmuchemi@yahoo.com

Ukiwa na suala lolote kuhusu utafiti huu na ungependa kumuuliza mtu mwingine ila anayefanya utafiti, unahimizwa kupata ushauri kutoka kwa:

The Director, Institute of Tropical Medicine and Infectious Diseases (ITROMID)
Jomo Kenyatta University of Agriculture and Technology (JKUAT)
P.O. box 62000- 00200 Nairobi
Tel: 067-52711
Email: itromid@nairobi.mimcom.net

Au

Prof. A. N. Guantai

Chairperson, Kenyatta National Hospital/ University of Nairobi- Ethical Review Committee

P.O. box 20723- 00202 Nairobi, Kenya

Tel: +254 20 726300-9 or +254 20 726300 Ext 44355

Email: uonknh_erc@uonbi.ac.ke

Matarajio

Nitakuuliza maswali rahisi kuhusu familia yako, mimba iliyopo na uzazi uliyopita. Pia nitapima uzani wa mtoto, uzani wako, urefu na upana wa mkono wako iwapo utakubali kushiriki kwenye utafiti huu.

Madhara/ hatari ya kushiriki

Hatutarajii madhara au hatari yoyote kwako ukishiriki katika utafiti huu.Unaombwa kushiriki bila wasiwasi wowote kwani mahojiano yatafanyika faraghani na habari utakayoitoa itawekwa pasipo fahamu ya wengine na jina lako halitahifadhiwa.

Manufaa

Hakuna gharama yoyote utakayopitia kwa kushiriki na kushiriki kwako ni kwa hiari yako. Matokeo ya utafiti huu itasaidia kubuni sera na mikakati ya kutatua shida hii katika jamii. Unaposhiriki kwenye utafiti huu, utanufaika kwa mawaidha ya bure kuhusu lishe bora na jinsi ya kutunza mtoto na pia maelezo ya afya baada ya uzazi.

Hifadhi ya utafiti

Habari na mahojiano ya utafiti huu itawekwa kwa umakini na siri. Utapewa nambari itakayotumika kwenye utafiti na habari yako ya kibinafsi haitatolewa mtu yeyote bila ya idhini yako. Jina lako halitatajwa kwenye ripoti ya utafiti huu lakini huenda rekodi yako ikatathminiwa na kamati ya kushugulikia maadili ya utafiti ya hospitali kuu ya kitaifa ya Kenyatta.

Appendix 3: Part 11: Consent Form

Declaration of participant

I Miss/Mrs.……do hereby give consent/ assent to Mr. Onesmus Maina Muchemi to include me in the proposed study entitled 'Factors associated with low birth weight among infants born at Olkalou district hospital, Kenya'. I have read the information sheet and understood the purpose of the study and what will be required on my part if I agree to take part in the study. Any questions I have concerning my involvement in the study have been adequately clarified. I understand that I can discontinue from the study at any stage without any consequences. I also understand that I will be interviewed and that the weight of my baby, my weight and upper-arm circumference and height will be measured. I therefore consent voluntarily to participate in the study.

Respondent's signature (left thumb print)……

Date……

Name of person taking consent……..

Signature……..*Date*……

Appendix 3: SEHEMU YA PILI: FOMU YA IDHINI

Arifa ya mhojiwa wa hiari

Mimi Bi…….. natoa ruhusa kwa Bwana Onesmus Maina Muchemi kunihusisha kwa utafiti, 'Nini inayosababisha watoto kuzaliwa kwa uzani mdogo katika hospitali ya Olkalou, Kenya'. Nimesoma nakala ya habari kuhusu utafiti huu, nimeelewa madhumuni ya utafiti huu na pia yatakayotarajiwa kwangu nikikubali kushiriki. Maswala yote kuhusu kuhusika kwangu kwenye utafiti huu yamejibiwa kikamilifu. Nimeelewa kwamba ninaweza kutoendelea kushiriki bila ya mimi kuchukuliwa hatua yoyote. Naelewa nitahojiwa, na pia uzani wa mtoto wangu utapimwa, pia uzani na urefu wangu na upana wa mkono wangu pia. Nakubali kwa hiari yangu kushiriki kwenye utafiti huu.

Sahihi ya mhojiwa (alama yakidole gumba kushoto) ……

Tarehe ……

Jina la anayepewa ruhusa……..

Sahihi……..Tarehe……

Appendix 4: Computer generated random numbers

346 Random Numbers from 1 to 500. Generated by the OpenEpi Random Program www.openepi.com

257	163	223	440	480	449	461	101	214	95	420	11	22	195
79	472	175	395	144	19	234	297	353	416	304	39	106	207
95	179	27	46	66	481	119	250	116	81	100	238	419	218
308	461	449	226	302	66	11	468	31	124	105	340	23	63
171	145	103	431	452	490	183	29	142	239	101	487	126	215
291	249	241	32	288	289	73	187	175	91	194	111	124	49
298	157	422	306	55	43	296	427	307	28	347	192	75	299
41	35	445	106	378	475	45	432	425	83	362	458	137	151
377	68	269	161	208	3	274	8	311	395	489	244	231	399
475	293	149	464	182	431	226	371	400	294	176	25	218	258
109	317	7	297	410	229	232	35	4	424	494	402	263	162
293	475	293	150	497	82	462	188	106	283	271	290	99	212
44	61	103	474	76	237	457	282	352	472	284	431	364	414
174	24	261	190	343	16	61	37	326	462	50	299	244	47
268	185	182	366	297	208	48	309	353	230	254	153	253	479
227	241	175	394	457	262	30	99	114	413	107	37	263	206
184	156	80	294	405	85	194	17	52	128	307	345	207	59
322	483	494	498	49	81	274	325	333	359	361	70	311	344
168	413	280	248	280	42	271	488	494	464	350	474	326	211
423	415	480	183	48	445	317	392	266	266	150	381	26	153
281	491	406	412	165	242	251	457	189	163	239	261	495	52
151	63	466	341	156	177	172	91	272	162	321	466	275	153
346	276	379	270	213	332	326	399	252	471	442	151	290	138
379	379	468	184	248	115	146	476	345	105	131	95	36	134
344	397	9	377	88	177	472	271	224	5				

Appendix 5: Unconditional logistic regression models

Model 1

Term	Odds Ratio	95%	C.I.	Coefficient	S. E.	Z-Statistic	P-Value
Apgar score status (Yes/No)	4.7222	0.2127	104.8538	1.5523	1.5818	0.9813	0.3264
Female infant (Yes/No)	2.6104	0.6863	9.9297	0.9595	0.6817	1.4076	0.1592
Maternal age (Yes/No)	0.0000	0.0000	>1.0E12	-9.9041	346.1024	-0.0286	0.9772
Premature birth (Yes/No)	3.2570	0.3783	28.0396	1.1808	1.0984	1.0750	0.2824
Prematureraptureofmembranes (Yes/No)	2.8282	0.4149	19.2773	1.0396	0.9793	1.0617	0.2884
LBW of previous baby(Yes/No)	7.2376	1.6010	32.7190	1.9793	0.7697	2.5714	0.0101
RESIDENCESTATUS (Yes/No)	2.7321	0.4295	17.3792	1.0051	0.9440	1.0647	0.2870
CONSTANT	*	*	*	-3.4825	0.6322	-5.5088	0.0000

Model 2

Term	Odds Ratio	95%	C.I.	Coefficient	S. E.	Z-Statistic	P-Value
Apgar score status (Yes/No)	4.7754	0.2140	106.5638	1.5635	1.5844	0.9868	0.3237
Female infant (Yes/No)	2.6577	0.6991	10.1035	0.9775	0.6813	1.4346	0.1514
Premature birth (Yes/No)	3.2754	0.3795	28.2703	1.1865	1.0997	1.0789	0.2806
Prematureraptureofmembranes (Yes/No)	2.8465	0.4165	19.4529	1.0461	0.9806	1.0668	0.2861
LBW of previous baby (Yes/No)	7.3162	1.6167	33.1091	1.9901	0.7703	2.5836	0.0098
RESIDENCESTATUS (Yes/No)	2.7545	0.4317	17.5762	1.0132	0.9456	1.0715	0.2839
CONSTANT	*	*	*	-3.5060	0.6299	-5.5656	0.0000

Model 3

Term	Odds Ratio	95%	C.I.	Coefficient	S. E.	Z-Statistic	P-Value
Female infant (Yes/No)	2.8499	0.7917	10.2583	1.0473	0.6535	1.6026	0.1090
Premature birth (Yes/No)	3.5699	0.5894	21.6230	1.2725	0.9190	1.3847	0.1662
Prematureraptureofmembranes (Yes/No)	2.6814	0.4059	17.7118	0.9863	0.9632	1.0240	0.3058
LBW of previous baby (Yes/No)	5.9696	1.3811	25.8020	1.7867	0.7468	2.3923	0.0167
RESIDENCESTATUS (Yes/No)	2.4531	0.3978	15.1263	0.8974	0.9281	0.9669	0.3336
CONSTANT	*	*	*	-3.3916	0.6017	-5.6369	0.0000

Model 4

Term	Odds Ratio	95%	C.I.	Coefficient	S. E.	Z-Statistic	P-Value
Female infant (Yes/No)	2.9403	0.8162	10.5917	1.0785	0.6539	1.6494	0.0991
Premature birth (Yes/No)	3.2043	0.5425	18.9255	1.1645	0.9061	1.2851	0.1988
Prematureraptureofmembranes (Yes/No)	2.8401	0.4324	18.6534	1.0438	0.9603	1.0870	0.2770
LBW of previous baby(Yes/No)	5.8471	1.3728	24.9040	1.7659	0.7393	2.3885	0.0169
CONSTANT	*	*	*	-3.3109	0.5949	-5.5652	0.0000

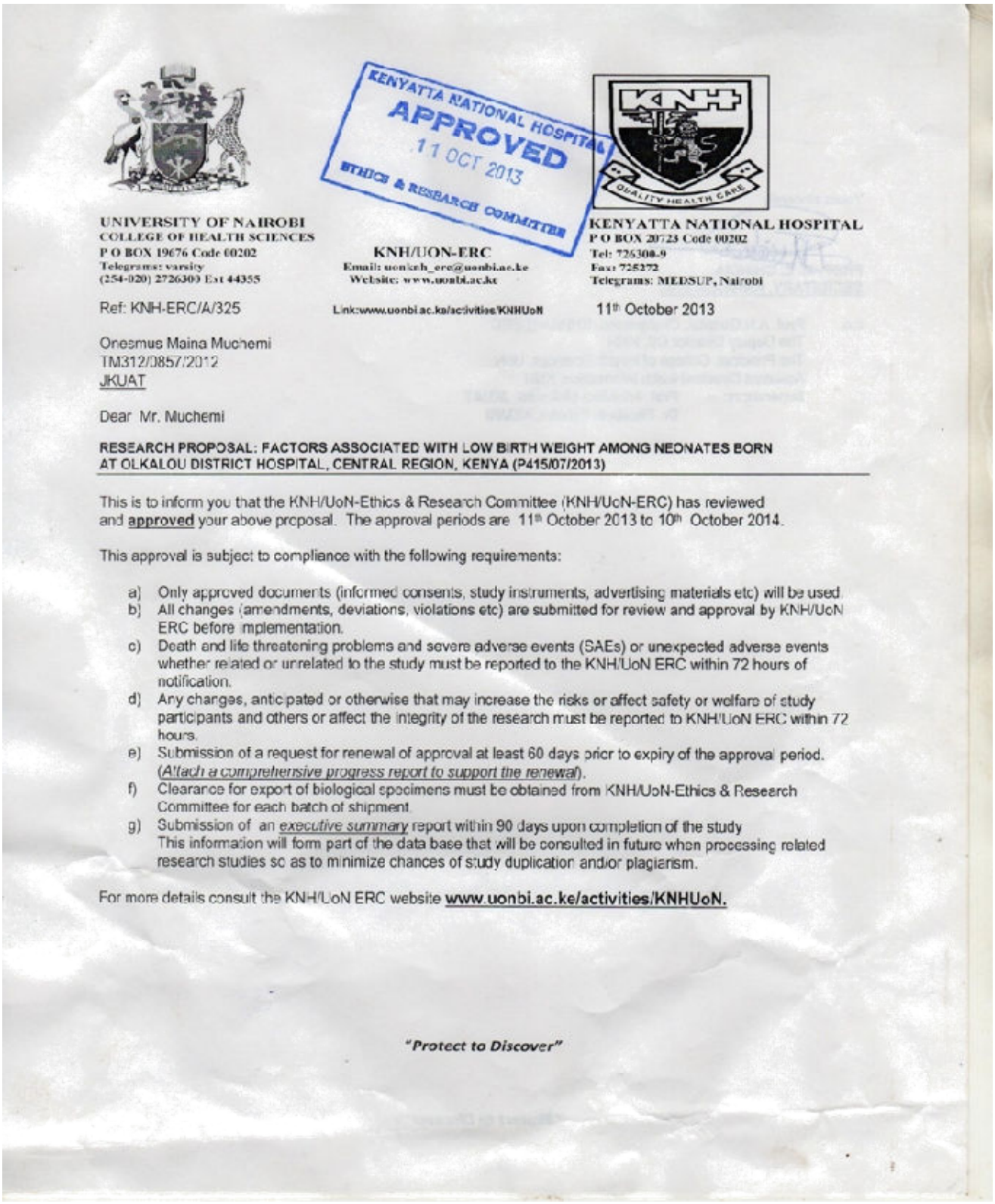
Model 5

Term	Odds Ratio	95%	C.I.	Coefficient	S. E.	Z-Statistic	P-Value
Female infant (Yes/No)	2.9382	0.8238	10.4796	1.0778	0.6488	1.6612	0.0967
Premature birth (Yes/No)	2.9500	0.5061	17.1938	1.0818	0.8994	1.2028	0.2290
LBW of previous baby (Yes/No)	6.4496	1.5551	26.7491	1.8640	0.7258	2.5684	0.0102
CONSTANT	*	*	*	-3.2275	0.5799	-5.5655	0.0000

Final model

Term	Odds Ratio	95%	C.I.	Coefficient	S. E.	Z-Statistic	P-Value
Female infant (Yes/No)	3.3724	1.1378	9.9954	1.2156	0.5544	2.1928	0.0283
LBW of previous baby (Yes/No)	5.0733	1.5882	16.2063	1.6240	0.5926	2.7406	0.0061
CONSTANT	*	*	*	-3.0569	0.4959	-6.1649	0.0000

Appendix 6: Ethical approval letter



KENYATTA NATIONAL HOSPITAL
APPROVED
11 OCT 2013
ETHICS & RESEARCH COMMITTEE

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
(254-020) 2726300 Ext 44355

KNH/UON-ERC
Email: uonknh_erc@uonbi.ac.ke
Website: www.uonbi.ac.ke
Link:www.uonbi.ac.ke/activities/KNHUoN

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/325

11th October 2013

Onesmus Maina Muchemi
TM312/0857/2012
JKUAT

Dear Mr. Muchemi

RESEARCH PROPOSAL: FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT AMONG NEONATES BORN AT OLKALOU DISTRICT HOSPITAL, CENTRAL REGION, KENYA (P415/07/2013)

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 11th October 2013 to 10th October 2014.

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.uonbi.ac.ke/activities/KNHUoN.**

"Protect to Discover"

Yours sincerely

PROF. M. C. CHINDIA
SECRETARY, KNH/UON-ERC

c.c. Prof. A.N.Guantai, Chairperson, KNH/UoN-ERC
The Deputy Director CS, KNH
The Principal, College of Health Sciences, UoN
Assistant Director/Health Information, KNH
Supervisors: Prof. Anselimo Makokha, JKUAT
Dr. Elizabeth Echoka, KEMRI

"Protect to Discover"