SPATIAL DISTRIBUTION OF LOW BIRTH WEIGHT AND ASSOCIATED MATERNAL FACTORS IN MOMBASA COUNTY: A HOSPITAL BASED STUDY

BY:

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DEDICATION

I dedicate this work to Dr. Ljubomir Radovnikovic whom without his encouragement, daily reminder, and support, I would not go as far as I am with my masterös degree. I also dedicate it to my mother whom without her determination, I would not have attained my undergraduate and I would not be as strong willed as I am now and finally to the rest of my family members whose support I could always count on and which will always be treasured and appreciated.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ANC	-	Antenatal Care
ART	-	Antiretroviral Therapy
BMI	-	Body Mass Index
CI	-	Confidence Interval
CPGH	-	Coast Province General Hospital
FP	-	Family Planning
GIS	-	Geographic Information System
Hb	-	Hemoglobin
HBC	-	Home-Based Care
HIV	-	Human Immune Deficiency Virus
HTSP	-	Healthy timing and spacing of pregnancies
IMR	-	Infant Mortality Rate
IQ	-	Intelligence Quotient
ITN	-	Insecticide-treated bed nets
IUGR	-	Intra-Uterine Growth Retardation
KCFS	-	Kenya County Fact Sheet
KDHS	-	Kenya Demographic Health Survey
KEPH	-	Kenya Essential Package for Health
KNBS	-	Kenya National Bureau of Statistics
Km^2	-	Kilometre squared
KNH	-	Kenyatta National Hospital
KShs	-	Kenyan Shillings
LBW	-	Low Birth Weight
MDG	-	Millennium Development Goals
MICS	-	Multiple Indicator Cluster Survey
MNCH	-	Maternal Neonatal and Child Health
MOPHS	-	Ministry of Health and Sanitation
MOMS	-	Ministry of Medical Services
MUAC	-	Mid Upper Arm Circumference
NBU	-	New Born Unit
NBW	-	Normal Birth Weight
NO_2	-	Nitrous Dioxide

OR	-	Odds Ratio
PAH	-	Polycyclic Aromatic Hydrocarbons
PAH-DNA	-	Polycyclic Aromatic Hydrocarbon-Deoxyribonucleic Acid
PM	-	Particulate Matter
SD	-	Standard Deviation
SDG	-	Sustainable Development Goals
SO_2	-	Sulphur dioxide
STI	-	Sexual Transmitted Infection
TVOC	-	Total Volatile Organic Compounds
UNDP	-	United Nations Development Program
UNICEF	-	United Nations Childrenọs Fund
USA	-	United States of America
USD	-	United States Dollars
U5MR	-	Under Five-Mortality Rate
VOC	-	Volatile Organic Compounds
WHO	-	World Health Organization

OPERATIONAL DEFINITIONS

Antenatal Care (ANC): The care given to pregnant mothers to monitor their pregnancy.

APGAR score: This is the score given at birth to assess the newborns health.

Body Mass Index BMI: denoted by weight (kg)/height^2 (m^2)

Normal BMI for adults 18.5- 24.9, Low BMI less than 18.5, High BMI more than 30.

Environmental factors: In this study, they are depicted by residence.

Gestational age: Number of completed weeks since the last menstrual period of the mother. A term baby is a baby born between 37 and 42 completed weeks of gestation.

Hemoglobin (Hb) level: Hemoglobin levels; in this study it is the latest hemoglobin level before delivery.

Health care services levels: These have been defined in the Kenya Essential Package for Health (KEPH). Health care services are given at different levels depending on the specific activities and population served by the health facility.

Level 1 Community: a minimum package of community-based family planning services and community home-based care (HBC) services.

Level 2 Dispensaries, clinics: Maternal and neonatal child health (MNCH) and family planning (FP) services, sexually transmitted infection (STI) services, HIV counseling and testing services and HBC services.

Level 3 Health centers, maternities, nursing homes: MNCH, family planning, healthy timing and spacing of pregnancies (HTSP) services, STI services, HIV counseling and testing services and HBC services.

Level 4 District hospitals: MNCH/FP/HTSP services, STI services, HIV counseling and testing services, antiretroviral therapy (ART) and HBC services.

Levels 5 and 6 Provincial and National Referral Hospitals: family planning and HTSP services, STI services, HIV counseling and testing services and antiretroviral therapy (ART) (Ministry of Health Kenya, 2006).

Infant Mortality: Rate (IMR) Deaths of infants under one year of age live births.

Infant: A child who is at the earliest stage of extra uterine life, a time extending from the first month after birth to 12 months of age.

Intermediate Factors: These characteristics are a result of proximate factors and lead to low birth weight distribution.

Live birth: A baby born with any sign of life regardless of weight or gestation.

Low birth weight: (LBW) Birth weight less than 2,500 grams. In this study, the gestational age of relevance was from 28 weeks.

Maternal factors: Maternal factors which contribute to low birth weight. In this study, the maternal factors are residence, age, marital status, occupation, educational level, employment of mother, attendance to ANC, parity, infection by malaria, HIV status, ingestion of HIV medication and nutritional status.

Maternal height: Height measured at first ANC visit retrieved from the ANC card.

Maternal MUAC: **(Mild Upper Arm Circumference)** A MUAC cut off point of 23.0 cm was identified as the malnourished mothers (Ververs *et al,* 2013).

Maternal weight: weight taken at first ANC visit retrieved from the ANC card.

Medical factors: In this study they are HIV, status malaria, HIV treatment, previous low birth weight, and parity.

Neonate: This refers to a newborn from birth to 28 days.

Neonatal period: The first 28 days of life, divided into early neonatal period

Obstetric factors: Occurrences in relation to the pregnancy.

Parity: The number of pregnancies of the mother prior to the current.

Proximate factor: In this study, proximate factors are factors influencing maternal environment at pregnancy. They include socio demographic factors and socioeconomic factors.

Preterm birth: Preterm is defined as babies born alive before 37 weeks of pregnancy are completed. The sub-categories of preterm birth, based on gestational age:

- Extremely preterm (<28 weeks)
- Very preterm (28 to <32 weeks)
- Moderate to late preterm (32 to <37 weeks) (WHO 2012).

Socio Demographic: Factors In this study, these refer to age, ethnicity, education, and and marital status.

Socio Economic: Factors In this study, this refers to financial status (employment)

Spatial Distribution: Spatial distribution is the physical location of medical phenomena across space. In this study, where the mother lived during pregnancy was used as the geographical region. It was noted up to the ward level and was represented on the map.

ABSTRACT

Introduction

The target of the Millennium Development Goal 4 was to reduce child mortality rate by two thirds between 1990 and 2015. Low birth weight is one of the risk factors contributing to mortality in infants and children, more so, in developing countries. Low birth weight is defined as birth weight less than 2500g as defined by the World Health Organization. To achieve millennium development goal 4, it is necessary to identify specific problems associated with birth weight. To achieve this, it is essential to identify the areas with the most prevalence and investigate modifiable factors that increase the occurrence of Low Birth Weight. This will help in focusing interventions to the areas affected. Therefore, the main objective of this study was to map out where Low birth weight was prevalent in Mombasa County.

Methods

This was a descriptive all-inclusive cross-sectional study that was carried out from July 2013 to September 2013. The target population included all mothers who delivered in level four and five hospitals, after 28 weeks gestation and who had lived in Mombasa for at least 3 months during the pregnancy. A structured questionnaire was administered to mothers on discharge after delivery. Quantitative data were analyzed by descriptive statistics by computing frequencies. Newborns babies born with low birth weight were mapped and spatial distribution illustrated using arc geographical information systems. Risk factors that were associated with the delivery of low birth weight neonate were analyzed using odds ratio.

Results

A total of 1475 participants were enrolled in this study with a response rate of 100% based on the studyôs exclusion criteria and only 1349 participants were eligible. The overall prevalence of low birth weight was 10.1 % in this cohort. Most (91%) of deliveries took place at the gestational age of 28-36 weeks and comprised the majority of the low birth weight cohort in this study. Kisauni had the highest percentage of Low Birth Weight deliveries within the county. There was no significant difference in low birth weight distribution between the sub-counties. Nevertheless, the top five wards ñhotspotsò of Low Birth Weight included Airport (31.8%), Bamburi (18.8%), Timbwani (18.1%), Mtopanga (17%) and Miritini (16.2%). Mothers whose age was less than 20 years of age had a higher risk of having Low Birth Weight babies, Odds Ratio 1.9 (95% Confidence Interval; 1.1-3.4) p=0.031, compared to those who were older than 30 years of age. There were no significant associations of the prevalence of Low Birth Weight in mothers above 20 years of age. The mothers who were not married showed a significantly higher likelihood of delivering Low Birth Weight, Odds Ratio 1.7 (95% Confidence Interval 1.0-2.7), p=0.045. Other socio-demographic characteristics of the mothers were not significantly associated with Low Birth Weight (p>0.05).

Conclusion

Low birth weight deliveries in Mombasa County could occur anywhere within the county. Most Low Birth Weight was associated with single status; maternal ages less than 20 years of age; maternal height of at least 140-155 cm; late attendance to antenatal clinics; multiparous of more than 5 deliveries; previous Low Birth Weight delivery and Maternal Mid-upper circumference less than 23 cm.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The World Health Organization (WHO) defines ñLow birth weightò (LBW) as a birth weight less than 2500g (WHO 1992). LBW can result from intrauterine growth retardation and prematurity ñbirth at less than 37 weeks of gestational ageò (Langer 2011). The categories of low birth weight in the developed and underdeveloped world differ such that, in the developing world, majorities are intrauterine growth retardation (IUGR), whereas in developed countries, most LBW are preterm birth (Qadir &Bhutta 2009).

Low Birth Weight was identified to be a major contributor of Under 5 Mortality Rate (U5MR) as early as 1919 when Arvo Ylppo defined LBW as any child with a birth weight below 2500g to distinguish between preterm and term infants (Ylppo 1919). The First World Health Assembly (1948) then defined prematurity as a birth weight of 2500g or less. WHO in 1961 then realized that, this definition did not give satisfactory answers in relation to gestational age and other anthropometric measures (WHO 1961). Low birth weight (LBW) is used as an indicator for development as it is ña summary measure of a multifaceted public health problem that includes long-term maternal malnutrition, ill health, hard work and poor pregnancy health careò (Wardlaw and colleagues 2004). Owing to its vast association with morbidity and mortality, LBW has been studied in depth. Lubechenko (1972) stated that, "mortality and morbidity of LBW infants are related to their birth weight and gestational ageò. In under-resourced settings, there is an increased risk of child morbidity, mortality and disability in LBW infants. This contributes the burden to families, societies and health providers as a whole (Black and colleagues, 2008; Qadir and Bhutta, 2009).

For the purpose of this study, LBW is defined as a birth weight of less than 2500g at 28 weeks of gestation or more. Causes of LBW differ between populations and within populations which therefore, justifies the need to investigate factors that contribute to this outcome to the extent in which we explore and embark on interventions (Barker and colleagues 2003). LBW infants are prone to hypothermia, respiratory distress and infections which in turn leads to increased mortality Lawn and colleagues (2005). Furthermore, a child is prone to infections which also lead to early mortality (Ashworth 1998). The impact during adulthood is also dire; LBW babies have been documented to develop diabetes, coronary heart diseases and hypertension (Barker 1995; Osmond and Baker 2000).

As an eventuality, financial implications of LBW are highly significant whether the baby dies in the newborn unit or later develops chronic diseases during later life. These implications can be avoided by simply preventing low birth weights from occurring. One of the ways is to find out where the LBW prevalence is high in the community and then investigate further i.e. spatial analysis.

Nepathali (2005) explained that, ñSpatial analysis is indispensable to evaluating patient access to managed care provider networks or modeling demand for services based on the analysis of health and demographic characteristics of patientsò. The use of spatial analysis can give a detailed picture of LBW and show areas with high incidence. Direct causal impacts on intrauterine growth have been widely documented as early as 1987 including infantsô gender, ethnic origins, maternal height, maternal pre-pregnancy weight, maternal weight and height, maternal birth weight prior LBW delivery, gestational weight gain, morbidity and infections during pregnancy, cigarette smoking as well as alcohol intake (Kramer 1987).

Mother's knowledge, in particular, has been proven a great factor in pregnancy outcome especially birth weight, which begins as early as the primary school level. As a result, one of the Millennium Developing Goals (MDG 2) target is to increase education for the girl by 2015. As a mother learns more about her body conception and pregnancy, she realizes the importance of ANC care.

Therefore, the fact that maternal factors play an important role in fetal growth and optimization is indubitable. This is because the mother's genetic makeup, environment (both physiological and psychosocial), nutrition are all shared with the fetus in the womb. Hence, not the same risk factors are in present or applicable to different populations. This study maps out the low birth weights in Mombasa County and analyses the maternal risk factors that contribute to this distribution.

1.2 Statement of the Problem

Maternal and child health have always been of concern and an indicator of development. The fact that, maternal health is crucial in intrauterine development and optimization is indubitable. It is also a well-known fact that Low birth weight is an indicator of morbidity and mortality. Mortality rates of babies born with LBW are higher than those born with normal weight (Walker and colleagues 2007). Low birth weight contributes to neonatal mortality by 60-80%. In Kenya, LBW prevalence in the Coast province was one of the highest (KDHS 2008-09). The study aims at investigating the spatial distribution of LBW as well as associated maternal characteristics in Mombasa County.

The MDG 4 target was to reduce child mortality by two thirds between 1990 and 2015. Kenya is amongst the countries in sub-Saharan Africa who despite reported notable progress has recorded a high U5MR according to the MDG report card (MDG report card 2015).

Besides mortality, LBW is also associated with morbidity. Many LBW babies who survive need additional medical care. Besides causing an emotional burden to the family, financial costs are also implicated. Gathara and colleagues (2007) found the prevalence rate of admissions of LBW to New Born Unit (NBU) in Kenyatta National Hospital (KNH) was 51%. Simiyu (2004) managed to quantify the burden of infection amongst LBW infants in NBU, KNH and it was found that, out of 533 LBW babies, 17 had neonatal sepsis and the case fatality rate was 36.5%.

The maternal environment during pregnancy is paramount to its outcome. In addition, as noted by Barker and colleagues (2003), different areas have different contributing factors to this outcome. Hence the questions: Where are the low birth weights located in Mombasa county? What are the risk factors for the LBW babies in Mombasa? It is imperative that, we know the areas that are rampant with LBW so that we can come up with specific strategies to prevent this outcome. It is undisputed that, various campaigns such as nutrition campaigns, malaria campaigns, or HIV campaigns have helped to create the awareness of possible risks associated with this outcome. However, not the same strategies apply in different areas.

Spatial distribution has been studied severally in other countries to identify rampant areas. In Iran, Shakiba and colleagues (2008), used spatial distribution retrospectively in hospitals (using hospital records), to identify areas of high prevalence. This particular study is of a cross-sectional design and involved identifying mothers at the point of delivery.

The current study covered the whole county of Mombasa and four level 4 hospitals were recruited as proxies for even geographical distribution. The study was designed to be a cross-sectional descriptive study; whose objectives were to identify wards with higher BW prevalence using the hospitals as catchment areas. The data was collected from maternal ANC profile using a semi-structured questionnaire, which was administrated to mothers. Only maternal factors were tested including age, residence, religion, ethnicity, marital status, financial status (employment) and attendance to ANC, nutritional status (using anthropometric measures), HIV status and HIV medication. The results were mapped out and the associations made using Chi-Square, t-test and odd ratio.

1.3 Research Questions

The research questions that defined the objectives of the study included:

1. How are LBW geographically distributed in Mombasa County?
2. What are the maternal risk factors of LBW in Mombasa County?

1.4 Objectives of the study

1.4.1 Main Objective

The main objective of this study was to map out LBW and investigate the associated maternal factors in Mombasa County.

1.4.2 Specific Objectives

1. To determine the hot spots of LBW in Mombasa County.
2. To determine maternal factors associated with LBW distribution in Mombasa County.

1.5 Hypotheses

There were two hypotheses in this study

H_{01}: LBW is not evenly distributed within the population of Mombasa.

H_{02}: There is no association between LBW with maternal risk factors (residence, age, marital status, occupation, educational level, employment of mother, attendance to ANC, parity, infection by malaria, HIV status, ingestion of HIV meds and nutritional status).

1.6 Significance of the Study

Mapping out LBW in Mombasa demonstrated the spatial distribution of LBW and identified areas with higher prevalence. The study was able to give trajectory on areas with high prevalence of LBW within Mombasa County setting agenda for further research to investigate causes for the disparities. Further investigation of maternal risk factors leading to LBW informs policymakers on the way forward to minimize the occurrence of low birth weight in the region.

1.7 Justification

According to KDHS 2008-9, Mombasa county had 6.9% prevalence of LBW. Factors contributing to the prevalence of LBW in Mombasa have not yet been documented. As such, the study mapped out the prevalence of LBW and investigated maternal factors associated with the outcome.

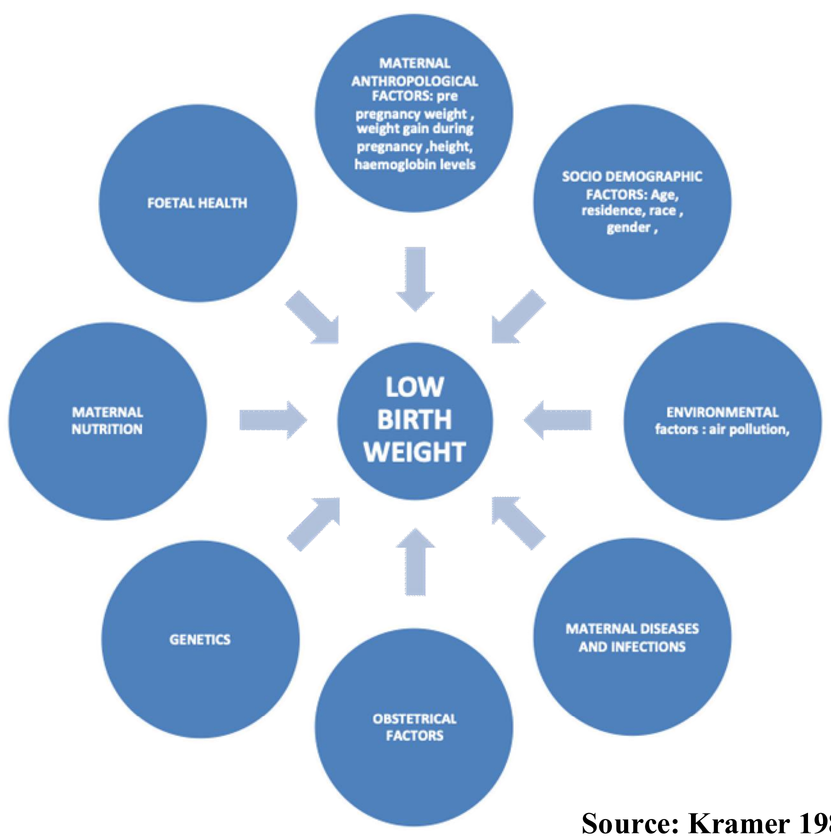
To achieve MDG 4, there was need to identify the areas with most prevalence, identify specific factors associated with Low birth weight and investigate modifiable factors that increased the occurrence of low birth weight. The first step was to look at where LBW prevails, then to know why it prevails at that particular area and finally, specific mitigations and interventions that could be made to improve the outcome. Mapping out LBW in Mombasa identified specific areas in need of specific intervention according to risk factors.

1.8 Scope of Research

The study involved mothers who delivered in level four and level five public hospitals in Mombasa County. All mothers who attended the hospitals for delivery between July and September 2013 were approached (within the study period). The mothers were approached after the delivery prior to discharge from the hospital. There were four hospitals chosen using purposeful sampling, each representing a sub-county. The research assistants obtained consent from the mothers prior to the interview and assisted in administering the questionnaire.

1.9 Conceptual Framework

The environment that surrounds the mother influences the growth and development of the fetus and therefore factors that affect LBW are those that mainly affect the mother during pregnancy. Kramer (1987) examined risk factors for LBW and concluded that, there were 43 factors associated with this outcome. Kramer's 43 factors were summarized into genetic and constitutional, demographic and psychosocial, obstetric, nutritional, maternal morbidity during pregnancy, toxic exposure and antenatal care. Factors in relation to the mother have been summarized in Figure 1.1 below.



Source: Kramer 1987

Figure 1.1 Factors Contributing to Low Birth Weight

Kramerôs conceptual framework consists of proximate factors that affect the maternal environment (Kramer 1987). From the review of literature, it was apparent that socioeconomic factors, socio demographic factors, medical factors and environmental factors affect the mothers' nutrition by either inadequate amounts of food and/or by disease. Low birth weight can then be predicted by maternal weight at term and maternal MUAC. Residence, however, effect the overall distribution of these low birth weights. Figure 1.2 shows the conceptual framework of this study.

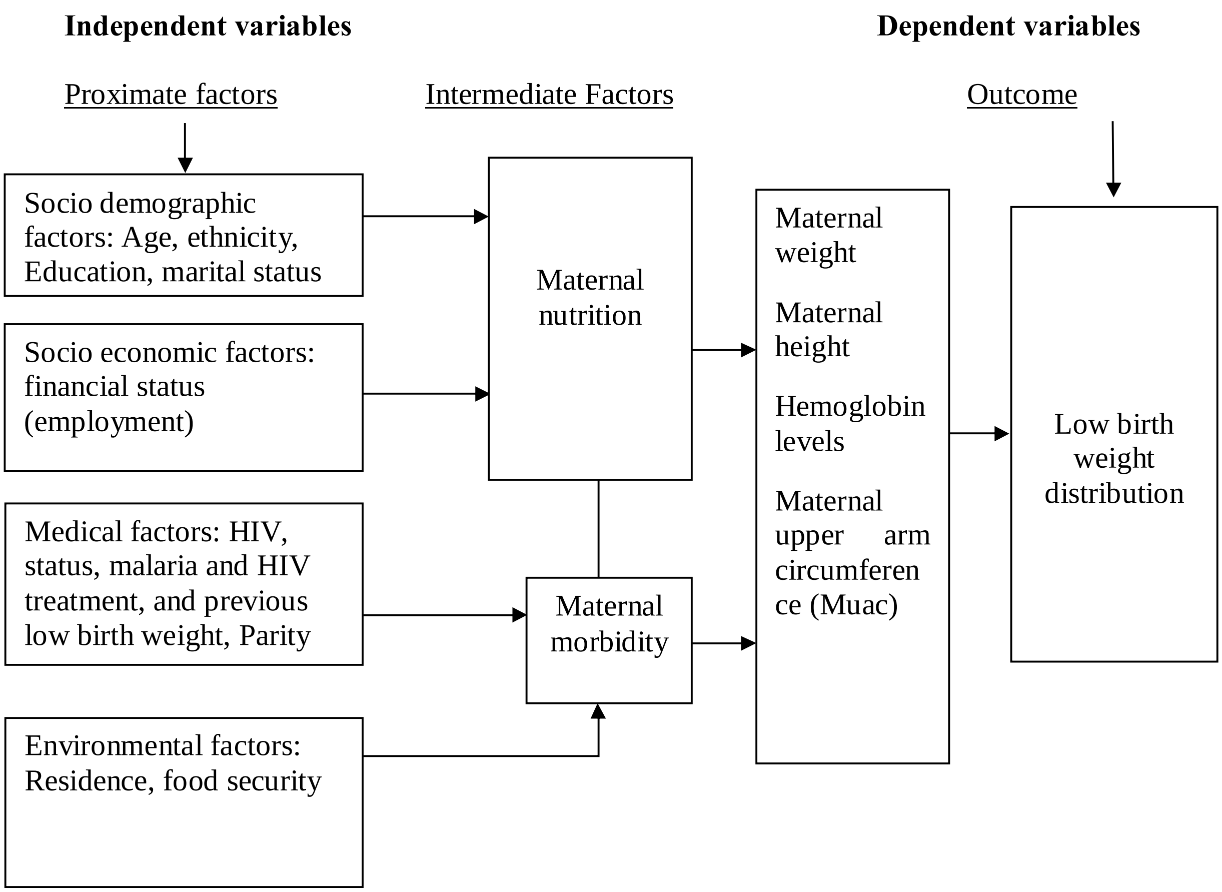


Figure 1.2 Conceptual Framework of Low Birth Weight

Socio-demographic factors such as maternal age, ethnicity, education and marital status (Kleinman and Kessel 1987; Parker JD, Schoendorf, Kiely1994; Barrington 2010) have an influence on birth weight either directly or indirectly. Culture and beliefs that lead to avoidance of certain food plays a role in nutritional status of the mother hence affecting the weight.

Figure 1.3 below illustrates intergenerational cycle of growth failure. A LBW new born is bound to grow into a malnourished teenager with low weight and height unless interventions are put in place. These malnourished teenagers either give birth or eventually grow into small adult women who bear LBW babies. The result is a vicious cycle of malnutrition from generation to generation and the growth of prevalence of LBW. High incidences of LBW occur in areas where there are many underweight women (Mason 1992).

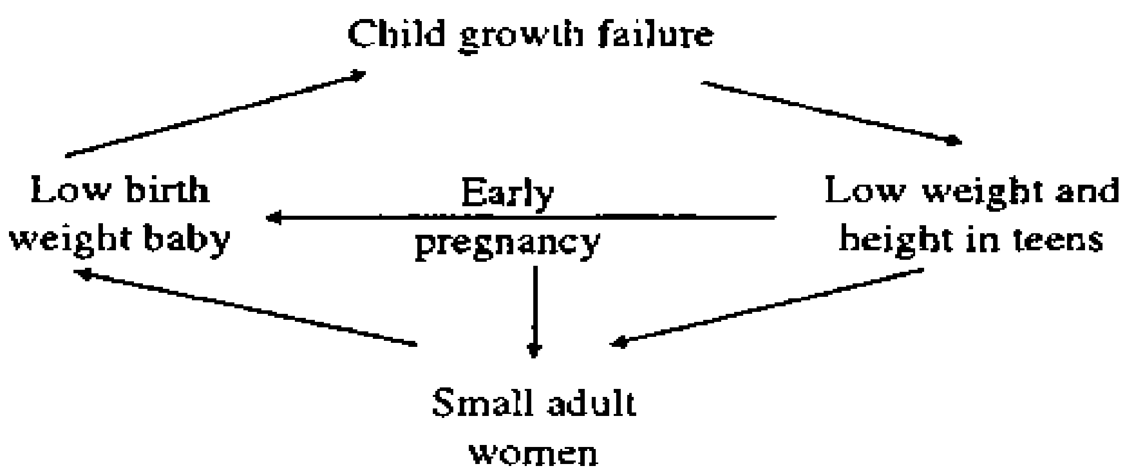


Figure 1.3 Intergenerational Cycle of Growth Failure

(Source: *Second Report on the World Nutrition Situation. Volume I: Global and Regional Results.* ACC/SCN, Geneva: Figure 4.9, p.56 in ACC/SCN (1992))

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Maternal and child health have increasingly over decades, become the spectrum of concern. Globally, there is a decrease in under-five mortality from 12 million in 1990 (You and colleagues 1991) to 6.9 million in 2011. Worldwide, there are around 2.9 million neonatal deaths and this presented the world with a challenge for Millennium Development Goal Four (MDG 4) before 2015 (Lozano and colleagues 2011). It is important to point out that unfortunately, 60-80% of the neonatal deaths are due to low birth weight. Of the 18 million LBW newborns, half are in South Asia and 3.1 million are located in Sub-Saharan Africa (UNICEF (2001). LBW rates have been stagnant from the year 2000 and have presented as a global challenge (UNICEF 2007).

A 2011 report by UNICEF stated that, the proportion of neonatal deaths to under-five deaths globally has increased from 10% in 1990 to more than 40% (UNICEF 2011). Further, You *et al*, reported that the bulk of the children who die under 5 years of age were from Sub-Saharan Africa where 1 in 9 children die (You and colleagues 2012). LBW, malnutrition in children and women as well as micronutrient deficiencies are responsible for about 50% of all under-5-deaths in the world (Ahmed, Hossain and Sanin 2012). Through multiple indicator surveys and demographic health surveys, UNICEF estimated global LBW of 15%, which is equivalent to 20 million newborns born with LBW (UNICEF 2012). Africa as a whole has a low birth rate of 14%; with both Eastern and Southern Africa having 14%, while LBW babies specifically in Kenya account for 10% (UNICEF 2009).

According to the demographic household survey (KDHS 2008-9), the Coast Province has a LBW prevalence of 6.9% of all live births. This is third to Nairobi whose prevalence LBW rate is 7.8% and North Eastern province at 8.2%. In addition, multiple indicators cluster survey in Mombasa prevalence of LBW was at 12% (KNBS 2010). Despite improvements in child mortality, (77 per 1000 live births in 2002 to 52 per 1000 live births in 2007) neonatal mortality only reduced marginally from 33 to 31 per 1000 live births (KDHS 2008-9). Furthermore, in a Kilifi hospital study, the prevalence of LBW (less than 2250g) was 19% (Ross and English 2005).

2.2 Global Studies on Low Birth Weight

Demographic health surveys of 62 countries in 2005 noted that, estimates of the prevalence of LBW are biased downwards (Blanc and Wardlow 2005). Two adjustments were recommended; weighing procedure that combines reported birth weights and mothersô assessment of childôs size at birth and categorization of one-quarter of all infants to have exactly 2500g weight as low birth weight. This helped in the categorizing the LBW in demographic health surveys especially those deliveries that occur at home.

According to the National Vital Statistics Report, the US LBW rate was at 8.15% in 2010. From 1990- 2006, LBW rose by 20% (Martin and colleagues 2012), while in Great Britain LBW rates remained stagnant at 7.2%. A population-based prospective observational study using registries in Kenya, Zambia, Guatemala, and India revealed that, almost half of the infants weighed less than 2500g, most of who died soon after (Belizan and colleagues 2012).

2.3 Studies around Africa

Studies on birth weight vary with regions as this is attributed to socioeconomic factors and environmental factors among others. In Africa, studies focus on the effect of tropical diseases on birth weight in particular malaria (Guyatt and Snow 2004; Steketee and colleagues 2001), HIV (Wei and colleagues) and nutrition as in the rest of developing the world. In support of this, a Malawian study in search of maternal anthropometrical factors associated with fetal growth and birth weight amongst HIV infected women proved that measuring MUAC was reliable and readily available tool for determining LBW in HIV-infected women (Ramlal *et al*, 2012).

In Sudan, maternal BMI was significantly associated with LBW (Adam *et al*, 2008) while in Egypt, maternal BMI investigated along with nutritional intake and hemoglobin levels. Maternal anthropometric measures were found to have a significant positive correlation with neonatal birth dimension. This was more evident in girls than in boys (Hassan, Shalaan & El-Masry 2011). In Malawi, a study to determine the factors associated with LBW using MICS showed that, maternal education and low poverty status predicted LBW in Malawi (Muula, Siziya, Rudatsikira 2011). In Uganda, a study to determine the prediction of LBW in HIV using maternal anthropometric factors whose LBW rate was 19.6, showed that each increase in kg and maternal weight, had 3 times chance of increased weight and, each cm increase in maternal height was associated with 8% less chance to deliver LBW (Young *et al*, 2012).

2.4 Studies in Kenya

Both the Multiple Indicator Cluster Survey and the KDHS reported high mortality rates both in infants (70:1000 live births) and under-fives (91:1000 live births) (MICS 2009 & KDHS 2008- 09). This is still higher than the overall mortality in Kenya according to the KDHS (2008-9). LBW contributes to these high mortality rates and the recorded prevalence of LBW for the whole of Kenya was 10% and Mombasa County was 6.9% respectively as per KDHS (2008-9).

In Meru, Central Kenya, of the 92% births weighed at birth, 7% of infants were estimated to weigh less than 2500 grams at birth (KNBS 2009). In 2004, a prospective and cross-sectional study in Eldoret to determine the mortality rate and causes of all deaths of infants showed that

37.3% of all admissions to the newborn unit were due to LBW (Ayaya *et al*, 2004). While at the Kilifi District Hospital at the Coast, 19% of babies weighed less than 2250g at birth (Ross & English 2005). Similarly, on investigating the quality of hospital care for sick newborns and severely malnourished children in Kenyan district hospitals revealed that 39% of all admissions to neonatal ward were due to LBW (Gathara et al, 2011). In Narok, another investigation also proved that LBW prevalence at 16.4% was higher than the national estimate of 8% and the local estimate of 7.1% in the KDHS (2008-9) (Migwi 2012).

In Kenya like the rest of the world, there have been many studies to determine risk factors for LBW. Malaria in pregnancy was implicated several times to be a common factor for LBW (Alusala & Estambale 2009, Guyatt and Snow 2004, Kassam *et al*, 2007, van Ejik et al, 2004). Furthermore in Mombasa and Kisumu, the treatment of malaria during ANC resulted in a decrease in LBW delivery by 22% (Parise et al, 2003). HIV has also been shown to be a causative to LBW (Musana *et al*, 2009, Obimbo et al, 2004, De Cock et al, 2004) and dual infection of malaria and HIV could increase the risk of LBW (Ayisi et al, 2003). At the Coast Province General Hospital (CPGH), a study aimed at examining the association between maternal and infant HIV infection and LBW showed that HIV mothers were more likely to deliver LBW babies, even after controlling for confounding factors. The study further confirmed that, low birth weight babies had a higher risk for contraction of HIV peri-partum (Mwanyumba et al, 2001). Another study by Inion and colleagues in the same hospital showed that, placental inflammation is associated with adverse obstetric outcomes including LBW babies (Inion et al, 2003). In addition, 19 percent of mothers with syphilis infection in a Nairobi maternity hospital delivered LBW (Gichangi et al, 2004).

Teenage mothers, in a study in KNH, were found to deliver equal numbers of LBW babies as older mothers and Chewing of khat (Catha edulis) was also correlated to LBW (Mwenda et al, 2003). A study in Machakos evaluating maternal weight gain in pregnancy showed low weight gain during pregnancy did not predict LBW in that community (Jahanssen *et al*, 1984).

2.5 Spatial Distribution of Low Birth Weight

The factors that determine the differences in birth weight within populations are not necessarily the same as those, which operate between populations (Barker *et al*, 2006). Spatial analysis assists in improving the effective prevention of LBW birth by informing efficient public health strategies. This approach enables the targeting of interventions within highly affected neighborhoods (Hall 2012). Furher, in support of this, a Namibian study that set out to determine whether LBW and Infant mortality were geographically correlated identified similarities in the spatial pattern in LBW and infant mortality with high risk in Central and Northern parts of the country (Kazembe &Kandala 2015).

Spatial clusters and patterns are mapped to illustrate the variation of LBW. Both Moranõs I. and the Local Indicator of Spatial Association (LISA) statistic methods can be used to predict trends. The race was shown to contribute highly to variations in spatial correlations to LBW (Tiu, Tedders & Tian 2012). In a study which assessed the geographic distribution of LBW in New York State among singleton births using a spatial regression approach in order to identify priority areas for public health actions, low birth weight showed statistically significant auto-correlation in the study area (Moran's I 0.16 p-value 0.0005). The proportion of LBW was higher in areas with larger Hispanic or populations and high smoking prevalence. It was concluded that ñSmall-area analyses of LBW can identify areas for targeted interventions and display unique local patterns that should be accounted for in prevention strategiesò (Insaf &Talbolt 2016).

Another study in Southern India was done to examine the spatial distribution of LBW and the role of maternal socioeconomic and environmental factors using Getis-Ord Gi hotspot analysis tool in ArcGIS 10. Spatial analysis to identify statistically significant spatial clusters showed that ten villages had high spatial clustering of LBW (Francis et al, 2012). Several studies have been done using the GIS systems to determine the hotspots for LBW in Korea (Ha *et al*, 2006) and Iran (Shakiba *et al*, 2008). Further, in Brazil, a spatial analysis of neonatal mortality and associated factors proved that, mortality was profoundly associated with LBW (Goncalves *et al*, 2011).

Similarly, a study that investigated the spatial inequality of LBW in Brazil identified higher rates of low birth weight were found in the south/southeastern states (Global Moran: 0.267, $p = 0.02$). Clusters of the high-high type in the Southeast and of the low-low variety in States in the Amazon region are detected. The inequality in the distribution of low birth weight reflects the socio-economic conditions of the States. More developed regions had higher rates of LBW, therefore, the presence of the service and its use decreased infant mortality and increased LBW (Lima et al, 2013).

Another study in Brazil analyzed the spatial distribution of low birth weight (LBW) in the State of Sergipe, Brazil, between 1995 and 1998 using cluster analysis, correlation analysis, multiple regression analysis and multiple comparisons. The results showed grouping similarities in the municipalities' health districts from the cluster analysis. Spatial occupation patterns influenced the descending trend of LBW in the area. The study also concluded that the percentage of LBW is a useful indicator of individual risk, but as a collective health indicator, it does not appear capable of expressing differences between regions that do not display strong inter-variability (Gurgel 2005).

Kent et al, (2013) also studied area-level risk factors for adverse birth outcomes and examined trends in urban and rural settings. Their study showed that LBW rates had decreased in general. However, the isolated rural region had increased trends in adverse birth outcomes including LBW. It was concluded that, densely populated urban areas had higher rates of adverse birth outcomes. High-poverty African areas have higher odds of adverse birth outcomes in urban versus rural regions. The study also concluded that, trends in preterm births and LBW suggest interventions that have decreased adverse birth outcomes elsewhere may not be reaching isolated rural areas.

2.6 Risk Factors of Low Birth Weight

In Santiago Chile, in a study to define the risk factors for LBW and IUGR, eight variables showed association with low birth weight. The factors included: parity, previous history of a bad outcome, previous low birth weight, maternal weight during pregnancy, number of ANC visits, the month of first ANC visit, smoking, and intra-hepatic cholestasis of pregnancy (Vega *et al*, 1993). In Nepal, a study examining the risk factors of LBW retrospectively showed that, of the 306 eligible samples 26% were born with low birth weight. The associated risk factors were attendance to ANC, maternal level of education and maternal age was most profound (Yadav, Chaudhary, Shrestha 2011). Where-as in India, LBW was anticipated by maternal weight/age combination, educational level, and income group (Karim & Mascie-Taylor 1997). A cross-sectional study within a hospital in Qatar also confirmed that low socioeconomic status, maternal age (more than 35 years), maternal education (those not educated up to tertiary level) and maternal occupations (homemakers) were prone to more risks for both the mother and fetus (Bener *et al*, 2012) leading to low birth weight.

During the research period, in Taiwan, it was reported that LBW was more common in teenagers (less than 20 years), older (more than 30 years), first time, unmarried mothers, those with basic educational attainment and residents of aboriginal districts (Li and Chang 2005). In Nigeria, teenagers also predominantly delivered LBW babies. However, the study suggested that, if the prenatal care were given to teenage mothers, the outcome would be the same as in older mothers (Oboro *et al*, 2003). Monitoring Body Mass Index (BMI) and weight gain during pregnancy were found to be a useful procedure for establishment of the nutritional intervention aimed at reducing maternal and fetal risk in Brazil (Goncaves *et al*, 2012).

In Moshi Tanzania, mothers without formal education were 4 times more likely to give birth to LBW neonates than those who had attained higher education. There was a linear decrease in low birth weights of newborns as paternal educational level increased and there was no statistically significant difference among parentsô occupations regarding LBW of their newborns. Unmarried mothers were more likely to give birth to LBW (OR 1.65; 95%CI=1.2-2.2) (Siza 2008).

2.7 Maternal Nutritional Factors and Low Birth Weight

Low birth weight is also an indicator of maternal health status that could include maternal nutrition, ill health and poor pregnancy health care (Wardlaw et al, 2004). Maternal weight, height, and BMI were cited as predictors of LBW (Moss and Chugani 2014; Mohanti *et al*, 2005). Furthermore, Ojha and Malla (2007) found that, in their study maternal weight of less than 45 kg had 3 times more likelihood of delivering a LBW baby than those with normal weight. In support of this, a community-based cohort in Karnataka, India whose prevalence of LBW was 29% showed that, maternal weight of less than 45 kg at gestation was found to have a causal effect in delivering LBW newborns (Metgud *et al*, 2012).

Further, a study in Sri Lanka of maternal BMI also supported this theory; illustrating that maternal weight less than 50.4kg on their first visit (13 weeks), and BMI were strong predictors of low birth weight in the population studied (Jananthan *et al*, 2009).

Karim & Mascie-Taylor (1997) also saw in a population they studied in Dhaka Bangladesh that a maternal weight lower than 50 Kg is a predictor of LBW. In India, Mumbare (2012) showed that, maternal height and maternal pre-delivery weight amongst others were good predictors of low birth weight. With reference to maternal MUAC in Ethiopia, women with MUAC of less than 23cm had more LBW babies than those with MUAC of more than 23cm (Nega *et al*, 2012). In contrast, a North Indian study population which was studied showed that mothers whose weight was <40 prior to pregnancy and had a BMI of more than 19.8 favored good obstetric outcome. The study also established that, hemoglobin of 7g/dl or more also favor good outcome (Kumar, Chaudhary and Prasad 2010).

2.8 Infections and Low Birth Weight

Malaria during pregnancy has been reported previously to be a determinant of intra-uterine growth retardation (IUGR) (Kramer 1987). A study analyzing 32 cross-sectional datasets in Africa showed that, provision of mothers with ITNs significantly lowered the risk of neonatal mortality. The study further showed pregnant mothers who did not have protection against malaria including intermittent preventive therapy in pregnancy and insecticide-treated nets had a significant association with LBW (Eiselle and colleagues 2012). A Colombian cohort study on malaria infection in pregnancy confirmed that, gestational malaria was associated with increased risk in LBW (Tobon ï Costano, Solano, and Sanches Trujillo 2011). Malaria in pregnancy has been implicated to be a common factor for LBW (Alusala & Estambale 2009, Guyatt and Snow 2004, Kassam and colleagues 2007, van Ejik and colleagues 2004).

In Nigeria a study investigating the co-morbidities of neonates born with malaria, LBW prevalence was found to be 29.3% (Yilgwan, Hyacinth, and Oguche 2011). Hypertension, pre-eclampsia, and eclampsia are predominantly (46.67%) associated with LBW, schistosomiasis was also largely associated with (33.33%) of LBW babies. High prevalence of LBW also resulted from mothers who were diagnosed with anemia (25%), thromboembolic diseases (20%), tuberculosis (17%) and malaria (14.8%). Gestational conditions including Premature rupture of membranes (38%), placenta previa (17%) and abruption of the placenta (15.5%) also contributed to the outcome. The infants in this cohort were mostly born at 37 weeks (OR = 2; CI=1.5, 2.8) (Siza 2008).

A cross-sectional study done to assess the risk of adverse outcome of pregnancy between women with and without pneumonia showed a higher risk of LBW, preterm and low APGAR score (Chen and colleagues 2012). Meanwhile, a study in Birmingham, Britain, established that, mothers with tuberculosis were more likely to have babies also infected with tuberculosis who were much more lighter (Asuguo and colleagues 2012). Besides, studies have shown HIV as a factor that increases the prevalence of LBW (Musana and colleagues 2009, Obimbo and colleagues 2004, De Cock and colleagues 2004). In addition, a study in the Coast Province General Hospital (CPGH) confirmed that, HIV-infected mothers were more likely to deliver LBW babies (Mwanyumba and colleagues 2001).

2.9 Maternal Habits and Low Birth Weight

Studies have proven the relation of birth weight to maternal smoking (Horta and colleagues 1997; Sram and colleagues 2002; Suzuki and colleagues 2008). Andres and Day suggested that maternal smoking is responsible for 20-30% of all infants of low birth weight and a 150% increase in overall prenatal mortality (Andres and Day 2000). However, a study by Lundsberg, Bracken, and Saftlas showed that for alcohol consumption during pregnancy, LBW is not a useful neonatal outcome due to the heterogeneous mix of preterm delivery and IUGR (Lundsberg and colleagues 1997).

2.10 The effect of Air Pollution on Low Birth Weight

Several studies have shown causality of air pollution to birth weight (Rosner and colleagues 2011; Bell and colleagues 2010; Parker and colleagues 2005; Lee and colleagues 2003). Biological mechanisms have been studied to show that pollution affects the growth of the fetus, premature births and low birth weight (Sram and colleagues 2005).

In China, a community-based cohort study revealed that higher levels of total suspended particles and sulfur dioxide (SO_2) appeared to contribute to preterm births (Xu and colleagues 1995). SO_2 and total suspended particles have both been culprits of LBW and prematurity; more so SO2. This was especially true when exposed to these pollutants during the first trimester (Bobak 2000).

During pregnancy, exposure to fine particulate matter of less than or equal to 2.5 microns in diameter is associated with the reduction of birth weight by 140.3g, length by 1.0 cm and head circumference by 0.5 cm (Jedrwiski and colleagues 2004). When environmental pollutants are tested in pregnant mothers who have been exposed, results show that there is a quite significant transplacental transfer of polyromantic hydrocarbons (PAH) and WBC PAH-DNA adduct levels increased with exposure to environmental exposure to PAH from ambient pollutants. Children born under such circumstances had decreased birth weight ($p= 0.05$), birth length ($p= 0.02$) and head circumference ($p= 0.0005$) as compared to the newborns with lower adducts ($n= 135$) (Perera and colleagues 1999). Risk of preterm was found to be 25% higher with exposure to nitrogen dioxide (NO_2) and LBW increased with increasing formaldehyde exposure (Maroziene and Grazuleviciene 2002).

In Valencia Spain, maternal exposure to air pollution in pregnancy was assessed. NO_2 was found to reduce birth length to 0.27 cm and birth weight to 40.3g during the first trimester. The rest of the pregnancy had a reduction in birth length of 0.17 cm proving that air pollution has an effect on fetal growth (Ballester and colleagues 2010). Fugitive emissions of Volatile Organic Compounds at some refueling stations in two Metropolitan cities of India, Mumbai and Delhi were studied. It showed that, in Delhi refueling emissions are major sources of Volatile Organic Compounds besides diesel combustion engines. Meanwhile in Mumbai, evaporative emissions were found to be the major contributors of Total Volatile Organic Compounds concentration in ambient air (Srivastava and colleagues 2005).

In Los Angeles, California in an effort to prove that traffic exhaust results in LBW (including both long-term local exposures and short-term regional exposures) a study was carried out that showed that, mothers residing in Los Angeles who delivered at term had greater odds of delivering a low weight baby when exposed to higher levels of traffic exhaust pollutants in the third trimester (Ghosh and colleagues 2011). In Sweden, pregnant mothers who were exposed to NO2 via traffic emissions during the first trimester delivered preterm or short gestation whereas second-trimester exposure resulted only in short gestation. High exposure to NO2 during last week of gestation was associated with preterm delivery and shorter duration of gestation (Olsson and colleagues 2012).

In Orange County, California, the effects estimated for vehicle emissions were compared with pre-eclampsia, preterm birth, and very preterm birth. The study concluded that traffic air pollution is associated with adverse outcomes regardless of exposure assessment (Wu and colleagues 2011). Further, a cohort study of traffic-related air pollution impacts of birth outcome in Canada illustrated that LBW was associated with living approximately 50 meters from the highway (Brauer and colleagues 2008).

2.11 Consequences of the Low Birth Weight

Low Birth Weight is the root of many diseases and conditions in later stages of life (Danton Hill and colleagues 2004). In fact, LBW seems at least an indicator for poor health outcomes in adulthood if not an independent predictor in its own right. Besides contributing to high mortality, morbidity, and disability in neonates, infancy and childhood, LBW has a long-term impact on health outcomes in adult life. The financial burden to the family, community, health sector and society as a whole is profound (WHO 2005).

Barker and colleagues (2003) reported that the causes of LBW between populations and within populations differed. He concluded that there is need to determine the nature of the factors that contribute to poor growth and development before birth, both within and between populations; and the extent to which they are amenable to specific interventions. Based this theory, LBW causes cannot be the same as in Nairobi as they are in Mombasa. Children who were born as LBW have been seen to have less intellectual ability as adults than their normal weight counterparts. Lower IQ, slower learning capabilities and lower grades are some of the consequences related to LBW infant (Hack and colleagues 2002). LBW newborns also have stunted growth (Christian, 2009). Further Low Birth Weight is prone to failure to thrive and poor attainment of developmental milestones (Mbuya, Mduduzi, Chideme, Chasekwa, and Mishra (2010). Furthermore, a mother born LBW is more likely to give birth to offspring with low birth weight especially girls (Victoria and colleagues 2008). The cycle then repeats itself producing adults who are less productive and children who become a burden to society as a whole.

During the research period, in South India researchers who examined the metabolic effects of LBW after 20 years showed that the men born with LBW were lighter, shorter had reduced BMI and had an increased diastolic blood pressure (Thomas and colleagues 2012). Children who were born LBW due to under nutrition are known to develop stroke, hypertension and diabetes Mellitus type 2 later on in life (Järvelin 1998).

2.12 Summary and Critical Analysis of the Reviews

In this chapter, literatures related to this study were reviewed. The studies showed different factors that result in LBW babies. From the literature reviewed, it showed that spatial analysis could be useful in indicating óhotspotsô of LBW and to analyze factors in relation to this outcome. Tiu, Tedder, and Tien (2012) stated that ñThe identification of spatial patterns of LBW prevalence is a critical first step in a more complete understanding of the epidemiology of this public health challenge and these techniques are instrumental in designing valid observational and analytical studies to more fully study the problemò. Barker and colleagues (2006) support these facts when he said that the different populations have different causes of low birth weight.

Studies in Georgia (Tiu, Tedder and Tien 2012), Iran (Shakiba and colleagues 2008) used retrospective birth records to map out the low birth weights in different areas. They all revealed that the maternal risk factors were associated with areas the mothers were living. In regards to the maternal factors, BMI, pre-pregnancy weight (Jananthan et al 2012) and weight at term (Olga and Mala 2007), were suggested as some of the predicting factors of low birth weight. With interests to this dispute, it is necessary to investigate whether the weight at first ANC visit will suggest a prediction in the community in Mombasa.

It is clear that, studies regarding LBW in Mombasa County are scarce. With the difficulty in achieving MDG 4, the government needs to identify areas with the need for change. With this in mind, the researcher found it necessary to locate these infants and investigate maternal factors associated with this outcome.

2.13 Research Gap

From the literature, LBW accounted for 60-80% of neonatal deaths globally. Meanwhile, 20 million babies are born with LBW confirming a public health problem that has been recognized for decades. Despite the knowledge of the contribution of LBW to infant mortality (Mc Cormick 1985), child reduction strategies in children in this regard have not been addressed (Shrimpton 2003).

The Kenya Demographic Health Survey (2007-2008) revealed that in Kenya 10% of the live births were LBW. Migwi (2012) challenged that the percentage of LBW in Narok was not as quoted by the KDHS 2008-9. The KDHS 2008-9 also quoted that LBW in the Coastal Province was 6.9%. In addition, Ross and English study in Kilifi District Hospital revealed that the prevalence of LBW was 19% confirming that these figures were not applicable in the areas of data collection. In addition, MICS in Mombasa revealed that the LBW was 11.6% (KNBS 2009), raising the question: is LBW prevalence for the Coast Province given in the KDHS 2008-9 the same as in Mombasa county?

Kramer and colleagues (1987) stated that several factors in the maternal environment favor the likelihood of LBW birth. Maternal nutrition plays a crucial role in influencing fetal growth and birth outcomes. It is a modifiable risk factor of public health importance in the effort to prevent adverse birth outcomes, particularly among developing/low-income populations (Abu-Saad and Fraser 2010). The risk for delivering LBW in mothers who were HIV positive in Mombasa was also illustrated by Mwanyumba and colleagues (2001) when they examined the relationship between maternal HIV infection and infant and LBW in CPGH retrospectively. In a sentinel site survey, HIV prevalence in pregnant women in Mombasa was 6.0%, which is the second highest in the province (MOPHS and MOMS 2010).

Similarly, Parise and colleagues (2003) illustrated that, in Kisumu as well as Mombasa, prevention of malaria in a pregnant mother improved pregnancy outcome in reference to low birth weight. Feiko and colleagues (2003) also illustrated the same in western Kenya. There is a push to encourage pregnant mothers to visit ANC at least twice. In Kilifi, a study showed three visits were protective and avoided bad outcomes (Brown and colleagues 2008). They also showed the relationship of level of education to ANC visits stating, ñThe women with secondary education or above were more likely to attend for ANCò. With all these facts in mind, the question came into the researcherôs mind: where are these low birth weights in Mombasa County and what are the common factors influencing their geographical distribution?

CHAPTER THREE

METHODOLOGY

3.1 Study Area

Mombasa County is the second largest county in Kenya measuring 219 km^2 at the Coast Province of Kenya (KCFS 2011). It lies at 4° 3' 0" South, 39° 40' 0" East. The population in Mombasa at the time of the study was 939,370 with a population density of 4292 people per km^2 according to the Kenya County Fact Sheet (KCFS 2011). Mombasa County has five sub-counties: Changamwe with population of 250,179, Kisauni 194,065, Likoni 166,008, Mvita 143,128, and Nyali 186,990 respectively. The percentage of fully immunized at < 1 year is 72.5% and malaria diagnosis was 31.5%. At least 68.9% of deliveries took place in the hospitals.

This study was carried out in four public health facilities representing each sub-county. These included Coast Province General Hospital, Likoni Sub County hospital, Port Reitz Sub County hospital and Tudor Sub County hospital. These health facilities represent each geographical sub-region by merit of an average number of live births per month.

3.2 Study Design

The study design used in this study was a descriptive cross-sectional study conducted at four health facilities in Mombasa County.

3.3 Study Population

The study population involved mothers delivering live births in hospitals for three months in Mombasa County, Coast of Kenya.

3.4 Sample Size Determination

Low birth weight is a subset of total live birth, which is a continuous event and is not measurable (i.e. infinite). Therefore, a sample collected at any period is representative of a population. In addition, it was not predictable when a LBW neonate will be born. Nevertheless, to calculate the minimal sample size required for this study a formula was used.

The prevalence used was (6.9%) from the KDHS 2008-9, which was most appropriate and applied to the population in question. In statistics, a proportion of 10% and less is regarded as a rare occurrence.

$$N = \frac{Z^2 \times P\,(1-P)}{d^2}$$

Where N = sample size

Z = level of confidence

P = proportion of low birth weights in coast province = 6.9% (KDHS 2008-9)

d = product of reliability coefficient

The minimum number of participants required = 100.

Due to the complexities explained, this study included all live births who were delivered in 4 public health hospitals between 1st July 2013 and 30th September 2013.

3.5 Variables

The dependent variable/outcome for the study was Low Birth Weight. The independent variables were: Residence, Maternal Weight, Maternal Height, Gravidity, Tribe, Religion, Maternal HIV Infection, HIV Medication, Maternal Education Level and Occupation.

3.6 Sampling

3.6.1 Sampling Frame

Participants were drawn from a list of 50 health facilities offering delivery services in Mombasa County. This was obtained from Ministry of Health Information Systems Department (Cheburet 2012 unpublished).

3.6.2 Selection of Study Sites

There were 50 public health facilities providing delivery services in Mombasa County in 2013. Since LBW is a rare event in this population, a large sample size was needed to represent the population. This research was restricted to three level 4 hospitals and one level five hospital because of logistical issues associated with traveling and training of Research Assistants. Hospitals were then chosen within each division on merit of the number of live births using purposeful sampling (See appendix 11). These hospitals were Coast Province General Hospital (for Mvita, Nyali and Kisauni Districts), Likoni Sub County Hospital (for Likoni District), Port Reitz Sub County Hospital (for Changamwe district) and Tudor Sub County Hospital (a proxy for Mvita district).

3.7 Selection of Study Participants

An all-inclusive sample of mothers delivering in the selected hospitals (depending on those who gave consent) was used. The mothers came for delivery randomly, therefore, assuring randomization. During the study period, all mothers who had delivered were approached and upon consent, the Research Assistants administered the interview.

3.7.1 Inclusion Criteria

a) Mothers living in Mombasa during pregnancy for more than 4 months

b) Mothers of gestational age of more than 28 weeks

c) Single pregnancy

d) All deliveries including those who delivered at the healthcare facility and before arrival to the healthcare facility

3.7.2 Exclusion Criteria

a) Mothers not living in Mombasa during pregnancy less than 4 months

b) Mothers of gestational age of less than 28 weeks

c) Multiple pregnancies

3.8 Research Instruments

Structured questionnaires (Appendix 3 &5) with the following sections were used:

Section 1- Bio-data: information of age, residence (up to ward level), marital status, religion, ethnicity, occupation, and monthly household income.

Section 2-Assessment of risk factors: level of education, employment during pregnancy, parity, gestational age, previous delivery of low birth weight, multiple pregnancy, presence of antenatal care during pregnancy, number of times of ANC attendance during the pregnancy, treatment for malaria during pregnancy, HIV status and positive treatment with HIV meds.

Section 3-Assessment of nutritional status of the mother:

- Maternal weight was recorded from ANC book during the first visit.
- Maternal height was measured using a standardized Height board
- Maternal MUAC was measured using a standard dressmakersô tape during the interviews.
- The gender and weight of the newborn were recorded.

Upon consent, the Research Assistant administered the questionnaires to mothers on discharge and took anthropometric measures of both mothers and babies. Of importance were: the residence during pregnancy (residence, up to the ward level was noted), weight and height. At delivery, babies were weighed and their respective weights noted.

3.9 Collection of Data

3.9.1 Recruitment and Training of Research Assistants

Research Assistants were Clinical Officers who were recruited from the respective health facilities and trained on the sampling methods, data collection and data collecting tools. Emphasis was made on the accuracy of transfer of responses to data tool and measurements.

3.10 Minimization of Errors and Biases

All mothers attending the hospital for delivery were recruited ensuring large sample size. Mothers who came to the hospital for delivery were not pre-chosen therefore ascertaining randomization and minimizing sampling errors. During the collection of data, the assigned supervisor for each hospital supervised coordination and conduct in the study to reduce non-sampling errors.

In addition, questionnaires were tested in a pilot study at Shanzu Health Center prior to the actual study to assess the questionnairesô efficacy. Adjusted questionnaires were filled and were reviewed with Research Assistants at the end of each day for completeness and accuracy. In addition, maternal height and MUAC were measured twice and the average recorded to minimize errors.

3.11 Study Limitations

The data for this study was collected from public level 4 and level 5 hospitals; deliveries that took place in private institutions within the community were not collected due to resource constraints. This may have resulted in under-reporting. The study also depended on mothers' knowledge and information of where she lived during the pregnancy. Since the new constitution divided Mombasa into different wards, some mothers were not aware of these wards. However, to elicit the accurate geographical bearings mothers were asked their locations which were used to identify the wards at which they had resided during the pregnancy reducing the risk of misinformation.

Complete case analysis was conducted and there was no attempt to manipulate the missing data. However, less than 1% of the data for a given factor that was considered in the analysis was missing and did not significantly bias the findings.

3.12 Assumptions of the Study

In this study, the maternal hemoglobin and weight measurements were taken during antenatal visits by hospital staff who assumed to have been recorded measurements accurately. It was also assumed that hospital equipment used to take these measurements were equally standardized and calibrated and Research Assistants recorded the response to the questionnaires to precision.

3.13 Data Processing and Analysis

3.13.1 Quantitative Data Analysis

Data was entered, checked and cleaned using SPSS version 17.0. Associated factors of LBW were assessed using odds ratio. Low birth weight was noted according to occurrence and residence and mapped out. Pie charts and bar graphs were used to interpret data.

3.13.2 Spatial Data Analysis

Spatial distribution is the physical location of data across space. A geographic information system (GIS) allows one to visualize, question, analyze, and interpret data to understand relationships, patterns, and trends. The Mombasa county map was developed using Arc map 10.2 and individual ward prevalence was calculated using SPSS and translated into the map to show the areas where high prevalence was noted.

The spatial distribution of LBW hotspots was illustrated by utilizing different color shadings in different categories of LBW prevalence on the Mombasa map. This illustrated high spatial clustering in various wards. The categories used were red which was equivalent to 20%, pink less than 15%, orange less than 10% and green 0 (zero) LBW. The ones with no shading meant no data was available.

3.14 Ethical Considerations

Approval to conduct the study was sought from Kenyatta National Hospital and the University of Nairobi Ethics and Research Committee (Appendix 1), Ministry of Health, Kenya, Mombasa County Government and the Mombasa County Hospitals which was granted. The researcher also obtained the informed consent of the participants in which case, they were assured of confidentiality. The names of the participants were kept anonymous during data collection and throughout the data processing exercise and publication. All the participants in the study were informed of the right to withdraw from the study or to request that the data collected about them not be used and to get access to the report of the findings.

CHAPTER FOUR

RESULTS

4.1 Introduction

One thousand four hundred and seventy five (1,475) mothers who delivered in the selected hospitals were recruited in this study with a 100% response rate. Of these, only 1,349 mothers met the eligibility criteria and were enrolled in the study. Exclusions included mothers who did not live in Mombasa during the pregnancy for at least 4 months during the pregnancy (79); those who delivered before 28 weeks of gestation (10) and those who had twin deliveries (13).

Twenty-eight (28) questionnaires were incomplete.

A total no of 1399 participants were interviewed in Coast Province General Hospital (734), Port Reitz Sub County Hospital (326), Tudor Sub County Hospital (125) and Likoni Sub County Hospital (214). Out of the 1399, only 1349 lived in Mombasa for more 4 months and were included in the analysis.

4.2 Socio-demographic Characteristics of Study Participants

4.2.1 Distribution by Residence (Districts)

Out of the total number of (1349) who lived in Mombasa county, 26.7% in Kisauni, 25.4 % lived in Likoni, 21.0% in Changamwe, 10.7% in Nyali,10.7% lived in Jomvu and 5.6% lived in Mvita (table 4.1).

Table 4.1: Maternal Distributions by Sub County Residence in Mombasa County

Residence	Frequency	Percentage
Mvita	75	5.6
Likoni	342	25.4
Nyali	145	10.7
Kisauni	360	26.7
Jomvu	144	10.7
Changamwe	283	21.0
Total	1349	100

4.2.2 Maternal Age Distribution

Mothers who were eligible for this study ranged from14 to 48 years of age. The average age was 25.1 years (SD 5.0years). Most mothers (71.7%) were aged between 20-29 years (see Fig 4.4).

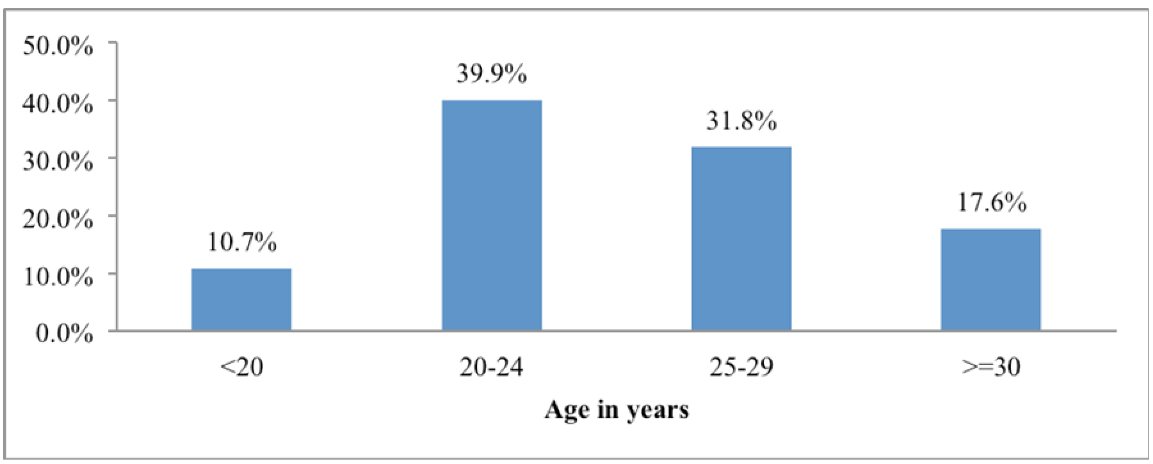


Figure 4.4: Participants Age Distribution

4.2.3 Marital Status

In this study most participants were married (89.5%) while only 9.3% were single; 0.1% were divorced; 0.8% separated and 0.2% were widowed as shown in Table 4.2 below.

Table 4.2: Marital Status

Marital status	Frequency	Percent
Single	126	9.3
Married	1208	89.5
Separated	11	0.8
Divorced	1	0.1
Widowed	3	0.2
Total	**1349**	**100**

4.2.4 Religious Affiliation of Participants

Most participants were of Christian faith (71%), 387 (28.7%) of Muslim faith and only four (0.3%) practiced traditional customs.

4.2.5 Ethnicity

The ethnic distribution of the mothers was assessed and showed that 34.8% were Mijikenda, 16.5% Kamba, 10.5% Luo, 10.2% Taita, 8.7% Luhya, and 7% were from the Kikuyu community. Those who belonged to the Kisii community comprised of 2.9%, Swahili 2.5% and Meru 2.4% (see fig 4.5).

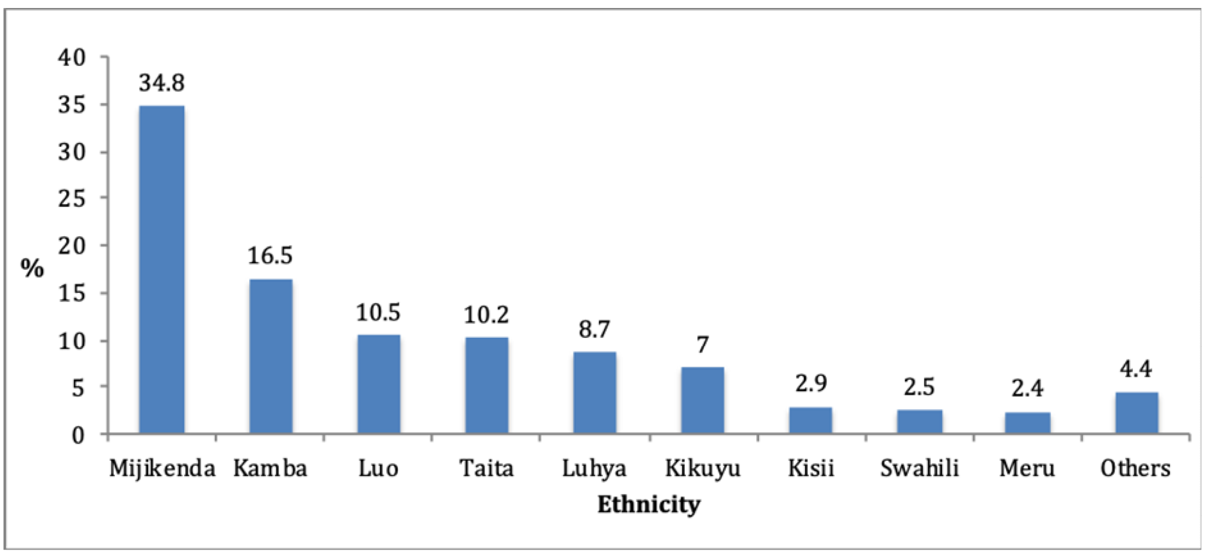


Figure 4.5: Participants by Ethnic Distribution

4.2.6 Employment

Majority of the study population were unemployed (67.4%) while 18.9% (255) were self-employed, 13.4% (181) were formally employed and 0.3% (4) of the mothers were still students (Fig 4.6).

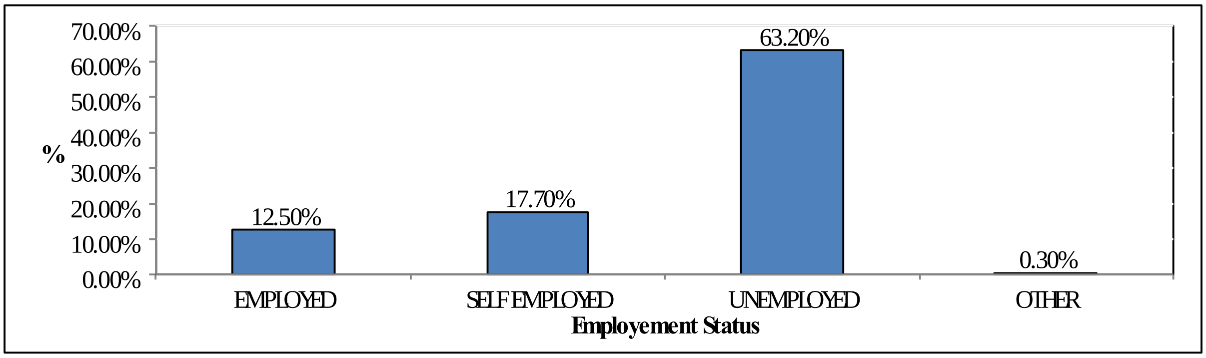


Figure 4.6: Participants Employment Status

4.2.7 Household Income

Economic status was determined by the household income; slightly more than half (58.8%) earned less than 5,000 Kenyan shillings Kshs (USD 58) per month, while 26.8% earned up to USD 117 (5,000-10,000 Kshs), and 7.7% between 10,001 and 20,000 Kshs, 1.9% between 20,001 and 30,000 Kshs and 1.1% earned more than Kshs.30,000.

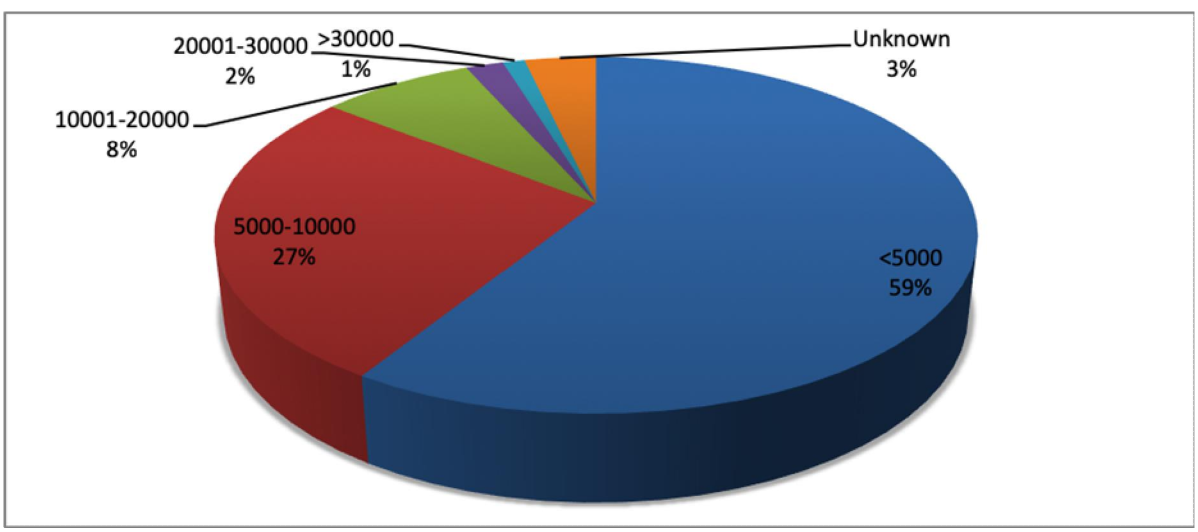


Figure 4.7: Monthly Household Income

4.2.8 Maternal Education

A little more than half 51%, (674) of the participants had achieved a primary school education, while 33.4% (450) were educated up to secondary level and only 9.7% (134) had a tertiary education; During the period of the study only 5.6% (75) had not attended school at all and1.3% (16) went for vocational classes after primary school (Table 4.3)

Table 4.3: Maternal Education (n=1349)

Level of Education	No. of Participants	Percentage
None	75	5.6
Primary	674	50.0
After primary (Vocational)	16	1.4
Secondary	450	33.4
University	134	9.9
Total	1349	100

4.3 Pregnancy Related Characteristics

According to the dates reported from the antenatal cards and mothersô recollection, most deliveries 91%, took place at 28 - 36 weeks of gestation classifying them as preterm deliveries. Most participants (56.8%) had also reported a previous delivery and 43.1% reported that this was their first delivery. During the research period, almost all mothers (99.8%) reported to have attended antenatal care clinics (ANC) during the current pregnancy; out of which 81.7% reported attending more than once, 12.5% twice and 5.8% more than twice. Further, first attendance to ANC clinic were mostly during the second trimester (65.3%), 21.1% in the third trimester and only 13.1% during the first trimester.

Malaria during pregnancy was reported by 27.8% of the participants and with regard to HIV testing, only three (3) mothers were not tested for HIV while those who were tested showed a HIV prevalence of 6.2% (84) of whom 69 (78.6%) were on HIV treatment. History of LBW in previous deliveries was reported among 9.0% of the mothers while maternal hemoglobin (Hb) levels prior to delivery ranged from 5g/dl to 16.4 g/dl with an average Hb of 10.34 g/dl (+/- 2.83). Majority of the mothers in this study (70.3%) had a Hb $\leq$11 g/dl.

Table 4.4: Participants' Health-related characteristics in Mombasa County

Variable	Number (%)
Previous delivery (n=1349)	
Yes	766 (56.8)
No	583 (43.2)
Birth order (n=1349)	
1st	581 (43.1)
2-3	602 (44.6)
4-5	145 (10.7)
More than6	21 (1.6)
Gestation (n=1349)	
28-36 weeks	1234 (91.5)
>36 weeks	115 (8.5)
ANC attendance (n=1349)	
Yes	1346 (99.8)
No	3 (0.2)
Frequency of ANC attendance (n=1346)	
Once	78 (5.8)
Twice	168 (12.5)
More than twice	1100 (81.7)
First attendance to ANC (n=1346)	
1st trimester	183 (13.6)
2nd trimester	879 (65.3)
3rd trimester	284 (21.1)
Treated for malaria (n=1349)	
Yes	375 (27.8)
No	974 (72.2)
HIV testing(n=1349)	
Yes	1346 (99.8)
No	3 (0.2)
HIV results (n=1346)	
Positive	84 (6.2)
Negative	1262 (93.8)
HIV treatment (n=84)	
Yes	66 (78.6)
No	18 (23.3)
Previous delivery of LBW (n=1326)	
Yes	122 (9.0)
No	1204 (89.3)
Maternal hemoglobin g/dl (n=1304)	
<11.0	917 (70.3)
More than 11.0	387 (29.7)

4.4 Maternal Anthropometric Measures

Motherôs weight was also recorded from the ANC book during the first ANC visit; only 18 mothers lacked weight measurements. The weight range of this study population was between 36.9 kg and 153 kg with the average weight of 64.4kg (+/-12.2 Kg) with majority (62.2%) weighing between 55 kg and 74.9 Kg.

Maternal height was measured during the interview; 11 mothers were not measured due to severe illness. The mothersô height ranged between 140cm and 180cm with an average height of 159.9cm (SD ±6.8 cm). Majority (69.8%) measured between 155cm and 169.9cm tall (Table 4.5). In addition, maternal BMI was calculated which ranged from 14.4Kg/m^{2}and 59.8 Kg/m^2 with average of 25.2Kg/m^2 (SD± 4.6 Kg/m^2). Though more than a half (52.2%) of participants were of normal BMI, 31.7% were overweight and 13.3% were obese. During the study period maternal MUAC was 27.2cm with most mothers MUAC measuring 27cm (Table 4.5).

Table 4.5: Participants Anthropometric Measures

Variable	Number (%)	Mean	SD
Maternal height (cm)		159.86	±6.75
140-154.9	277 (21.0)		
155-169.9	921 (69.8)		
170-184	121 (9.2)		
Mean **maternal weight (Kg)**		64.37	±12.21
35-54.9	266 (20.2)		
55-74.9	821 (62.2)		
75 and above	232 (17.6)		
Mean **maternal BMI**		25.2	±4.6
Underweight	37 (2.8)		
Normal	689 (52.2)		
Overweight	418 (31.7)		
Obese	175 (13.3)		
Maternal MUAC (cm)		27.12	±3.61
>23	111 (8.3)		
<23	1229 (91.7)		

4.5 Characteristics of Newborn Babies

There were 1,349 newborns during the study period, of whom 694 (51%) were male and 655 (49%) female with a ratio of 1:1. Most newborns (91.5%) were born at 28-36 weeks of gestation (preterm) while 8.5% were born at term (>36 weeks). Only 2 newbornsô weights were not recorded in their charts. The minimum newborn weight was 1.0kg and maximum weight was 5.5kg. However, most of the babies weighed 3kg and the average weight was 3.14kg (SD ±0.6).

4.6 Spatial distribution of Low Birth Weight in Mombasa County

This study sample showed the overall prevalence of low birth weight of 10.1 % at (95% CI: 8.6, 11.9) in Mombasa County. In Mvita district, no baby was born with low birth weight, while Likoni Sub County had 9.9% prevalence rate (95% CI; 7.1,13.7), Nyali 11% (95% CI: 7.1-13.7), Kisauni 12.8% (95% CI: 9.6-16.8), Jomvu 10.4% (95% CI:6-16) and Changamwe 8.8% at 95% CI:5.8-12.8). Overall, Kisauni Sub County had the highest percentage of LBW deliveries within the selected sites between July 2013 and September 2013. However, there was no significant difference in LBW across the county as seen in the overlapping confidence intervals plotted in Fig 4.8.

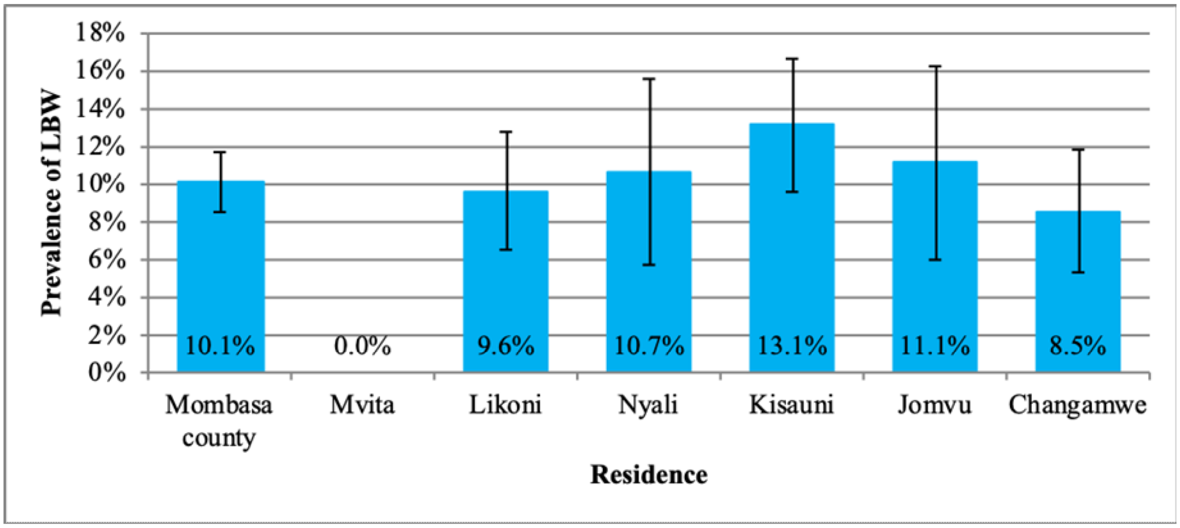


Figure 4.8: Comparison of prevalence of LBW across the sub-counties

The distribution of LBW in the wards is as shown in Table 4.6. Although some wards reported a higher prevalence of low birth weight than others, there were no significant differences as shown by the overlapping at 95% confidence intervals.

Table 4.6: Spatial Distribution of LBW in Sub-counties and wards of Mombasa County

Sub-county	No. of Live Births	No. LBW (%)	Ward	No. of Live Births	No. of LBW(%)	95% CI
Mvita	72	0 (0.0)	Tudor	28	0 (0.0)	-
			Tononoka	14	0 (0.0)	-
			Shimanzi/Ganjon	15	0 (0.0)	-
			Majengo	12	0 (0.0)	-
			Mji Wa Kale	3	0 (0.0)	-
Likoni	343	33 (9.6)	Mtongwe	27	3 (11.1)	2.4-29.2
			ShikaAdabu	54	5 (9.3)	3.1-20.3
			Bofu	13	0 (0.0)	-
			Likoni	216	19 (8.8)	5.4-13.4
			Timbwani	33	6 (18.2)	7.0-35.5
Nyali	150	16 (10.7)	Frere Town	42	2 (4.8)	0.6-16.2
			Ziwa La Ngombe	26	4 (15.4)	4.4-34.9
			Mkomani	13	1 (7.7)	0.2-36.0
			Kongowea	51	6 (11.8)	4.4-23.9
			Kadzangani	18	3 (16.7)	3.6-41.2
Kisauni	358	47 (13.1)	Mjambere	47	5 (10.6)	3.6-23.1
			Junda	103	8 (7.8)	3.4-14.7
			Bamburi	64	12 (18.8)	10.1-30.5
			Mwakirunge	13	2 (15.4)	1.9-45.5
			Mtopanga	47	8 (17.0)	7.7-30.8
			Magongoni	26	4 (15.4)	4.4-34.9
			Shanzu	58	8 (13.8)	6.3-25.8
Jomvu	144	16 (11.1)	Jomvu Kuu	83	8 (9.6)	4.3-18.1
			Miritini	37	6 (16.2)	6.2-32.0
			Mikindani	24	2 (8.3)	1.0-27.0
Changamwe	282	24 (8.5)	Port Reitz	42	3 (7.1)	1.5-19.5
			Kipevu	8	0 (0.0)	-
			Airport	22	7 (31.8)	13.9-54.9
			Changamwe	159	9 (5.7)	2.6-10.5
			Chaani	51	5 (9.8)	3.3-21.4

The top five wards which were hotspots of LBW in Mombasa County included Airport (31.8%), Bamburi (18.8%), Timbwani (18.1 %), Mtopanga (17%) and Miritini (16.2%). Several wards did not have any deliveries with LBW including Bofu, Kipevu, Majengo, Mji wa Kale, Shimanzi, Tononoka and Tudor as illustrated in Table 4.7 and Fig 4.9.

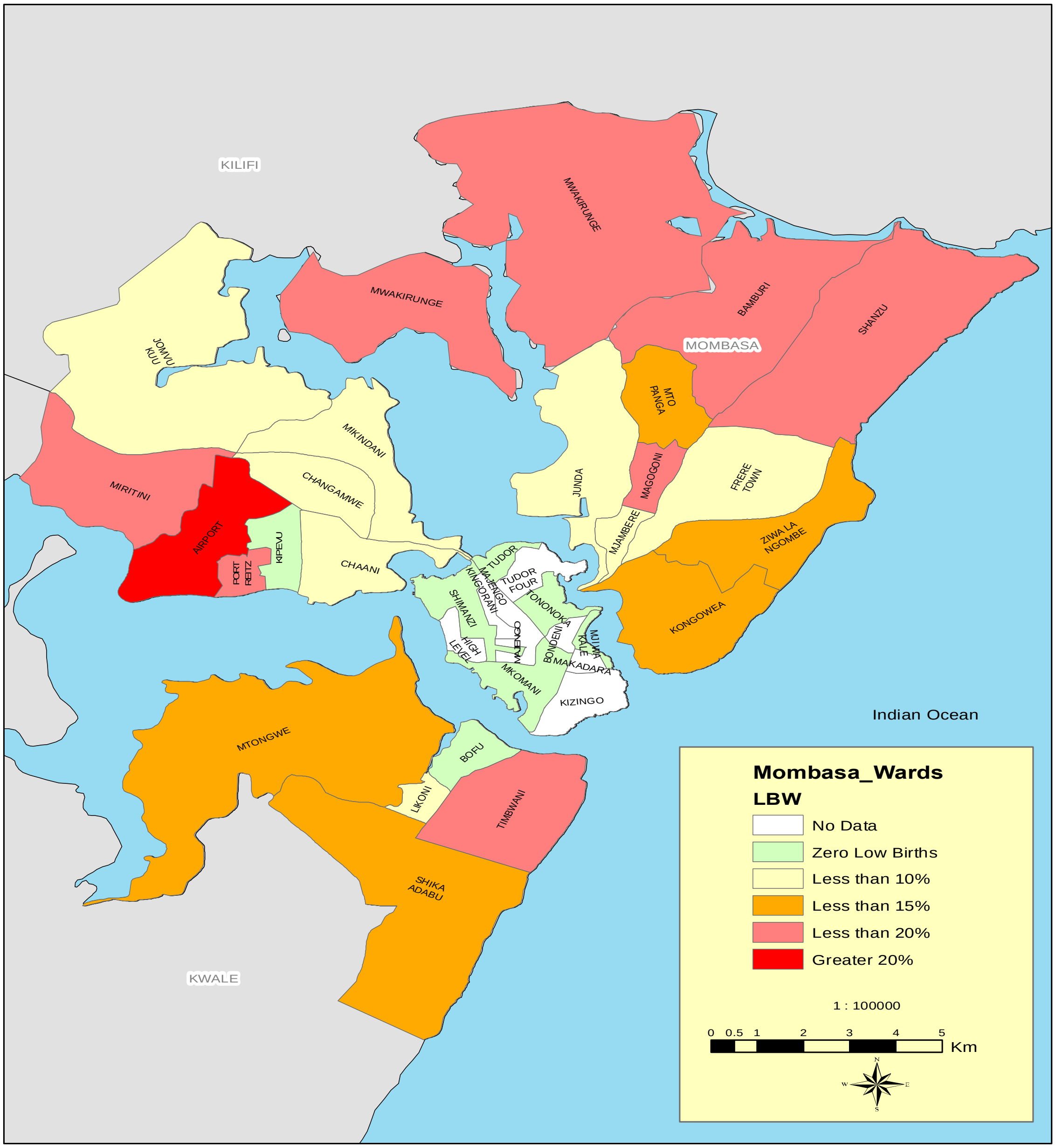


Figure 4.9: Spatial Distribution of Low Birth Weight in Mombasa County

Table 4.7 Spatial Distribution of LBW in Mombasa County

Ward	Live Births reported	LBW	LBW %	95% CI
Airport	22	7	31.8	13.9-54.9
Bamburi	64	12	18.8	10.1-30.5
Bofu	13	0	0.00	
Chaani	51	5	9.8	3.3-21.4
Changamwe	159	9	5.7	2.6-10.5
Frere Town	42	2	4.8	0.6-16.2
Jomvu Kuu	83	8	9.6	4.3-18.1
Junda	103	8	7.8	3.4-14.7
Kadzangani	19	3	16.7	3.6-41.2
Kipevu	8	0	0.00	
Kongowea	51	6	11.8	4.4-23.9
Likoni	216	19	8.8	5.4-13.4
Magogoni	26	4	15.4	4.4-34.9
Majengo	12	0	0.00	
Mikindani	24	2	8.3	1.0-27.0
Miritini	37	6	16.2	6.2-32.0
Mjambere	47	5	10.6	3.6-23.1
Mji Wa Kale	3	0	0.00	
Mkomani	12	1	7.7	0.2-36.0
Mtongwe	27	3	11.1	2.4-29.2
Mtopanga	47	8	17.0	7.7-30.8
Mwakirunge	13	2	15.4	1.9-45.5
Port Reitz	42	3	7.1	1.5-19.5
Shanzu	57	8	14.0	6.3-25.8
ShikaAdabu	54	5	9.3	3.1-20.3
Shimanzi/Ganjoni	15	0	0.00	
Timbwani	33	6	18.1	7.0-35.5
Tononoka	14	0	0.00	
Tudor	28	0	0.00	
Ziwa La Ngombe	26	4	15.4	4.4-34.9
Total No. of Births	**1349**	**136**	**10.1**	**8.6-11.9**

Color code:

Greater than 20%
Less than 20%
Less than 15%
Zero LBW
Less 10%

4.7 Low Birth Weight and its Associated Factors

4.7.1 Socio-demographic factors associated with LBW

In the study, mothers whose age was less than 20 years of age had a higher risk of having LBW babies, OR 1.9 (95% CI; 1.1-3.4) p=0.031, compared to those who were older than 30 years of age. There were no significant associations of prevalence of LBW in mothers above 20 years of age. The mothers who were not married showed a significantly higher likelihood of delivering LBW, OR 1.7 (95% CI 1.0-2.7), p=0.045. Other socio-demographic characteristics of the mothers were not significantly associated with LBW (p>0.05) (Table 4.8).

Table 4.8: Socio-demographic Factors Associated with LBW in Mombasa County

Variable	No of deliveries <2500gn (%)	No of deliveries ≥2500g n (%)	OR (95% CI)	*P* value
Age group (years)				
Less than 20	28 (19.4)	116 (80.6)	1.9 (1.1-3.4)	0.031
20-24	48 (8.9)	490 (91.1)	0.8 (0.5-1.3)	0.293
25-29	33 (7.7)	395 (92.3)	0.7 (0.4-1.1)	0.119
More than 29	27 (11.3)	211 (88.7)	1.0	
Marital status				
Unmarried	21 (14.9)	120 (85.1)	1.7 (1.0-2.7)	0.045
Married	115 (9.5)	1092 (90.5)	1.0	
Employment				
Employed	17 (9.4)	164 (90.6)	1.0	
Self-employed	26 (10.2)	229 (89.8)	1.1 (0.6-2.1)	0.782
Unemployed	93 (10.2)	815 (89.8)	1.1 (0.6-1.9)	0.729
Other	0 (0.0)	4 (100.0)	-	0.999
Education				
Up-to Primary	80 (10.7)	668 (89.3)	1.2 (0.8-1.7)	0.328
Vocational training	3 (18.8)	13 (81.3)	2.3 (0.6-8.4)	0.202
Secondary or higher	53 (9.1)	531 (90.9)	1.0	
Employed during pregnancy				
Yes	26 (12.4)	184 (87.6)	1.3 (0.8-2.1)	0.230
No	110 (11.9)	1028 (90.3)	1.0	
Household monthly income (Kshs)				
Less than 5000	90 (11.5)	693 (88.5)	1.0	
5000-10000	34 (9.2)	335 (90.8)	0.8 (0.5-1.2)	0.245
10001-20000	9 (8.7)	95 (91.3)	0.7 (0.4-1.5)	0.389
20001-30000	3 (11.5)	23 (88.5)	1.0 (0.3-3.4)	0.994
More than 30000	0 (0.0)	16 (100.0)	-	0.998

4.7.2 Pregnancy-Related Factors Associated with LBW

Delivery at 28-36 weeks of gestation was associated with higher risk of LBW OR 2.6(95% CI;1-6.5), p=0.033. Mothers who had delivered previously were less likely to deliver low (OR 0.7 (95% CI; 0.5-1.0), p=0.026. However, mothers who had delivered 2 or more babies were 1.6 times at risk of delivery in a LBW delivery (95% CI 1.1-2.2), p=0.015. Visiting ANC more than once reduced the risk of LBW deliveries by 20% (95% CI 0.1-0.4), p<0.001 while late attendance of ANC, especially at 3rd trimester increased the risk at 2.7 times (95% CI 1.3-2.5), p=0.008.

Similarly, a history of previous LBW delivery was associated with 3.4 times increased the risk of LBW in the current delivery, (95% CI 2.1-5.3), p<0.001. Mothers who weighed 35-54Kg associated with LBW delivery (OR 2.3 (95% CI 1.2-4.3), p=0.014. MUAC was also tested using t-test and it was found that mothers with LBW babies had significantly smaller MUAC of mean 26.3cm (SD ±3.0) than those with the birth weight of more than 2500g with a mean of 27.2 cm(SD±3.7), p=0.008 (see Table 4.9).

Table 4.9: Pregnancy-Related Factors Associated with LBW in Mombasa County

Variable	Birth weight <2500g n (%)	Birth weight >2500g n (%)	OR (95% CI)	*P* value
Gestation (weeks)				
28-36 weeks	131 (10.7%)	1103 (89.3%)	2.6 (1.0-6.5)	0.033
>36 weeks	5 (4.3%)	110 (95.7%)	1.0	
Previous delivery				
Yes	65 (8.5)	700 (91.5)	0.7 (0.5-1.0)	0.026
No	71 (12.2)	512 (87.8)	1.0	
Birth order				
1st	72 (12.4)	509 (87.6)	0.5 (0.2-1.3)	0.133
2-3	41 (6.8)	561 (93.2)	0.2 (0.1-0.7)	0.007
4-5	18 (12.5)	126 (87.5)	0.5 (0.1-1.4)	0.170
More than 6	5 (23.8)	16 (76.2)	1.0	
Parity				
2 or more	64 (8.3)	703 (91.7)	1.6 (1.1-2.2)	0.015
First	72 (12.4)	509 (87.6)	1.0	
ANC attendance				
Yes	135 (10.0)	1210 (90.0)	4.5 (0.4-49.8)	0.273
No	1 (33.3)	2 (66.7)	1.0	
Number of ANC visits				
Once	24 (30.8)	54 (69.2)	4.9 (2.9-8.2)	<0.001
Twice	19 (11.3)	149 (88.7)	1.4 (0.8-2.4)	0.210
More than twice	92 (8.4)	1007 (91.6)	1.0	
Stage at first ANC visit				
1st trimester	10 (5.5)	173 (94.5)	1.0	
2nd trimester	87 (9.9)	791 (90.1)	1.9 (1.0-32.7)	0.062
3rd trimester	38 (13.4)	246 (86.6)	2.7 (1.3-5.5)	0.008
Treated for malaria				
Yes	33 (8.8)	342 (91.2)	0.8 (0.5-1.2)	0.327
No	103 (10.6)	869 (89.4)	1.0	
HIV results				
Positive	8 (9.5)	76 (90.5)	0.9 (0.4-2.0)	0.872
Negative	127 (10.1)	1134 (89.9)	1.0	
HIV treatment				
Yes	7 (10.1)	62 (89.9)	1.0 (0.5-2.2)	0.987
No	129 (10.1)	1150 (89.9)	1.0	
Previous delivery of LBW				
Yes	30 (24.6)	92 (75.4)	3.4 (2.1-5.3)	<0.001
No	106 (8.8)	1097 (91.2)	1.0	
Maternal Hemoglobin level (g/dl)				
<=11.0	98 (10.7)	819 (89.3)	1.4 (0.9-2.1)	0.139
>11.0	31 (8.0)	356 (92.0)	1.0	
BMI (kg/m^2)				
Under weight<18.5 kg	4 (10.8)	33 (89.2)	1.1 (0.4-3.1)	0.787
Normal(18.5-24.9)	71 (10.3)	617 (89.7)	1.0	
Overweight(25-29.9)	47 (11.2)	371 (88.8)	1.1 (0.7-1.6)	0.629
Obese(Ó30)	10 (4.7)	165 (94.3)	0.5 (0.3-1.0)	0.062
Maternal MUAC cm				
<23	11(9.9)	100 (90.1)	2.0(1.0-4.0)	0.035
>23	63 (5.1)	1166(94.9)	1	

4.8 Multivariate Analysis

All the variables from the bivariate analysis that were significantly associated with LBW were included in the logistic regression model to determine their independence in predicting LBW. As shown in table 4.9, early gestation at delivery, higher birth order, previous delivery of LBW and smaller height of the mother predicted a higher risk of LBW delivery. On the other hand, a higher number of ANC visits was found to be associated with the reduced chance of LBW deliveries. All the other factors were not independently associated with LBW. There was no substantial change in the magnitude of the risk for most of the factors except for the previous LBW delivery that showed a higher adjusted OR of 6.0 (95% CI 3.0-10.7), p<0.001.

Table 5.0: Predictors of Low Birth Weight

Variable	OR (95% CI)	*P value*
Maternal age group		
<20	1.2 (0.6-2.5)	0.659
20-24	0.6 (0.3-1.0)	0.063
25-29	0.6 (0.3-1.2)	0.153
>=30	1.0	
Gestational age		
28-32	11.6 (4.3-31.0)	<0.001
33-37	1.6 (0.6-4.1)	0.352
>=38	1.0	
Birth order		
2 or more	2.7 (1.6-4.5)	<0.001
First	1.0	
Number of ANC visits		
More than 1	0.3 (0.2-0.6)	<0.001
Once	1.0	
Previous delivery of LBW	6.0 (3.0-10.7)	<0.001
Maternal Height		
140-154.99	2.8 (1.2-6.7)	0.016
155-169.99	1.6 (0.7-3.5)	0.266
170-184	1.0	

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Discussion

LBW in this study is defined as birth weight less than 2.5Kg. The overall prevalence of Low birth weight in this study in Mombasa county was 10% which was higher than the prevalence reported in the KDHS 2008-09 at 6.9%, but concurs with the MICS (2012) which had reported a similar 10.1%. This is not a rare finding, as different studies have shown the same variabilities (Migwi 2012). Unlike the KDHS 2008-9 that used household survey design, this study was hospital-based hence could have contributed to higher prevalence since there was a higher chance of mothers bringing their babies to the hospitals due to conditions associated with LBW. Similar hospital-based surveys in the Kenya Coast region have reported a high prevalence of LBW with one in Kilifi hospital reporting 19% (Ross and English 2005).

According to the analysis, most LBW were classified as preterm. However, since the average weight on newborns was 3.14kg, it can be due to wrong reported dates of LMP and consequently wrong calculation of gestational age resulting in high records of pre-term deliveries. A study which has investigated the reported LMP accuracy states that 4 in 5 births is accurate and recommends that data entry and data recording should be collected accurately (Berg and Bracken 1992).

The study set out to identify geographical hotspots of LBW in Mombasa County. It should be noted that this study was designed to capture mothers delivering in public health hospitals. This may present as a limiting factor to capture the majority of the mothers as it has been documented that most deliveries do occur at home in the presence of a doula or birth attendant. Nevertheless, when assessing the KCFS (2012), it is reported that the majority population residing in Mombasa resides in urban areas and this may contribute to better attendance to hospitals. A similar study in Brazil stated that, urbanization would result in better outcomes in infant mortality and also higher reporting of LBW (Lima et al, 2013).

Spatial distribution of LBW showed disparities in Mombasa County. However, between the sub-counties, the distribution of LBW was equal. The sub-county with the highest prevalence of LBW reported was Kisauni, while the least was from Mvita sub-county. The number of deliveries as a whole reported in the Coast General Hospital was low despite having a general high fertility and population (KCFS 2012). This may be due to the fact that, fewer mothers accessed the public health facilities as compared to private facilities in Mvita sub-county compared to Kisauni resulting in under-reporting in this specific sub-county.

Mapping out LBW at the ward level revealed that, Airport ward had the highest prevalence of LBW while other wards in the Changamwe sub-county reported a lower prevalence. Current statistics show that, the wards in Kisauni sub-county universally had high prevalence of LBW. Similar findings were seen in Nyali sub-county where 3 out of 5 wards (which surround Kisauni sub-county) had relatively high low birth weights. This could be attributed to the high population density, high pollution rates or poor antenatal practices in Kisauni sub-county.

The high prevalence rates seen in the Airport ward (Changamwe sub-county), could be ascribed to constant high exposure to greenhouse gases (Awuor 2008). The presence of the second largest airport (leading to several flights); several factories; several go-downs; not forgetting the main highway connecting the rest of the country and region can undoubtedly result in delivery of LBW newborn. This argument is supported by Rosner and colleagues 2011; Bell and colleagues 2010; Parker and colleagues 2005; Lee and colleagues 2003 in the theory implicating air pollution to have a causal effect on LBW. Low Birth Weight is an indicator of maternal health status that could include maternal nutrition, ill health, and poor pregnancy health care (Wardlaw and colleagues 2004). Although almost all the mothers attended the clinic and had more than one clinic visit, more than 40% of them had Hb less than 10g/dl. In addition, there was a high prevalence (25%) of self-reported malaria during pregnancy which, in previous studies (Kramer 1987) has been reported to be a determinant of intra-uterine growth retardation (IUGR). Malaria in pregnancy has been implicated to be a common factor for LBW (Alusala & Estambale 2009, Guyatt and Snow 2004, Kassam and colleagues 2007, van Ejik and colleagues 2004).

In this study, the HIV status of the mother was not associated with LBW. This was unexpected results since previous studies showed that HIV is a factor that increases the prevalence of LBW (Musana and colleagues 2009, Obimbo and colleagues 2004, De Cock and colleagues 2004). This is especially seen in a similar study in the Coast Province General Hospital (CPGH) confirmed that HIV-infected mothers were more likely to deliver LBW babies (Mwanyumba and colleagues 2001).

Maternal age of less than 20 years increased the risk two fold of LBW babies. This contradicted results of a study done in KNH that showed that teenage mothers had equal numbers of LBW babies as older mothers (Wassuna and Mohammed 2002). However, other studies around the world have reported an increased risk of LBW among mothers of younger age (Yadav, Chaudhary, Shrestha 2011). Other studies have shown that there was a higher risk of LBW among teenagers (Li and Chang 2005, Oboro and colleagues 2003) and those who were older than 30 years (Li and Chang 2005).

There was a 1.7 fold increase in the risk of LBW babies among the unmarried women in this study. This was similar to findings from a study in Taiwan that reported unmarried mothers do experience more incidences of LBW babies (Li and Chang 2005, Siza 2008). This could be explained by stress due to community un-acceptance or due to the lack of proper antenatal care as a result of the separation.

Education levels of the mothers, employment status and income level had no effect on the occurrence of LBW. This was a contradiction to widely documented findings identifying maternal education, maternal occupations and low socioeconomic status of the mothers to be factors associated with LBW in children (Bener and colleagues 2012, Siza 2008, Muula and colleagues 2011). Similarly, KDHS 2008-9 reported that, children whose mothers have no education and those with lower wealth quintile were more likely to be smaller than average or very small than normal children (KNBS and ICF Macro, 2010).

Preterm delivery (at 28-36 gestation) had almost three-fold risk of LBW babies. This concurs with a study in Tanzania which showed a two-fold increased risk of LBW babies if the gestational age at birth is below 37 weeks (Siza, 2008). Also, nulliparous women had a 1.6-fold risk of LBW compared to the multipara women. On the other hand, having a history of previous delivery was 30% protective against LBW. This was similar to the findings in Taiwan that report increased risk of LBW if the woman is giving birth for the first time (Li and Chang 2005).

Antenatal clinic (ANC) attendance was identified in this study to be among the factors that greatly influence the outcomes of delivery in terms of the weight of the baby. The number of visits was important with women who had attended ANC more than once having 80% reduced the risk of LBW. In addition, this study found that the timing of ANC visit was important showing that late initiation of antenatal care was detrimental to the baby outcomes. There was a three-fold increased risk of LBW among mothers who attended the clinic for the first time in the third trimester of their pregnancy. Similar results have been reported elsewhere where ANC attendance, the number of prenatal visits and month of first prenatal visit influenced the birth weight of the children (Vega and colleagues 1993, Yadav and colleagues 2011). When a mother visits ANC earlier, reversible factors that can cause LBW can be dealt with by earlier interventions.

A history of LBW was found to be an indicator of an increased likelihood of LBW babies in the subsequent births. This study concluded that a history of LBW delivery has 3.4 fold-increased chance of delivering a LBW. This shows that, there is a chance of intervening in the subsequent pregnancies to reduce the odds when a history of LBW is known. This is similar to Koirala and Bhattaôs (2015) study in Nepal and Kramerôs (1987) meta-analyses that revealed similar findings with the same correlation.

Maternal anthropometric measures have been reported as significantly associated with neonatal birth dimension (Hassan and colleagues 2011). This study showed that low maternal weight was associated with a 2.3 fold increased risk of LBW deliveries. Further, women with LBW babies had significantly lower BMI. This also concurred with Moss and Chugani (2014) and Mohanti et al, (2005) who found that BMI was a good predictor of LBW. Various studies elsewhere have reported similar findings showing an increase in BMI at enrollment was associated with decreased odds of LBW (Young and colleagues 2012). Maternal MUAC <23 cm was associated with twice the number of LBW deliveries in this study. Migwiôs and Nega *et al* (2012), studies also reported the same findings in their studies and Maternal MUAC has been noted to be a predictor of LBW.

5.2 Conclusions

Delivery of Low Birth Weight (LBW) infants is common in Mombasa County with an occurrence of one LBW delivery in ten deliveries. These findings underlined the magnitude of LBW as a public health problem in the region. There was no significant difference in the spatial distribution of LBW deliveries in this cohort.

The maternal factors associated with LBW in this study were early gestation at delivery, higher birth order, previous delivery of LBW and smaller height of the mother predicted a higher risk of LBW delivery. On the other hand, a higher number of ANC visits was found to be associated with a reduced chance of LBW deliveries.

5.3 Recommendations

1. LBW has been identified as a spectrum of concern and as such data on LBW is sensitive. It is important that, health workers report accurate details during visits for early identification of risks associated with adverse outcomes of pregnancy.
2. Community awareness programs focused on mother who delivered LBW, multiparous and mothers who were shorter than average at hotspot areas would be beneficial to increase the awareness of the importance of early attendance of ANC and maternal nutrition which would prevent the outcome.
3. The findings of this study reinforce suggestions that, the local government should develop strategies to sustain the high levels of ANC attendance and care, and strengthen the information channels to educate the mothers on the importance of attending the clinic to the recommended 4 visits.
4. Further studies to investigate factors associated with LBW should be designed by the Public Health workers and the County Government of Mombasa representatives. For the wards that were identified as hotspots in the other sub-counties (other than Kisauni sub-county), it is recommended that, comparative studies be designed by public health

experts to identify differences and the risk factors associated with the delivery of LBW. Subsequently, interventions targeting the area can be developed to prevent this outcome.

5. The Public Health, Obstetrics and neonatal care experts should design studies focused on the community to examine spatial patterns so as to be able to get a better representation of the sample that is not available in hospital-based studies.

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APPENDIX 1: ETHICS APPROVAL

KENYATTA NATIONAL HOSPITAL
APPROVED
19 JUN 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/170

19th June 2013

Dr. Faiqa Kassim Ebrahim
School of Public Health
University of Nairobi.

Dear Dr. Kassim

RESEARCH PROPOSAL: SPATIAL DISTRIBUTION OF LOW BIRTH WEIGHT AND ASSOCIATED MATERNAL FACTORS IN MOMBASA COUNTY: A HOSPITAL BASED STUDY (P275/5/2013)

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 19th June 2013 to 18th June 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.

APPENDIX 2: CONSENT FORMS

Participants Informed Consent Explanation:

My name is Dr. Faiqa K Ebrahim. I am a student at the University of Nairobi, School of Public Health. I am carrying out a research on the ñSpatial Distribution of Low Birth weight in Mombasa County. A Hospital Based Study.ò The overall objective of this research is to map out low birth weight and to look at the associated maternal risk factors. The research method will include a structured maternal questionnaire.

Potential benefits

The benefits to the population include the identification areas of need for antenatal care to prevent such an outcome, post-natal care for the babies born low birth weight and overall improvement of healthcare to avoid under-five death.

Data Collection Procedure

The questionnaire shall compromise some questions on your social background, obstetric and medical risk factors and some measurements.

Voluntarism

This is not a test, there no right or wrong answers. You are not obliged to answer all the questions. However, your full participation will be greatly appreciated, as it shall contribute to overall prevention of low birth weight in Kenya. If you however feel to withdraw you are free to do so.

Confidentiality

Your responses shall be kept confidential and your name shall not be recorded anywhere on the questionnaire.

Contact

In case of any questions regarding this study, please contact me on 0733935110, Or KNH/UON-ERC secretary on Telephonenumber+2542726300-19 Ext.44102

Consent Form

I é é é é é é é (Respondent) have been explained to and read the explanation of the study and I agree to participate.

Participants Signature é é é é é é é é é é é Date é é é é é é é é

Interviewers Signature é é é é é é é é é é é Date é é é é é é é é

APPENDIX 3: CONSENT FORMS IN SWAHILI

<u>Maelezo ya Ruhusa kutoka kwa wamama Participants Informed Consent Explanation:</u>

Jina langu ni Daktari Faiqa K Ebrahim. Ninasomea katika Chuo Kikuu cha Nairobi. Ninaendeleza utafiti katika ñusambazaji wa watoto waliozaliwa na wizani mdogo na mambo ya hatari ya wamamaò. Utafiti unaojihusisha na hospitali katita kaunti ya Mombasa. Malengo ya utafiti huu ni kuweka kwa ramani watoto waliozaliwa na kilo zilizopungua na kutafuta sababu za hatari za wamama. Mbinu ya utafiti utakuwa ni huojaji ya wamama.

<u>Manufaa zilizotarajiwa</u>

Manufaa kwa uma inahusisha utambuaji wa sehemu zinazo hitaji zahanati za uzazi ili kuzuia tokeo kama hilo, kujali watoto waliozaliwa na wizani mdogo baada ya uzazi na uboreshaji wa afya kwa jumla ili kuzuia vifo vya watoto chini ya miaka mitano.

<u>Mbinu za ukusanyaji data</u>

Huojaji huu utajumuishwa baadhi ya maswali ya hatari ya kijamii, ujauzito na afya na baadhi ya vipimo.

<u>Kujitolea</u>

Huu sio mtihani, hakuna majibu sahihi ama majibu yenye makosa. Hujafungiwa kujibu maswali yote. Lakini, ushirikiano wako kamili utashukuriwa kwa ukubwa kwani itachangia kwa ukubwa kuzuia kuzaliwa kwa watoto wenye uzani mdogo wa Kenya. Pindi utakapotaka kujiandisha basi uko huru kufanya hivyo.

<u>Usiri</u>

Majibu yenu yatawekwa kwa usiri na majina yenu hayatarekodiwa kwokote kwenye huojaji huu.

<u>Uwasiliano</u>

Iwapo utakuwa na swali lolote kuhusiana na utafiti huu, tafadhali wasiliana nami kupitia rununu ya mkono nambari 0733935110, ama Katibu wa Kamati ya Maadili kwenya nambari +2542726300-19 Ext.44102

Ruhusa

Mimi é é é é é é é . (mwenye kujibu) nimeelezewa na nimesoma maelezo ya utafiti huu na nimekubali kushiriki

I é é é é é é é (Respondent) have been explained to and read the explanation of the study and I agree to participate.

Sahihi ya Mshiriki é é é é é é é é é é é Tarehe é é é é é é é é

Sahihi ya Mhoji é é é é é é é é é é é Tarehe é é é é é é é é

APPENDIX 4: AUTHORIZATION LETTER

DR. FAIQA KASSIM EBRAHIM,
UNIVERSITY OF NAIROBI,
COLLEGE OF HEALTH SCIENCES,
SCHOOL OF PUBLIC HEALTH,
P.O. BOX 30197-00100,
NAIROBI.
DATEé é é é é é é é é ..

THE PROVINCIAL DIRECTOR OF MEDICAL SERVICES,
COAST PROVINCE,
P.O.BOXé é é é é ...,
MOMBASA

Dear Sir/Madam,

REF: REQUEST TO CARRY OUT A RESEARCH AT YOUR INSTITUTIONS

I am Dr. Faiqa Kassim Ebrahim pursuing a Masters of Public Health degree in the University of Nairobi, School of Public Health. I am in part II currently and one of the requirements for the award of the degree is a research project. I have proposed to carry out a research on ó**Spatial Distribution of Low Birth Weight and Associated Maternal Factors In Mombasa County: A Hospital Based Study'** with approval of the University of Nairobi/Kenyatta National Hospital Ethical Research Committee between April and May 2013.

My colleagues and I will be using questionnaires to collect data from the mothers delivering in four hospitals under your supervision namely: Coast Province General Hospital, Likoni Sub County Hospital, Port Reitz Sub County Hospital and Tudor Sub County Hospital. The objective of the study is to map out low birth weight in the county and assess some maternal factors. I donøt intend to interfere with the smooth running of your institutions at any point and the data collected will be kept completely confidential. The results of the study shall be disseminated to your office upon completion of my study for your future use. I look forward to your positive consideration. Thank you in advance.

Yours faithfully,

Dr. Faiqa Kassim Ebrahim

APPENDIX 5: REQUEST LETTER TO THE INSTITUTIONS

DR. FAIQA KASSIM EBRAHIM,
UNIVERSITY OF NAIROBI,
COLLEGE OF HEALTH SCIENCES,
SCHOOL OF PUBLIC HEALTH,
P.O. BOX 30197-00100,
NAIROBI.

DATEé é é é é é é é é ..

THE SUB COUNTY MEDICAL OFFICER OF HEALTH,
é é é é é é é HOSPITAL,
P.O.BOXé é é é é ...,
MOMBASA.

Dear Sir/Madam,

REF: REQUEST TO CARRY OUT A RESEARCH AT YOUR INSTITUTION

I am Dr. Faiqa Kassim Ebrahim pursuing a Masterǿs of Public Health degree in the University of Nairobi, School of Public Health. I am in part II currently and one of the requirements for the award of the degree is a research project. I have proposed to carry out a research on ŏ**Spatial Distribution of Low Birth Weight in Mombasa County: A Hospital Based Study'** with approval of the University of Nairobi/Kenyatta National Hospital Ethical Research Committee.

My colleagues and I will be using questionnaires to collect data from the mothers delivering in your hospital to map out low birth weight in your district. I donǿt intend to interfere with the smooth running of your institution at any point and the data collected will be kept completely confidential. The results of the study shall be disseminated to your office upon completion of my study for your future use. I look forward to your positive consideration. Thank you in advance.

Yours faithfully,

Dr. Faiqa Kassim Ebrahim

APPENDIX 6: QUESTIONNAIRE

QUESTIONNAIRES TO MOTHERS WHO HAVE DELIVERED (Administered by the research assistant)

Section A: Bio – Data (Personal Information)

Instruction: Information obtained from maternal ANC book and direct questions

Phone no.________________

1. Did you live in Mombasa during the whole pregnancy?

   ( ) Yes

   ( ) No

   If no go to no. 2, if yes go to no. 3

2. How long did you live in Mombasa?

   ( ) less than 1 month
   ( ) 2-4 months
   ( ) more than 4 months

   District ________ Division _________ Location___________ Ward__________

3. What is your age? ____________ (Confirm with ID)

4. Marital status

   ( ) Single

   ( ) Married

   ( ) Separated

   ( ) Divorced

   ( ) Widowed

5. What is your religion?

   ( ) Muslim

   ( ) Christian

   ( ) Hindu

   ( ) Traditional

( ) Other (Specify)____________

6. What is your ethnic group?

( ) Mijikenda

( ) Swahili

( ) Taita

( ) Taveta

( ) Kamba

( ) Other (Specify)____________

7. Are you employed?

( ) Formally employed

( ) Self employed

( ) Unemployed

( ) Other (Specify)____________

8. Monthly household incomeé é é é é é é é é ..

Section B: Assessing Risk Factors for Low Birth Weight

Instructions: Tick according to the information from ANC card and clients response.

1. What is the highest level of school you attended?

( ) None

( ) Primary

( ) Post-Primary/Vocational

( ) Secondary/'A' Level

( ) College (Middle Level)

( ) University

2. Were you employed/ working during this pregnancy?

( ) Yes

( ) No

3. Have you given birth before?

( ) Yes

( ) No

4. If yes what is the birth order of this baby?

( ) 1

( ) 2-3

( ) 4-5

( ) 6 or more

5. When did your last menstrual period start? _____Day _____Month _________ Year

6. How many months pregnant were you when you gave birth________________

7. Was this single or multiple pregnancy?

( ) Single

( ) Twins or more

Other (specify) ______________

8. Did you receive antenatal care during this pregnancy?

( ) Yes

( ) No

9. If yes, please indicate how many times

( ) Once

( ) Twice

( ) More than twice

10. When did you first visit ANC with this pregnancy?

( ) 1st trimester

( ) 2nd trimester

( ) 3rd trimester

11. During this pregnancy did you take any drugs to prevent you from getting malaria

( ) Yes

( ) No

12. Have you been tested for HIV?

( ) Yes

( ) No

13. If yes, what is your status?

( ) Positive

( ) Negative

14. When did you know your status? ....

15. Are you on any HIV treatment?

( ) Yes
( ) No

16. Have you given birth to a baby of less than 2.5 kg before?

( ) Yes

( ) No

Section C: Maternal Antenatal Profile, Anthropometry and Birth Outcome.

INSTRUCTIONS: Maternal MUAC will be measured using the adult MUAC tape provided and height will be measured using the height board; The maternal Hb levels, weight and babies' sex and weight will be acquired from the ANC card.

Hb levelé é é é é

Heighté é é é é .

Weight é é é é ..

Maternal MUACé é é ..

Babies Birth weighté é é é é é é é

Sex of the newborn

( ) Male ( ) Female

APPENDIX 7: QUESTIONNAIRE IN KISWAHILI

HOJAJI KWA WAMAMA WALIOJIFUNGUWA (*Iliotolewa na waaidishi wa utafiti)*

PANDE A: Maelezo Ya Binafsi

Maelekezo: Maelezo kutoka kwa kitabu cha zahanati ya ujauzitonamaswali kwa wamama

Nambari ya simu_____________

1. Uliishi Mombasa miezi 9 ya ujauzito wako?

   ( ) Ndio

   ( ) La

   Ikiwa jibu lako ni la endelea na swali la pili, ikiwa ni ndio endelea na swali la tatu

2. Kwa muda gani wa ujauzito wako uliishi Mombasa?

   ( ) Chini ya mwezi mmoja

   ( ) Kati ya miezi miwili na minne

   ( ) Zaidi ya miezi minne

   Wilaya________Divisheni _________ Tarafa___________ Wadi__________

3. Una umri gani?_____ (***peleleza na kitambulisho***)
4. Hali ya ndoa

   ( ) Mzazi mmoja

   ( ) Kwenye ndoa

   ( ) Tengana

   ( ) Mtaliki

   ( ) Mjane

5. Kundi lako la imani ni gani?

   ( ) Muislamu

   ( ) Mkristo

   ( ) Mhindi

   ( ) Kitamaduni

   ( ) Zenginezo (Eleza Zaidi) _____________

6. Wewe nikabila gani?

( ) Mijikenda

( ) Swahili

( ) Taita

( ) Taveta

( ) Kamba

( ) Zenginezo (Eleza zaidi)é é é .

7. Je umeanjiriwa?

( ) Ndio

( ) La

Ikiwa umeanjiriwa, kazi yako ni ya aina gani?

( ) Kazi ya Rasmi

( ) Kazi ya Binafsi

( ) Bila Kazi

( ) Zenginezo (Eleza)

8. Mapato ya mwezié é é é é é é é é ..

Pande B: Kutathmini hatari ya kuzaliwa kwa uzito wa chini

Maelekezo: maelezo kutoka kwa kitabu cha zahanati ya ujauzito na maswali kwa wamama

17. Ni kiwango kipi cha elimu ulichofikia?

( ) Sijasoma

( ) Shule ya Msingi

( ) Baada ya Shule ya Msingi

( ) Shule ya Upili

( ) Chuo Kikuu

18. Uliajiriwa ukiwa mja mzito?

( ) Ndio

( ) La

19. Umesha jifunguwa kabla ya uzazi huu?

( ) Indio

( ) La

20. Ikiwa ndio, ni mtoto wa ngapi?

( ) Wa kwanza

( ) 2-3

( ) 4-5

( ) Sita ama zaidi

21. Siku yako ya mwisho kuanza hedhi ilikuwa gini? _____Tarehe ____Mwezi ____ Mwaka

22. Ulijifungua ukiwa mja mzito miezi mingapi________________

23. Ni mimba ya mtoto mmoja ama zaidi?

( ) Mmoja

( ) Mapacha ama zaidi

24. Ulihudhuria zahanati yeyote ya ujauzito?

( ) Ndio

( ) La

25. Ikiwa jibu lako ni ndio, mara ngapi?

( ) Mara Moja

( ) MaraMbili

( ) Zaidi Ya Mara Mbili

26. Mara yako ya kwanza kuhudhuria zahanati ni lini?

( ) Miezi Tatu Ya Kwanza

( ) Miezi Tatu Ya Pili

( ) MieziTatu Ya Mwisho

27. Katika ya ujauzito huu uliwahi kutibiwa malaria?

( ) Ndio

( ) La

28. Ushapimwa ukimwi?

( ) Ndio

( ) La

29. Ikiwa ndio, unajua hali yako?

( ) Ndio

( ) La

30. Ulijua lini hali yako ....

31. Unahudhuria matibabu yeyote ya ukimwi?

( ) Ndio

( ) La

32. Umewahi kujifunguwa mtoto chini ya 2.5 kg?

( ) Ndio

( ) La

Pande C: VipimoVya Wamama Waliojifungua Na Matokeo Ya Uzazi.

Maelekezo: Maternal MUAC will be measured using the tape provided and urefu utapimwa kutumia bodi ya urefu; kiwango cha himoglobini cha wamama, uzito wa wamama na jinsia ya watoto waliozaliwa litachukuliwa kutoka kitabu cha kliniki cha uzazi.

Kiwango cha himoglobini é é é é é

Urefu wa mama é é é é é .

Uzito wa mama é é é é ..

Maternal MUACé é é ..

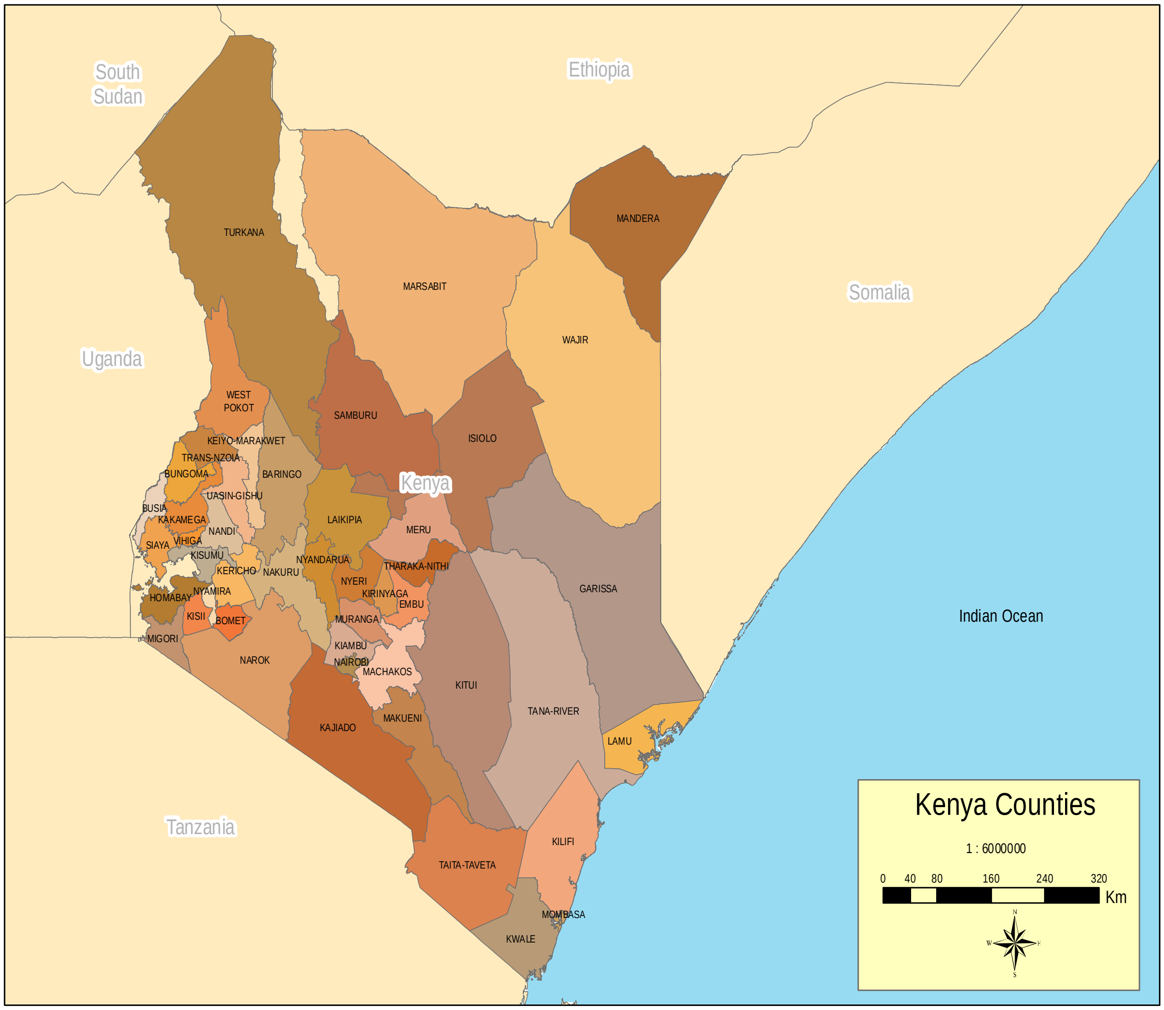
Uzito wa mtoto wa kuzaliwaé é é é é é é é

Jinsia ya Mtoto

( ) Mwanaume

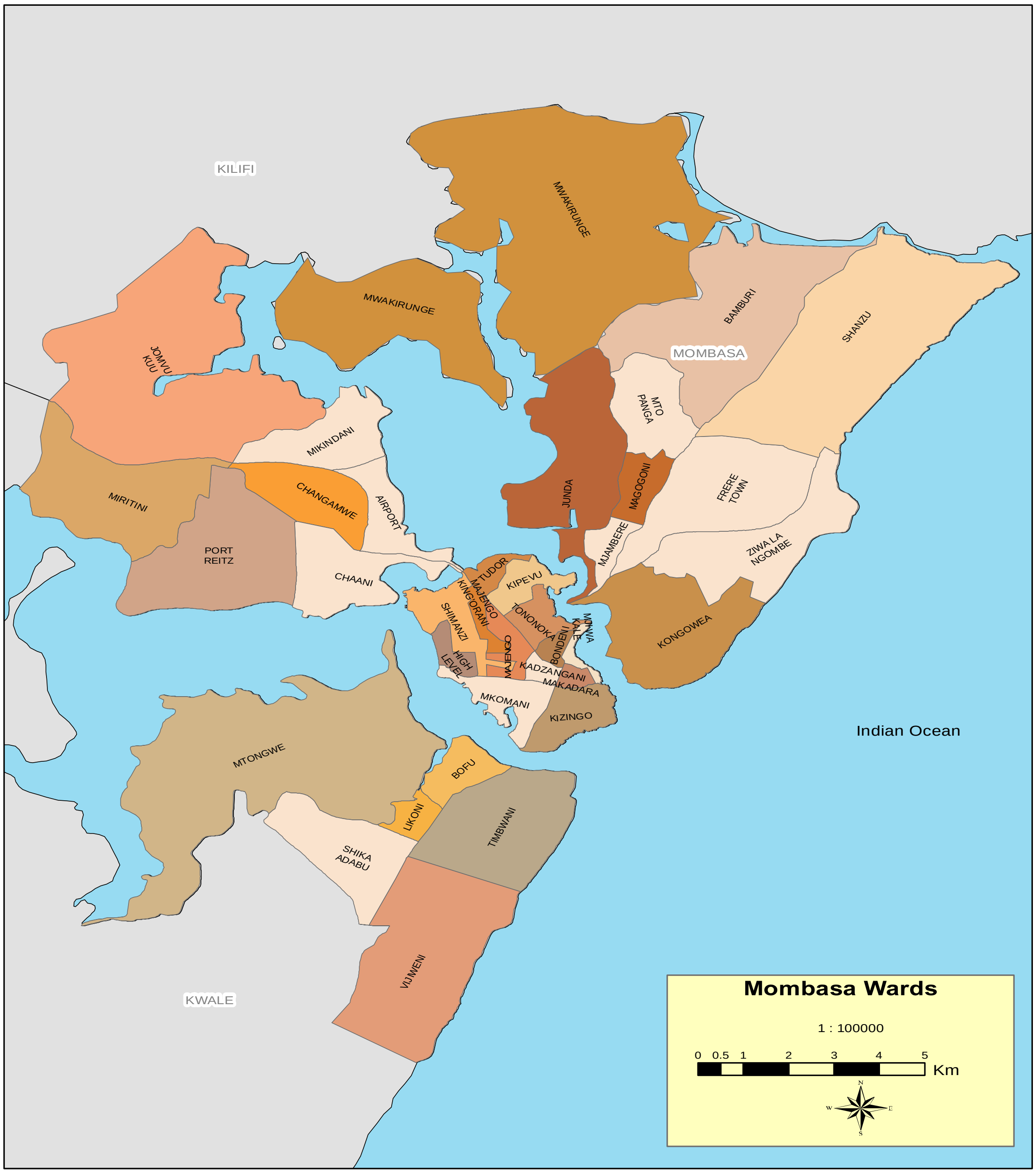
( ) Mwanmke

APPENDIX 8: KENYA MAP



Source: UNSOA Hughes (2013 unpublished)

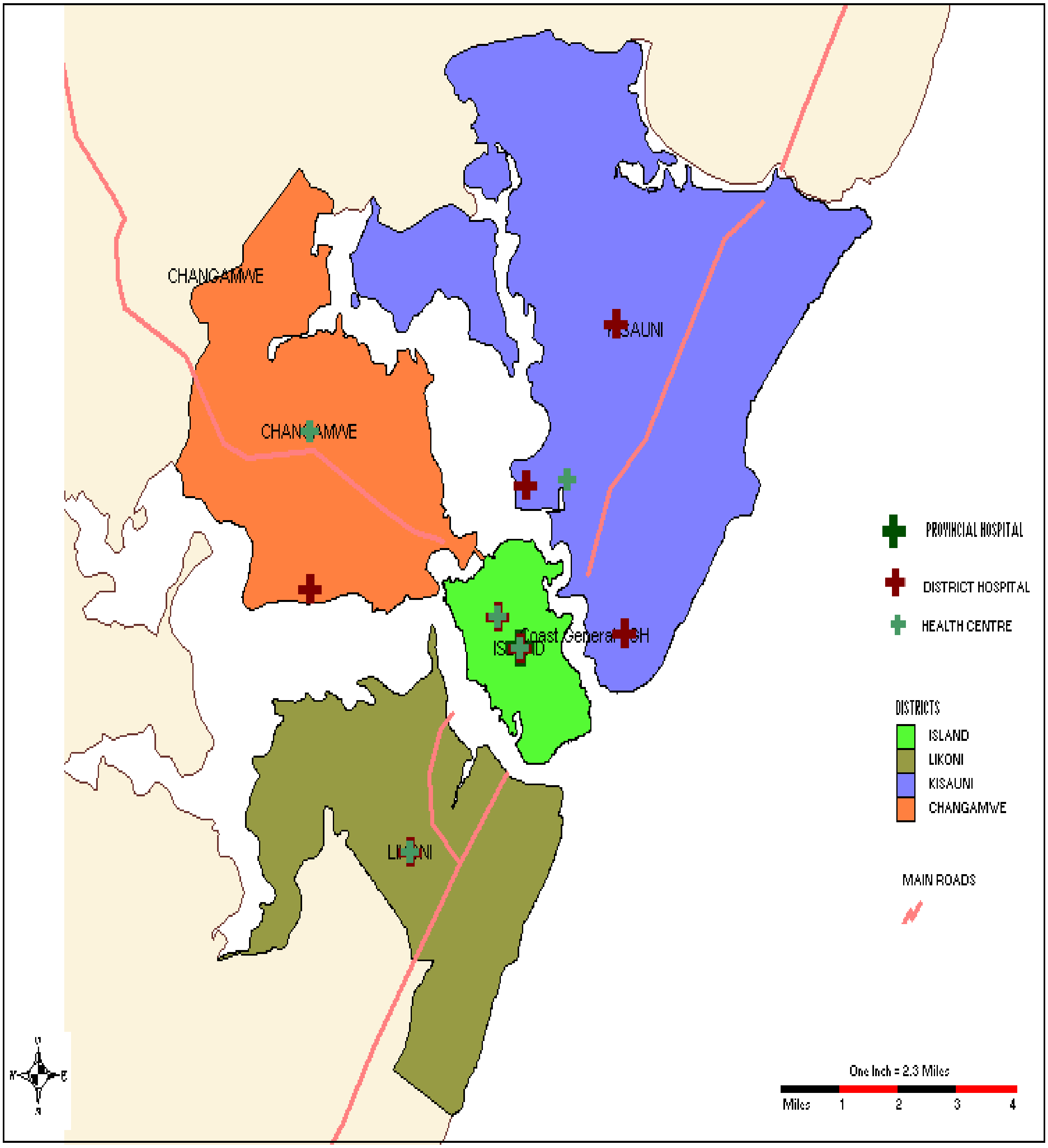
APPENDIX 9: MOMBASA COUNTY MAP



So

urce: UNSOA 2013 GIS by Hughes, unpublished

APPENDIX 10: MOMBASA COUNTY MAP WITH HEALTH FACILITIES



Source: **Records from Ministry of Health Kenya: Department of Statistics: Cheburet, unpublished**

APPENDIX 11: LIVE BIRTH RATES IN MOMBASA COUNTY HOSPITALS

Organization unit	Total live deliveries in the year 2012
Aga Khan Hospital (Mombasa)	651
Al Farouque Hospital	153
Bomu Hospital (Changamwe)	4199
Coast Provincial General Hospital (CPGH)	13513
Jocham Hospital	504
Kenya Navy (MIR) Hospital	441
Likoni Sub County Hospital	2456
Mary Immaculate Hospital (Mombasa)	714
Mewa Hospital	906
Mombasa Hospital	1220
Pandya Memorial Hospital	1005
Port Reitz Sub County Hospital	3961
Sayyida Fatimah Hospital	868
Tudor Sub County Hospital	1499
Grand Total	**32090**

Source: **Records from Ministry of Health Kenya: Department of statistics: Cheburet, unpublished**

APPENDIX 12: DUMMY TABLES

Residence According to Ward	**No. of live birth deliveries**	**No. of low birth weight deliveries**	**Prevalence**
Kisauni (Wards)			
Total			
Mvita (Wards)			
Total			
Changamwe (Wards)			
Total			
Likoni (Wards)			
Total			

Socio-demographic factors per ward	No. of live birth weight deliveries	No. of low birth weight deliveries	Prevalence
Maternal age ➢ less than20 ➢ 20-35 ➢ 36- 45 ➢ More than 46 ➢ Unknown			
Total			
Religion ➢ Christian ➢ Muslim ➢ Hindu ➢ Traditional ➢ Others			
Total			
Ethnicity ➢ Mijikenda ➢ Swahili ➢ Taita ➢ Taveta ➢ Kamba ➢ Other			
Total			
Marital status ➢ Single ➢ Married ➢ Separated ➢ Divorced ➢ Widowed			
Total			
Education ➢ None ➢ Primary ➢ Post/primary/vocational ➢ Secondary ➢ College or university			
Total			
Employment ➢ Self Employed ➢ Formally Employed ➢ Unemployed			
Total			

Maternal Risk Factors per ward	No. of live birth weight deliveries	No. of low birth weight deliveries	Prevalence
Gestational age ➢ < 38/40 ➢ 38- 40 ➢ <40/40			
Total			
Parity ➢ Nulliparous ➢ Para 1 ➢ Multiparous			
Total			
ANC visits ➢ None ➢ Once ➢ Twice ➢ More than twice			
Total			
Previous history of low birth weight ➢ Yes ➢ No			
Total			
Malaria during pregnancy ➢ Yes ➢ No			
Total			
HIV status ➢ Positive ➢ Negative			
Total			
Taking HIV medication ➢ Yes ➢ No			
Total			

Nutritional factors Per ward	No. of live birth weight deliveries	No. of low birth weight deliveries	Prevalence
Maternal Hb ➢ <8 ➢ 8-10 ➢ 11-15 ➢ >15			
Total			
Maternal height ➢ <140 ➢ 140-150 ➢ 150 -160 ➢ 160 -170 ➢ > 180			
Total			
Maternal weight (kg) ➢ < 45 ➢ 45 ï 55 ➢ 55-70 ➢ 70 -85 ➢ 85- 100 ➢ 100			
Total			
Weight of the new born (g) ➢ < 2500 ➢ >2500			
Total			
Sex of the new born ➢ Male ➢ Female			
Total			