DETERMINANTS OF LOW BIRTH WEIGHT IN ZAMBIA:

EVIDENCE FROM THE 2007 AND 2013/14 ZAMBIA DEMOGRAPHIC AND HEALTH SURVEYS (ZDHS)

By

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Dissertation submitted to the University of Zambia in partial fulfilment of the Degree of Master of Public Health in Population Studies

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DECLARATION

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CERTIFICATE OF APPROVAL

The University of Zambia approves this dissertation of **Mwaka Hachisaala** in partial fulfilment of the requirements for the award of the degree of Master of Public Health in Population Studies.

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ABSTRACT

Of the estimated 130 million infants born each year worldwide, 20 million are born with a birthweight below 2.5 kg referred to as low birth weight (LBW) and about 97 percent of these births are occurring in the developing countries. The prevalence of LBW results from a complex chain of socio-economic and demographic, reproductive behavior, nutritional and environmental factors. In Zambia, the prevalence has been static for 7 years. This study aimed to estimate the prevalence of LBW across 2007 and 2013/14 Zambia Demographic and Health Survey by province and identify the determinants pf LBW in Zambia in 2013/14.

The study was a cross-sectional study. Data were extracted from the 2007 and 2013/14 ZDHS from the child's file for women aged 15-49 years using a data extraction tool that was developed based on the questions asked in the questionnaire. Firstly, overall and provincial prevalence's were estimated from the 2007 and 2013/14 data. Secondly, maps illustrating provincial variation of LBW prevalence were constructed and provincial statistical differences were assessed. Lastly, determinants of LBW were investigated. This involved descriptive statistics which included cross tabulations. Analytical statistics were done using bivariate logistic regression and to control for confounder multiple logistic regression was applied. A weighted analysis using STATA version 15.0 was used and level of significance was set at 5 percent.

A total number of 8005 births within the five years preceding the survey were extracted as the study population. LBW prevalence remained stable between 2007 and 2013/14, at around 9 percent with no statistical difference. All provinces showed an increased prevalence except Central, Eastern, Lusaka, Northern and North-western. North-western was the only province that showed statistical difference. Mothers aged 20-34 years (AOR: 0.56 (0.44-0.71)) were 44 percent less likely to deliver LBW children than those aged below 20 years. Mothers aged 35-49 years (AOR: 0.53 (0.35-0.83)) were 47 percent less likely to deliver LBW children compared to mothers aged below 20 years. Compared to mothers who had not made any ANC visit, mothers who made 1-3 visits (AOR: 0.16 (0.04-0.62)) were 84 percent less likely to deliver a LBW child. Mothers who had made four or more visits (AOR: 0.14 (0.04-0.52)) were 86 percent less likely to deliver a LBW child compared to the mothers who did not make any ANC visit.

The prevalence of LBW in Zambia remains high overall but showing sharp differential variation across the provinces in Zambia. This burden is concentrated in younger and predominantly rural mothers suggesting that there may be additional underlying inequity related to factors negatively associated with access or utilization of services. The study, therefore, recommends the need to have more programs that target such populations at risk including but not limited to programs against teenage pregnancies and strengthening the use of ANC services especially in provinces that showed an increased prevalence.

Keywords: Low birthweight, Determinants, Antenatal care, Child survival, Neonatal mortality

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ACRONYMS

ANC	-	Antenatal care
CPH	-	Census of Population and Housing of Zambia
BMI	-	Body Mass Index
CSA	-	Census Supervisory Area
CSO	-	Central Statistical Office
HIV	-	Human Immunodeficiency Virus
IAP	-	Indoor air pollution
LBW	-	Low birth weight
NICU	-	Neonatal Intensive Care Unit
SEA	-	Standard Enumeration areas
TDRC	-	Tropical Disease Research Centre
UTH	-	University Teaching Hospital
WHO	-	World Health Organization
ZDHS	-	Zambia Demographic Health Survey

Chapter 1: Introduction

1.1 Background

A child's weight or size at birth is an important indicator that shows the vulnerability of the child, their increased likelihood of developing childhood diseases and chances of surviving (CSO, 2014). Low birth weight (LBW) is an indicator of the reproductive health status of a country and is defined as weight measured at birth which is less than 2500g (WHO and UNICEF, 2004). This cut off-point was developed based on the international epidemiological observations that infants weighing less than 2500g are approximately twenty times more likely to die than heavier babies and also allows international comparability (WHO and UNICEF., 2004). Just like the other adverse birth outcomes, a great majority of these births with a LBW are occurring in the low- and middle-income countries(Kim and Saada, 2013).

LBW is a result of preterm birth (born before 37 weeks of gestation) or restricted fetal (intrauterine) growth or an overlap between these two circumstances, which usually have the poorest outcomes (WHO, 2015). A majority of these cases in developing countries are due to intra-uterine growth retardation, while pre-term birth has been found to be common in the developed countries (Qadir and Bhutta, 2009). Several studies have found LBW to be associated with increased neonatal morbidity and mortality, psychiatric disorders, inhibition of growth and cognitive development, and an increased risk of non-communicable diseases, such as, diabetes and cardiovascular conditions, later in life (Risnes et al., 2011; Harding et al., 2001; Ediriweera et al., 2017). An epidemiological study showed that LBW babies were 20 times as likely to die as normal-weight babies (Kramer., 1987).

According to Lau and others (Lau et al., 2013), the most critical stage regarding child survival for infants born with a LBW is the neonatal period and nearly half of all neonatal deaths are directly or indirectly linked to LBW. Every year, it is estimated that 130million births occur globally and 15percent of these births are of LBW, accounting for about 20 million births (WHO, 2015). About 97percent of these occur in low and middle-income countries (WHO, 2015). The prevalence of LBW is highest in regions of Southern Asia (26 percent), followed by Western Africa (15 percent), East and Southern Africa (both 14 percent), Middle Africa (13 percent) and Northern Africa and

South-Eastern Asia (both 12 percent) (UNICEF and WHO, 2019). There is need to take into consideration that these rates are unacceptably high. Currently, data on LBW is limited or unreliable since many of the deliveries occur in homes or small health centers and are not reported in official figures (WHO, 2014). This may imply that there could be an underestimation of the prevalence of LBW (WHO, 2014).

In Zambia, the prevalence of LBW reduced from about 11 percent in 2002 to 9 percent in 2007 (CSO, 2003; CSO, 2009). The 2013/14 Zambia Demographic and Health Survey (ZDHS) reported that there were no changes in the number of LBW infants that were born between 2007 and 2014. This implied that LBW was static at 9 percent prevalence in both rounds of the surveys. Lusaka and the Copperbelt province had the highest percentage of LBW neonates at 10 percent while Central province had the lowest at 7 percent (CSO, 2014).

1.2 Problem Statement

Global estimates have shown that neonatal mortality accounts for 40 percent of all deaths among children under-five years and LBW contributes to about 60 to 80 percent of the deaths (WHO and UNICEF, 2004). One in every eleven children born in Zambia has a LBW. The prevalence of nine percent has been static for seven years (CSO, 2014). The adverse perinatal outcomes that have been associated with LBW in Zambia include stillbirth, a low Apgar score, admittance to the Neonatal intensive care unit (NICU) and very early neonatal death (Chibwesha et al., 2016). A Zambian study by Lukonga and Michelo (2015) also showed that LBW was the strongest determinant of LBW of neonatal mortality.

LBW being an important indicator of the health status of a country requires an understanding of factors associated with it (WHO, 2015). Multiple factors such as socioeconomic and demographic factors, reproductive factors, morbidity during pregnancy and environmental factors have been found to influence LBW. Despite the efforts the Government of Zambia has put in place to improve child survival, the country, however, is still faced with a burden of LBW infants. Factors influencing LBW at a national level remain unknown. This study identified the different factors associated with LBW in Zambia.

1.3 Justification of the Study

Birth weight is an important key indicator of the reproductive health and general health status of a country (WHO, 2006). Zambia has had a static and high prevalence of LBW between 2007 and 2013, and the factors associated with it are not clearly known. This study is distinguished from the other studies that have investigated the problem of LBW in Zambia, in that the study used nationally representative data to identify the determinants of LBW on the Zambian population. Establishing the factors associated with the static prevalence of LBW in Zambia will provide evidence that can be used in the different policies and interventions aimed at improving this adverse birth outcome among women in Zambia.

This study contributes to the body of knowledge that is relevant in reducing the births of LBW infants in line with the World Health Assembly plan that set a goal to reduce this number by 30 percent by the year 2025(WHO, 2015).

1.4 Research Question

What is the prevalence pattern of LBW and what are the determinants of LBW among women 15 to 49 years in Zambia?

1.5 Research Objectives

1.5.1 General objective

To estimate the prevalence pattern of LBW and determine what could be the setting specific critical drivers of LBW among women aged 15 to 49 years in Zambia.

1.5.2 Specific Objectives:

1. To visualize the pattern variation of the prevalence of LBW across 2007 and 2013/14 ZDHS by province using GIS mapping.
2. To determine the socio-economic and demographic, reproductive behavior and environmental characteristics associated with LBW using the 2013/14 ZDHS.

1.6 Conceptual Framework

The following conceptual framework (figure 1) was adapted to help answer and analyze the data related to the general and specific objectives. It was developed by Magadi and colleagues (2004), in a study that looked at pathways of the determinants of unfavorable birth outcomes in Kenya. It shows the distal, intermediate and proximate determinants of birth-weight. The framework illustrates that the birth weight of a neonate is dependent on various factors that have a direct or an indirect association. From the framework, distal factors were identified to be socio-economic and demographic factors, namely the maternal age, maternal educational status, household wealth index, marital status, maternal occupational status, place of residence and ethnicity. The framework further illustrates that the distal factors are linked to the birth weight through intermediate factors which are the reproductive behavior factors, namely, birth order, birth intervals, parity, desirability of pregnancy, use of family planning, time to nearest Health Facility, prior abortions or stillbirths. The proximate determinants had a direct influence on birth weight and these included the number of antenatal care visit, the timing of the first antenatal visit, maternal height, maternal weight for height and smoking of cigarettes/tobacco.

An important variable that was singled out in this framework was antenatal care, which was considered to be a central link between the distal and the intermediate variables and birth weight. It is worth noting that the framework also acknowledges that birth order, multiple births and the sex of the neonate are considered to have a direct association with the birth weight. This study used this framework as a guide to explore the role the factors that were identified play as determinants of LBW in Zambia.

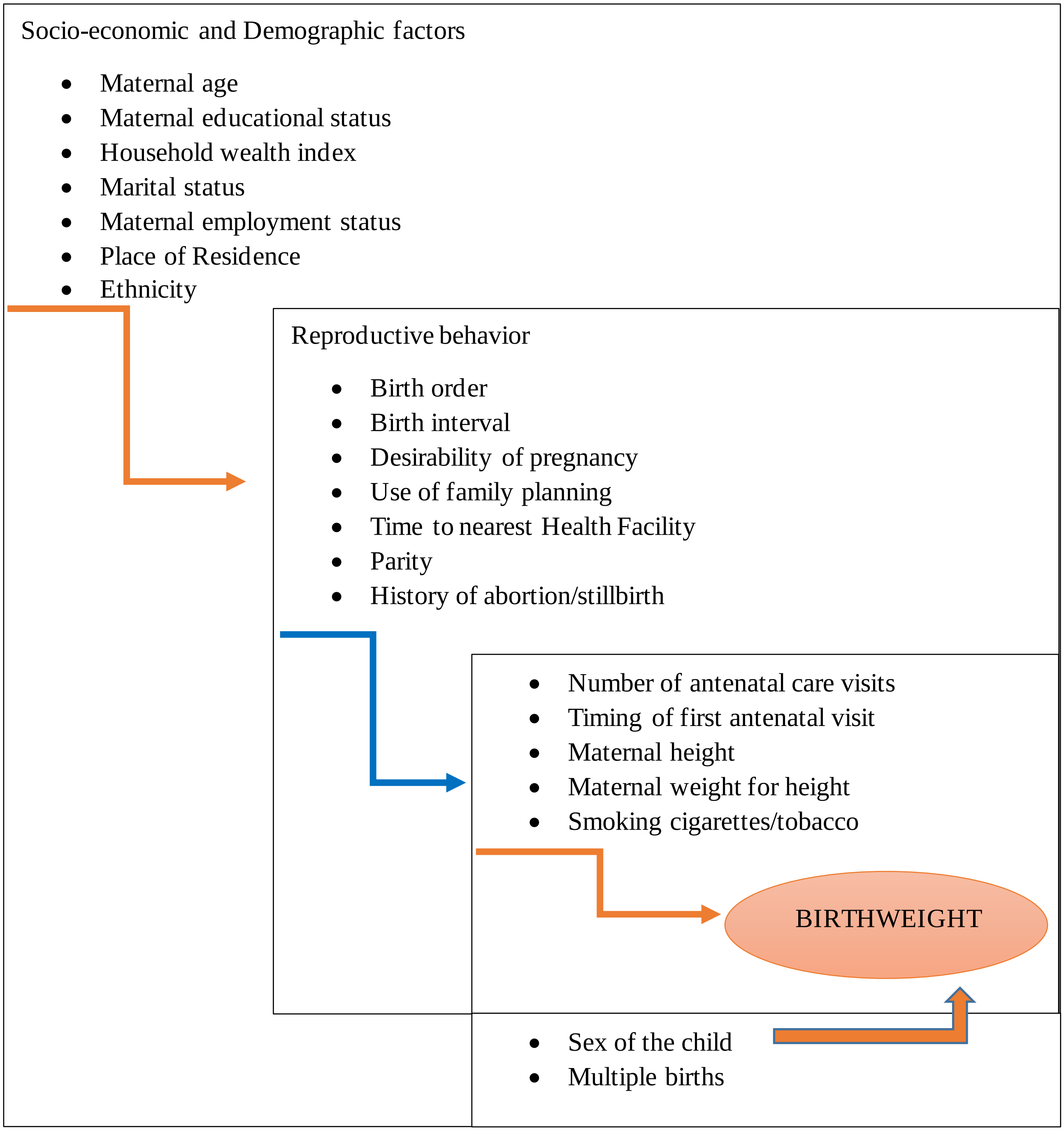

Figure 1: Conceptual framework of Pathways of the Determinants of Unfavourable birth outcomes

(Adapted from Magadi et al., 2004)

Chapter 2: Literature Review

2.1 Prevalence of LBW

A study by Chhea and others (2014) in Cambodia used children data from all singleton live births in health facilities from the 2010 and 2014 Cambodia demographic and health survey 2010 to describe the changes in prevalence over time. Their study showed that the prevalence of LBW remained stable at around 7 percent of in both 2010 and 2014. Similarly, a study that was conducted in Nepal using the 2006 and 2011 Nepal Demographic and Health Survey showed that the prevalence of LBW did not in significantly reduce over the five years (Khanal et al., 2014b)

2.2 Determinants of LBW

2.2.1 Socio-economic and Demographic

Age. The matter of maternal age has been discussed at length in the context of different birth outcomes. Different studies conducted have provided evidence that maternal age is an important risk factor for many adverse birth outcomes. These studies have shown that maternal ages less than 20 years have a significant association with LBW compared to maternal ages between 35 to 49 years (Manyeh et al., 2016; Demelash et al., 2015). Similarly, A case-control study by Sharma and others (2015) conducted in Nepal at a tertiary hospital that looked at LBW at term and its determinants found that younger ages of the mothers were a determinant of LBW.

Findings from a study conducted in Ethiopia that looked at the prevalence of "small size" babies, based on the Ethiopian Demographic and health survey, showed that the prevalence of having small size babes varied inversely and significantly across maternal age groups(Alemu and Umeta, 2016). This means that as the maternal age group increased, the risk of having a small size baby declined.

Furthermore, Gebregzabiherher and colleagues (2017) revealed that mothers aged less than 20 years were 1.7 times likely to deliver LBW babies than mothers aged 20–34 years. In Ghana, Agorinya and others (2018) conducted a cross-sectional study that used data from January 2009 to December 2011 using the Navrongo Health and Demographic Surveillance System. Their study showed that maternal ages 20-49 were associated with reduced odds of delivering a LBW infant. This was contrary to a study conducted by Mahumud and colleagues (2017) which investigated the distribution and determinants of LBW in 10 selected developing countries and used data from the Demography and Health Surveys (DHS). Their study showed that mothers aged between 35 to 49 years were found to have a significantly greater risk of delivering LBW babies than younger mothers. These findings are similar to a study that investigated maternal factors contributing to LBW deliveries South Africa that showed that maternal age was associated with LBW for older women(20-35 years) compared to younger women (Tshotetsi et al., 2019)

From the above, the scientific evidence has shown that younger women have an increased risk of giving birth to LBW babies. However, other studies failed to show that younger women are more likely to have infants with a LBW. These inconsistencies may be attributed to the differences in methodologies and characteristics of the study population.

Household Wealth Quintile. Several findings have been established with regards to the association between socioeconomic status and health. A study conducted by Muula and others (2011) in Malawi found that the odds of delivering a LBW baby were higher among women from lower wealth status. Similarly, evidence from other studies shows a significantly increased risk of LBW among infants born to mothers with a lower wealth status of households in comparison with the rich group (Sebayang et al., 2012; Mahumud et al., 2017). Frimmel and Pruckner (2014) also showed that a family's economic status had a positive impact on birth weight. Yet in a separate study in India (Kader and Perera, 2014) showed that women from the 'poor' and 'middle-class' socio-economic status were an insignificant risk factor for giving birth to an infant with LBW. In Bangladeshi however, a significant relationship between birth weight and family per head yearly income was found (Khatun and Rahman, 2008). Findings from all the above studies suggest that there are essential socioeconomic factors linked to LBW.

Place of Residence. In most studies, place of residence, either rural or urban, has been used as a proxy for the socioeconomic status of the individual. In Ethiopia**,** Tema (2006) found that mothers who lived in the urban area had a higher risk of delivering LBW babies. Contrary to these findings, a case-control by Demelash and others *(*2015) showed that mothers who resided in rural areas were two times more prone to deliver LBW babies compared to mothers from the urban area.

Despite the different studies conducted showing that place of residence was a significant risk factor for giving birth to an infant with LBW, other studies found that it was an insignificant risk factor for giving birth to an infant with LBW (Kader and Perera, 2014; Gebregzabiherher et al., 2017)

Maternal Education. According to the United Nations (2003), a cross-country comparison over time shows that increases in educational attainment precedes improvements in health status. Studies have shown that mothers with no formal education had a higher risk of delivering LBW babies than more highly educated mothers (Mahumud et al., 2017; Demelsh et al., 2015). These findings are in agreement with findings of a study by Siza (2008) that found that mothers without formal education were 4 times likely to give birth to LBW babies than those who had attained higher education.

Another study conducted by Muula and colleagues (2011) showed that compared to mothers who had attained at least secondary level of education, mothers who had no formal education were more likely to bear children who had LBW. Similarly, Kader and colleagues (2014) found that women that had no education had the largest effect in explaining the prevalence of LBW in their study and that the Women that had only attained primary education had higher odds of giving birth to a baby with a LBW than the women that had attained higher education.

Manyeh and others (2016) in their study revealed that the level of education was not significantly associated with birth weight, which is in contrast with what other studies have found. From the above review, there are mixed conclusions regarding the role of education on LBW.

2.2.2 Reproductive Behavioral Factors

Parity. Manyeh and others (2016) found that women with a parity between two and three were more likely to have babies who weighed more than 2.5 kg respectively, and those with a parity higher than three were more than two times likely to have babies weighing less compared to those with parity one. In a study conducted in a rural block of Assam with the objectives of finding out the prevalence of LBW babies among the study population and the effect of selected maternal and socio-demographic characteristics on birth weight found that LBW was more common among primiparous mothers (Borah and Agarwalla, 2016). Similarly, a study by Muula and colleagues (2011) showed that parity was associated with LBW. These findings were inconsistent with the findings of a study in sudan Elhassan and colleagues (2010) that showed evidence of no association between LBW and Parity.

Birth Interval. Evidence has shown that children born within a short birth spacing interval of fewer than 18 months are at increased risk of poor health, including LBW (Kaur et al., 2014). How this transcends to LBW is also evident in a study by Rafati and others (2005) that found that short and long intervals between pregnancies were associated with an increased risk of LBW. These findings are further confirmed in a systematic review and meta-analysis that aimed at estimating the pooled prevalence of low birth weight and the effect size of associated factors of LBW in Ethiopia. The study found that an inter-pregnancy interval of less than 24months was associated with LBW (Endalamaw et al., 2018). Similarly, a study in India showed that a birth interval that was of less 18 months was associated with LBW(Borah et al., 2016).

In Ethiopia preceding birth interval was eliminated from the final model that showed the variables that were associated with LBW (Alemu and Umeta, 2016). Similarly, a study that used data from the Nepal Demographic and Health Survey to determine factors associated with LBW found that birth interval was not associated with LBW (Khanal et al., 2014a). The above review also showed a diverse relationship with regards to the association between LBW and birth interval.

Birth Order. In a cross-sectional study that evaluated all births that were registered in all the maternity hospitals in Yazd, Iran in 2008, findings showed that the risk factors that were associated with LBW were births of the first and second-order (Golestan et al., 2011). Similarly, other studies have also shown evidence that birth order had a significant association with LBW (Milanzi, 2017; Bugssa et al., 2014.)

Antenatal care. The maternal nutritional status before and during pregnancy of a woman is essential, especially as the demand for macronutrients and micronutrients increases. Therefore antenatal care (ANC) provides the starting point of providing a positive pregnancy experience for the women. The WHO found evidence that if a woman only had four ANC visits, the perinatal deaths would still increase. They further found evidence that showed that an increasing number of ANC contacts was associated with an increase in maternal satisfaction. Due to this evidence, the WHO now recommends that a pregnant woman makes a minimum of eight contacts: five contacts in the third trimester, one contact in the first trimester, and two contacts in the second trimester. Furthermore, they provided guidelines on ANC that were recommended and others were context-specific. Among the recommendations given are those that address the problem of LBW such as providing nutrition education among the undernourished populations on increasing the daily energy and protein intake and lower the daily caffeine intake during pregnancy (WHO, 2016)

A study in Nepal, ANC was found to be consistently associated with LBW for the pooled survey data, and for each data set for 2006 and 2011 survey. Not attending antenatal care increased the odds of having a LBW infant by more than two times (Khanal et al., 2014a). This was also the case in a study by Mahumud and colleagues (2017) that found that ANC visits was associated with significant reductions in LBW while receiving inadequate ANC was associated with an elevated risk of LBW.

Similarly, in Zimbabwe, a study by Yaya and others (2017) measured the prevalence of LBW and explored the association between adequate utilization of prenatal care (PNC) services and LBW. The study showed that an inadequate number of ANC visits was associated with higher odds of delivering a LBW infant than those with at least four visits. Similarly, Siza (2008) found that there was a statistically significant difference between the proportions of LBW infants from mothers who did not receive antenatal care services and those who attended the services in Tanzania. Furthermore, other studies found that women who had no antenatal visits or had attended less than four ANC visits were associated with LBW (Kader and Perera, 2014; Khanal et al., 2014b). Evidence from the literature above has shown strong evidence of an existing relationship between ANC and LBW.

BMI. He and others (2018) investigated the association between body mass index (BMI) and birth weight in selected countries in Africa; Burkina Faso, Ghana, Malawi, Senegal, and Uganda. Their study showed that compared with normal-weight mothers, underweight mothers in all five countries had higher odds of having LBW babies but this was statistically significant for Senegal only. Similarly, Endalamaw and colleagues (2019) showed that underweight mothers were more than five times the risk to give birth to LBW infants. Karim and others (2016) also observed that the prevalence of LBW children was much higher among underweight mothers compared to normal weight and overweight mothers. In this case, the association between mothers' nutritional status and childbirth weight was significant.

2.2.3 Environmental factors

Smoking. Previous studies have shown that having maternal smoking has been associated with LBW. Vardavas and others (2010) compared smokers to non-smokers and found that there were increased odds of LBW among smokers compared to non-smokers. Similarly, Samper (2012) assessed body composition differences by anthropometry between newborns from smoking mothers and those from non-smoking mothers. They showed that the Infants who were born from non-smoking mothers were heavier, longer, and body circumferences were larger than those from smoking mothers. Furthermore, Vielwerth and others (2007) showed that maternal smoking was associated with reduced birth weight.

Indoor air pollution. Exposure to indoor air pollution (IAP) from solid fuel use has been connected to approximately 1.5 million annual deaths (WHO, 2006). Milanzi and others (2017) conducted a cross-sectional analysis using secondary data from the 2010 Malawi Demographic Health Survey and found that the use of high pollution fuels resulted in a reduction in mean birth weight compared to low pollution fuel use after adjustment for child, maternal and household characteristics. In contrast with the above study, a study conducted in Nepal showed that the type of cooking fuel used in households was not associated with LBW (Khanal et al., 2014a).

2.3 The Gap in literature

This literature review has revealed that the factors associated with LBW seem to vary across different studies. Thus, conducting country or area-specific studies helps generate information for localized policy formulation. While various studies have been carried out in other countries, including systematic analysis on LBW and factors that influence it, there seems to be insufficiently detailed literature on Zambia. One study by Kasonka (2001) only established the incidence and documented the characteristics of the LBW infants delivered at the University Teaching Hospital (UTH) in Lusaka and did not establish the factors associated with it. Another study conducted by Chibwesha and colleagues (2017) used routine clinical data recorded between 2006 and 2012 in Lusaka. It showed that having twins, a complication of placental abruption, giving birth at less than 37 weeks, extremes of maternal age (less than 20 years and more than 30 years), primiparity, prior stillbirth, prior preterm birth, and pre-gestational diabetes were associated with LBW. It further showed that the first prenatal care visit during the second or third trimester, low body mass index, anemia, syphilis, Human Immunodeficiency Virus (HIV) infection, and hypertension during pregnancy were all associated with increased odds of delivering a LBW neonate. These studies that have been reviewed were carried out more than ten years ago and did not use nationally representative data such as that from the ZDHS. Therefore, this study used more recent and nationally representative information in Zambia, the present study identified determinants of LBW using the ZDHS conducted in 2013/14.

Chapter 3: Methodology

3.1 Study Population

The study population was made up of women aged 15 to 49 years who were interviewed during the ZDHS 2013/14. The ZDHS is a nationally representative sample survey of men and women in the reproductive age-group conducted every after 5 years and is designed to provide up-to-date information on the sampled respondents

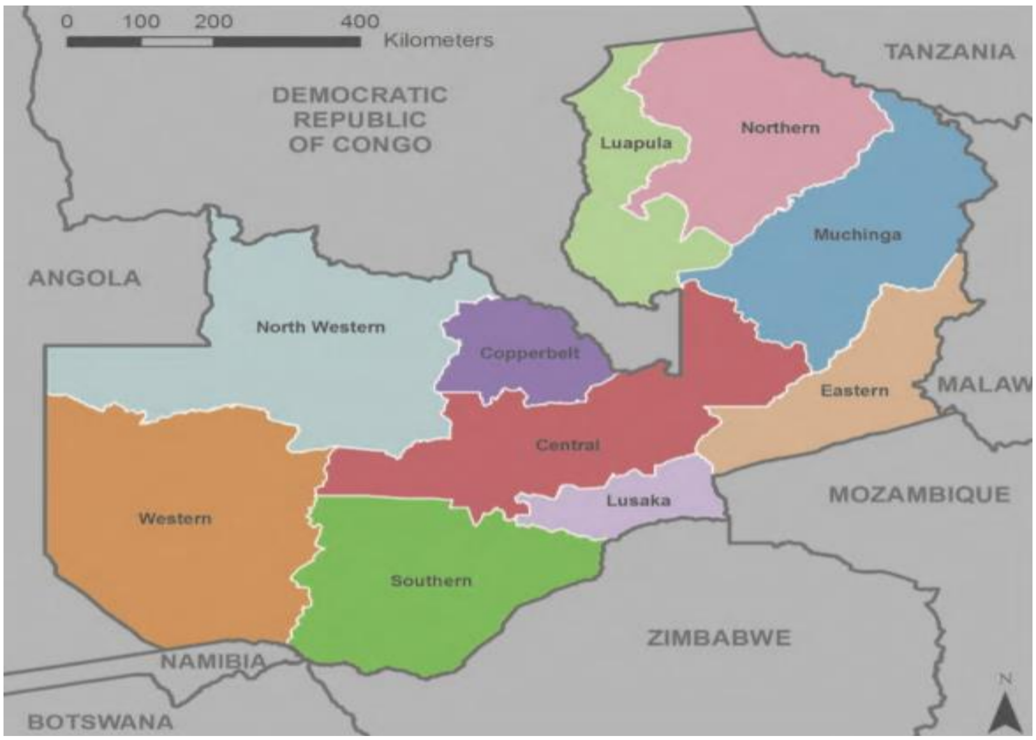

Figure 2: Map of Zambia
Source: CSO, 2014.

3.2 Study Setting

The research setting for the study is Zambia which is a land-locked country that is found in the Sub-Saharan part of Africa, with its capital city being Lusaka. Figure 2 below shows the map of Zambia and the ten (10) distinct administrative provinces. These provinces are further divided into 74 districts. The Lusaka and the Copperbelt provinces are predominantly urban and the other eight (8), Central, Eastern, Muchinga, Northern, Luapula, North-western, and Southern are predominantly rural (CSO, 2014).

3.3 The 2007 and 2013/14 sample design

The sample for the 2007 and 2013/14 was designed to provide estimates of population and health indicators at the national and provincial levels. The ZDHS uses a two-stage stratified cluster sample design. The sample for the 2007 ZDHS was obtained from a sampling frame adopted from the 2000 Census of Population and Housing of Zambia (CPH), while that of the 2013/14 adopted a sampling frame from the 2010 CPH. A stratified sample selected in two stages from the CPH sampling frames was used to obtain a representative sample of 8,000 households for the 2007 surveys while 18,052 households were obtained for the 2013/14 survey. The Stratification was done in such a way that each province was separated into urban and rural areas then the samples were selected independently in every stratum by a two-stage selection.

In the first stage, Standard enumeration areas (SEA's) were selected with probability proportional to the SEA size. A SEA sometimes called a cluster is a geographical area with an average size of 110 households or 510 people and contains information about its location, the type of residences, the number of households, and the population. The SEAs that had been selected and had more than 300 households were segmented, with only one segment selected for the survey with probability proportional to the segment size; this meant that in the ZDHS a cluster is either a SEA or a segment of a SEA. The 2007 had 320 SEA’s while the 2013/14 had 722 SEA’s.

In the second stage, a complete list of households in the selected EA’s was used as the sampling frame from which households were selected for enumeration using probability systematic sampling. An average of 25 households were selected in every selected EA. All private households were listed but people living in institutional households such as army barracks, hospitals, police camps, boarding schools, etc. were excluded. Sampling without replacement was performed and no changes of the pre-selected households were allowed in the implementing stages, this helped prevent bias.

The questionnaire that was used includes information such as background characteristics (age, education, literacy, etc.), reproductive history, fertility preferences, maternal health (antenatal, delivery, and postnatal care), breastfeeding and infant feeding practices, child immunization and childhood illnesses, child mortality, women's work, husbands' background characteristics and maternal mortality among other variables. A total of three questionnaires were used in all three surveys: The Household Questionnaire, the Woman's Questionnaire, and Man's Questionnaire. In addition to English, the questionnaires were translated into seven major local languages, Nyanja, Bemba, Kaonde, Lunda, Lozi, Tonga, and Luvale (CSO, 2014). All women aged 15-49 and all men age 15-59 who were either permanent residents of the households in the ZDHS sample or visitors present in the household on the night before the survey were eligible to be interviewed.

3.4 The LBW determinants study design

This study was cross sectional study that used secondary data which was extracted from the 2007 and 2013/14 ZDHS focusing on LBW babies born to women of 15-19 years old. The study was designed to estimate the prevalence of LBW across 2007 and 2013/14 ZDHS by province using GIS mapping and also determine the association between socio-economic, reproductive behaviours and environmental characteristics and LBW in Zambia. The data set comprised of women who had a live birth in the five years preceding the surveys. The variables for analysis were extracted from the child's file. The main question which was used was the question that asked on whether or not the child was weighed at birth. This was followed by the question which asked about how much the child had weighed. The following eligibility criteria were used to select the participants that were part of the analysis in this study:

Eligibility criteria

Inclusion criteria:

- All women aged 15-49 years who had given birth during the five years preceding the survey.
- All mothers who had reported the weight of the child

Exclusion criteria:

- All women who reported a birthweight that was 4000g and above

- All women who did not have singleton births.

3.5 Data extraction and cleaning

All the information required for the analysis was obtained from the 2007 and 2013/14 ZDHS data set under the individual recode. The individual recode contained all the responses to the woman's questionnaire used during the surveys. Only variables that were important for analysis were kept as part of the data cleaning process. All dependent variables were checked for completeness and only those variables with complete information were included for analysis. For this study, the child file dataset was used to extract the variables associated with the birth of LBW infants amongst women of childbearing years in the ZDHS. Table 1 below shows the variables of interest that were extracted from the available data. The outcome variable, birth weight was reported by the mothers. A binary outcome variable was created, LBW was a weight that was less than 2500g and the normal weight was a weight between 2500g and 3999g and ten (10) exposure variables were selected based on the available literature.

Table 1: List of Variables, Definition, indicators, and measurements

Type of Variable	Operational Definition	Indicator	Scale of Measurement
Dependent Variable			
Low Birth Weight	-LBW -No LBW	Number, Percentage (%)	Binary
Independent Variable			
Maternal age	Age at last birthday	Age in years	Continuous
Maternal educational status	1. No education 2. Primary 3. Secondary 4. Tertiary	Number, Percentage (%)	Ordinal
Household wealth Quintile	1. Poor 2. Middle 3. Rich	Number, Percentage (%)	Ordinal
Place of residence	1. Rural 2.Urban	Number, Percentage (%)	Binary
Birth order	1. First 2. Second 3. Third or more	Number, Percentage (%)	Ordinal

Birth interval	1. <24 months 2. ≥24 months	Number, Percentage (%)	Binary
Parity	1. One 2. Two-three Four or more	Number, Percentage (%)	Ordinal
Number of ANC visits	1. 0 visits 2. 1-3 visits 3. 4 or more visits	Number, Percentage (%)	Binary
Smoking of cigarettes/tobacco	-Smokes -Does no smoke	Number, Percentage (%)	Binary
Type of Cooking fuel	-Relatively polluting -Non-relatively polluting	Number, Percentage (%)	Binary

3.6 Sampling

The study adopted the sampling procedure used by the ZDHS, it did not sub-sample from the ZDHS. The sample size therefore, included all the women from the selected households who had given birth during the five years before each of the surveys and met the inclusion and exclusion criteria.

3.7 Data management and analysis

Stata Version 15.0 Stata Corporation College Station, Texas (StataCorp, 2015) was used for both cleaning and analysis. The data was imported in the software and then cleaned by ensuring that all incomplete and inconsistent entries are accounted for and excluded in the analysis, using the complete case analysis. To adjust for sample weight and multi-stage sampling a Complex Survey Design using Stata procedure was used.

The prevalence of LBW and its distribution across the 10 provinces was estimated, using 2007 and 2013/14 ZDHS. The results were then used to construct maps illustrating the provincial variation in the prevalence of LBW and pattern over time, by adding the estimated prevalence's to the provincial shapefile using ARC GIS software V10.4 which generated the thematic maps. Significant difference was assessed between 2007 and 2013/14 ZDHS, and between provincial LBW in 2010 and 2013/14 ZDHS, using the Chi-square test.

All variables of interest were categorical variables, therefore, proportions were used as descriptive statistics to summarize the data from the 2013-14 ZDHS. The birth weight, age of the mother at birth and BMI were continuous variables, however, they were categorized and summarized using proportions as well (CSO, 2014). The association between LBW and the independent variables were tested by using the Chi-squared test (χ^2) after checking the assumptions. To test the strength of the associations between significant variables in the Chi-square test, crude (unadjusted) odds ratios were used.

All variables in the unadjusted logistics regression were then included in the multiple logistic regression model, regardless of whether they were significant or insignificant to generate adjusted odds ratios (AOR). Using backward stepwise multiple regression model, variables that were most insignificant at $p>0.05$ were removed at each level and this was done until only those that were significant at 5 percent remained in the model.

3.8 Ethical Considerations

Ethical approval from the Tropical Disease and Research Centre (TDRC) in Ndola, Zambia and the US Centre for Disease Control and Prevention (CDC) Atlanta's Research Ethics Review board by the ZDHS. Consent to participate in the survey was sought from the participants. In the re-analysis of the data, confidentiality was observed and anonymity of the information was maintained. Since there was no direct contact with participants, as the study involved the use of secondary data, no obvious physical injury to participants nor unfairness in their selection was observed. In addition to the above, ethics approval was obtained from the University of Zambia Biomedical Research and Ethics committee (UNZABREC) [Reference number: 028-08-18) and National Health Research Authority (NHRA) while Permission was sought from the Central Statistical office to use the ZDHS data.

Chapter 4: Results

4.1 General Characteristics of Study Population from 2013/14 ZDHS

The distribution of the study population used in the analysis is shown in table 2 below.

A total of 13,383 women had given birth five years before the survey and of these births, 8005 births were included in the analysis. Below is the percentage distribution of background characteristics.

Table 2: Distribution of Background Characteristics of respondents, Zambia Demographic and health survey, 2013/14 (N= 8005)

	2013	
Factor	**Number**	**Percentage**
Maternal Age		
<20	1609	20.1
20-34	5434	67.9
35-49	963	12.0
Maternal Education		
No Education	594	7.4
Primary	3929	49.1
Secondary	3039	38.0
Tertiary	437	5.5
Place of Residence		
Urban	3801	47.5
Rural	4204	52.5
Household Wealth Quintile		
Poor		
Middle	2805	35.0
Rich	1607	20.1
	3593	44.9
Birth Order		
1st	2068	25.8
2nd-3rd	2830	35.4
4th or higher	3107	38.8
Birth interval		
<24months	823	13.9
≥ 24 months	5113	86.1
Parity		
1	1463	18.3
2-3	3091	38.6
4+	3452	43.1
BMI		
Underweight	605	7.6

Normal	5314	66.9
Overweight	2025	25.5
Number of ANC visits		
0 visits	15	0.3
1-3 visits	2519	42.0
≥4visits	3459	57.7
Mother's smoking status		
Yes	100	1.2
No	7904	98.8
Type of Cooking Fuel		
Relatively Polluting	6875	88.1
Relatively non- polluting	930	11.9

Table 2 above shows that at the time of pregnancy, the majority of women were aged 20-34 years at 68 percent. The results also showed that at the time of the survey, about half of the women had attained primary education level at 49 percent. Distribution by location showed that 53 percent resided in urban areas while 47 percent resided in rural areas. Furthermore, the results showed that majority of the respondents were from rich households at 45 percent. The majority (86%) of the children had a preceding birth interval of more than 24months and 39 percent were of the fourth or higher order. The study also revealed that about 43 percent of the women had more than 3 children,

In General, The majority (67%) of the women had a normal BMI, 58 percent of the women had attained the required minimum number of ANC visits, 99 percent did not smoke cigarette and 88 percent used relatively polluting fuels as the main source for cooking. The frequency distribution of predictor variables is summarized in table two (see Table 2).

4.2 Descriptive analysis of LBW prevalence in 2007 and 2013/14 ZDHS by province

Overall, the prevalence of low birth weight among the samples in the two surveys remained stable between 2010 and 2014, at about 9percent respectively. However, the variation by province varied across the 2 surveys. The prevalence in the two years showed no statistical difference (p=0.6582). Figure 2 shows the distribution of LBW prevalence in the 2007 and 2013/14 ZDHS by province, with the darker color indicating a higher prevalence of LBW.

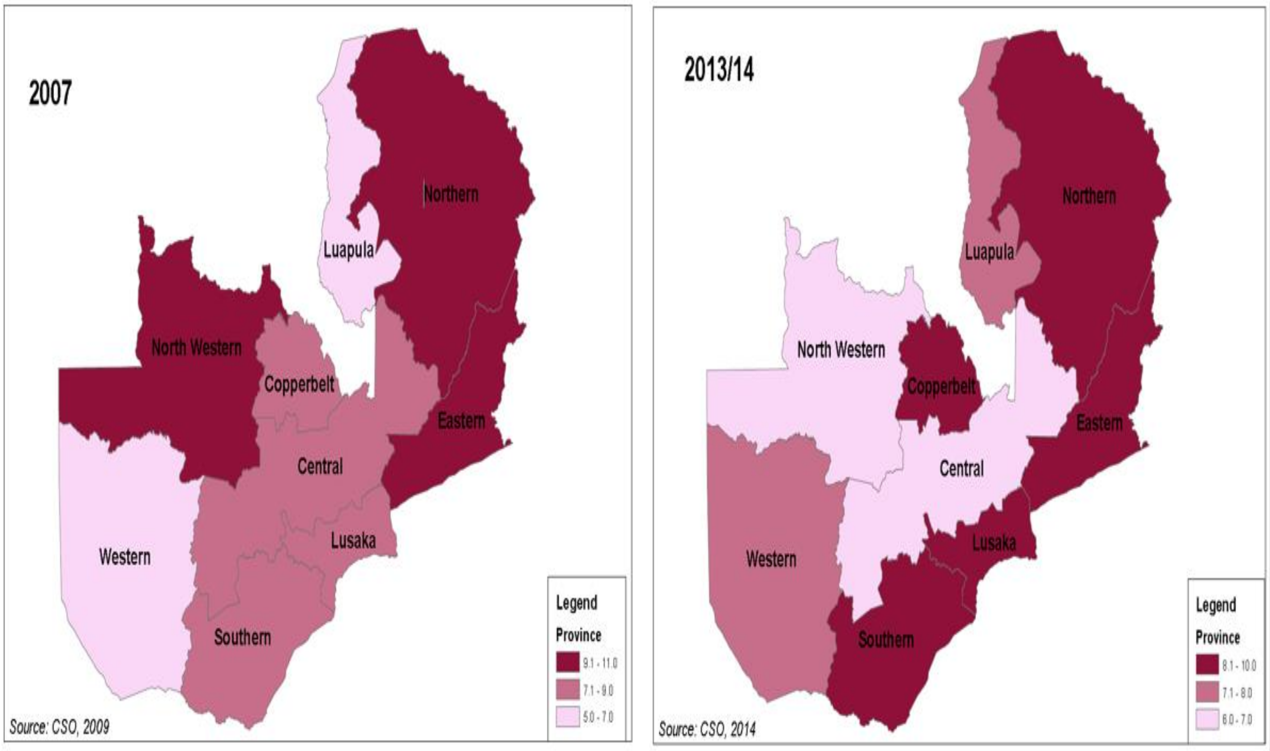

Figure 3: Distribution of LBW prevalence in the 2007 and 2013/14 ZDHS by Province

Figure 3 above shows the data on LBW prevalence for nine provinces in Zambia, with the darker areas indicating a higher prevalence. In 2007, the highest LBW prevalence was observed in North-western province (11.2%) and Northern (10.2%), and the lowest in Western (7.3%) and Luapula (5.4%). This distribution changed between 2007 and 2013/14. In 2013/14, the highest prevalence of LBW was in Southern (10.2%) and Copperbelt (9.4%), which was a slight increase compared with 2007 (9.2% for Southern and 8.9% for Copperbelt). However, the increases observed in both provinces was statistically insignificant. ($p>0.05$). LBW prevalence in North-Western and Northern declined slightly in 2013/14, to 6 percent and 9 percent, respectively, but only statistically significant for North-western ($p<0.05$).

4.3 Association between Background Characteristics and LBW in 2013/14

This section presents the results of the association between background characteristics and LBW using Pearson's Chi-square test. The study revealed that there was an association between maternal age, birth order, parity and number of antenatal care and LBW while maternal education, household wealth quintile, places of residence, BMI, mother's smoking status, type of cooking fuel and birth interval showed no evidence of an association with LBW.

Table 3: Association between background characteristics and LBW

Factor	No LBW ≥2500g	Percent	LBW <2500g	Percent	P-value
Maternal Age					
<20	1401	87.10	208	12.90	**<0.0001***
20-34	5023	92.45	410	7.55	
35-49	887	92.15	76	7.85	
Maternal Education					0.5170
No Education	542	91.19	52	8.81	
Primary	3584	91.22	345	8.78	
Secondary	2771	91.17	268	8.83	
Tertiary	411	93.83	27	6.17	
Place of Residence					0.3934
Urban	3459	90.99	342	9.01	
Rural	3953	91.65	351	8.35	
Household Wealth Quintile					0.9327
Poor	2567	91.50	238	8.50	
Middle	1464	91.09	143	8.91	
Rich	3281	91.32	312	8.68	
Birth Order					
1st	1806	87.30	263	12.70	**<0.0001***
2nd-3rd	2622	92.66	208	7.34	
4th or Higher	2884	92.82	223	7.18	
Birth interval					0.1392
<24months	751	91.24	72	8.76	
≥ 24 months	4755	92.69	359	7.01	
Parity					**<0.0001***
1	1284	87.78	179	12.22	
2-3	2823	91.33	268	8.67	
4+	3204	92.85	247	7.15	
BMI					
Underweight	535	88.37	70	11.63	0.0606
Normal	4845	91.18	469	8.82	
Overweight	1872	92.46	153	7.54	
Number of ANC visits					**0.004***
0 visits	9	59.49	6	40.51	
1-3 visits	2288	90.85	230	9.15	
≥4visits	3194	92.32	266	7.68	
Mothers Smoking status					0.7274
Yes	93	92.58	7	7.42	
No	7218	91.32	686	8.68	
Type of Cooking Fuel					0.2845
Relatively Polluting	6276	91.28	600	8.72	
Relatively non- polluting	863	92.72	68	7.28	

*Significant variables at **0.05** level of significance

Among the women below the age of 20 years, 13 percent had a LBW compared to those who were aged 20-34 years and 35- 49 years who both had 8 percent, and this difference was statistically significant ($p<0.05$). LBW was highest among children whose mothers had no education, attained primary and secondary education at 9 percent whilst those who had attained tertiary education were six percent and this association was not statistically significant ($p>0.05$). Other analysis showed that there was no significant difference ($p>0.05$) amongst mothers from poor (9%), middle (9%) and rich households (9%). LBW was much higher among mothers who had one child (12%) compared to mothers with two to three (9%) and four and more children (7%), with the association between parity and childbirth weight being significant ($p<0.05$). There was a statistical difference between birth order and LBW ($p<0.05$), with all births that were of the first order being thirteen and those of the second or third order and fourth or higher-order being seven percent.

Mothers who were underweight and had a LBW child represented a proportion of 12percent while those who had a normal BMI and were overweight were 9percent and 8percent, respectively and this was statistically insignificant ($p>0.05$).). Forty-one percent of those mothers who did not make any ANC visit had a child with a LBW, this proportion was statistically significant ($p<0.05$) from nine percent and eight percent for those who had made one to three and four or more visits, respectively. Few mothers (7%) smoked cigarettes and its association with LBW was statistically insignificant ($p>0.05$). No association was found between the type of cooking fuel and LBW with the majority (92%) of the women using highly polluting cooking fuel (see table 3 above).

4.4 Logistic Regression Analysis

This section used simple and multivariable logistic regression in order to analyze the relationship between the dependent variable (LBW) and explanatory variables (Maternal age, mothers highest level of education, Place of residence, household wealth quintile, birth order, parity, birth interval, BMI, ANC, type of cooking fuel and smoking status of the mother). The model allowed to estimate the probability that the child born could have a LBW or not. Table 4 below shows both unadjusted and adjusted estimates and that 1.0 was the odds of the reference group or category. Therefore, for instance, the odds of having a LBW baby was odds ratio times greater (OR>1) or times less (OR<1) for the women not in the reference group compared to those in the reference group.

Table 4: Crude and adjusted measures of the effect of independent variables on LBW

Factor	OR (95% CI)	P-value	AOR (95% CI)	P-value
Maternal Age				
<20	1.00		1.00	
20-34	0.55 (0.45-0.68)	**<0.0001***	0.65(0.36-1.15)	0.135
35-49	0.58(0.38-0.87)	**0.009***	0.70(0.32-1.51)	0.360
Maternal Education				
No Education	1.00		1.00	
Primary	1.00(0.67-1.47)	0.981	0.74(0.45-1.23)	0.265
Secondary	1.00(0.67-1.51)	0.994	0.70(0.41-1.22)	0.235
Tertiary	0.68(0.38-1.23)	0.202	0.96(0.39-2.40)	0.993
Place of Residence				
Urban	1.00		1.00	
Rural	0.92 (0.76-1.11)	0.393	0.89(0.62-1.29)	0.552
Household Wealth Quintile				
Poor	1.00		1.00	
Middle	1.05(0.81-1.37)	0.701	0.97(0.63-1.48)	0.900
Rich	1.02(0.81-1.28)	0.845	1.13(0.71-1.81)	0.585
Birth Order				
1st	1.00		-	-
2nd-3rd	0.54(0.43-0.68)	**<0.0001***		
4th or More	0.53(0.42-0.67)	**<0.0001***		
Birth interval				
≥ 24months	1.00		1.00	
<24 months	1.27(0.92-1.75)	0.140	1.49(0.97-2.27)	0.97
Parity				
1	1.00			
2-3	0.68(0.54-0.87)	**0.002***	-	-
4+	0.55(0.44-0.70)	**<0.0001***		
BMI				
Normal	1.00		1.00	
Underweight	1.36(1.00-1.85)	0.051	1.14(0.70-1.83)	0.576
Overweight	0.84(0.64-1.11)	0.228	0.72(0.48-1.06)	0.090
Number of ANC visits				
0 visits	1.00		1	
1-3 visits	0.15(0.04-0.58)	**0.006***	0.19(0.04-0.83)	**0.027***
≥4visits	0.12(0.03-0.47)	**0.002***	0.18(0.04-0.76)	**0.020***
Mothers Smoking status				
Yes	1.00		1.00	
No	1.19(0.45-3.09)	0.728*	0.90(0.28-2.84)	0.854
Type of Cooking Fuel				
Relatively Polluting	1		1	
Relatively non- polluting	0.82(0.57-1.19)	0.285	0.62(0.31-1.25)	0.178

*Significant variables at **0.05** level of significance, **OR:** Odds ratio**, AOR:** Adjusted Odds Ratio, **95% CI:** 95% confidence interval. **(-)**: No results because the variable was not included in the final model due to being insignificant at >0.05 or due to multicollinearity.

In unadjusted analysis, maternal age of 20-34 and 35-49 (OR=.55, 95% CI: 0.45, 0.68; p<0.0001 and OR=0.58, 95% CI: 0.38, 0.87; p=0.009) showed a reduced likelihood of delivering a LBW baby compared to the maternal age of less than 20 years. Similarly, children of the second or third and fourth or higher-order (OR=0.54, 95% CI: 0.43, 0.68; p<0.0001 and OR=0.53, 95% CI: 0.42, 0.67; p<0.001 respectively) showed a reduced likelihood of LBW than children of the first order. Decreased likelihood of LBW was seen in children born to mothers who had two to three and four or more children ever born (OR=0.68, 95% CI: 0.54, 0.87, p=0.002 and OR=0.55, 95% CI: 0.44, 0.70; p<0.0001, respectively) in comparison to mothers who only had one child ever born. Having made 1-3 ANC visits showed reduced odds of having a LBW (OR=0.15, 95% CI: 0.04, 0.58; P=0.006) compared to not having made any visits and was also significant. Similarly, mothers who had four or more visits were less likely to deliver LBW infants (OR=0.12, 95% CI: 0.03, 0.47; P=0.002). Maternal education, place of residence, household wealth quintile, type of cooking fuel, smoking status of the mother, BMI and birth interval showed no association with LBW.

Table 4 also shows the findings from the first multivariable analysis that was run. All variables were included in the first model that was run, whether they were statistically significant or not at the univariate analysis. The Odds ratios for LBW were adjusted for all variables in the model. Due to multicollinearity, birth order and parity were excluded from the analysis. The results revealed that after adjusting for the all the variables, having made 1-3 ANC visits (AOR=0.19, 95% CI: 0.04, 0.83; P=0.027) and having made four or more ANC visits (AOR=0.18, 95% CI: 0.04, 0.76; P=0.020) still showed reduced likelihood of delivering a LBW infant and were significantly associated with LBW. The association between maternal age and LBW was not evident anymore, after adjusting for the other variables in the model. Maternal education, place of residence, household wealth quintile, BMI, birth interval, smoking status of the mother, and type of cooking fuel still showed no association with LBW in the adjusted model.

4.5 Determinants of LBW in 2013/14

This section presents the results from the backward stepwise multiple regression model of LBW and the independent variables. Backwards stepwise regression involves entering all variables of interest into the model and removing the variable that is most insignificant at p>0.05 and this is done until only those that are significant remain in the model. Therefore, the final model whose results are presented below only comprised of the variables that were statistically significant at 5 percent.

The goodness-of-fit test for binary response models using survey data known as the Hosmer-Lemeshow test was used to determine the best model using the 'estat gof' command which is only available after svy: logistic commands have been run. This test is used to determine whether the fitted model accurately explains the observed outcome in the data. If the F statistic is less than 0.05, the model is rejected as it is not good at explaining the observed outcome and if it is greater than 0.05, then the model is a good fit. In our Final model, the goodness of fit test at 5 percent level of significance found an F statistic=0.9998, implying that our model is a good fit.

From the analysis, the final model included maternal age and number of antenatal visits and these were all statistically significant at p<0.05. The study revealed that older ages were associated with reduced odds of having a LBW child. Mothers aged 20-34 years were 44 percent less likely to deliver LBW children compared to mothers aged below the age of 20 years and this can be as low as 29 percent and as high as 56 percent at 95percent confidence interval. Similarly, mothers aged 35-49 years were 47 percent less likely to deliver LBW children compared to mothers below the age of 20 years and this can be as low as 17percent and as high as 65 percent at 95percent confidence interval. The analysis also revealed that compared to mothers who had not made any ANC visit, mothers who made 1-3 visits were 84 percent less likely to deliver a LBW child and this can be as low as 38 percent and as high as 96 percent at 95 percent confidence interval. Furthermore, mothers who had made four or more visits were 86 percent less likely to deliver a LBW child compared to the mothers who did not make any ANC visit and this could be as low as 48percent and as high as 96percent at 95percent interval. The results of the analysis are presented in Table 5 below.

Table 5: Determinants of LBW using Backwards Stepwise Multiple Regression

Variable	AOR 95%CI)	P-value
Maternal Age		
<20	1.00	
20-35	0.56(0.44-0.71)	**<0.0001***
35-49	0.53(0.35-0.83)	**0.005***
ANC		
0 visits	1.00	
1-3 visits	0.16(0.04-0.62)	**0.008***
≥4visits	0.14(0.04-0.52)	**0.004***

*Significant variables at **0.05** level of significance, **AOR:** Adjusted Odds Ratio, **95% CI:** 95% confidence interval

Figure 4 below shows the analysis of the association of LBW and maternal age by residence after adjusting for the number of ANC visits. The analysis showed that in both the urban and rural areas, maternal ages 20-34 and 35-49 years still showed reduced odds of delivering a LBW child compared to mothers aged less than 20 years. Although the odds are weakened in the rural areas compared to the urban areas in both age groups, this was statistically significant for all age groups except for 35-49 years in the rural areas.

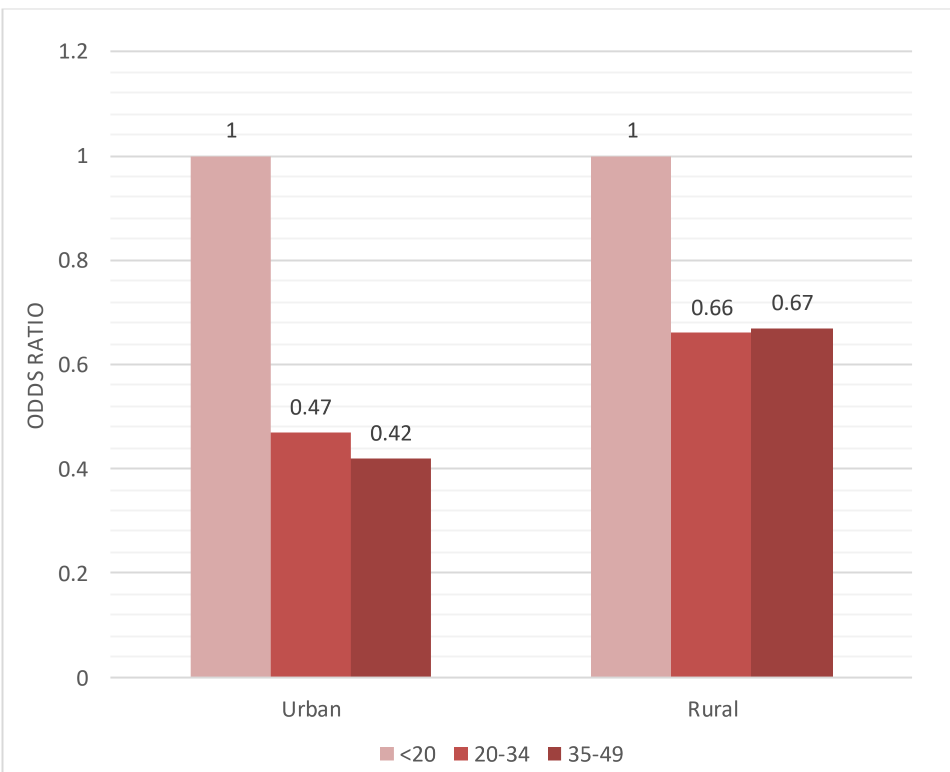

Figure 4: Number of ANC Visits adjusted for Maternal Age

Analysis of the association between LBW and ANC by residence after adjusting for maternal age showed that visiting ANC 4 times and above tended to be associated with reduced odds of delivering a LBW child compared to mothers who did not make any ANC visit in both urban and rural areas. Although the protective effect was weakened in rural areas than in the urban areas. Similarly, in both the urban and rural areas, mothers who had made 1-3 ANC visits were associated with reduced odds of delivering a LBW child, this is shown in figure 5 below. The associations observed between Number of ANC visits and LBW were statistically significant in the urban areas but insignificant in the rural areas.

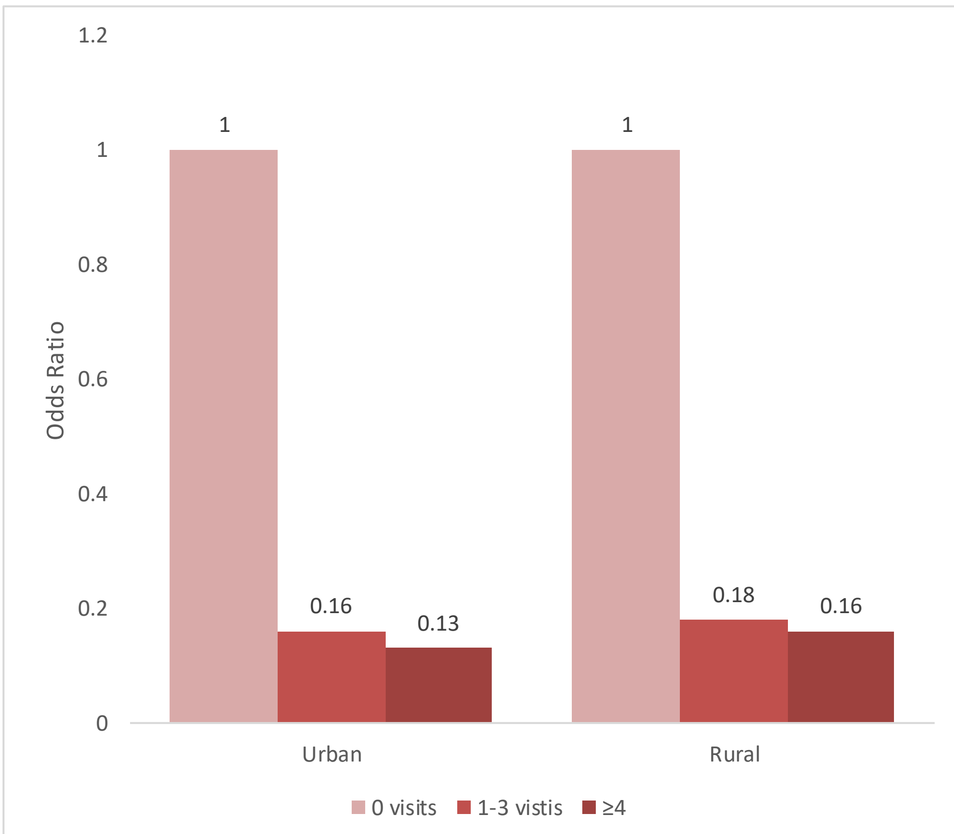

Figure 5: Maternal age adjusted for number of ANC Visits

Chapter 5: Discussion

5.1 Study Discussion

In the present study, LBW prevalence remained stable between 2007 and 2013/14 but showed some sharp differential variations across provinces. Our analysis of the 2013/14 ZDHS further revealed that lack of any ANC visits and maternal ages less than 20 years were the core drivers of LBW in this population.

Prevalence of LBW

This study estimated the provincial variations in the prevalence of LBW in Zambia and the changes in prevalence over time, based on the 2007 and 2013/14 ZDHS. Our findings showed that the prevalence of LBW had remained static at around 9 percent of the sample that was included in the analysis in both the 2007 ZDHS and the 2013/14 ZDHS and the difference was insignificant. This finding is consistent with the prevalence presented in the 2 survey reports which had included multiple births and those infants who were overweight (CSO, 2009; CSO, 2014). Results similar to the findings in this study were seen in Cambodia and Nepal which showed that the prevalence was stable in the 2 different survey rounds that were analysed and observed no statistical difference(Khanal et al., 2014b, Chhea et al., 2018). It must be noted that this prevalence of 9 percent is much lower than the global average of 15 percent and the Southern Africa region average of 14 percent (UNICEF and WHO, 2019).

The distribution of LBW prevalence by province across the 2 survey rounds showed some sharp differential variations. The increases in the prevalence were observed in Copperbelt, Luapula, Southern and western provinces whilst reductions were observed in the Central, Eastern, Lusaka, Northern and North-western provinces, however, the observed differences were not significant except in Northwestern province. The reasons for this variation are not known but it would sound logical to attribute the significant difference observed in North-Western Province to the increase in the number of pregnant women utilizing ANC services from a skilled provider which increased from 85 percent in 2007 to 96 percent in 2013/14.

Maternal Age

Maternal age constituted an important risk factor with women less than 20 years of age recording the highest proportion (12.90%). Mothers were aged 20-39 years were less likely to have a LBW infant compared to the mothers aged less than 20 years. By implication, giving birth between 20-34 years of age was a protective factor against LBW. The analysis by residence further showed that this protective effect was more advantageous in urban than rural areas.

This finding is not surprising as among young mothers below the age of 20 years, the LBW may be attributed to the physiological needs associated with adolescence. As the adolescent is still growing, they compete with the foetus for nutrients and the pregnancy may limit maternal growth (Rah et al., 2008). It is also reasonable to think that young women aged less than 20 years may have inadequate knowledge on how to take care of themselves during the time of pregnancy or that they are more likely to delay to utilize ANC services (Sinyange et al., 2016). The finding that this is predominantly among the mothers in the rural areas suggests that there is need for a strong system to be put in place to focus entirely on the younger mothers in this population.

The strong association between maternal age and birth weight that has been observed in this study is comparable to the findings of a study conducted by Agorinya and others (2018) that showed that maternal ages 20-34 and 35-49 years were protective against LBW. Similar results obtained by Gebregzabiherher and colleagues (2017) also revealed that mothers aged less than 20 years were more likely to deliver LBW babies than mothers aged 20–34 years. However other studies have shown no significant association between mother's age and LBW (Mahumud et al., 2017 and Tshotetsi et al., 2019)

Frequency of ANC visits

The present study also revealed that the number of ANC visits influences the delivery of LBW babies. Compared to mothers who did not make any visit, mothers who had made at least one or more ANC visit were less likely to deliver a LBW infant. This shows that making at least one or more ANC visits was a protective effect against LBW. A further analysis by residence revealed that the protective effect was reduced in the rural areas compared to the urban areas, making it rather important to improve the coverage and uptake of ANC.

The findings in this study are similar to the findings of study by Khanal and others (2014b) in Nepal that showed that mothers who had no antenatal visits were more likely to have small size infants than those who had attended four or more antenatal visits. Another study in Zimbabwe by Yaya and others (2017) also found that making ANC visits are protective against LBW. These results are as expected as they re-emphasize the important role that ANC plays as one of the components of maternal care on which the life of mothers and babies depend. During ANC visits, health workers carry out several assessments, screen for potential risk factors, and apply preventive interventions to avoid LBW and other poor birth outcomes. Different risk factors remain undiagnosed if one does not attend ANC during pregnancy. The reduced protective effect in the rural area suggests that there may be additional underlying inequity related to factors negatively associated with access or utilization of services. This may also be attributed to long distances they need to cover to get to the nearest health service provider and lack of knowledge on the importance of ANC.

Results similar to the findings in this study were seen in other studies conducted in Bangladeshi, Ethiopia, Ghana and Malawi that showed that mothers highest education level, household wealth quintile, place of residence, birth interval, BMI, mothers smoking status and type of cooking fuel are not associated with LBW (Alemu et a., 2011, Manyeh et al., 2016, Karim et al., 2016 and Milanzi., et al, 2017).

5.2 Strengths and Limitations

One of the strengths of this study is that it is based on nationally representative data derived from validated questionnaires and methodology with a high response rate (96.2%). The statistical analysis used also accounted for the multi-stage cluster sampling to ensure that findings could be generalizable to the entire country. Our study assessed factors influencing LBW based on the nationwide survey that collects a large number of socioeconomic and health-related determinants from five years preceding the survey. Due to the small sample size amongst the mothers who did not attend ANC, the results should be interpreted with caution. Another limitation in the use of the 2013/14 survey data reported about five years ago may not reflect prevailing situation as the picture may have changed. However, we cannot measure the effect of these limitations but we are confident that our findings make a significant contribution to the existing knowledge emphasizing the importance of reducing the problem of LBW in Zambia that is a strong determinant of neonatal mortality.

Chapter 6: Conclusions and Recommendations

6.1 Conclusion

This study set out to estimate the prevalence pattern of LBW and determine the setting specific critical drivers of LBW among women aged 15 to 49 years in Zambia. The findings clearly indicate that the prevalence of LBW in Zambia remains high overall but showing sharp differential variation across the provinces in Zambia. Furthermore, this burden is concentrated in younger mothers and mothers who do not attend ANC and this predominantly among rural mothers suggesting that there may be additional underlying inequity related to factors negatively associated with access or utilization of services. The high prevalence of LBW points to the need for strategies that enhance maternal health and child survival in Zambia. Given that LBW has the strongest influence on the neonatal mortality in Zambia, the study, therefore, recommends the need to have more programs that target such populations at risk including but not limited to programs against teenage pregnancies and strengthening the use of ANC services especially in provinces that showed an increased prevalence.

6.2 Recommendations

These findings suggest several courses of action to reduce the prevalence in the country especially in the provinces that have shown an increase in prevalence. Younger maternal ages have shown to be influencing LBW in Zambia, hence the need to develop preventive measures that will help reduce the burden of LBW. Findings in the study highlight the importance of strengthening strategies that are already in place to eliminate early marriages which can avoid teenage pregnancies. There is also the need to keep girls in school and enhance their knowledge on sexual and reproductive health education in schools, health centers and the community that will increase their knowledge on adverse birth outcomes amongst teenagers. Efforts to ensuring the implementation these programs will aid in delaying their likelihood of getting pregnant at an early age as they will be focused on attaining higher education.

Study findings show that not attending any ANC visit also significantly influences LBW. The promotion of the use of ANC services needs to be strengthened, especially now that the number of visits has been increased to a minimum of eight contacts with a health facility. This can be done through community-based health education approaches or using the radios and televisions to stress its importance. This is because ANC has been found to provide a platform for early detection and timely treatment of any possible complication, therefore, it is through this that the detection of and reduction of LBW can be achieved. Efforts should be made to take up the context-specific WHO recommendation of providing nutrition education among the undernourished populations on increasing the daily energy and protein intake, considering that there was a higher prevalence of LBW among the underweight mothers (WHO., 2016). Further research is needed to further understand the exact ways in which the identified factors influence LBW in Zambia.

REFERENCES

Agorinya, I. A., Kanmiki, E. W., Nonterah, E. A., Tediosi, F., Akazili, J., Welaga, P., Azongo, D. & Oduro, A. R. 2018. Socio-demographic determinants of low birth weight: evidence from the kassena-nankana districts of the upper east region of Ghana. *Plos One,* 13**,** E0206207

Alemu, T. & Umeta, M. 2016. Prevalence and predictors of "small size" babies in ethiopia: in-depth analysis of the Ethiopian Demographic and Health Survey, 2011. *Ethiop J Health Sci,* 26**,** 243-50.

Borah, M. & Agarwalla, R. 2016. Maternal and socio-demographic determinants of low birth weight (LBW): a community-based study in a rural block of Assam. *J Postgrad Med,* 62**,** 178-81.

Bugssa, G., Alemayehu, M. & Dimtsu, B. 2014. Socio-demographic and maternal determinants of low birth weight at mekelle hospital, Northern Ethiopia: A cross sectional Study. *Open Journal Of Advanced Drug Delivery,* 2**,** 609-18.

Demelash, Habtamu, Achenif Motbainor, Dabere Nigatu, Ketema Gashaw & Addisu Melese. 2015. "risk factors for low birth weight in bale zone hospitals , South-east Ethiopia : A case – control study." *Bmc Pregnancy And Childbirth* 1–10.

Chhea, C., Ir, P. & Sopheab, H. 2018. Low Birth Weight of Institutional Births In Cambodia: Analysis of The Demographic And Health Surveys 2010-2014. *Plos One,* 13**,** E0207021.

Chibwesha, C. J., Zanolini, A., Smid, M., Vwalika, B., Phiri Kasaro, M., Mwanahamuntu, M., Stringer, J. S. & Stringer, E. M. 2016. Predictors And Outcomes of Low Birth Weight In Lusaka, Zambia. *Int J Gynaecol Obstet,* 134**,** 309-14.

Central Statistical Office, Central Board Of Health, & ORC Macro. 2003. Zambia Demographic and Health Survey 2001-2002. Calverton, Maryland, USA: Central Statistical Office, Central Board of Health, and ORC Macro International Inc.

Central Statistical Office (CSO and TDRC), Ministry of Health, Tropical Diseases Research Centre (CSO and TDRC), University of Zambia & Macro International Inc. 2009. Zambia Demographic and Health Survey 2007. Calverton, Maryland, USA: CSO and Macro International Inc.

Central Statistical Office (CSO and TDRC), Ministry Of Health & ICF International. 2014. Zambia Demographic and Health Survey 2013-14. Rockville, Maryland, USA: Central Statistical Office, Ministry of Health, and ICF International Inc.

Dasgupta A &Basu R. Determinants of low birth weight in a block of Hooghly, West Bengal: A multivariate analysis. Int J Biol Med Res 2011;2(4):838-42.

Demelash, H., Motbainor, A., Nigatu, D., Gashaw, K. & Melese, A. 2015. Risk factors for low birth weight in bale zone hospitals, South-east Ethiopia : A case-control study. *Bmc Pregnancy Childbirth,* 15**,** 264.

Ediriweera, D. S., Dilina, N., Perera, U., Flores, F. & Samita, S. 2017. Risk of low birth weight on adulthood hypertension - evidence from a tertiary care hospital in a south asian country, Sri Lanka: A retrospective cohort study. *Bmc Public Health,* 17**,** 358.

Elhassan, E. M., Abbaker, A. O., Haggaz, A. D., Abubaker, M. S. & Adam, I. 2010. Anaemia and low birth weight in medani, hospital Sudan. *Bmc Res Notes,* 3**,** 181.

Endalamaw, A., Engeda, E. H., Ekubagewargies, D. T., Belay, G. M. & Tefera, M. A. 2018. Low Birth weight and its associated factors in Ethiopia: a systematic review and meta-analysis. *Ital J Pediatr,* 44**,** 141.

Frimmel, W., & Pruckner, G. J. (2014). Birth weight and family status revisited: evidence from austrian register data. Health Economics, 23(4), 426-445.

Gebregzabiherher, Y., Haftu, A., Weldemariam, S. & Gebrehiwet, H. 2017. The prevalence and risk factors for low birth weight among term newborns in adwa general hospital, Northern Ethiopia. *Obstet Gynecol Int,* 2017**,** 2149156.

Golestan, M., Akhavan Karbasi, S. & Fallah, R. 2011. Prevalence and risk factors for low birth weight in yazd, Iran. *Singapore Med J,* 52**,** 730-3.

Harding, L., Walker, L. G., Lloyd, D. & Duffty, P. 2001. A Controlled study of children born at gestation 28 weeks or less: psychological characteristics at seven to ten years of age. *Health Bull (Edinb),* 59**,** 81-90.

He, Z., Bishwajit, G., Yaya, S., Cheng, Z., Zou, D. & Zhou, Y. 2018. Prevalence of low birth weight and its association with maternal body weight status in selected countries in africa: a cross-sectional study. *Bmj Open,* 8**,** E020410.

Hodek, J.-M., Von Der Schulenburg, J.-M. & Mittendorf, T. J. H. E. R. 2011. Measuring economic consequences of preterm birth-methodological recommendations for the evaluation of personal burden on children and their caregivers. 1**,** 6.

Kader, M. & Perera, N. K. 2014. Socio-economic and nutritional determinants of low birth weight in india. *N Am J Med Sci,* 6**,** 302-8.

Kasonka L, 2001, A study of low birtheight infants delivered at the university teaching hospital in lusaka. Master's Thesis, University Of Zambia.

Kaur S, Upadhyay Ak, Srivastava Dk, Srivastava R & Pandey On. Maternal correlates of birth weight of newborn: a hospital based study. Ind J Comm Health. 2014:26 (2); 187-191

Khanal, V., Sauer, K., Karkee, R. & Zhao, Y. 2014a. Factors associated with small size at birth in nepal: further analysis of Nepal demographic and health survey 2011. *Bmc Pregnancy Childbirth,* 14**,** 32.

Khanal, V., Zhao, Y. & Sauer, K. 2014b. Role of antenatal care and iron supplementation during pregnancy in preventing low birth weight in Nepal: comparison of national surveys 2006 And 2011. *Arch Public Health,* 72**,** 4.

Khatun, S. & Rahman, M. 2008. Socio-Economic Determinants of low birth weight in bangladesh: a multivariate approach. *Bangladesh Med Res Counc Bull,* 34**,** 81-6.

Kim, D. & Saada, A. 2013. The Social determinants of infant mortality and birth outcomes in western developed nations: a cross-country systematic review. *Int J Environ Res Public Health,* 10**,** 2296-335.

Kramer, M. S. 1987. Determinants of low birth weight: methodological assessment and meta-analysis. *Bull World Health Organ,* 65**,** 663-737.

Lau, C., Ambalavanan, N., Chakraborty, H., Wingate, M. S. & Carlo, W. A. 2013. Extremely low birth weight and infant mortality rates in The United States. *Pediatrics,* 131**,** 855-60.

Lukonga, E. & Michelo, C. 2015. Factors associated with neonatal mortality in the general population: evidence from The 2007 Zambia Demographic And Health Survey (Zdhs); A Cross Sectional Study. *Pan Afr Med J,* 20**,** 64.

Magadi, M., Diamond, I., Madise, N. & Smith, P. (2004). Pathways of the determinantsof unfavorable birth outcomes in Kenya. *Journal Of Biosocial Science, 36*(2), 153–76.

Mahumud, R. A., Sultana, M. & Sarker, A. R. 2017. Distribution and determinants of low birth weight in developing countries. *J Prev Med Public Health,* 50**,** 18-28.

Manyeh, A. K., Kukula, V., Odonkor, G., Ekey, R. A., Adjei, A., Narh-Bana, S., Akpakli, D. E. & Gyapong, M. 2016. Socioeconomic and demographic determinants of birth weight in

southern rural ghana: evidence from Dodowa Health and Demographic Surveillance System. *Bmc Pregnancy Childbirth,* 16**,** 160.
Milanzi, E. B. & Namacha, N. M. 2017. Maternal biomass smoke exposure and birth weight in malawi: analysis of data from The 2010 Malawi Demographic And Health Survey. *Malawi Med J,* 29**,** 160-165.
Muula, A. S., Siziya, S. & Rudatsikira, E. 2011. Parity and maternal education are associated with low birth weight in Malawi. *Afr Health Sci,* 11**,** 65-71.
Qadir, M. & Bhutta, Z. A. 2009. Low birth weight in developing countries. *Small For Gestational Age.* Karger Publishers.
Rah, J. H., Christian, P., Shamim, A. A., Arju, U. T., Labrique, A. B. & Rashid, M. J. T. J. O. N. 2008. Pregnancy and lactation hinder growth and nutritional status of adolescent girls in rural Bangladesh. 138**,** 1505-1511.
Rafati S, Borna H, Akhavirad Mb. & Fallah N. 2005. “Maternal determinants of giving birth to low-birth-weight neonates.” 8(4):277–81.
Risnes, K. R., Vatten, L. J., Baker, J. L., Jameson, K., Sovio, U., Kajantie, E., Osler, M., Morley, R., Jokela, M., Painter, R. C., Sundh, V., Jacobsen, G. W., Eriksson, J. G., Sorensen, T. I. & Bracken, M. B. 2011. Birthweight and mortality in adulthood: a systematic review and meta-analysis. *Int J Epidemiol,* 40**,** 647-61.
Samper, M. P., Jimenez-Muro, A., Nerin, I., Marqueta, A., Ventura, P. & Rodriguez, G. 2012. Maternal active smoking and newborn body composition. *Early Hum Dev,* 88**,** 141-5.
Sebayang, S. K., Dibley, M. J., Kelly, P. J., Shankar, A. V. & Shankar, A. H. 2012. Determinants of low birthweight, small-for-gestational-age and preterm birth in lombok, Indonesia: analyses of the birthweight cohort of The Summit Trial. *Trop Med Int Health,* 17**,** 938-50.
Sharma, Sudesh Raj, Smith Giri, Utsav Timalsina, & Sanjiv Sudarshan Bhandari. 2015. “Low Birth weight at term and its determinants in a tertiary hospital of Nepal : A Case-Control Study.” 1–10.
Sinyange, N., Sitali, L., Jacobs, C., Musonda, P. & Michelo, C. J. T. P. A. M. J. 2016. Factors associated with late antenatal care booking: population based observations from the 2007 Zambia Demographic And Health Survey. 25.
Siza, J. E. 2008. Risk factors associated with low birth weight of neonates among pregnant women attending a referral hospital in Northern Tanzania. *Tanzan J Health Res,* 10**,** 1-8.
Tshotetsi, L., Dzikiti, L., Hajison, P. & Feresu, S. 2019. Maternal factors contributing to low birth weight deliveries in tshwane district, South Africa. *Plos One,* 14**,** E0213058.
Tema, T. 2006. Prevalence and determinants of low birth weight in jimma zone, southwest Ethiopia. *East Afr Med J,* 83**,** 366-71.
United Nations .2003. World Development Report 2003, United Nations, New York.
United Nations Children’s Fund & World Health Organization. 2019. Low Birthweight: Country, Regional and Global Estimates. New York. Who.
Vardavas, C. I., Chatzi, L., Patelarou, E., Plana, E., Sarri, K., Kafatos, A., Koutis, A. D. & Kogevinas, M. 2010. Smoking and smoking cessation during early pregnancy and its effect on adverse pregnancy outcomes and fetal growth. *Eur J Pediatr,* 169**,** 741-8.
Vielwerth, S. E., Jensen, R. B., Larsen, T. & Greisen, G. 2007. The impact of maternal smoking on fetal and infant growth. *Early Hum Dev,* 83**,** 491-5.
World Health Organization.2015. *Global Nutrition Targets 2025: Low Birth Weight Policy Brief.2014.2025.*
World Health Organization & Unicef, 2004. Low Birthweight: Country, Regional And Global Estimates.

World Health Organization.2006. *Reproductive Health Indicators : Guidelines For Their Generation, Interpretation And Analysis For Global Monitoring.*

World Health Organization.2006. *Fuel For Life: Household Energy And Health*. Geneva, Switzerland Who

World Health Organisation. 2016. *Who Recommendations On Antenatal Care For A Positive Pregnancy Experience,* World Health Organization.

Yaya, S., Bishwajit, G., Ekholuenetale, M. & Shah, V. 2017. Inadequate utilization of prenatal care services, socioeconomic status, and educational attainment are associated with low birth weight in Zimbabwe. *Front Public Health,* 5**,** 35.

Zeleke, B. M., Zelalem, M. & Mohammed, N. 2012. Incidence and correlates of low birth weight at a referral hospital in Northwest Ethiopia. *Pan Afr Med J,* 12**,** 4

APPENDICES

Appendix I: Data Extraction tool

The following data was extracted from the child file to answer the research question on the prevalence pattern of LBW and what are the determinants LBW among women 15 to 49 years in Zambia The questionnaire from the ZDHS is an internationally validated data collection tool on demographic and health information.

	Variables	Questions from ZDHS questionnaire	Response expected	Number of respondents
	Outcome Variable			
	Birth weight	Was (NAME) weighed at birth?	Yes or No	
		How much did (NAME) weigh?	Weight in Kilograms	
1.	**Respondent's Background**			
	Mothers age	How old were you on your last birthday?	Age in years	
	Mothers Education level	Have you ever attended school?	Yes or No	
		What is the highest level of school you attended?	Primary, secondary, or higher?	
	Place of Residence	Categorized in the dataset	Rural or urban	
	Household Wealth index	Wealth index as described in the ZDHS dataset	1. Lowest 2. Middle 3. Highest	
2	**Reproductive behavioral factors**			
	Birth order	Birth order as described in the ZDHS dataset	1. First 2. Second 3. Third or more	
	Birth Interval	Birth Interval as described in the ZDHS dataset	1. <24 months 2. 24-47 months 3. 48+ months	
	Parity	Parity as described in the ZDHS dataset	1. Primiparous 2. Multiparous	

	BMI	Calculated from the height and weight in the ZDHS dataset	1.Underweight 2.Normal 3.Overweight	
	Number of ANC visits	Did you see anyone for antenatal care for this pregnancy?	Yes or No	
		How many times did you receive antenatal care during this pregnancy?	Number of times	
3	**Environmental factors**			
	Maternal Smoking	Do you currently smoke or use any (Other) type of tobacco?	Yes or No	
	Type of cooking fuel	What type of fuel does your household mainly use for cooking?	1. Relatively polluting 2. Relatively non-polluting	

Appendix II: Ethics Approval

UNIVERSITY OF ZAMBIA
BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
Fax: + 260-1-250753
Federal Assurance No. FWA00000338

Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia
E-mail: unzarec@unza.zm
IRB00001131 of IORG0000774

12th September, 2019.

Your Ref: 028-08-18.

Ms. Mwaka Hachisaala,
University of Zambia,
School of Veterinary Medicine,
P.O.Box 32379,
Lusaka.

Dear Ms. Hachisaala,

RE: RESEARCH STUDYAMENDMENT: "FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT IN ZAMBIA: EVIDENCE FROM THE 2001/2" (REF. NO. 028-08-18)

We acknowledge receipt of the request for amendments to the aforementioned proposal.

The Amendments were reviewed and approved as follows:

1. Change of title from Factors Associated with Low Birth Weight in Zambia: Evidence from The 2001/2 To 2013/14 Zambia Demographic and Health Survey (ZDHS) to Determinants of Low Birth Weight in Zambia: Evidence from the 2007 and 2013/14 Zambia Demographic and Health Survey (ZDHS).
2. Objectives of the study to include;
   1. To estimate the prevalence of LBW across 2007 and 2013/14 ZDHS by province using GIS mapping.
   2. To determine the socio-economic and demographic, reproductive behaviour and environmental characteristics associated with LBW using the 2013/14 ZDHS.
3. The study will only make use of the 2007 and 2013/14 dataset.

Yours sincerely,

Munsaka.

Sody Mweetwa Munsaka, BSc., MSc., PhD
CHAIRPERSON
Tel: +260977925304
E-mail: s.munsaka@unza.zm

Appendix III: National Health Research Authority certificate Approval Letter

NATIONAL HEALTH RESEARCH AUTHORITY

Paediatric Centre of Excellence, University Teaching Hospital, P.O. Box 30075, LUSAKA

Tell: +260211 250309 | Email: znhraseo@gmail.com | www.nhra.org.zm

Ref No:... ………………………… **Date: 29th July, 2019**

The Principal Investigator
Ms. Mwaka Hachisaala
University of Zambia
School of Medicine
PO Box 50110,
LUSAKA

Dear Ms. Hachisaala,

Re: Request for Authority to Conduct Research

The National Health Research Authority is in receipt of your request for authority to conduct research titled **"Determinants of Low birth Weight in Zambia: Evidence from the 2007 and 2013/14 Zambia Demographic and Health Survey (ZDHS)."** I wish to inform you that following submission of your request to the Authority, our review of the same and in view of the ethical clearance, this study has been **approved** on condition that:

1. The relevant Provincial and District Medical Officers where the study is being conducted are fully appraised;
2. Progress updates are provided to NHRA quarterly from the date of commencement of the study;
3. The final study report is cleared by the NHRA before any publication or dissemination within or outside the country;
4. After clearance for publication or dissemination by the NHRA, the final study report is shared with all relevant Provincial and District Directors of Health where the study was being conducted, University leadership, and all key respondents.

Yours sincerely,

Dr. Godfrey Biemba
Director/CEO
National Health Research Authority

All correspondences should be addressed to the Director/CEO National Health Research Authority

Appendix IV: Permission Letter from Central Statistical Office

REPUBLIC OF ZAMBIA

CENTRAL STATISTICAL OFFICE

[All correspondence should be addressed to the Director]
[Website: www.zamstats.gov.zm]

REF:
CSO 101/ 8/13

2st August, 2018

Mwaka Haachisala

University of Zambia

Ridgeway Campus.

LUSAKA.

RE: **PERMISSION TO ACCESS THE2001-02, 2007 AND 2013-14 ZAMBIA DEMOGRAPHIC AND HEALTH SURVEY (ZDHS) DATASET**

Reference is made to the above captioned subject.

We acknowledge receipt of your request dated 7th July, 2018 in which you requested to use the 2013-14 Zambia Demographic and Health Survey (ZDHS) dataset for your academic research work.

I am pleased to inform you that your request has been approved and The Central Statistical Office is delighted to provide the 2013-14 ZDHS anonymized dataset.

We look forward to receive a copy of your dissertation and wish you all the best.

Sincerely

Goodson Sinyenga

ACTING DIRECTOR OF CENSUS AND STATISTICS

P. O. Box 31908, Lusaka, Zambia, Tel: +260- 211- 251377 / 253655 / 251385 / 257605 / 257604
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"To coordinate and provide timely, quality and credible official statistics for use by stakeholders and clients for sustainable development"