THE INFLUENCE OF BIRTH WEIGHT ON UNDER-FIVE CHILDREN'S NUTRITIONAL STATUS IN ZAMBIA

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DECLARATION

I, Salaza Kunda, hereby declare that this dissertation is my original work and has not been presented for any other awards at the University of Zambia or any other University.

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APPROVAL

This dissertation of **SALAZA KUNDA** is approved as fulfilling part of the requirements for the award of the degree of Master of Arts in Population Studies at the University of Zambia.

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Examiner 3____________________ Signature ____________________ Date ________________

Chairperson, Board of Examiners ____________________ Signature ____________Date _________

Supervisor____________________ Signature ____________________ Date ________________

DEDICATION

Dedicated to my mother Kenneth Kabamba, my wife Cecilia Nsofwa, my brothers (Sydine Mwansa and Haggai Chibuye) and my sisters (Elizabeth Chileshe, Joyce Mwape and Mable Mwape)

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ABSTRACT

This study aimed at investigating the influence of birthweight on under–five children's nutritional status in Zambia. The study also investigated maternal health, child, household and mother's characteristics as they indirectly influence birthweight and nutritional status of children. Knowledge generated from this study is an important requirement for an enabling environment for developing effective nutritional intervention strategies for pregnant women malnutrition reduction in Zambia.

The Zambia Demographic and Health Survey child dataset of 2013/14 and Stata 14.0 were used for the analysis. Descriptive analysis; bivariate and multivariate using binary logistic regression, producing Odds Ratios of Stunting, Underweight and Wasting among under-five children associated with birthweight were used. The sample included Children aged 0–59 months of age, women aged 15–49 years of age for whom complete and plausible anthropometric data were collected and that children had their birthweight reported. Children with underweight birthweight were the reference category.

Results show that most of the under five children had a normal birthweight. More than half of the children were males and more were from rural areas. Bivariate results show that children with normal birthweight were less stunted, underweight and wasted. Children whose mothers took Iron tablets were less underweight and those whose mothers took anti-malaria drugs were less stunted and less underweight and for those who took Vitamin A were less wasted. Children whose households had no improved source of water and shared toilet facility were more likely to be stunted, underweight and wasted. Children whose mothers had one or more births in the last year were more likely to be stunted, underweight and wasted. Additionally, results from multivariate analysis showed that children in rural areas, regions were stunting, underweight and wasting is high and those in poor wealth quintile household were more likely to be stunted, underweight and wasted than children in urban areas, regions were stunting, underweight and wasted is low, middle and rich wealth quintile households. Children whose mothers had secondary education or higher and normal BMI, overweight and obese were significantly less stunted, underweight and wasted.

The findings of this study have led to a conclusion that birthweight influences the nutritional status of under-five children and that maternal food supplements, age of the child and sex, BMI, residence, wealth quintile, education level, number of children a woman has in the past year and ever born, affect birth outcome and nutritional status of children.

Recommendation from this study include; investing in strategies that support adequate nutrition before and during pregnancy such as the 1000 most critical days of life, led by SUN, Maternal, Adolescent, Infant and Young Child Nutrition, management of severe acute malnutrition, Nutrition and HIV programme, School health Nutrition and Food and National Security programme. Further studies such as qualitative, cohort and longitudinal studies be carried out in Zambia on the influence of birth weight on nutritional status of children. A study that can follow up a cohort of women while pregnant and children from birth to five years.

Keywords: *Birth weight, nutritional status, stunting, underweight and wasting.*

ACRONYMS

AIDS	Acquired Immune-Deficiency Syndrome
BAZ	BMI-for-age
BF	Body Fat
BMI	Body Mass Index
BLR	Binary Logistic Regression
CPH	Census of Population Housing
CSO	Central Statistical Office
CEB	Children Ever Born
FFMI	Fat-Free Mass Index
FMI	Fat Mass Index
HAZ	Height-for-Age
HIV	Human Immune-Deficiency Virus
NCHS	National Center for Health Statistics
UNICEF	United Nations Children's Emergency Fund
USAID	United States Agency for International Development
WAZ	Weight-for-Age
WC	Waist circumference
WHO	World Health Organization
WHZ	Weight-for-Height
ZDHS	Zambia Demographic and Health Survey

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CHAPTER ONE: INTRODUCTION

1.1 Background

The study aims at investigating the influence of birthweight on the under–five children's nutritional status in Zambia. The study will also investigate other factors that may indirectly influence the nutritional status of children through birthweight.

Child growth is the most widely used measure of children's nutritional status. The three widely used indicators for children nutrition status include: underweight, stunting and wasting. Underweight also known as Weight-for-Age (WAZ) acts as a measure of both acute and chronic malnutrition (WHO: 2013:107). Children whose WAZ is more than two standard deviations below the median of the reference population are considered "moderately or severely underweight". Furthermore, those children whose WAZ is more than three standard deviations below the median are classified as "severely underweight".

Stunting also known as Height-for-Age (HAZ) is a measure of linear growth. Children whose HAZ is more than two standard deviations below the median of the reference population are considered short for their age and are classified as "moderately or severely stunted". Those children whose height for age is more than three standard deviations below the median are classified as "severely stunted". Stunting is a reflection of chronic malnutrition as a result of failure to receive adequate nutrition over a long period and includes recurrent or chronic illness (WHO 2013:107). Finally, children whose Weight-for-Height (WHZ) is more than two standard deviations below the median of the reference population are classified as "moderately or severely wasted" while those who fall more than three standard deviations below the median are "severely wasted". Wasting is usually the result of a recent energy intake deficiency (WHO 2013:107).

Globally wasting was estimated at 8% in 2012 while Stunting was estimated at 25.7% and underweight at 15.7% in 2012 (WHO Statistics 2013: 107).

By region, prevalence rates for stunting and underweight in children under five years of age have declined in all developing regions since 1990, indicating improved nutrition resulting from enhanced access to and availability of food (Lancet 2013). However, progress in reducing the prevalence of stunting has been slightly more limited than that of underweight in most regions. Many countries in Africa still report prevalence rates of 30 % or more, which the

World Health Organization (WHO) classifies as high (WHO-UNICEF 2012:21). There are a lot of factors contributing to these trends ranging from maternal, biological, demographic and socio-economic factors. In the similar vein other studies have demonstrated that stunting is determined among other factors, the child's birth weight (Adair and Guilkey 1997; Ricci and Becker 1996; Semba et al. 2008). These studies showed that likelihood of stunting was significantly increased by diarrhoea, febrile respiratory infections, early supplemental feeding and low birth weight. Other studies have shown that adults who stand taller or were born heavier fare better on a range of social, economic, and cognitive outcomes (for example, Currie 2009; Steckel 2008). Interpretations of these patterns are fairly uniform for birth weight but more variable for height

The birth weight measured during the first hour after birth is considered an appropriate indicator of an individual's health. Birth weight has an influence on the child's growth and development and, over the long term, has repercussions on health of these individuals in adulthood. According to WHO (2012:45), birth weight is defined as the first weight of an infant obtained within less than the first 60 completed minutes after birth; a normal birth weight or full-size infant is one weighing 2500g or more. Low Birth Weight (LBW) on the other hand is defined as new born infants weighing < 2500g, irrespective of gestational age. In developed countries, Low Birth Weight (LBW) is linked to prematurity in almost all cases; in developing countries, however, its principal cause is intrauterine growth restriction. Low birth weight is a risk factor linked with both infant mortality and morbidity and is used to investigate the conditions for survival and the quality of life of individuals (WHO 2012:119).

Several studies in the world have acknowledged that adequate nutrition before and during pregnancy has greater potential for a long term health of both mother and the child and it is important during the course of pregnancy (Singh et al., 2009). Woman's nutritional status has important implications for her health as well as for the health of her children (MoH National Strategic Plan 2017-2021). A woman who has been well nourished before conception begins her pregnancy with reserves of several nutrients so that the recurrent needs of the growing foetus can be met without adversely affecting her health. Infants, who have been well nourished in the womb, have an enhanced chance of entering life in very good health. Mother's diet should provide adequate nutrients so that maternal stores do not get depleted (MoH National Strategic Plan 2017-2021). Maternal nutrition is an important factor responsible not only for the health of a baby, but also for the baby's long term growth (Jackson and Robinson, 2001).

Therefore, understanding maternal nutrition and foetal growth relationship is critical (Rao et al., 2001; Rao et al., 2007). Birth weight is an important determinant of new born survival, healthy growth and development. As mentioned earlier, birth weight is an index of mother's health and nutritional status during pregnancy and a positive correlation between the quality of maternal diet and birth weight of infant has been reported in several studies (Mirdula et al., 2003).

Under nutrition in the first 1,000 days' post conception represents a fundamental squandering of human potential. In these crucial days, the body is quickly laying down its fundamental building blocks for brain development and future growth. Any disturbance leaves a long-lasting mark: damage from under nutrition in early life is largely irreversible. The school performance of undernourished children is below potential. They have lower work capacity and productivity as adults. Later in life they have an increased likelihood of being overweight and developing associated chronic diseases such as cardiovascular disease, diabetes and cancer, and to suffer from mental health issues (Hoddinott et al., 2013; Haddad, 2013a; World Bank, 2013a). In addition, when girl children suffer from under nutrition, their own children are more likely to suffer from it in their first 1000 days' post conception (UNSCN, 2010:78).

Worldwide women and children are particularly vulnerable to malnutrition for many reasons, including age, dietary intake, biological and socio-economic factors. These women tend to have no say in decision making with regard to how resources are used in the household and have limited or no access to health care services.

1.1.1 Nutritional status in the Zambian Context

The rates of malnutrition in Zambia is among the highest in the world and these rates are reducing the country's chances of achieving its aspiration to be a prosperous upper-middle-income country by 2030. Results from the ZDHS (2013/14:158) showed that 40% of children under five in Zambia are stunted, or too short for their age. This indicates chronic malnutrition. Wasting (too thin for height), which is a sign of acute malnutrition, is far less common (6%). In addition, 15% of Zambian children are underweight, or too thin for their age. The nutritional status of Zambian children has generally improved from 53% in 2001-02 to 45% in 2007 and 40% in 2013 as shown in Figure 1.1

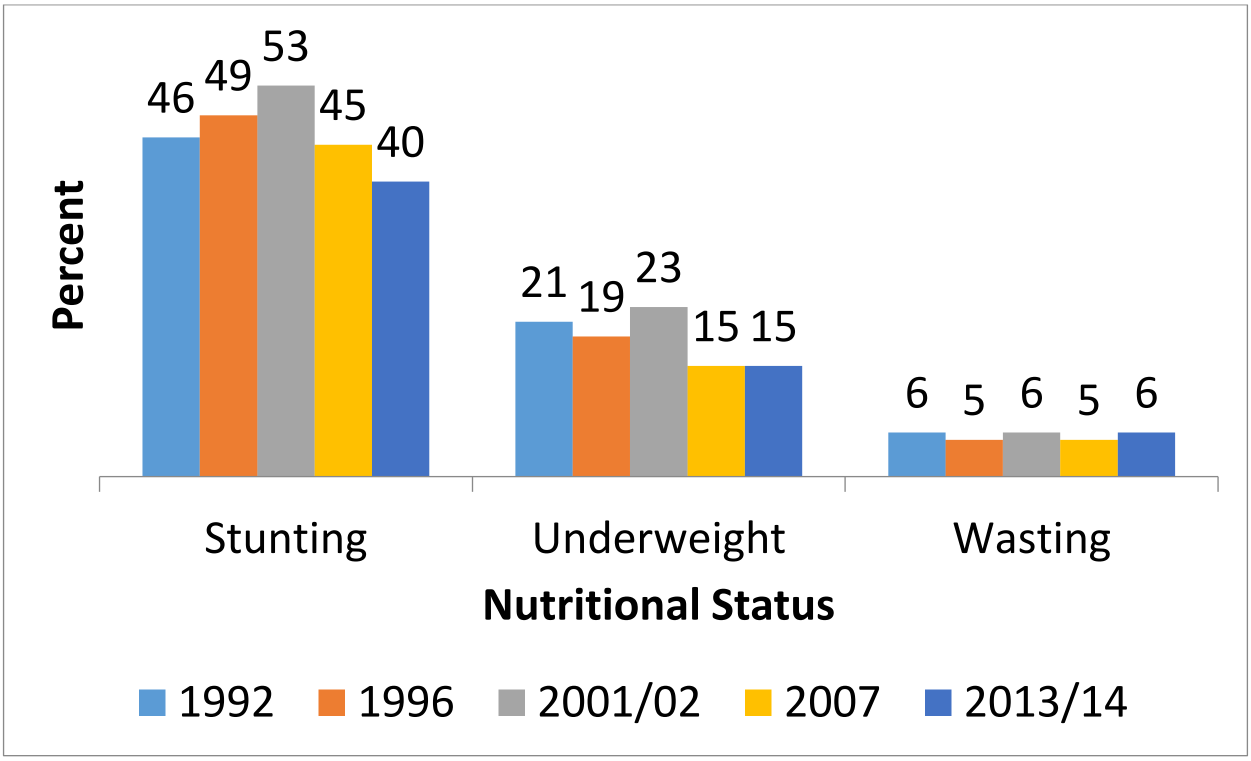

Figure 1.1: Trends in Stunting, Underweight and Wasting levels of under-five children in Zambia. ***Source: ZDHS 2013/2014***

However, despite the reduction in stunting the percentage has still remained too high for the country when compared with other African nations with similar or lower per capita income, including Kenya (35%) and Mauritania (32%) WHO 2013:107).

The Government of the Republic of Zambia recognizes malnutrition as a serious public health problem, therefore, it has partnered with other cooperating partners in promoting nutrition activities to improve nutritional status of women so that they can have babies with normal birthweight. Some of the programs include; the UN-led Scaling Up Nutrition (SUN) a global movement that unites national leaders, civil society, bilateral and multilateral organizations, donors, businesses and researchers in a collective effort to improve nutrition movement. The SUN program aims at addressing stunting with a focuses on the First 1000 Most Critical Days of life (that is pregnancy period and the first two years of the child's life (USAID 2014). The government of the republic of Zambia is committed to the attainment of the SDGs and Africa agenda 2063 on nutrition. The SDG related to nutrition is to end hunger, achieve food security and improved nutrition and sustainable agriculture by 2030. While the Africa agenda 2063 Africa aspires to be a prosperous continent, with the means and resources to drive its own development, with sustainable and long-term stewardship of its resources and where African people have high standard of living and quality of life, sound health and wellbeing (Africa

Agenda 2063:2). This also is line with the government's efforts to expand coverage of social assistance programmes to address income insecurity of the poor and vulnerable as well as support access to access to health and education, improved nutrition and human capital (7th National Development Plan:88). Government through the ministry of Health is committed to implement the aspirations to meet universal primary health care according to the National Health Strategic plan 2017 -2021. The ministry has made some positive strides, such as reduction in stunting levels among children aged less than five years and achieving an almost three-quarters (73 percent) level of exclusive breastfeeding. Further, the sector has implemented high-impact nutrition-specific interventions and strengthened linkages with other sectors implementing nutrition-sensitive interventions. The acute malnutrition database was operationalised, and provincial and frontline staff were trained in nutritional packages

Therefore, relying on this background, understanding the relationship and factors associated with birth outcomes and children's nutritional status may provide a basis for developing and monitor nutritional interventions (such as the 1000 most critical days of life, led by SUN, Maternal, Adolescent, Infant and Young Child Nutrition, management of severe acute malnutrition, Nutrition and HIV programme, School health Nutrition and Food and National Security programme that will improve nutritional status and long-term quality of life and reduce mortality, morbidity, and health-care costs.

1.2 Statement of the problem

Birth weight is the most sensitive and reliable indicator of health of an infant and associated with their health and survival. Additionally, if these children continue to receive inadequate nutrition which are critical to growth and development, their productivity may be affected when they become adults. With this regard, there have been campaigns in Zambia to promote and improve women's nutritional status when they are pregnant to ensure that their birth outcome is of great desire. Among the various campaigns include: educating women on the importance of receiving adequate micro-nutrients that are needed for the growth of the foetus. Furthermore, during prenatal care, pregnant women are encouraged to go to the health facilities to receive maternal education. Some of the lessons taught include: information on different types of food they need to take to promote their nutritional status so that in the end they can influence their birth outcome.

Low birth weight in babies lead to high risk of infectious diseases. This is due to the fact that these babies start at a low developmental path and are more prone to die compared with babies with normal birth weight (WHO 2013:119).

The Government of the Republic of Zambia recognizes malnutrition as a serious public health problem, therefore, it has partnered with other cooperating partners in promoting nutrition activities to improve nutritional status of women so that they can have babies with normal birthweight. Some of the programs include; the UN-led Scaling Up Nutrition (SUN) a global movement that unites national leaders, civil society, bilateral and multilateral organizations, donors, businesses and researchers in a collective effort to improve nutrition movement. The SUN program aims at addressing stunting with a focuses on the First 1000 Most Critical Days of life (that is pregnancy period and the first two years of the child's life (USAID 2014).

In as much as several studies have been carried out in Zambia to provide necessary information on causes of malnutrition, many of these studies have concentrated on determinants of malnutrition in under-five children and are often area specific (for example a certain geographical area). Furthermore, these studies have not fully investigated the influence of birth weight on under five children's nutritional status and these studies include: Chipili G and Msuya J (2016) whose study assessed the extent to which the small scale farmers are implementing the best practices of nutrition-sensitive agriculture in the Central Province, Bwalya Bupe Bwalya (2013): Influence of Maternal Characteristics on Under-five Nutritional Status in Zambia though used the perceived size of the child and not the actual birthweight. However, it is not clear whether or not birth weight influences under-five children's nutritional status.

1.3 Rationale of the study

Many studies have been written about the causes of child malnutrition and the means of reducing it. But the role of birth weight in determining children's nutritional status has gone largely unnoticed. Thus, unreliable and inadequate decisions are made based on assumptions and unjustified conclusions. This often results in selection of inappropriate policies and programs only to discover the consequences after implementation. Knowledge of the influence of birth weight on under five children's nutritional status is therefore an important requirement for an enabling environment for developing effective nutritional intervention strategies for pregnant women malnutrition reduction in Zambia. The knowledge generated from this study would help monitor the health related programmes and nutritional interventions such as the

1000 most critical days of life, led by SUN, Maternal, Adolescent, Infant and Young Child Nutrition, the Comprehensive Africa Agriculture Development Programme (CAADP) which is an African-led program bringing together governments and diverse stakeholders to reduce hunger and poverty and promote economic growth in African countries through agricultural development, management of severe acute malnutrition, Nutrition and HIV programme, School health Nutrition and Food and National Security programme. These programmes and interventions can improve nutritional status and long-term quality of life and reduce mortality, morbidity, and health-care costs.

A more comprehensive approach in understanding how birthweight affects children's nutritional status can contribute to more effective policy responses such as the Zambia National Advocacy plan 2017-2019, the 2063 Africa Agenda on Nutrition and Zambian Scaling up Nutrition in Zambia) to reduce malnutrition among pregnant mothers, which, in turn, can influence birth outcome. Nowadays, in the developing world and Zambia particularly, such information is often inadequate. Therefore, this study is envisioned to contribute to the reduction in the knowledge gap about the influence of birth weight (perceived size of the child at birth) on child nutrition status more specific height-for-age and weight-for-age and weight-for height for under five children.

1.4 Objectives of the study

1.4.1 General Objectives

To investigate the influence of birthweight on under-five children's nutritional status in Zambia.

1.4.2 Specifics Objectives

i. To determine the maternal health characteristics that influence birth outcome and under-five children's nutritional status in Zambia
ii. To determine the household characteristics that influence birth outcome and nutritional status of under-five children in Zambia
iii. To determine the mother characteristics that influence birth outcome and nutritional status of under-five children in Zambia
iv. To determine the Child characteristics that influence under-five children's nutritional Status

1.5 Research questions

- What are factors associated with Birth outcome and under-five nutritional Status in Zambia?
- Does birthweight influence under-five children's nutritional status in Zambia? If yes, how?
- What Maternal health characteristics influence birth outcome and under-five children's nutritional status
- What household characteristics influence birth outcome and under-five children's nutritional status
- What mother characteristics influence birth outcome and under-five children's nutritional status?
- What Child characteristics under-five children's nutritional status

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This section discusses the literature that were reviewed in line with the study problem. Literature review helps in refining the problem statement and helps the researcher to become familiar with various types of methodology that might be used in the study. This chapter therefore, presents literature reviewed on the influence of birthweight on under five children's nutritional status.

2.2 Empirical review

2.2.1 Birthweight

Birth weight is the most sensitive and reliable indicator of health of an infant and is associated with the health and survival of children. Under-five children nutritional status has been studied and supported by many nutritionists (experts), researchers in different parts of the world (UNCEF 2013). At population level, the proportion of infants with a low birth weight is an indicator of a multifaceted public health problem that includes long-term maternal malnutrition, ill health, hard work and poor health care in pregnancy (WHO 2010).

A research was conducted by Janet Currie and Tom Vogl, both of Princeton University on the early-life health and adult circumstance in developing countries. The research investigated the long-term effects of health shocks before age 10 in developing countries through the use of review of recent researches. The research revealed that the size and shape of the human body provide a window into the cumulative shocks it has experienced over its lifetime. A growing body of evidence documents that healthy children tend to become healthy and wealthy adults (Almond and Currie 2010, 2011; Currie 2011).

In this respect, anthropometric markers such as birth weight and child height are related to future schooling, employment, earnings, family formation, and health. The findings were in line with conclusions from natural experiments that suggest that these relationships in large part reflect a pathway running from childhood health to adult outcomes (Almond and Currie 2010, 2011; Currie 2011). To the extent that inequalities and shortfalls in adult outcomes are predicted by early-life health, these results may offer additional justification for policies aimed at improving child health. The study further revealed that on average, adults who stand taller or were born heavier fare better on a range of social, economic, and cognitive outcomes (Almond and Currie 2010, 2011; Currie 2011).

Another study was conducted by (Maria. E.F.A Motta el tal, 2005) in Brazil to evaluate the association between low birth weight and nutritional status at the end of the first year of life. The study employed a nested case-control study design within a cohort. The study was carried out at maternity hospitals in four cities in the Zona da Mata Meridional in Pernambuco state, Brazil. New born infants were recruited during the first 24 hours of life. Their weights were measured at birth and at the end of the first year of life. The study found that low birth weight was significantly associated with nutritional risk at the end of the first year of life (Ibid). Children born weighing 1,500 grams to 2,499 grams had 29 times the chance of being at nutritional risk at 12 months of life than those whose birth weights had been > 3,500 grams.

Therefore, from the findings of this research, it is evident enough to conclude that low birth weight is an important risk factor of nutritional risk at the end of the first year of life. It is important to adopt strategies for its reduction and prevention. However, in as much as the study concluded with these findings, it did not state the selecting criteria of maternity hospitals as well as the reasons for following up of new born infants up to 12 months and not the 24 months recommended by WHO guidelines on child nutrition.

Another study was conducted in Malaysia on birth weight, nutritional status and body composition among Malaysian children aged 7 to 10 years. Several studies have indicated that lower birth weight is associated with lower body mass index, but the use of birth weight in predicting later nutritional status and adiposity remains inconsistent. The study aimed at examining the relationship between birth weight and nutritional status with body composition among Malaysian children.

The survey employed stratified random sampling design to sample 398 boys and 389 girls from the main ethnic groups, namely Malays, Chinese, Indians, Sabah and Sarawak natives. Anthropometric measurements comprised body weight, height, waist circumference (WC) and body fat (BF). Body mass index (BMI), fat mass index (FMI) and fat-free mass index (FFMI) adjusted with height were included, and birth weight was obtained by parental report. Nutritional status such as weight-for-age (WAZ), height-for-age (HAZ) and BMI-for-age (BAZ) were determined using the WHO growth reference for 5–19 years.

The findings of the study from multiple regression analysis indicated that birth weight positively predicted later nutritional status; 1kg increase in birth weight predicted 0.70, 0.46, and 0.58 unit increases in weight-for-age, height-for-age and BMI -for-age respectively. Therefore, the study suggested that nutritional status and adiposity are influenced by birth weight. Birth weight is not only an indicator of the nutritional status during infancy, but also a risk factor that affect child growth and development.

In Africa, a study was conducted by Girma, Woldemariam and Timotiows Genebo in November, 2002 on the determinants of nutrition status of women and children Ethopia. The study was based on data from the 2000 Demographic and Health Survey with reference to 13,447 women age 15-49 years and 9,768 children under five of interviewed mothers with complete and plausible anthropometric data. In this study, the indicator used to assess chronic energy deficiency malnutrition in women was body mass index (BMI). The indicator was used because it is the most frequently used standardized indicator of thinness (wasting) to assess the progressive loss of body energy in developing countries. To determine the nutrition status of children height and weight measurements were taken with great consideration on age and sex and were converted into Z-scores based on the National Center for Health Statistics (NCHS) reference population recommended by the World Health Organization (WHO).

Findings from this study revealed that the basic determinants of women nutrition presented in the conceptual framework in figure 2.1 as adapted from the UNCEF framework such as household economic status (wealth quintile), education level of the women, place of residence, women's empowerment and control over income also determines the birth outcome and hence nutrition status of the child. However, for the purposes of this study, the interest is to see the interrelationship between birthweight and nutrition status of the under five children. The literature reviewed in this study showed that birth weight, child growth, and adolescent growth determine nutritional status before and during pregnancy (maternal nutrition).

Maternal nutrition also influences fetal growth and birth weight (ACC/SCN, 1992). The presence of an intergenerational link between maternal and child nutrition means a small mother will have small babies who in turn grow to become small mothers. Some findings on the relationship between maternal and child nutrition (Loaiza, 1997; Teller et al., 2000; Genebo et al., 1999) showed that a high proportion of low-birth-weight and stunted children were observed among malnourished mothers. Therefore, this literature indicates that actions towards improving women and child nutrition should always be integrated for effective utilization of scarce resources and to reduce the intergenerational link (mother-child) of under nutrition.

2.2.2 Maternal Health Characteristics

The maternal health characteristics reviewed in this literature include the following: Taking anti-malaria and Iron tablets during pregnancy and anti-natal visits. David Seidenfeld el tal

(2016) carried a rapid qualitative assessment, a process evaluation and an impact evaluation to assess the implementation of the first stage of the 1000 Most Critical Days Programme coordinated by the National Food and Nutrition Commission (NFNC), in coordination with several donors, including the Department for International Development (DFID) in order to address Zambia's child undernutrition. The programme targeted households with children under 24 months of age and includes a package of activities and supports that focused on maternal and adolescent nutrition; deworming and vitamin A supplementation; family planning; growth monitoring; iron and folic acid supplementation; iodised salt, micronutrients, and breastfeeding; fortified staples and specialized nutritional products; a mother- and baby-friendly hospital initiative; and management of severely malnourished children (National Food and Nutrition Commission of Zambia, 2011). The programme was being implemented with a package of nutrition activities to poor households with pregnant women or new-born children living in rural areas. The ultimate goal of the intervention was to improve nutrition and reduce morbidity amongst children during their first 1000 days of life. However, the programme was being implemented in only 14 Districts of Zambia. And the program did not specify how the household to participate in the programme were selected.

Black RE, Victora CG el tal (2013) also found that deficiencies of vitamin A and zinc result in deaths; deficiencies of iodine and iron, together with stunting, can contribute to children not reaching their developmental potential. Maternal undernutrition contributes to fetal growth restriction, which increases the risk of neonatal deaths and, for survivors, of stunting by 2 years of age. However, the study used prevalence to estimate chronic condition of stunting, this approach may not be suitable to estimate acute wasting. Children with severe acute malnutrition either die or recover within a few weeks, and their numbers cannot be estimated by prevalence surveys, which will miss many cases. Incidence, rather than prevalence, is needed to estimate the burden of severe acute malnutrition.

Bhutta ZA el tal (2013) conducted a study were they reviewed interventions that affect maternal and child undernutrition and nutrition-related outcomes. And these interventions included promotion of breastfeeding; strategies to promote complementary feeding, with or without provision of food supplements; micronutrient interventions; general supportive strategies to improve family and community nutrition; and reduction of disease burden (promotion of handwashing and strategies to reduce the burden of malaria in pregnancy). The study showed that although strategies for breastfeeding promotion have a large effect on survival, their effect on stunting is small. In populations with sufficient food, education about complementary feeding increased height-for-age Z score by 0·25 (95% CI 0·01–0·49), whereas provision of food supplements (with or without education) in populations with insufficient food increased the height-for-age Z score by 0·41 (0·05–0·76).

The study showed that effective micronutrient interventions for pregnant women included supplementation with iron folate (which increased haemoglobin at term by 12 g/L, 2·93–21·07) and micronutrients (which reduced the risk of low birthweight at term by 16% (relative risk 0·84, 0·74–0·95). The study further recommended micronutrient interventions for children which included strategies for supplementation of vitamin A (in the neonatal period and late infancy), preventive zinc supplements, iron supplements for children in areas where malaria is not endemic, and universal promotion of iodised salt. However, most of the interventions identified for modelling were based on products, and it is not clear why the modelling was not done for nutrition-sensitive interventions and interventions for disease prevention and management, especially when some of these were described as effective by the authors themselves

Candyce Hamel el tal (2015), carried out the study on the link between maternal care during pregnancy and childbirth and childhood malnutrition in Bauchi and Cross River states in Nigeria. The used a cross sectional design to provide a link between poor care during pregnancy and childbirth and childhood malnutrition in two states. The study found that in both states, a child whose mother had fewer than four government antenatal care visits was more likely to be malnourished (Cross River: OR 1.85, 95% CI_{ca} 1.33-2.55; Bauchi: OR 1.29, 95%CI_{ca} 1.02-1.63). However, the study failed to mention for those who deliver before a 4^{th} ANC visit. A study by Yimer G (2010**)** in southern Ethiopia found that the number of antenatal visits a mother had during pregnancy was inversely related to stunting in the child. WHO (2013), noted that good antenatal care links the woman and her family with the formal health system, increases the chance of using a skilled attendant at birth and contributes to good health through the life cycle. Antenatal visits are an indicator of contact with health services and health seeking behaviour, which may be associated with better care and feeding practices for young children. However, the report was not clear as to whether or not the number of antenatal visits matter in determining the birth outcome and nutritional status of the under-five children

2.2.2 Characteristics of the Household

Underlying determinants which impacts mother's nutritional status, manifest themselves at the household level. The first household food security, is assured access to enough food of adequate quality for living an active healthy life. The second is the quality of caring practices for women and the third is health environment and services conditions mother's exposure to pathogens and the use of preventative and curative health care. Therefore, characteristics of the household form part of the underlying causes of children's nutritional status that include: Wealth quintile, source of drinking water, access to improved sanitation facility, residence (rural or urban) and region. The study carried out by (Maria. E.F.A Motta el tal, 2005) in Brazil to evaluate the association between low birth weight and nutritional status at the end of the first year of life that living in a household with no latrine were significantly associated with nutritional risk at the end of the first year of life. Children living in households without a flush toilet had three times the chance of nutritional risk at 12 months of life in relation to those that had a latrine with a septic tank at home. These findings were in line with the UNICEF frame work for the determinant of women and child nutritional status which shows sanitation to be one of the underlying determinants of birth outcome. (UNICEF, 2013)

2.2.3 Mother Characteristics

The study considered the following mother characteristics as underlying causes of nutritional status of children that include: mother's age, nutritional status (BMI), control of household economic resources, education level, and employment status, and religion, access to information, marital status and total children ever born. A study conducted by Wamani in Uganda revealed that stunting was least common among children of more educated mothers and those from wealthier families. Maternal nutrition knowledge and marital status contribute significantly to the nutritional status outcome in children. Women who receive minimal education are generally more aware than those who have no education on how to utilize available resources for the improvement of their own nutritional status and that of their families (Wamani *et al*., 2005).

2.2.4 Child Characteristics

Children's nutritional status is also more sensitive to factors such as feeding/weaning practices, care, and exposure to infection at specific ages. Stunting in children is positively associated with age (Anderson, 1995 as cited in Aschalew, 2000). Local and regional studies in Zambia have also shown an increase in malnutrition with increase in age of the child. (CSO 2015). Vitamin A is an essential micronutrient for the immune system and plays an important role in maintaining the epithelial tissue in the body. Severe vitamin A deficiency (VAD) can cause eye damage. VAD can also increase severity of infections such as measles and diarrhoeal diseases in children and slow recovery from illness (WHO 2013).

Vitamin A supports growth, especially skeletal growth. Adequate micronutrient intake by mothers does not only benefit them but precedes and extends beyond the reproductive years to optimize completion of adolescent growth and establish body nutrient reserves before pregnancy and after (David Seidenfeld el tal, 2016). This is best achieved safely through a consistent balanced intake of nutrient-rich foods, including fortified foods, and nutrient supplements when necessary.

2.3 Conceptual Framework

In this study the United Nations Children's Fund's (UNICEF) conceptual framework for the causes of child malnutrition, death, and disability was adapted based on the available information in the ZDHS 2013/13 data sets. The framework lays out the immediate (most proximate), underlying, and basic (most distant) causes of child malnutrition (UNICEF 2013). The analysis and interpretation of these data was based on this framework. The frame work has been adapted because nutritional status on its own is an outcome of different factors.

According to the framework in Figure 2.1, the immediate determinants of which manifests themselves at the level of the individual mothers, are dietary intake (energy, protein, fat and micronutrients) and health status. For the purposes of this study, number of antenatal visits, took anti-malaria drugs and took Iron tablets are some of the variable that were included under the immediate cause. These factors themselves they are interdependent. A mother with inadequate dietary intake is more susceptible to disease; disease in turn depresses appetite, inhibits the absorption of nutrients in food and competes for a mother's energy.

Underlying determinants which impacts mother's nutritional status, manifest themselves at the household level. The first household food security, is assured access to enough food of adequate quality for living an active healthy life. The second is the quality of caring practices for women and the third is health environment and services conditions mother's exposure to pathogens and the use of preventative and curative health care. The underlying causes of children's nutritional status have been divided into two groups: characteristics of the house hold that include: Wealth quintile, access to safe water, access to improved sanitation facility, residence and province. On the other hand, characteristics of mother include: mothers age, nutritional status (BMI), control of household economic resources, education level, and employment status, and religion, access to information, marital status, children a woman has in the last 5 years and total children ever born.

These aspect of care for women affects children's birth weight and hence nutritional wellbeing during pregnancy and lactation. Women are typically the main care takers of children after birth and in order to provide quality care they need continued adequate food consumption and health care, rest, and measures to protect their mental health, such as protection from abuse.

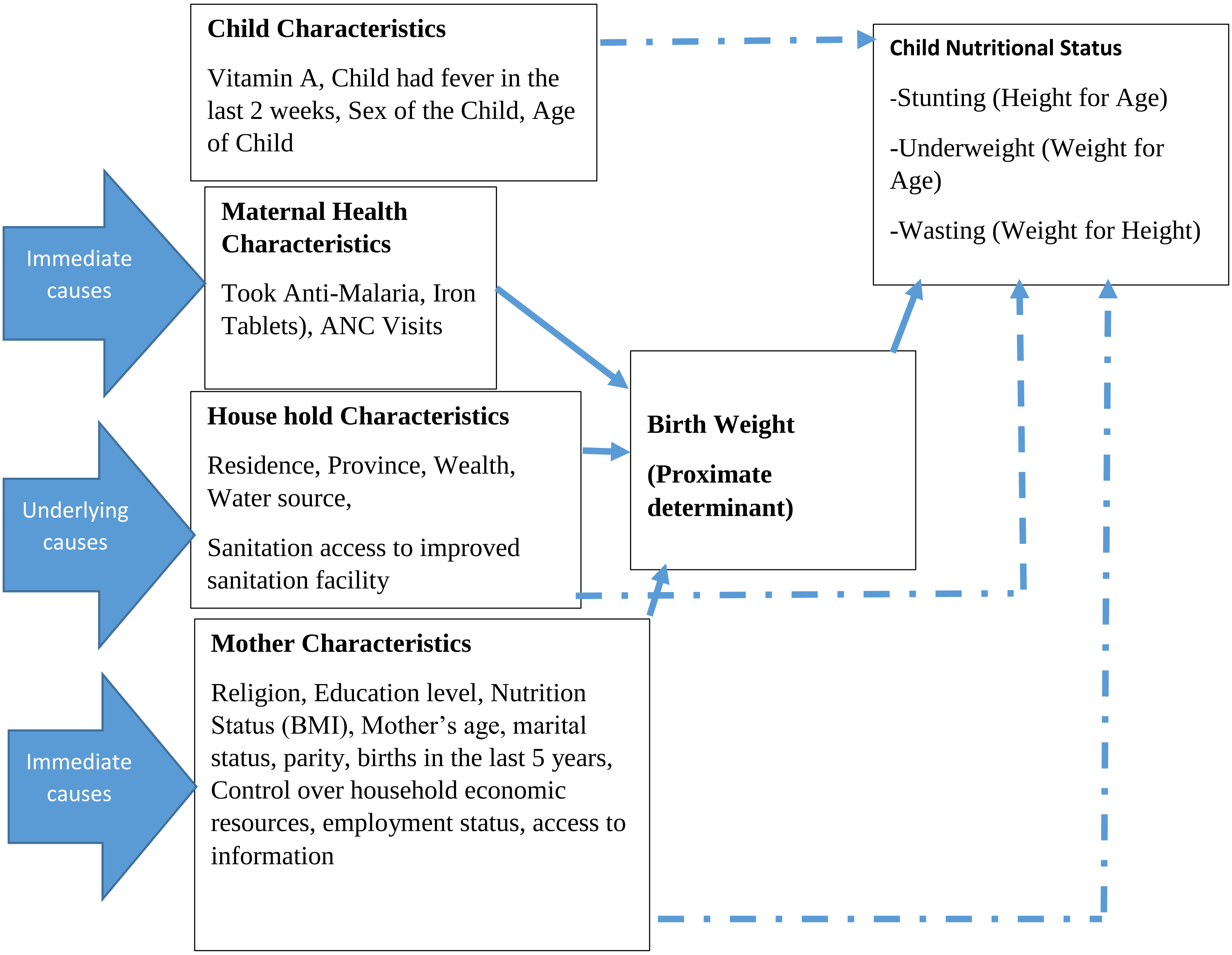

Figure 2.1 conceptual framework extracted from UNICEF framework. Source: *Adapted from UNICEF conceptual frame work for the study of child and women nutritional status* UNICEF, 2013, *Improving Child Nutrition*: 6 http://www.unicef.org

However, the conceptual framework clearly shows that it is possible that apart from birth weight, these other factors may also have an influence on nutrition status of the child. This is shown by the dotted lines pointing directly to the nutrition status. While this framework has strengths and that it has been recommended in coming up with comprehensive nutrition programs, one of the major limitations is that many existing secondary data sources do not allow researchers to follow this framework in its entirety in understanding child nutrition (Zottarelli et al, 2007). For example, in trying to explain whether the birthweight of the child influences child nutrition status, certain variables were left out depending on what was available in the ZDHS.

CHAPTER THREE: STUDY METHODOLOGY

3.1 Introduction

In order to achieve the objectives and research question for this study, a systematic and scientific approach was employed paying particular attention to the study design and population definition. It is important to note that this study was analytical survey with the view of examining the influence of birthweight on under five children's nutritional status in Zambia.

3.2 Research Design

A non-interventional type of research design was employed in this study. The study used this design for a simple reason that it was conducted in an uncontrolled and natural setting. And that the study attempted to examine the influence of birthweight on the children's nutritional status in Zambia. The fact that the study used data from ZDHS that employed a cross-sectional research design, it was also a cross-sectional study.

3.3 Data Sources

The study was based on secondary data obtained from the Zambia Demographic and Health Survey (ZDHS) conducted in 2013/14. The 2013/14 ZDHS data set was selected because it is the most recent survey with up to date information regarding the nutritional status of under-five children in Zambia. The ZDHS is a nationally representative population based cross-sectional survey whose main objective is to provide information on levels and trends in fertility, childhood mortality, use of family planning methods, and maternal and child health indicators including HIV and AIDS. In addition, it is part of the national effort to monitor impacts of the countries health programs.

However, the focus of this study was only the child dataset because it contains all information regarding women aged 15-49 and children aged 0-59 months. The data was collected by the Zambia Central Statistical Office (CSO) in partnership with the Ministry of Health. The sampling frame used for the 2013-14 ZDHS was adopted from the Census of Population Housing (CPH) of the Republic of Zambia conducted in 2010, provided by the CSO. The sample for the 2013-14 ZDHS was designed to provide estimates of population and health indicators at the national and provincial levels including rural and urban. This information provides a strong source of data that was relevant for this study. Therefore, this sample is representative enough to be used in examining the influence of birth weight on children's nutritional status.

3.4 Target Population

The target population for this study is the children aged 0-59 months. The study employed the following inclusion criteria to the sample. Children aged 0–59 months of age for whom complete and plausible anthropometric data were collected and that the children had their birthweight reported. This is because these groups are among the most vulnerable to malnutrition. In addition, maternal health and nutrition has got a huge influence on the birth out come and hence nutritional status of the children below the age of five.

3.5 Inclusion Criteria

This study employed the following inclusion and exclusion criteria into the sample

- Only children aged 0-59 months whose birthweight was reported were included in the sample.
- Children who had missing record on age were excluded from the sample
- A child who had information on height and weight measurements taken
- Children with birthweight greater than 5000grams and those with less than 1000 grams were excluded from the sample
- For the analysis of the Weight-for-Height, Weight-for-Age and Height-for-Age Z-scores, this paper relied on the recommendations from World Health Organization which has defined limits for acceptable data based on the 1977 and revised in 2006 NCHS/WHO growth charts.

- In this study a fixed exclusion range was used for this analysis because the mean z-score for HAZ was above -1.5.

    - Height-for-age: <-5.0 and >+3.0
    - Weight-for-age: <-5.0 and >+5.0
    - Weight-for-height: <-4.0 and >+5.0

These limits have been used in the analysis of anthropometric data worldwide (WHO 2006:7).

3.6 Sampling Method and Sample Size

The 2013-14 ZDHS sampling frame was adopted from the Census of Population and Housing (CPH) of the Republic of Zambia conducted in 2010, provided by the Central Statistical Office (CSO). Consisting of 25,631 enumeration areas (SEA) created for the CPH 2010. The 2013-14 ZDHS used a stratified sample and selection was done at two stages from the 2010 CPH sampling frame. The stratification was achieved by separating every province into urban and rural areas. Therefore, the 10 provinces were stratified into 20 sampling strata. Then the samples were selected independently in every stratum by a two-stage selection. A representative sample of 18,052 households was drawn for the 2013-14 ZDHS survey. And this sample included 16,411 women aged 15-49, 16,209 men aged 15-59 from urban and rural areas. From the identified samples of males and females who were eligible, 96 percent was successfully interviewed for females and 91 percent was successfully interviewed for males. The KR recode file (child file) had a total of 13, 457 cases; with 12,311 children aged 0 to 59 months while 1,146 had missing records on age, therefore, these were excluded from the sample. Further 8 956 children had their birth weight reported. Children with birthweight greater than 5000grams (4 547 cases) and those with less than 1000 grams (6 cases) were removed. Therefore, the sample size used in the analysis of Height-for-age was 7388, while Weight -for -age was 7589 and Weight-for-height was 7544 children.

3.7 Identification and definition of Variables

Based on the literature and the UNICEF conceptual frame work for the determinants of child and women nutrition, the following variables have been identified and defined to guide the study.

3.7.1 Dependent Variables

The study had three outcome variables namely stunting, underweight and wasting that defines children's nutritional status defined by the Z-scores of the height-for-age (HAZ), weight-for-age (WAZ) and weight-for-height (WHZ) of the child. In this respect height-for-age, weight-for-age and weight-for-height more than two standard deviations below the new growth standards published by WHO in 2006 reference reflected chronic, underweight and acutely malnutrition respectively

3.7.2 Independent Variables

In this study the major predictor of child nutrition was birth weight (perceived size of the child at birth). This is the variable that was examined in order to determine its influence on under five children's nutritional status. The other factors that had influence on the nutritional status of under-five children were categorised under the immediate factors which focused on the maternal factors and these included: whether or not the mother while pregnant received some Iron Tablets, some vitamin A, anti-malaria and attended antenatal. All these factors play a very big role in influencing birth outcome.

However, as shown in the conceptual framework and established in the literature, there are other factors that may also influence children's nutritional status directly without operating through the birth weight. The variables have been divided into characteristics of the household and characteristics of the mother. Characteristics of the household include: wealth index (quintile), access to safe water (source of drinking water), access to improved sanitation facility (toilet facility shared with other households), residence (rural/urban), and province. Characteristics of the mother include: nutritional status of the mother (BMI), occupation of the mother, age of mother at the birth of the child, mother's education level, and marital status, control of household economic resources, number of births a woman has in the last 5 years' parity and access to information (frequency of reading newspaper, listening to radio and watching TV).

3.7.3. Operational Definition and Measurement of Variables

Table 1: Operational Framework

Variable	Question	Indicator	Scale of measurement
Dependent variable			
Nutritional Status (Stunting, Underweight and Wasting)		**0**. Not Stunted **1**. Stunted **0**. Not Underweight **1**. Underweight **0**. Wasted **1**. Not wasted	Nominal
Independent Variables			
Age	How old were you last birthday?	**1.** 15-24 **2.** 25-34 **3.** 35-44 **4.** 45-49	Ordinal
Residence	Based on where the respondent resides.	1. Urban 2. Rural	Nominal
Marital status	Have you ever been married? Are you currently married? What is your marital status now? (Divorced, widowed or separated)	**1**.Never-married **2**.Married **3**.Formally married	Nominal
Region	Based on where the respondent resides **Stunting:** 1. Lower Prevalence<36.5% (C/Belt, Lusaka, and Western) 2. Middle Prev. 36.6%-39.9% (North-Western and Southern) 3. Higher Prev >40+ (Central, Eastern, Luapula, Muchinga and Northern). **Underweight:** 1. Lower Prevalence<15% (C/Belt, Eastern, Lusaka, North-Western and Southern) 2. Middle Prev. <=18% (Central,	1. Lower Prevalence 2. Middle Prevalence 3.Higher Prevalence	Ordinal

	Muchinga and Western) 3. Higher Prevalence (Luapula, and Northern). **Wasting:** 1. Lower Prevalence <4%(Muchinga, Northern and Southern) 2. Middle Prev. 4.1%-6% (North-Western, Western Central, C/Belt and Eastern) 3. Higher Prevalence 6.1%-13%+(Luapula, and Lusaka).		
Religion	What is your religion?	1.Catholic 2.Protestant 3. Muslim	Nominal
Birth weight	How much did your child weigh at birth? Data was captured from the under-five card	0.Underweight 1.Normal	Ordinal
Number of children	In total how many children do you have?	1 2 3 4+	Ordinal
Education	Have you ever attended school? What is the highest level you have attended?	0.No education 1.Primary 3.Secondary 4.Higher	Ordinal
Employment	Are you currently employed? What is your occupation?	1.Not working 2.Working	Nominal
Wealth		0.Poor 1.Middle 2.Rich	Ordinal
Sex of the Child	**Is (NAME) male or female?**	1.Male 2.Female	Nominal
Body Mass Index (BMI)		1.Underweight 2.Normal 3.overweight 4.obese	Nominal
Access to information	Do you have access to read a newspaper? Do you have access to listen to the radio Do you have access to watch the TV	0.Yes had access 1.No access **This variable was just recoded and generated**	Nominal
Control over economic resources	Do you have control to decides on how to spend your earnings, large household purchases and daily needs?	0.Yes had control 1.No control **This variable was just recoded and generated**	Nominal
Number of ANC Visits	How many times did you go for ANC during Pregnancy	1.One 2.Two	Nominal

		3.Three 4.Four or more	
Mother recipient of supplement food	Were you given or bought Iron tablets during pregnancy Did you receive Vitamin A dose in the first 2 months after delivery?	0.No 1.Yes	Nominal
	Did you take Fansidar for Malaria	0.No 1.Yes	Nominal

3.8 Data Processing and Analysis

The study used Stata Software Version 14 to perform data analysis on the variables of interest. However, before any analysis was performed, data were weighted so that the sample can be representative and be able to be generalised to the entire population. The weighting process was carried out as follows: The primary Sampling unit-v021 was identified, then a sample-strata for sampling errors v022 which is province by rural-urban in the data set was identified. Thereafter, the weights v005 were identified and the variable for weighting the data was generated by dividing the weights by 1000 000. Thereafter the weighted data was produced by this command; svyset v021 [pweight = sampwt], strata(v022).

In this study, the type of analysis involved univariate analysis, bivariate analysis and multivariate regression analysis using binary logistic regression. Univariate analysis was used to describe the characteristics of the study participants and variable outputs.

Bivariate analysis was used to test for association between independent variables and the dependent variable. Secondly, Bivariate and multivariate analysis were performed using Binary logistic regression (BLR). Multivariate analysis was also performed using Binary logistic regression in order to determine how the independent variables interact with each other to influence the nutritional status of under-five children in Zambia while controlling for the net effects of each independent variable.

Binary Logistic regression was used because the dependent variable (Nutritional Status) had three outcome variables (Stunting, Underweight and Wasting) and these outcomes were coded as either (1) Stunted or (0) not Stunted, (1) Underweight or (0) not Underweight, (1) Wasted (0) not Wasted with one or more explanatory variables. In addition, the reason why Binary logistic regression was used over Chi2 or Fischer's exact test in this study was that logistic regression provides a quantified value for the strength of the association adjusting for other variables (removes confounding effects). The exponential of coefficients correspond to odd ratios for the given factor.

The stepwise (forward) method was used in order to exclude variables that were not significant in the model, based on the p-value (less than 0.05 means significant and greater than 0.05 means non-significant). The R^2 (coefficient of determination) was also used to measure the variation. The R^2 is a number that indicates the proportion of the variance in the dependent variable that is predictable from the independent variable. The Akaike's (AIC) and Schwarz's Bayesian information criterion (BIC) was used to compare between models for the goodness of fit (Frank J. Fabozzi el tal 2014:402). Contingency tables were used to facilitate the presentation of study findings. Odds ratios(ORs) and Adjusted Odds Ratios (AORs) were used to help the interpretation of the results. However, before data can be fitted in the model, a correlation was done to test for presence multicollinearity among variables and the study ensured that there is no multicollinearity in the variables. Microsoft-Excel was used to enhance graphs and make tables for easy interpretation of findings and Microsoft Word for report writing.

The dependent variables, were classified into dichotomized categories either stunted (1) or not stunted (0), underweight (1) or not underweight (0) and wasted (1) or not wasted (0). Children with underweight birthweight were used as a reference category. In addition, Independent Samples tests were performed to compare the children's differences in the means for nutritional status (HAZ, WAZ and WHZ) using birthweight as a main predictor variable.

3.9 Model Building Using Logistic Regression

3.9.1 Binary Logistic Regression

In order to measure the extent of the effect of each independent variable on the dependent variable, logistic regression analysis was performed. In this analysis, the dependent variable, "Nutritional Status", (which had 3 outcome variable, Stunting, Underweight and Wasting) was recoded into a binary form with 0 representing "not stunted, not Underweight, not wasted" and 1 representing "Stunted, underweight, wasted". Reference categories among the explanatory variables were selected in order to compare the odds of Stunting, Underweight and Wasting within respective explanatory variables. The reference categories were selected based on the category which is on the top or likely to have little influence on nutritional status of under-five children. The model fitting was based on the following logit model function:

$$\text{Prob } (y=1/x) =\wedge (x\beta) = \frac{\exp(x\beta)}{1+\exp(x\beta)}$$

$$p = \frac{e^{\beta o+\beta 1X1+\beta 2X2+\cdots+\beta nXn}}{1 + e^{\beta o+\beta 1X1+\beta 2X2+\cdots+\beta nXn}}$$

Assuming that the P is a linear combination of variables of interest, the function can be presented as:

$$logit(P) = \beta 0 + \beta 1X1 + \beta 2X2 + \cdots + \beta nXn$$

Where P= the dichotomous dependent variable called logit and defined in this study as:

1=Stunted, Underweight, Wasted
0=Not stunted, Not underweight, Not Wasted

Others are:

β_0=Intercept
β_1, β_2, β_n=Logistic Regression coefficient of X_1, X_2, X_n
X_1, X_2, X_n= Independent variables
Exp=Exponential Value
n=the number of predictors (independent variables) Frank J. Fabozzi (2014).

In this study, odds ratios were adopted for interpretation. These (Odds ratios) represent a constant effect of a predictor X (independent variable) on the likelihood that one outcome will occur. In other words, the exponential function of the regression coefficient (e^{b1}) is the odds ratio associated with a one-unit increase in the exposure (independent variable).

3.9.2 Multivariate Logistic Regression

Multivariate logistic regression involved building a model on how nutritional status is influenced by birthweight, maternal, child, household and mother characteristics; age, place of residence, literacy, sex, marital status, religion, region, number of children, education level, employment status, wealth index, ANC visits and BMI. In building the models, stepwise forward method was used and three final models were developed to help explain which of the maternal, child, household and mother characteristics variables influence under-five children's nutritional status in Zambia. The log likelihood ratio statistics and Akaike's (AIC) and Schwarz's Bayesian information criterion (BIC) was used to compare between models for the goodness of fit (Frank J. Fabozzi el tal 2014:402). The comparison was made between the BIC values of the models and the model with the lower BIC values were adopted. The following models were developed:

For Stunting:

Model 1: Birthweight with Stunting

1. $logit(Stunting) = \beta 0 + \beta 1 Birthweight$

Model 2 Maternal health characteristics with Stunting

1. $logit(Stunting) = \beta 0 + \beta 1 Anti - malaria$

Model 3: Household Characteristics with Stunting

1. $logit(Stunting) = \beta 0 + \beta 1 Residence$
2. $logit(Stunting) = \beta 0 + \beta 1 Residence + \beta 2 Region$
3. $logit(Stunting) = \beta 0 + \beta 1 Residence + \beta 2 Region + \beta 3 Wealth\ Quintile$
4. $logit(Stunting) = \beta 0 + \beta 1 Residence + \beta 2 Region + \beta 3 Wealth\ Quintile + \beta 4 Source\ of\ water$
5. $logit(Stunting) = \beta 0 + \beta 1 Residence + \beta 2 Region + \beta 3 Wealth\ Quintile + \beta 4 Source\ of\ water + \beta 5 toilet\ facilityshared$

Model 4: Mother Characteristics with Stunting

1. $logit(Stunting) = \beta 0 + \beta 1 Religion$
2. $logit(Stunting) = \beta 0 + \beta 1 Religion + \beta 2 Educationlevel$
3. $logit(Stunting) = \beta 0 + \beta 1 Religion + \beta 2 Educationlevel + \beta 3 BMI$
4. $logit(Stunting) = \beta 0 + \beta 1 Religion + \beta 2 Educationlevel + \beta 3 BMI + \beta 4 CEB$
5. $logit(Stunting) = \beta 0 + \beta 1 Religion + \beta 2 Educationlevel + \beta 3 BMI + \beta 4 CEB + \beta 5 Access\ to\ information$

Model 5 Child Characteristics with Stunting

1. $logit(Stunting) = \beta 0 + \beta 1\ child\ had\ fever$
2. $logit(Stunting) = \beta 0 + \beta 1\ child\ had\ fever + \beta 2\ Sex\ of\ the\ child$
3. $logit(Stunting) = \beta 0 + \beta 1\ child\ had\ fever + \beta 2 sexof\ the\ child + \beta 3\ Age\ of\ the\ child$

Model 6. Birthweight, Maternal health, Household, Mother and Child characteristics with Stunting

1. $logit(Stunting) = \beta 0 + \beta 1 Birthweight$
2. $logit(Stunting) = \beta 0 + \beta 1 Birthweight + \beta 2 Anti - malaria$
3. $logit(Stunting) = \beta 0 + \beta 1 Birthweight + \beta 2 Anti - malaria + \beta 3 Residence + \beta 4 Region + \beta 5 Wealth\ Quintile + \beta 6 Source\ of\ water + \beta 7 Toilet\ facility\ shared$

4. $logit(Stunting) = \beta 0 + \beta 1 Birthweight + \beta 2 Anti - malaria + \beta 3 Residence + \beta 4 Region + \beta 5 Wealth\ Quintile + \beta 6 Source\ of\ water + \beta 7 Toilet\ facility\ shared + \beta 8 Religion + \beta 9 Education\ Level + \beta 10 BMI + \beta 11 CEB + \beta 12 Accesstoinformation$
5. $Logit(Stunting) = \beta 0 + \beta 1 Birthweight + \beta 2 Anti - malaria + \beta 3 Residence + \beta 4 Region + \beta 5 Wealth\ Quintile + \beta 6 Source\ of\ water + \beta 7 Toilet\ facility\ shared + \beta 8 Religion + \beta 9 Education\ Level + \beta 10 BMI + \beta 11 CEB + \beta 12 Accesstoinformation + \beta 13 Child\ had\ fever + \beta 14 Sex\ of\ the\ child + \beta 15\ Age\ of\ the\ Child$

For Underweight:

Model 1: Birthweight with Underweight

1. $logit(Underweight) = \beta 0 + \beta 1 Birthweight$

Model 2 Maternal health characteristics with Underweight

1. $logit(Underweight) = \beta 0 + \beta 1 Iron\ tablets$

Model 3: Household Characteristics with Underweight

1. $logit(Underweight) = \beta 0 + \beta 1 Region$
2. $logit(Underweight) = \beta 0 + \beta 1 Region + \beta 2 Wealth\ Quintile$

Model 4: Mother Characteristics with underweight

1. $logit(Underweight) = \beta 0 + \beta 1 Mstatus$
2. $logit(Underweight) = \beta 0 + \beta 1 Mstatus + \beta 2 Educationlevel$
3. $logit(Underweight) = \beta 0 + \beta 1 Mstatus + \beta 2 Educationlevel + \beta 3 BMI$
4. $logit(Underweight) = \beta 0 + \beta 1 Mstatus + \beta 2 Educationlevel + \beta 3 BMI + \beta 4 births\ in\ last\ 5 year$
5. $logit(Underweight) = \beta 0 + \beta 1 Mstatus + \beta 2 Educationlevel + \beta 3 BMI + \beta 4 births\ in\ last\ 5 year + \beta 5 CEB$
6. $logit(Underweight) = \beta 0 + \beta 1 Mstatus + \beta 2 Educationlevel + \beta 3 BMI + \beta 4 births\ in\ last\ 5 year + \beta 5 CEB + \beta 6 lAccess\ to\ information$

Model 5 Child characteristics with Underweight

1. $logit(Underweight) = \beta 0 + \beta 1 sexof\ the\ child$
2. $logit(Underweight) = \beta 0 + \beta 1 sexof\ the\ child + \beta 2 age\ of\ the\ child$

Model 6. Birthweight, Maternal health, Household, Mother and Child characteristics with Underweight

1. $logit(Underweight) = \beta 0 + \beta 1 Birthweight$
2. $logit(Underweight) = \beta 0 + \beta 1 Birthweight + \beta 2 Iron\ tablets$
3. $logit(Underweight) = \beta 0 + \beta 1 Birthweight + \beta 2 Iron\ tablets + \beta 3 Religion + \beta 4\ Wealth\ Quintile$
4. $logit(Underweight) = \beta 0 + \beta 1 Birthweight + \beta 2 Iron\ tablets + \beta 3 Religion + \beta 4\ Wealth\ Quintile + \beta 5 Mstatus + \beta 6\ Education\ Level + \beta 7 BMI + \beta 8 Births\ in\ the\ last\ 5\ years + \beta 9 CEB + \beta 10\ Access\ to\ information$
5. $Logit(Underweight) = \beta 0 + \beta 1 Birthweight + \beta 2 Iron\ tablets + \beta 3 Religion + \beta 4\ Wealth\ Quintile + \beta 5 Mstatus + \beta 6\ Education\ Level + \beta 7 BMI + \beta 8 Births\ in\ the\ last\ 5\ years + \beta 9 CEB + \beta 10\ Access\ to\ information + \beta 11\ Sex\ of\ the\ Child + \beta 12\ Age\ of\ the\ Child$

For Wasting:

Model 1: Birthweight with Wasting

1. $logit(Wasting) = \beta 0 + \beta 1 Birthweight$

Model 2: Household Characteristics with Wasting

1. $logit(Wasting) = \beta 0 + \beta 1 Region$
2. $logit(Wasting) = \beta 0 + \beta 1 Region + \beta 2 Wealth\ Quintile$

Model 3: Mother Characteristics with Wasting

1. $logit(Wasting) = \beta 0 + \beta 1 BMI$
2. $logit(Wasting) = \beta 0 + \beta 1 BMI + \beta 2 Births\ in\ last\ 5 years$

Model 4 Child Characteristics with Wasting

1. $logit(Wasting) = \beta 0 + \beta 1 VitaminA$
2. $logit(Wasting) = \beta 0 + \beta 1 VitaminA + \beta 2\ Child\ had\ fever$

3. $logit(Wasting) = \beta 0 + \beta 1 VitaminA + \beta 2\ Child\ had\ fever + \beta Age\ of\ the\ Child$
4. $logit(Wasting) = \beta 0 + \beta 1 VitaminA + \beta 2\ Child\ had\ fever + \beta Age\ of\ the\ Child + \beta\ Sex\ of\ the\ Child$

Model 5. Birthweight, Household, Mother and Child characteristics with Wasting

1. $logit(Wasting) = \beta 0 + \beta 1 Birthweight$
2. $logit(Wasting) = \beta 0 + \beta 1 Birthweight + \beta 2 Religion + \beta 3 Wealth\ Quintile$
3. $logit(Wasting) = \beta 0 + \beta 1 Birthweight + \ + \beta 2 Region + \beta 3 Wealth\ Quintile + \beta 4 BMI + \beta 5 Births\ in\ last\ 5 years$
4. $logit(Wasting) = \beta 0 + \beta 1 Birthweight + \ + \beta 2 Region + \beta 3 Wealth\ Quintile + \beta 4 BMI + \beta 5 Births\ in\ last\ 5 years + \beta 6 VitaminA + \beta 7 childhad\ fever + + \beta 8 age\ of\ the\ child + \beta 9 sexof\ the\ child$

3.10 Ethical Consideration

Since this study is based on the 2013/14 ZDHS data, consent for using the data sets was obtained from Measure DHS, which is the main funder and custodian of the data sets, hence, the recognized relevant authority. The data set was accessed through measure DHS website by signing in the request to use their data set for academic purpose only. Furthermore, analysis and reporting was precisely and accurately done in accordance with the goal of Measure DHS of maintaining high standards in terms of data quality and accuracy. The study output is to be published in aggregated data and therefore, confidentiality of individual respondents will be completely maintained.

3.11 Study Limitations

In as much as the conceptual framework guided the analysis, not all the variables in the conceptual framework were readily available in the data set. The UNICEF framework assumes that the basic causes of malnutrition, disability and death are political context and governance dynamics which include law and order, political stability and democratic accountability. In addition, it assumes economic and income constraints at individual level, household and national level. Variables on political context and governance dynamics and economic and income constraints at national level are not captured in the ZDHS. Additionally, the current presentation of DHS only allows disaggregation by province. It is currently not possible to explore the prevalence of malnutrition at District level in Zambia. This is extremely important for service planning delivery, monitoring and evaluation.

Further, the cross-sectional nature of DHS data does not enable to determine causality between the dependent and independent variables but only association which this study has been able to do.

CHAPTER FOUR: STUDY FINDINGS

4.1 Introduction

The objective of this chapter is to present the findings of the study. The study begin by presents results for data quality assessment. The frequency and percent distribution of women and children in the study sample is by maternal, child, household and mother characteristics. The chapter also presents results of cross tabulations of all selected independent variables against the dependent variable. Furthermore, using the logistic models, results are shown, discussed and interpreted.

4.2 Data Quality Assessment

To uphold data quality assurance, UNICEF and WHO recommends that the following minimum criteria for inclusion be met:

- The study employs a cross-sectional population-based random sample,
- The study covers the full, or nearly full, age range of children 0 to 5 years,
- The study has a minimum sample size of 400,
- The study utilizes standard measurement techniques
- for height and weight (WHO, 2008),
- The study derives estimates based on the WHO Growth Standards using the standard indicators and cut off points (e.g., for stunting—proportion of children with height-for-age below –2 standard deviations (SD); underweight—proportion of children with weight-for-age below –2 SD; wasting—proportion of children with weight-for height below –2 SD; and overweight—proportion of children with weight-for-height above +2 SD) (UNICEF 2012).

In the ZDHS 2013/14 Child data set, there were a total of 13 457 cases of children aged whose information was collected. Out of this number 1 146 had missing age so these were removed. The sample remained with 12 311 children aged 0-59 months. Further 8 956 children had their birth weight reported in the data set. However, this study did not consider children with birthweight greater than 5000grams (4 547 cases) and those with less than 1000 grams (6 cases), these were removed. The next step was to was to assess all outliers by the help of the z-scores to define which observations are beyond the range of what one would normally expect to find in a population. Typically, these outliers are the result of data entry errors or wrong measurement, rather than from true extreme growth of the child. In this case a fixed exclusion range was used for this analysis because the mean z-score for HAZ was above -1.5. For Stunting (Height-for-age), Children with <-5.0 and >+3.0 were removed while for Underweight

(Weight-for-age), Children with <-5.0 and >+5.0 were removed and finally for Wasting (Weight-for-height), Children with <-4.0 and >+5.0 were removed from the sample. Therefore, the sample size used in the analysis of Height-for-age was 7388, while Weight -for -age was 7589 and Weight-for-height was 7544 children. In addition, before data can be fitted in the model, a correlation was done to test for presence of multicollinearity among variables and the study ensured that there is no multicollinearity in the variables.

4.3 Descriptive Analysis

Table 2 shows the distribution of stunting, underweight and wasting among under five children in Zambia. The table shows that 37.2% of children were stunted while 13.7% were underweight and 5.9% were wasted.

Table 2: Distribution of Stunting, Underweight and Wasting among Under-five children

	Stunting		**Underweight**		**Wasting**	
	Not Stunted	**Stunted**	**Not Underweight**	**Underweight**	**Not Wasted**	**Wasted**
Number	4638	2750	6553	1036	7092	452
Percent	62.78	37.22	86.35	13.65	94.01	5.99
n	**7388**	**100**	**7589**	**100**	**7544**	**100**

Source: Calculated using the 2013/14 ZDHS data set

Table 3.0 shows the distribution of under five children (0-59 months) and women aged (15-49 years) who were sampled to be considered for the analysis of Stunting, Underweight and Wasting by Birthweight, Maternal health Characteristics, household, mother and Child characteristics. In this study birthweight is the variable considered to be the major explanatory of under-five nutritional status in other words it is taken as a proximity variable influencing nutritional status of children. The Maternal health characteristics considered in this report include: number of ANC visits, whether or not the woman took iron tablets, took ant-malaria drugs. Similarly, the household characteristics considered in this report included: place of residence, region, wealth quintile, source of drinking water and whether or not the household uses shared toilet. Additionally, the characteristics of the mother considered in this report are: religion, age of the mother, marital status, education, BMI, children ever born, occupation, access to information and control over resources. On the other hand, the characteristics of the child include: sex of the child, age of the child, whether or not a child had fever two weeks prior to the survey and whether or not a child received Vitamin A supplement two weeks after delivery.

The descriptive results show that majority (91.2%) of the children had a normal birthweight while 8.8% were underweight. Additionally, the table shows that more women from rural areas (54.9% for stunting, 54.7% for underweight and wasting) were included in the sample. With respect to region, 42% of children were from lower prevalence for stunting, 68.2% for underweight and 23.8% for wasting.

Likewise, 48% of women were in the age group 25-34 followed by 31.3% from age group 15-24. Similarly, the majority (82.2%) of the women were married while 8.5% were not married. In terms of education level, half (50.1%) of the women had primary education while only 5.2% had higher education. In terms of occupation, more than half (55.5%) of the women were working while 44.5% were not working.

Table 3: Distribution of under-five children (0-59 months) and Women (15-59 years) by Maternal Health, Household, Mother and Child Characteristics

	STUNTING		UNDERWEIGHT		WASTING	
Variable	**Frequency**	**Weighted Percent**	**Frequency**	**Weighted Percent**	**Frequency**	**Weighted Percent**
Birthweight						
Underweight	639	8.8	663	8.9	662	8.9
Normal	6633	91.2	6813	91.1	6771	91.1
Maternal Health Characteristics						
Number of ANC Visits						
First Visits	69	1.3	70	1.2	69	1.2
Second Visits	408	7.4	416	7.4	414	7.4
Third Visits	1787	32.6	1849	32.7	1836	32.6
At least 4 visits	3221	58.7	3323	58.7	3307	58.8
Took Iron Tablets						
No	164	3.0	170	3.0	168	3.0
Yes	5381	97.0	5549	97.0	5518	97.0
Took Anti-malaria						
No	260	4.7	264	4.6	263	4.6
Yes	5280	95.3	5449	95.4	5417	95.4
Characteristics of the household						
Place of Residence						
Urban	3283	45.1	3386	45.3	3366	45.3
Rural	3990	54.9	4090	54.7	4067	54.7
Region						
Lower Prevalence	3055	42.0	5095	68.2	1770	23.8
Middle Prevalence	1323	18.2	1314	17.6	3569	48.0
Higher Prevalence	2895	39.8	1067	14.3	2094	28.2
Wealth quintile						
Poor	2645	36.4	2711	36.3	2694	36.2
Middle	1503	20.7	1544	20.6	1535	20.6
Rich	3125	43.0	3222	43.1	3204	43.1
Source of drinking Water						
Improved	4869	67.0	5009	67.1	4983	67.1
Not Improved	2393	33.0	2457	32.9	2439	32.9
Toilet Facility Shared						
No	3475	57.7	3567	57.5	3544	57.5
Yes	2549	42.3	2635	42.5	2618	42.5
Characteristics of the Mother						

Religion						
Catholic	1231	17.0	1270	17.0	1261	17.0
Protestant	5990	82.6	6155	82.5	6120	82.5
Muslim	34	0.5	35	0.5	35	0.5
Age of Mother						
15-24	2278	31.3	2348	31.4	2339	31.5
25-34	3489	48.0	3578	47.9	3559	47.9
35-44	1415	19.5	1459	19.5	1445	19.4
45-49	91	1.3	92	1.2	90	1.2
Marital Status						
Never Married	616	8.5	640	8.6	635	8.5
Married	5976	82.2	6141	82.1	6106	82.1
Separated/Divorced/Widowed/Cohabiting	680	9.4	696	9.3	692	9.3
Education Level						
No education	586	8.1	608	8.1	606	8.2
Primary	3643	50.1	3739	50.0	3710	49.9
Secondary	2663	36.6	2745	36.7	2733	36.8
Higher	377	5.2	380	5.1	381	5.1
BMI						
Underweight	543	7.5	554	7.4	553	7.5
Normal Weight	4844	66.8	4980	66.8	4944	66.7
Over weight	1313	18.1	1364	18.3	1358	18.3
Obese	551	7.6	558	7.5	558	7.5
Births in last 5 years						
One	3608	49.6	3713	49.7	3695	49.7
Two	3117	42.9	3198	42.8	3177	42.7
Three	533	7.3	550	7.4	548	7.4
Four	15	0.2	15	0.2	14	0.2
Total children ever born						
One	1225	16.8	1261	16.9	1257	16.9
Two	1496	20.6	1530	20.5	1522	20.5
Three	1246	17.1	1288	17.2	1281	17.2
Four and above	3306	45.5	3398	45.4	3372	45.4
Occupation						
Not Working	3228	44.5	3331	44.7	3313	44.7
Working	4019	55.5	4119	55.3	4094	55.3
Access to Information						
Yes had access	5993	82.4	6161	82.4	6124	82.4
No Access	1280	17.6	1315	17.6	1309	17.6
Control Over Resources						
Yes had Control	6187	85.1	6358	85.0	6324	85.1
No Control	1086	14.9	1118	15.0	1109	14.9
Characteristics of the Child						
Sex of Child						
Male	3702	50.9	3809	50.9	3783	50.9
Female	3570	49.1	3667	49.1	3650	49.1
Age of the Child in Months						
0-12	1633	22.5	1694	22.7	1681	22.6
13-23	1438	19.8	1505	20.1	1497	20.1
24-45	2612	35.9	2670	35.7	2654	35.7
46-59	1589	21.8	1608	21.5	1601	21.5
Child had fever in the last two weeks						
No	5668	78.1	5827	78.1	5793	78.1
Yes	1594	21.9	1634	21.9	1625	21.9
Received Vitamin A						
No	1612	29.2	1652	29.0	1644	29.0
Yes	3908	70.8	4041	71.0	4016	71.0
Total	7,388	100	7589	100	7544	100

Source: Calculated using the 2013/14 ZDHS data set

4.4 Relationship between maternal health characteristics, household and mother's characteristics with birthweight

Table 4 shows the results from the cross tabulation between maternal health characteristics and Birthweight. The results show that 91.8% of children whose mothers had gone for antenatal at least 4 times had normal birthweight compared with 83.5 % of children whose mothers had gone for antennal only for the first visit had normal birthweight. The results showed a high significant relationship between number of antenatal visits and birthweight (p=0.0074). Additionally, the results showed that 92% of children whose mothers took Iron tablets during pregnancy had normal birthweight compared with 89% of children whose mothers did not take Iron tablets during pregnancy had normal birthweight. Furthermore, results showed that 92.1% of children whose mothers took anti-malaria drugs during pregnancy had normal birthweight as compared 87.5% of children whose mothers did not take anti-malaria drugs during pregnancy who had normal birthweight. The results showed a high significant relationship between taking anti-malaria drugs during pregnancy and birthweight (p=0.0284).

Table 4: Maternal health characteristics influencing Birthweight-Chi-Square test Asymp. Sig. (2 sided)

	Underweight Birthweight		**Normal Birthweight**		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Maternal Health Characteristics					**0.0074**
Number of ANC Visits					
First Visits	11	16.5	58	83.5	
Second Visits	45	11.1	363	88.9	
Third Visits	121	6.8	1666	93.2	
At least 4 visits	265	8.2	2956	91.8	
Iron Tablets					0.2607
No	18	11.0	146	89.0	
Yes	433	8.0	4948	92.0	
Took Anti-malaria					**0.0284**
No	33	12.5	227	87.5	
Yes	417	7.9	4863	92.1	
Total	4638	100.0	2750	100.0	

Source: Calculated using the 2013/14 ZDHS data set

Table 5 shows results from a cross tabulation between household characteristics and birthweight. The results show that 92.1% of children in rural areas had normal birthweight compared with 90.1% of children in urban areas who had a normal birthweight. The results showed high significant relationship between place of residence of mothers and the birthweight of a child (p=0.0183). Additionally, the results show that 92.5% of children in higher prevalence region had normal birthweight compared with 89.9 % in lower prevalence regions who had normal birthweight. Results show a high significant relationship between region and birthweight of the child (p=0.008). Table 5 also shows that 90.1% of children in rich wealth quintile had normal birthweight compared with 91.8% of children in poor wealth quintile who had a normal birthweight. Furthermore, results in table 5 show that 92.2% of children whose households did not share a toilet facility had normal birthweight compared with 90.1% of children whose households shared a toilet facility. The results show a high significant relationship between sharing a toilet facility and birthweight (p=0.025).

Table 5: Household characteristics influencing Birthweight--Chi-Square test Asymp. Sig. (2 sided)

	Underweight		**Normal Birthweight**		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Place of Residence					**0.0183**
Urban	324	9.9	2959	90.1	
Rural	316	7.9	3674	92.1	
Region					**0.0083**
Lower Prevalence	310	10.1	2745	89.9	
Middle Prevalence	112	8.5	1211	91.5	
Higher Prevalence	218	7.5	2429	92.5	
Wealth quintile					**0.0740**
Poor	216	8.2	2429	91.8	
Middle	113	7.5	1390	92.5	
Rich	310	9.9	2815	90.1	
Source of drinking Water					0.9291
Non-Improved	211	8.8	2182	91.2	
Improved	426	8.7	4442	91.3	
Toilet Facility Shared					**0.0250**
No	270	7.8	3205	92.2	
Yes	253	9.9	2296	90.1	
Total	**4638**	**100.0**	**2750**	**100.0**	

Source: Calculated using the 2013/14 ZDHS data set

Table 6 shows results from cross tabulation between mother's characteristics and birthweight of the child. The results indicate that 89.2% of children whose mothers were in the age group 15-24 had normal birthweight as compared with 90.9% of children whose mothers were in the age group 35-44 who had normal birthweight. Results show a high significant relationship between age of the mother and birthweight of the child. Additionally, the table shows that 92.1% of children whose mothers had one birth in the last five years had normal birthweight compared with 85.8% and 89.1% of children whose mothers had three and four births in the last 5 years respectively had normal birthweight. The results show a high significant relationship between number of births a woman has in the last 5 years and birthweight of the child (p=0.0074).

Table 6.0: Mother's characteristics influencing Birthweight- Chi-Square test Asymp. Sig. (2 sided)

	Underweight Birthweight		Normal Birthweight		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Religion					0.0798
Catholic	85	6.9	1146	93.1	
Protestant	548	9.1	5443	90.9	
Muslim	3	7.4	32	92.6	
Age of Mother					**0.0088**
15-24	245	10.8	2033	89.2	
25-34	262	7.5	3227	92.5	
35-44	129	9.1	1286	90.9	
45-49	4	4.1	87	95.9	
Marital Status					0.1660
Never Married	66	10.7	550	89.3	
Married	523	8.8	5453	91.2	
Separated/Divorced/Widowed/Cohabiting	50	7.4	630	92.6	
Education Level					0.5322
No education	57	9.7	529	90.3	
Primary	328	9.0	3314	91.0	
Secondary	230	8.6	2433	91.4	
Higher	23	**6.3**	354	93.7	
Body Mass Index (BMI)					0.2858
Underweight	60	11.1	483	88.9	
Normal Weight	436	9.0	4408	91.0	
Over weight	99	7.5	1215	92.5	
Obese	43	7.8	508	92.0	
Births in last 5 years					**0.0074**
One	284	7.9	3324	92.1	
Two	279	8.9	2838	91.1	
Three	76	14.2	458	85.8	
Four	2	10.9	13	89.1	
Total children ever born					0.1221
One	135	11.0	1090	89.0	
Two	132	8.8	1364	91.2	
Three	104	8.3	1142	91.7	
Four and above	269	8.1	3037	91.9	
Occupation					0.4264
Working	366	9.1	3653	90.9	
Not Working	272	8.4	2955	91.6	
Access to Information					0.6523
Yes had access	532	8.9	5461	91.1	
No Access	107	8.4	1172	91.6	
Control Over Resources					0.4965
Yes had Control	552	8.9	5635	91.1	
No Control	87	8.0	999	92.0	
Total	**4638**	**100**	**2750**	**100**	

Source: Calculated using the 2013/14 ZDHS data set

4.5 The influence of Birthweight, Maternal Health Characteristics, Household, Mother and Child Characteristics on Stunting

4.5.1 Birthweight Influencing Stunting

Table 7 shows the results from the cross tabulation between birthweight and Stunting. The results in the table show that 58.7% of children whose birth weight was underweight were stunted as compared with 35.9% of children whose birth weight was normal who were stunted. The results showed a high significant relationship between birth weight of the child and Stunting ($p<0.0001$).

Table 7: Birthweight Influencing Stunting-Chi - square test Asymp. Sig. (2-sided)

	Not Stunted		Stunted		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Birthweight					**<0.0001**
Underweight	264	41.3	375	58.7	
Normal	4251	64.1	2382	35.9	
Total	**4638**	**100.0**	**2750**	**100.0**	

Source: Calculated using the 2013/14 ZDHS data set

4.5.2: Maternal Health Characteristics Influencing Stunting

Table 8 shows the results from a cross tabulation between maternal health characteristics and Stunting. The results in the table show that 36.2% of children whose mothers had gone for antenatal for at least 4 visits were stunted compared with 30.3% of children whose mothers had gone for antenatal only for the first visit were stunted. Additionally, results show that 37.4% of children whose mothers took Iron tablets during pregnancy were stunted compared with 37.2% of children whose mothers did not take any Iron tablets during pregnancy. Furthermore, the results show that 44.2% of children whose mothers did not take anti-malaria drugs during pregnancy were stunted compared with 37% of children whose mothers took anti-malaria drugs during pregnancy. The results did not show any significant differences in stunting among maternal health characteristics.

Table 8: Maternal Health Characteristics Influencing Stunting-Chi-Square test Asymp. Sig. (2 sided)

	Not Stunted		Stunted		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Number of ANC Visits					**0.1586**
First Visits	48	69.7	21	30.3	
Second Visits	241	59.1	167	40.9	
Third Visits	1093	61.2	694	38.9	
At least 4 visits	2056	63.8	1166	36.2	
Iron Tablets					**0.9747**
No	103	62.8	61	37.2	
Yes	3371	62.6	2010	37.4	
Took Anti-malaria					**0.0865**
No	145	55.8	115	44.2	
Yes	3327	63.0	1954	37.0	
Total	4638	100.0	2750	100.0	

Source: Calculated using the 2013/14 ZDHS data set

4.5.3: Household Characteristics Influencing Stunting

Table 9 shows results from a cross tabulation between household characteristics and Stunting. The results in the table show that 40% of the children in rural areas were stunted compared with 35.4% of children in urban areas who were stunted. The results show a high significant relationship between residence and Stunting (p=0.0020). By region, the table shows that 42% of children who were stunted were from region of high prevalence (Central, Eastern, Luapula, Muchinga and Northern) compared with 35% and 34% of those from Lower and middle prevalence (Copper belt, Lusaka and Western) respectively. The results show a high significant relationship between region and stunting (p=0.0000). Additionally, 42.8% of children in the poor wealth quintile were stunted compared with 40% and 32.8% of children in the middle and rich wealth quintile respectively who were stunted. The results show a high significant relationship between wealth quintile and Stunting (p=0.0000). The table further show that 40.9% of children who were stunted had access to non-improved water sources compared with 36.4% who had access to improved water sources. The results show a high significant relationship between source of drinking water and stunting (p=0.0011). The table also show that 39.6% of children from households were they share a toilet facility were stunted compared with 35.6% who were stunted who did not share a toilet facility. The results show a significant relationship between shared toilet facility and Stunting (p=0.0105).

Table 9: Household Characteristics Influencing Stunting-Chi-Square test Asymp. Sig. (2 sided)

	Not Stunted		Stunted		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Place of Residence					**0.0020**
Urban	2121	64.6	1162	35.4	
Rural	2395	60.0	1596	40.0	
Region					**0.0000**
Lower Prevalence	1977	64.7	1077	35.3	
Middle Prevalence	873	66.0	450	34.0	
Higher Prevalence	1665	57.5	1230	42.5	
Wealth quintile					**0.0000**
Poor	1512	57.2	1133	42.8	
Middle	902	60.0	601	40.0	
Rich	2101	67.2	1024	32.8	
Source of drinking Water					**0.0000**
Non Improved	1414	59.1	980	40.9	
Improved	3096	63.6	1773	36.4	
Toilet Facility Shared					**0.0225**
No	2236	64.4	1239	35.6	
Yes	1540	60.4	1009	39.6	
Total	**4638**	**100.0**	**2750**	**100.0**	

Source: Calculated using the 2013/14 ZDHS data set

4.5.4 Mother's Characteristics Influencing Stunting

Table 10 shows results from cross tabulation between mother's characteristics and Stunting. Results show that 38.7% of children whose religion was catholic were stunted compared with 37.9% and 6.3% whose religion was Protestant and Muslim respectively. The results show significant relationship between region and stunting (p=0.0105). Additionally, results show that 39.8% of children whose mothers were in the age group 15-24 were stunted compared with 25.3% of children whose mothers were in age group 45-49 who were stunted. In terms of marital status, 35.7% of children whose mothers were never married were stunted compared with 38% of children whose mothers were married who were stunted. Similarly, the results in the table show that stunting among under-five children decreases with the level of education of mothers (p=0.0000).

In addition, the results show that stunting among under-five children decreases as the mothers BMI increases (p=0.0000). The table also show that 37.7% of children whose mothers reported having one birth in the past 5 years were stunted as compared with 37.2% and 39.3% of children whose mothers reported having three and four and above births in the past 5 years respectively who were stunted. In addition, the results in the table show that 39.6% of children whose mothers had access to information were stunted compared with 30% of children whose mothers had no access to information. The results showed a high significant relationship between access to information and stunting (p=0.0000). Furthermore, results did not show any statistical differences in stunting between occupation status and control over household resources.

Table 10: Mother's Characteristics Influencing Stunting-Chi-Square test Asymp. Sig. (2 sided)

	Not Stunted		Stunted		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Religion					**0.0105**
Catholic	755	61.3	477	38.7	
Protestant	3720	62.1	2270	37.9	
Muslim	32	93.7	2	6.3	
Age of Mother					**0.0570**
15-24	1372	60.2	907	39.8	
25-34	2189	62.7	1300	37.3	
35-44	887	62.7	528	37.3	
45-49	68	74.7	23	25.3	
Marital Status					**0.5709**
Never Married	396	64.3	220	35.7	
Married	3703	62.0	2273	38.0	
Separated/Divorced/Widowed/Cohabiting	416	61.1	265	38.9	
Education Level					**<0.0001**
No education	326	55.7	260	44.3	
Primary	2159	59.3	1483	40.7	
Secondary	1717	64.5	946	35.5	
Higher	312	82.5	66	17.5	
BMI					**<0.0001**
Underweight	277	51.0	266	49.0	
Normal Weight	2935	60.6	1909	39.4	
Over weight	892	67.9	421	32.1	
Obese	393	71.2	159	28.8	
Births in last 5 years					**0.9676**
One	2248	62.3	1360	37.7	
Two	1925	61.8	1192	38.2	
Three	334	62.6	199	37.4	
Four	9	57.0	6	43.0	
Total children ever born					**0.3514**
One	774	63.2	450	36.8	
Two	951	63.6	545	36.4	
Three	783	62.8	464	37.2	
Four and above	2008	60.7	1298	39.3	
Occupation					**0.887**
Working	2499	62.2	1520	37.8	
Not Working	2000	62.0	1228	38.0	
Access to Information					**<0.0001**
Yes had access	3620	60.4	2373	39.6	
No Access	896	70.0	384	30.0	
Control Over Resources					**0.5864**
Yes had Control	3831	61.9	2356	38.1	
No Control	684	63.0	402	37.0	
Total	**4638**	**100.0**	**2750**	**100.0**	

Source: Calculated using the 2013/14 ZDHS data set

4.5.5 Child Characteristics influencing Stunting

Table 11 shows results from a cross tabulation between child characteristics and stunting. The results show that 40.1% of male children were stunted as compared with 35.6% of female children who were stunted. The results show a high significant relationship between sex of the child and Stunting (p=0.0009). Additionally, 22.8% of children in the age group0-12 months were stunted compared with 49.1% in age group 13-23, 45.2% in age group 24-45 and 31.3% in the age group 46-59 months who were stunted. The results show a high significant relationship between age group of under-five children and Stunting (p=0.0000). Furthermore, the results in the table show that 37.7% of children who did not receive Vitamin A supplement in two weeks after delivery were stunted compared with 37.2% of children who received Vitamin A supplement in two weeks after delivery who were stunted. Results in the table show that 37.5% of children who did not have fever in the last two weeks preceding the survey were stunted compared with 39.4% of children who had fever in the last two weeks before the survey who were stunted. Results did not show any statistical significant in stunting between children who received Vitamin A supplement and those who had fever in the last two weeks preceding the survey.

Table 11: Child Characteristics Influencing Stunting-Chi-Square test Asymp. Sig. (2 sided)

	NOT STUNTED		STUNTED		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Sex of Child					**0.0009**
Male	2217	59.9	1486	40.1	
Female	2298	64.4	1272	35.6	
Age of the Child in Months					**0.0000**
0-12	1261	77.2	373	22.8	
13-23	732	50.9	707	49.1	
24-45	1431	54.8	1181	45.2	
46-59	1091	68.7	498	31.3	
Received Vitamin A					**0.7841**
No	1004	62.3	608	37.7	
Yes	2453	62.8	1455	37.2	
Child had fever in the last two weeks					**0.2693**
No	3545	62.5	2123	37.5	
Yes	966	60.6	628	39.4	
Total	**4638**	**100.0**	**2750**	**100.0**	

Source: Calculated using the 2013/14 ZDHS data set

4.6 The Influence of Birthweight, Maternal Health Characteristics, Household, Mother and Child Characteristics on Underweight

4.6.1 Birthweight Influencing Underweight

Table 12 shows the results from the cross tabulation between birthweight and Underweight. The results in the table show that 30.5% of children whose birth weight was underweight were underweight as compared with 11.6% of children whose birth weight was normal who were underweight. The results showed a high significant relationship between birth weight of the child and Underweight (P=0.0000)

Table 12: Birthweight Influencing Underweight-Chi-Square test Asymp. Sig. (2 sided)

	Not Underweight		**Underweight**		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	P-Value
Birthweight					**<0.0001**
Underweight	461	69.5	203	30.5	
Normal	6021	88.4	792	11.6	
Total	**6533**	**100.0**	**1036**	**100.0**	

Source: Calculated using the 2013/14 ZDHS data set

4.6.2: Maternal Health Characteristics Influencing Underweight

Table 13 shows the results from a cross tabulation between maternal health characteristics and Underweight. The results in the table show that proportions of underweight (11.4%) among children whose mothers had gone for antenatal for at least 4 visits were lower compared with 16.5% and 18.5% of children whose mothers had gone for antenatal for the first and second visit respectively. Additionally, results show that proportion of underweight (12.5%) among children whose mothers took Iron tablets during pregnancy were lower as compared with 18.5% of children whose mothers did not take any Iron tablets during pregnancy. Results show high statistical significant relationship between number of antenatal visit and taking Iron tablets during pregnancy with underweight (p=0.0048 and p=0.0434). Furthermore, the results show that the proportion of underweight (12.5%) among children whose mothers took anti-malaria drugs during pregnancy were lower as compared with 16.3% of children whose mothers did not take anti-malaria drugs during pregnancy though the results did not show any significant differences.

Table 13: Maternal Health Characteristics Influencing Underweight-Chi-Square test Asymp. Sig. (2 sided)

	NOT UNDERWEIGHT		UNDERWEIGHT		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Number of ANC Visits					**0.0048**
First Visits	59	83.5	12	16.5	
Second Visits	339	81.5	77	18.5	
Third Visits	1601	86.6	248	13.4	
At least 4 visits	2943	88.6	380	11.4	
Iron Tablets					**0.0434**
No	138	81.5	31	18.5	
Yes	4854	87.5	695	12.5	
Took Anti-malaria					0.1572
No	221	83.7	43	16.3	
Yes	4766	87.5	683	12.5	
Total	**6533**	**100.0**	**1036**	**100.0**	

Source: Calculated using the 2013/14 ZDHS data set

4.6.3: Household Characteristics Influencing Underweight

Table 14 shows results from a cross tabulation between household characteristics and underweight. The results in the table show that 13.9% of the children in rural areas were underweight compared with 12.5% of children in urban areas who were underweight. By region, the table shows that 19.4% of children who were underweight were from a region of high prevalence (Luapula and Northern) compared with 12% and 13.5% of those from Lower (Copper belt, Eastern, Lusaka, North-Western and Southern) and middle prevalence (Central, Muchinga and Western) respectively. The results show a high significant relationship between region and underweight (p=0.0000). Additionally, 16.3% of children in the poor wealth quintile were underweight compared with 13% and 10.9% of children in the middle and rich wealth quintile respectively who were underweight. The results show a high significant relationship between wealth quintile and underweight (p=0.0000). The table further show that 14.7% of children who were underweight had access to non-improved water sources compared with 12.6% of children who had access to improved water sources. The results show a high significant relationship between source of drinking water and underweight (p=0.0310). The table also show that 13.9% of children from households were they share toilet facility were underweight compared with 12.5% of children who were underweight who did not share toilet facility.

Table 14: Household Characteristics Influencing Underweight-Chi-Square test Asymp. Sig. (2 sided)

	NOT UNDERWEIGHT		UNDERWEIGHT		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Place of Residence					0.2037
Urban	2962	87.5	425	12.5	
Rural	3520	86.1	570	13.9	
Region					**0.0000**
Lower Prevalence	4486	88.0	610	12.0	
Middle Prevalence	1136	86.5	178	13.5	
Higher Prevalence	860	80.6	207	19.4	
Wealth quintile					**0.0000**
Poor	2269	83.7	442	16.3	
Middle	1342	87.0	201	13.0	
Rich	2871	89.1	351	10.9	
Source of drinking Water					**0.0310**
Non Improved	2095	85.3	361	14.7	
Improved	4379	87.4	630	12.6	
Toilet Facility Shared					0.2574
No	3123	87.5	444	12.5	
Yes	2269	86.1	366	13.9	
Total	**6533**	**100.0**	**1036**	**100.0**	

Source: Calculated using the 2013/14 ZDHS data set

4.6.4: Mother's Characteristics Influencing Underweight

Table 15 shows results from cross tabulation between mother's characteristics and underweight. Results show that proportion of underweight among children reduces with education level of mothers. Children whose mothers had no education (17.8%) were more likely to be underweight than those with Primary (15%), secondary (11.2%) and higher 4.7% were underweight respectively. The results showed high significant relationship between education level and Underweight (p=0.0000).

In addition, the results in the table show that the proportions of underweight among children were lower as mothers BMI increases. Children whose mothers had an underweight BMI 24.2 were more likely to be underweight compared with 6.9% of children whose mothers reported having an obese BMI. The results showed a high significant relationship between BMI and Underweight (p=0.0000).

The table also show that 12.3% of children whose mothers reported having one birth in the past 5 years were Underweight as compared with 18% and 21% of children whose mothers reported having three and four and above births in the past 5 years respectively who were underweight. In addition, the results in the table show that 14.1% of children whose mothers had access to information were underweight compared with 9.4% of children whose mothers had no access to information. The results showed a high significant relationship between access to information and underweight (p=0.0001). Furthermore, results did not show any statistical differences in underweight among under-five children in terms of total children ever born, occupation status and control over household resources.

Table 15: Mother's Characteristics Influencing Underweight-Chi-Square test Asymp. Sig. (2 sided)

	NOT UNDERWEIGHT		UNDERWEIGHT		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Religion					0.4244
Catholic	1110	87.4	160	12.6	
Protestant	5323	86.5	831	13.5	
Muslim	33	94.3	2	5.7	
Age of Mother					0.1041
15-24	2011	85.6	337	14.4	
25-34	3141	87.8	437	12.2	
35-44	1248	85.5	212	14.5	
45-49	83	90.0	9	10.0	
Marital Status					**0.1577**
Never Married	558	87.2	82	12.8	
Married	5340	86.9	801	13.1	
Separated/Divorced/Widowed/Cohabiting	585	84.0	111	16.0	
Education Level					**0.0000**
No education	500	82.2	108	17.8	
Primary	3179	85.0	560	15.0	
Secondary	2437	88.8	308	11.2	
Higher	362	95.3	18	4.7	
BMI					**0.0000**
Underweight	420	75.8	134	24.2	
Normal Weight	4297	86.3	683	13.7	
Over weight	1225	89.8	139	10.2	
Obese	519	93.1	38	6.9	
Births in last 5 years					**0.0133**
One	3257	87.7	456	12.3	
Two	2762	86.4	436	13.6	
Three	451	82.0	99	18.0	
Four	12	79.0	3	21.0	
Total children ever born					0.5425
One	1112	88.2	148	11.8	
Two	1324	86.5	206	13.5	
Three	1113	86.4	175	13.6	
Four and above	2933	86.3	465	13.7	
Occupation					0.4678
Not Working	2903	87.1	429	12.9	
Working	3557	86.4	562	13.6	
Access to Information					**0.0001**
Yes had access	5290	85.9	871	14.1	
No Access	1192	90.6	123	9.4	

Control Over Resources					0.7178
Yes had Control	5508	86.6	851	13.4	
No Control	974	87.1	144	12.9	
Total	**6533**	**100.0**	**1036**	**100.0**	

Source: Calculated using the 2013/14 ZDHS data set

4.6.5: Child Characteristics Influencing Underweight

Table 16 shows results from a cross tabulation between child characteristics and underweight. The results show that 10% of children in the age group 0-12 months were underweight compared with 14.8% in age group 13-23, 14.7% in age group 24-45 and 13.2% in the age group 46-59 months who were Underweight. The results show a high significant relationship between age group of under five children and underweight (p=0.0004). Results did not show any statistical significant in underweight among children of different sex, those who had fever in the last two weeks preceding the survey and those received Vitamin A supplements.

Table 16: Child Characteristics Influencing Underweight-Chi-Square test Asymp. Sig. (2 sided)

	NOT UNDERWEIGHT		UNDERWEIGHT		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Sex of Child					0.0862
Male	3272	85.9	537	14.1	
Female	3210	87.5	457	12.5	
Age of the Child in Months					**0.0004**
0-12	1525	90.0	169	10.0	
13-23	1283	85.2	222	14.8	
24-45	2278	85.3	391	14.7	
46-59	1396	86.8	212	13.2	
Child had fever in the last two weeks					0.6751
No	5058	86.8	769	13.2	
Yes	1411	86.4	223	13.6	
Received Vitamin A					0.1948
No	1459	88.3	193	11.7	
Yes	3510	86.9	531	13.1	
Total	**6533**	**100.0**	**1036**	**100.0**	

Source: Calculated using the 2013/14 ZDHS data set

4.7 The influence of Birthweight, Maternal Health Characteristics, Household, Mother and Child Characteristics on Wasting

4.7.1 Birthweight Influencing Wasting

Table 17 shows the results from the cross tabulation between birthweight and Wasting. The results in the table show that 9.2% of children whose birth weight was underweight were wasted as compared with 5.4% of children whose birth weight was normal who were wasted. The results showed a high significant relationship between birth weight of the child and wasting (p=0.0015)

Table 17: Birthweight Influencing Wasting-Chi-Square test Asymp. Sig. (2 sided)

	NOT WASTED		WASTED		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Birthweight					**0.0015**
Underweight	601	90.8	61	9.2	
Normal	6408	94.6	364	5.4	
Total	**7,092**	**100**	**452**	**100**	

Source: Calculated using the 2013/14 ZDHS data set

4.7.2: Maternal Health Characteristics Influencing Wasting

Table 18 shows the results from a cross tabulation between maternal health characteristics and wasting. The results in the table show that proportions of wasting among under-five children whose mothers had gone for antenatal check-up for at least 4 visits (5.7%) were lower compared with 8% and 6.5% of children whose mothers had gone for antenatal for the first and second visit respectively. Additionally, results show that proportion of wasting among children whose mothers took Iron tablets during pregnancy (5.9%) were lower as compared with 8% of children whose mothers did not take any Iron tablets during pregnancy

Table 18: Maternal Health Characteristics Influencing Wasting-Chi-Square test Asymp. Sig. (2 sided)

	NOT WASTED		WASTED		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Number of ANC Visits					0.8072
First Visits	63	92.0	5	8.0	
Second Visits	387	93.5	27	6.5	
Third Visits	1723	93.8	113	6.2	
At least 4 visits	3120	94.3	188	5.7	
Iron Tablets					0.3679
No	155	92.0	13	8.0	
Yes	5192	94.1	325	5.9	
Took Anti-malaria					0.4887
No	251	95.2	13	4.8	
Yes	5091	94.0	326	6.0	
Total	**7,092**	**100**	**452**	**100**	

Source: Calculated using the 2013/14 ZDHS data set

4.7.3: Household Characteristics Influencing Wasting

Table 19 shows results from a cross tabulation between household characteristics and Wasting. The results in the table show that 5.6% of the children in rural areas were wasted compared with 5.8% of children in urban areas who were wasted. By region, the table shows that 7.8% of children who were wasted were from a region of high prevalence (Luapula and Lusaka) compared with 3.8% and 5.4% of those from Lower (Muchinga, Northern and Southern) and middle (North-Western, Central, Copper belt and Eastern) prevalence regions respectively. The results indicate the increase in proportions of wasting among children from Lower prevalence region to higher prevalence regions. The results showed high significant relationship between region and wasting (p=0.0003). Additionally, 6.3% of children in the poor wealth quintile were wasted compared with 4.7% and 5.7% of children in the middle and rich wealth quintile respectively who were wasted. The results did not show any statistical significant relationship among children in relation to place of residence, wealth quintile, source of drinking water and shared toilet facility with Wasting.

Table 19: Household Characteristics Influencing Wasting-Chi-Square test Asymp. Sig. (2 sided)

	NOT WASTED		WASTED		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Place of Residence					0.7451
Urban	3170	94.2	196	5.8	
Rural	3839	94.4	228	5.6	
Region					**0.0003**
Lower Prevalence	1703	96.2	67	3.8	
Middle Prevalence	3375	94.6	194	5.4	
Higher Prevalence	1931	92.2	163	7.8	
Wealth quintile					0.1795
Poor	2524	93.7	170	6.3	
Middle	1463	95.3	71	4.7	
Rich	3021	94.3	183	5.7	
Source of drinking Water					0.7798
Non Improved	2303	94.4	136	5.6	
Improved	4695	94.2	288	5.8	
Toilet Facility Shared					0.1301
No	3355	94.7	189	5.3	
Yes	2449	93.6	169	6.4	
Total	**7,092**	**100**	**452**	**100**	

Source: Calculated using the 2013/14 ZDHS data set

4.7.4: Mother's Characteristics Influencing Wasting

Table 20 shows results from cross tabulation between mother's characteristics and wasting. Results show that 6.6% of children whose mother's religion was catholic were wasted compared with 5.5% and 16.5% whose religion was Protestant and Muslim respectively. The results show statistical significant between religion and wasting (p=0.0222). Additionally, the results in the table show that the proportion of wasting among children decreases as mother education level increases. Children whose mothers had no education were more likely to be wasted (6.2%) compared with 5.6% and 5.5% of children whose mothers had primary and higher education level respectively

In addition, proportions of wasting among children decreases with Mothers BMI. Children whose mothers had an underweight BMI were more likely to be wasted (7.1%) as compared with 5.6% and 6.1% of children whose mothers reported having a BMI of normal weight and overweight respectively. The table also shows that 5.7% of children whose mothers reported having one births in the past 5 years were wasted as compared with 7.9% and 31.3% of children whose mothers reported having three and four births in the past 5 years respectively who were wasted. The results showed a high significant relationship between births in the last 5 years and Wasting (p=0.0006). Results did not show any statistical significant in wasting among children in relation with age of the mother, BMI, total children ever born, occupation, access to information and control over resources.

Table 20: Mother's Characteristics Influencing Wasting-Chi-Square test Asymp. Sig. (2 sided)

	NOT WASTED		WASTED		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Religion					0.0222
Catholic	1178	93.4	83	6.6	
Protestant	5786	94.5	334	5.5	
Muslim	29	83.5	6	16.5	
Age of Mother					0.2488
15-24	2190	93.6	150	6.4	
25-34	3375	94.8	184	5.2	
35-44	1358	94.0	87	6.0	
45-49	87	96.5	3	3.5	
Marital Status					0.3569
Never Married	591	93.1	44	6.9	
Married	5770	94.5	336	5.5	
Separated/Divorced/Widowed/Cohabiting	648	93.6	45	6.4	
Education Level					0.9656
No education	569	93.8	38	6.2	
Primary	3500	94.3	210	5.7	
Secondary	2578	94.3	155	5.7	
Higher	360	94.5	21	5.5	
BMI					0.4264
Underweight	514	92.9	39	7.1	
Normal Weight	4665	94.4	279	5.6	
Over weight	1275	93.9	83	6.1	
Obese	535	95.9	23	4.1	
Births in last 5 years					0.0006
One	3484	94.3	211	5.7	
Two	3012	94.8	165	5.2	
Three	504	92.1	43	7.9	
Four	9	68.7	4	31.3	
Total children ever born					0.1880
One	1177	93.6	80	6.4	
Two	1429	93.9	93	6.1	
Three	1196	93.3	85	6.7	
Four and above	3206	95.1	166	4.9	
Occupation					0.5687
Not Working	3131	94.5	182	5.5	
Working	3855	94.2	239	5.8	
Access to Information					0.5028
Yes had access	5768	94.2	356	5.8	
No Access	1241	94.8	68	5.2	

Control Over Resources					0.9713
Yes had Control	5963	94.3	361	5.7	
No Control	1046	94.3	63	5.7	
Total	**7,092**	**100**	**452**	**100**	

Source: Calculated using the 2013/14 ZDHS data set

4.6.5: Child Characteristics Influencing Wasting

Table 21 shows results from a cross tabulation between child characteristics and wasting. The table indicates that proportions of wasting among under-five children reduces with age. Children aged 0-12 months were more wasted (8.8%) as compared to those aged 46-59 months (4.4%). The results show a high significant relationship between age of a child and wasting (p=0.0000). Results did not show any statistical differences in wasting among children in terms of sex of the child, those who had fever in the last two weeks preceding the survey and those who received Vitamin A supplements.

Table 21: Child Characteristics Influencing Wasting-Chi-Square test Asymp. Sig. (2 sided)

	NOT WASTED		WASTED		
Variable	**Frequency**	**Percent**	**Frequency**	**Percent**	**P-Value**
Sex of Child					0.7346
Male	3571	94.4	212	5.6	
Female	3438	94.2	212	5.8	
Age of the Child in Months					**0.0000**
0-12	1533	91.2	147	8.8	
13-23	1412	94.3	85	5.7	
24-45	2532	95.4	122	4.6	
46-59	1531	95.6	71	4.4	
Child had fever in the last two weeks					0.4592
No	5454	94.1	339	5.9	
Yes	1540	94.8	85	5.2	
Received Vitamin A					0.1225
No	1562	95.0	82	5.0	
Yes	3762	93.7	254	6.3	
Total	**7,092**	**100**	**452**	**100**	

Source: Calculated using the 2013/14 ZDHS data set

4.8 Binary Logistic Regression Models on Stunting, Underweight and Wasting

This section focused on models with only one independent variable and a dependent variable. In addition, it continued to add all explanatory variables that showed significance at bivariate in one model (Multivariate).

4.8.1 Binary Logistic Regression Models on Stunting

Birthweight with Stunting

Table 22 shows the odds ratios from logistics regression models of stunting by birthweight. Results show that children with normal weight at birth were less likely to be stunted than those with underweight. The results showed significant differences in stunting among children with normal birth weight and those born with low birth weight.

Table 22: Unadjusted Odds Ratios from Bivariate Logistic Regression of birth weight with Stunting

	STUNTING		
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Birthweight			
Underweight	RC(1.00)	RC	
Normal	0.4134	**<0.0001**	[0.349-0.489]
Total	**7,388**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

Maternal Health Characteristics with Stunting

Results in table 23 show no significant differences in stunting among children whose mothers had gone for antenatal visits. Even though, the odds ratios suggest that children whose mothers had gone for antenatal visit more than once were more likely to be stunted, stunting decreases with as number of antenatal visits increases. However, the results show that children whose mothers took Iron tablets and antimalarial drugs during pregnancy were less likely to be stunted than those whose mothers did not take [OR=0.7205; 95% CI (0.557-0.932)]. However, results did not show any statistical differences in stunting among children whose mothers took antimalarial drugs and those children whose mothers did not take any antimalarial drugs during pregnancy.

Table 23: Unadjusted Odds Ratios from Bivariate Logistic Regression of Maternal Health Characteristics with Stunting

	STUNTING		
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Number of ANC Visits			
First Visits	RC(1.00)	RC	
Second Visits	1.518	0.115	[0.903-2.552]
Third Visits	1.323	0.262	[0.811-2.156]
At least 4 visits	1.249	0.368	[0.769-2.029]
Iron Tablets			
No	RC(1.00)	RC	
Yes	0.870	0.400	[0.629-1.203]
Took Anti-malaria			
No	RC(1.00)	RC	
Yes	0.721	**0.012**	[0.557-0.932]
Total	**7,388**		

Sig. at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

Household Characteristics with Stunting

Table 24 shows that the odds ratios for under five children of being stunted in the rural areas are 1.25 times with reference to urban areas. This entails that under five children in rural areas are significantly 25% more likely to be stunted as compared with under five children in urban areas (reference category). In terms of region, findings have shown that under-five children in high prevalence regions were 1.33 times more likely to be stunted with reference to under-five children in lower prevalence region. In relation to wealth quintile, the results show that children from both middle [OR=0.819; 95% CI :(0.725-0.926] and rich [OR=0.6097; 95% CI :(0.547-0.680)] wealth quintile families were less likely to be stunted with reference to children in poor wealth quintile. In terms of source of drinking water, the findings show that children whose households had access to improved sources of drinking water were 0.809 times less likely to be stunted with reference to children with non-improved sources of drinking water. In relation to toilet facility shared, table 24.0 shows that children from households were they share toilet facility were 1.136 times more likely to be stunted with reference to children from households were toilet facility is not shared.

Table 24: Unadjusted Odds Ratios from Bivariate Logistic Regression of Household Characteristics with Stunting

STUNTING			
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Place of Residence			
Urban	RC(1.00)	RC	
Rural	1.25	**0.0000**	[1.139-1.377]
Region			
Lower Prevalence	RC(1.00)	RC	
Middle Prevalence	0.93	0.332	[0.817-1.071]
Higher Prevalence	1.33	**0.0000**	[1.190-1.484]
Wealth quintile			
Poor	RC(1.00)	RC	
Middle	0.82	**0.0000**	[0.725-0.926]
Rich	0.61	**0.0000**	[0.547-0.680]
Source of drinking Water			
Non Improved	RC(1.00)	RC	
Improved	0.81	**0.0000**	[0.734-0.892]
Toilet Facility Shared			
No	RC(1.00)	RC	
Yes	1.14	**0.0170**	[1.023-1.264]
Total	**7,388**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

Mother Characteristics with Stunting

In Table 25 results show no significant difference in stunting among children whose mothers were protestant and Catholics. However, the odds ratios suggest that children whose mothers were Muslim [OR=0.265; 95% CI :(0.091-0.769)] were less likely to be stunted with reference to children whose mothers who were Catholic. In terms of age of the mother, results show that children whose mothers were in the age group 25 to 24 [OR=0.895; 95% CI :(0.803-0.996)] were less likely to be stunted with reference to those in age group 15-24. Results were not significant for those in age group 35-49. In relation to education level, the results show that children whose mothers had secondary and higher education, were significantly less likely to be stunted with reference to those with no education. This simply means that levels of stunting among under-five children decreases as education levels of mothers increases. Additionally, results show that stunting among under five children decreases as nutritional status (BMI) of mothers improves. Children whose mothers' body mass index was normal, overweight and obese were less likely to be stunted compared with children whose mother's body mass index was underweight. The results show significant differences in stunting among children between mothers' body mass index (BMI) and Stunting. The table further indicates that children whose mothers had four and more children throughout their life time were more likely to be stunted than children whose mothers had one child in their life time. In relation to access to information, results show that children whose mothers had no access to information were significantly less likely to be stunted than those who had access to access to information. Furthermore, results showed no significant differences in stunting among children in relation to marital status, number of births a woman has in the last 5 years, occupation status, and control over resources.

Table 25: Unadjusted Odds Ratios from Bivariate Logistic Regression of Mother's Characteristics with Stunting

STUNTING			
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Religion			
Catholic	RC(1.00)	RC	
Protestant	0.9357	0.305	[0.824-1.062]
Muslim	0.2652	**0.015**	[0.091-0.769]
Age of the Mother			
15-24	RC(1.00)	RC	
25-34	0.895	**0.043**	[0.803-0.996]
35-44	0.929	0.293	[0.812-1.065]
45-49	0.652	0.066	[0.413-1.029]
Marital Status			
Never Married	RC(1.00)	RC	
Married	1.148	0.096	[0.976-1.350]
Separated/Divorced/Widowed/Cohabiting	1.2290	0.06	[0.991-1.534]
Education Level			
No education	RC(1.00)	RC	
Primary	0.9399	0.49	[0.7888-1.120]
Secondary	0.7042	**<0.001**	[o.5876-0.844]
Higher	0.2629	**<0.001**	[0.192-0.361]
BMI			
Underweight	RC(1.00)	RC	
Normal Weight	0.6708	**<0.001**	[0.563-0.799]
Over weight	0.5215	**<0.001**	[0.426-0.639]
Obese	0.4324	**<0.001**	[0.335-0.557]
Births in last 5 years			
One	RC(1.00)	RC	
Two	1.1018	0.053	[0.999-1.216]
Three	1.0783	0.426	[0.896-1.298]
Four	1.4169	0.464	[0.558-3.599]
Total children ever born			
One	RC(1.00)	RC	
Two	1.0803	0.338	[0.922-1.265]
Three	1.1399	0.117	[0.968-1.342]
Four and above	1.2132	**0.005**	[0.1059-1.389]
Occupation		RC	
Working	RC(100)	RC	
Not Working	0.9452	0.251	[0.858-1.041]
Access to Information			
Yes had access	RC(1.00)	RC	
No Access	0.6154	**<0.001**	[0.539-0.703]
Control Over Resources			
Yes had Control	RC(1.00)	RC	
No Control	0.9162	0.205	[0.800-1.049]
Total	**7,388**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

Chid Characteristics with Stunting

Results in Table 26 show significant differences in stunting between female children and male children. Female children [OR=0.039; 95% CI :(0.740-0.894)] were less likely to be stunted compared with male children. In relation to age of child, the results show that children in older ages (13-39) were more likely to be stunted compared to those aged 0-12 months however, proportion of stunting decreases as the age of child increases. For instance, children in the age groups 13-23 and 24-45 months were 3.1596 and 2.9241 times more likely to be stunted with reference to those in age group 0-12 months. The results show statistical differences in stunting among children between age of the child and Stunting. Additionally, the results showed that children who had fever in the last two weeks prior to the survey were 1.138 times more likely to be stunted with reference to children who did not have fever. The results showed statistical significant differences in stunting among children who had fever in the last two weeks and those who did not have.

Table 26: Unadjusted Odds Ratios from Bivariate Logistic Regression of Child Characteristics with Stunting

STUNTING			
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Sex of Child			
Male	RC(1.00)	RC	
Female	0.039	**<0.0001**	[0.740-0.894]
Age of the Child in Months			
0-12	RC(1.00)	RC	
13-23	3.159	**0.0000**	[2.705-3.690]
24-45	2.924	**0.0000**	[2.544-3.361]
46-59	1.674	**0.0000**	[1.431-1.957]
Received Vitamin A			
No	RC(1.00)	RC	
Yes	0.983	0.7820	[0.872-1.108]
Child had fever in the last two weeks			
No	RC(1.00)	RC	
Yes	1.138	**0.0240**	[1.017-1.272]
Total	**7,388**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

4.7.2 Binary Logistic Regression Models on Underweight.

Birth weight with Underweight

The results in table 27 show that children whose birth weight was normal were 0.321 times less likely to be underweight in relation to children whose birth weight was underweight. This simply entails that children with normal birth weight were 68% less likely to be underweight as compared to children whose birth weight was underweight.

Table 27: Unadjusted Odds Ratios from Bivariate Logistic Regression of birthweight with Underweight

UNDERWEIGHT			
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Birthweight			
Underweight	RC(1.00)	RC	
Normal	0.321	**0.0000**	[0.266-0.386]
Total	**7,589**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

Maternal Health Characteristics with Underweight

Table 28 shows results from binary logistic regression of underweight with maternal health characteristics. The results show that children whose mothers took Iron tablets during pregnancy [OR=0.569; 95% CI :(0.385-0.841)] were less likely to be underweight compared with children whose mothers did not take Iron tablets during pregnancy. The results show statistical significant among children in relation to taking Iron tablets during pregnancy and Underweight. Furthermore, the results did not show any statistical differences in underweight among children in relation to antenatal visits and taking anti-malaria drugs during pregnancy.

Table 28: Unadjusted Odds Ratios from Bivariate Logistic Regression of Maternal Health Characteristics with Underweight

UNDERWEIGHT			
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Number of ANC Visits			
First Visits	RC(1.00)	RC	
Second Visits	0.995	0.9880	[0.5210-1.9048]
Third Visits	0.809	0.4950	[0.4411-1.4888]
At least 4 visits	0.685	0.2210	[0.3715-1.2531]
Took Iron Tablets During Pregnancy			
No	RC(1.00)	RC	
Yes	0.5691	**0.0050**	[0.3850-0.8410]
Took Anti-malaria During Pregnancy			
No	RC(1.00)	RC	
Yes	0.7964	0.2030	[0.5610-1.1311]
Total	**7589**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

Household Characteristics with Underweight

Table 29 shows that under-five children in high prevalence region [OR=1.688; 95% CI:(1.440-1.978)] were more likely to be underweight with reference to under-five children in lower prevalence region. In relation to wealth quintile, the results indicate that proportions of underweight among under-five children decreases as families move from middle to higher wealth quintiles [OR=0.729; 95% CI :(0.617-0.864)] and [OR=0.594; 95% CI :(0.511-0.692)] respectively. However, results did not show any statistical significant differences in underweight among under-five children in relation to place of residence, source of drinking water and whether or not the household had a toilet facility shared.

Table 29: Unadjusted Odds Ratios from Bivariate Logistic Regression of Household Characteristics with Underweight

UNDERWEIGHT			
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Place of Residence			
Urban	RC(1.00)	RC	
Rural	1.118	0.097	[0.980-1.2761]
Region			
Lower Prevalence	RC(1.00)	RC	
Middle Prevalence	1.172	0.0601	[0.9931-1.3830]
Higher Prevalence	1.688	**0.0001**	[1.4401-1.9780]
Wealth quintile			
Poor	RC(1.00)	RC	
Middle	0.729	**0.0001**	[0.6166-0.8641]
Rich	0.594	**0.0001**	[0.5111-0.6922]
Source of drinking Water			
Non Improved	RC(1.00)	RC	
Improved	1.043	0.628	[0.8801-1.2377]
Toilet Facility Shared			
No	RC(1.00)	RC	
Yes	1.091	0.246	[0.9422-1.2622]
Total	**7,589**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

Mother Characteristics with Underweight

Results in Table 30 show that children whose mothers were separated or divorced or widowed or cohabiting [OR=1.487; 95% CI :(0.617-0.864)] were more likely to be underweight with reference to those who are never married. Additionally, results show that the proportions of underweight among under-five children decreases [OR=0.670; 95% CI :(0.525-0.854)] to [OR=0.249; 95% CI :(0.148-0.419)] with increase in education levels of mothers. Further, the results show the proportions of underweight among under-five children decrease as nutritional status of mothers improves. The results also show that the proportions of underweight among under-children increases with the increase in the total number of children mothers have in their life time (Total children ever born) [OR=1.286.; 95% CI :(1.091-1.440)], [OR=1.750; 95% CI :(1.389-2.207)] and [OR=1.471.; 95% CI :(0.424-5.101)]. In relation to access to information, results show significant differences in underweight among children whose mothers had access to information.

However, the results did not show any statistical significant in underweight among under-five children in relation to religion, age of the mother, occupation and control over resources.

Table 30: Unadjusted Odds Ratios from Bivariate Logistic Regression of Mother's Characteristics with Underweight

UNDERWEIGT			
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Religion			
Catholic	RC(1.00)	RC	
Protestant	1.032	0.7321	[0.863-1.2333]
Muslim	0.223	0.1412	[0.030-1.6465]
Age of the Mother			
15-24	RC(1.00)	RC	
25-34	0.873	0.0744	[0.074-1.0133]
35-44	0.989	0.9045	[0.822-1.1898]
45-49	0.702	0.2987	[0.361-1.3667]
Marital Status			
Never Married	RC(1.00)	RC	
Married	1.108	0.3833	[0.879-1.3976]
Separated/Divorced/Widowed/Cohabiting	1.487	0.0082	[1.111-1.9901]
Education Level			
No education	RC(1.00)	RC	
Primary	0.944	0.625	[0.750-1.1899]
Secondary	0.670	**0.000**	[0.525-0.8543]
Higher	0.249	**0.000**	[0.148-0.4187]
BMI			
Underweight	RC(1.00)	RC	
Normal Weight	0.467	**0.0000**	[0.381-0.5734]
Over weight	0.319	**0.0000**	[0.246-0.4133]
Obese	0.229	**0.0000**	[0.157-0.3352]
Births in last 5 years			
One	RC(1.00)	RC	
Two	1.254	**0.000**	[1.091-1.4401]
Three	1.750	**0.000**	[1.389-2.2067]
Four	1.471	0.543	[0.424-5.1011]
Total children ever born			
One	RC(1.00)	RC	
Two	1.286	**0.029**	[1.025-1.613]
Three	1.396	**0.005**	[1.107-1.759]
Four and above	1.285	**0.013**	[1.054-1.566]
Occupation			
Not Working	RC(1.00)	RC	
Working	1.092	0.200	[0.955-1.2491]
Access to Information			
Yes had access	RC(1.00)	RC	
No Access	0.576	**0.0000**	[0.470-0.7067]
Control Over Resources			
Yes had Control	RC(1.00)	RC	
No Control	0.972	0.764	[0.805-1.1723]
Total	**7,589**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

Child Characteristics with Underweight

The result in Table 31 shows that female children [OR=0.829; 95% CI :(0.727-0.945)] were less likely to be underweight compared with male children. The results show a statistical significant in underweight among children in relation to sex of the child. In terms of age of the child, the results show that children from age groups 13-23 to 46-59 months were more likely to be underweight than those in the age group 0-12 months. For instance, children in the age group 13-23 [OR=1.584; 95% CI :(1.283-1.957)] and 24-45 [OR=1.654; 95% CI :(1.369-1.996)] months were more likely to be underweight with reference to those in age group 0-12 months. The results show statistical significant differences in underweight among under-five children in relation to age. However, results did not show any statistical differences in underweight among under-five children in relation to children who had fever in the last two weeks preceding the survey and receiving Vitamin A supplement.

Table 31: Unadjusted Odds Ratios from Bivariate Logistic Regression of Child Characteristics with Underweight

UNDERWEIGHT			
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Sex of Child			
Male	RC(1.00)	RC	
Female	0.829	**0.005**	[0.727-0.945]
Age of the Child in Months			
0-12			
13-23	1.584	**0.000**	[1.283-1.957]
24-45	1.654	**0.000**	[1.369-1.996]
46-59	1.382	**0.003**	[1.118-1.709]
Child had fever in the last two weeks			
No	RC(1.00)	RC	
Yes	1.119	0.152	[0.959-1.305]
Received Vitamin A			
No	RC(1.00)	RC	
Yes	1.049	0.587	[0.884-1.244]
Total	**7,589**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

4.7.3 Birthweight, maternal health Characteristics, Household, Mother and Child characteristics with Wasting

Birthweight with Wasting

The results in table 32 show that children who were born with normal weight were less likely to be wasted than those born with underweight birthweight. The table indicates that children who were born with normal birth weight [OR=0.703; 95% CI :(0.518-0.954)] were less likely to be wasted than those born with underweight birthweight.

Table 32: Unadjusted Odds Ratios from Bivariate Logistic Regression of birth weight with Wasting

WASTING			
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Birthweight			
Underweight	RC(1.00)	RC	
Normal	0.7027	**0.024**	[0.518-0.954]
Total	**7,544**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

Maternal Health Characteristics with Wasting

The results in table 33 did not show any significant in wasting among children in relation to number of antenatal visits, those who took iron tablets and anti-malaria drugs during pregnancy.

Table 33: Unadjusted Odds Ratios from Bivariate Logistic Regression of Maternal Health Characteristics with Wasting

WASTING			
Variable	**Odds Ratio**	**P-Value**	**95% CI**
# of ANC Visits			
First Visits	RC(1.00)	RC	
Second Visits	0.9969	0.995	[0.371-2.680]
Third Visits	1.1150	0.817	[0.443-2.804]
At least 4 visits	0.8745	0.775	[0.349-2.190]
Iron Tablets			
No	RC(1.00)	RC	
Yes	0.8873	0.706	[0.476-1.653]
Took Anti-malaria			
No	RC(1.00)	RC	
Yes	1.3189	0.358	[0.731-2.380]
Total	**7544**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

Household characteristics with Wasting

Table 34 shows that the proportions of wasting among under five children increases from a region of middle prevalence [OR=1.764; 95% CI :(1.352-2.302)] to a region of high prevalence [OR=2.412; 95% CI :(1.811-3.214)]. The results show high statistical significant in wasting among children in relation to region. In relation to wealth quintile, results indicate that children from middle wealth quintiles were less likely to be wasted than children from poor wealth quintile. However, results did not show any significant differences in wasting among children in relation to place of residence, source of drinking water and whether or not a household had a shared toilet facility.

Table 34: Unadjusted Odds Ratios from Bivariate Logistic Regression of Household Characteristics with Wasting

WASTING			
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Place of Residence			
Urban	RC(1.00)	RC	
Rural	0.975	0.7933	[0.806-1.179]
Region			
Lower Prevalence	RC(1.00)	RC	
Middle Prevalence	1.764	**0.000**	[1.352-2.302]
Higher Prevalence	2.412	**0.000**	[1.811-3.214]
Wealth quintile			
Poor	RC(1.00)	RC	
Middle	0.758	**0.0345**	[0.586-0.980]
Rich	0.857	0.158	[0.692-1.061]
Source of drinking Water			
Non Improved	RC(1.00)	RC	
Improved	1.141	0.1997	[0.933-1.397]
Toilet Facility Shared			
No	RC(1.00)	RC	
Yes	1.204	0.0786	[0.979-1.481]
Total	**7,544**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

Mother Characteristics with Wasting

Table 35 shows that children whose mothers were Muslims [OR=5.408; 95% CI :(2.332-12.540)] were more likely to be wasted than children whose mothers were Catholics. Additionally, results for mother's body mass index show that proportions of wasting decreases as nutritional status of mothers improve [OR=0.744; 95% CI :(0.537-1.033)] to [OR=0.733; 95% CI :(0.501-1.073)] and [OR=0.545; 95% CI :(0.325-0.915)].

In relation to births in the past 5 years, results show that the proportions of wasting among under-five children increases as the number of children a woman has in the past 5 years increases [OR=1.012; 95% CI :(0.828-1.238] to [OR=1.344; 95% CI :(0.956-1.889)] and [OR=5.011; 95% CI :(1.620-15.500)]. However, results did not show any statistical significant differences in wasting among children in relation to age of the mother, marital status, education level, total children ever born, occupation, access to information and control over resources.

Table 35: Unadjusted Odds Ratios from Bivariate Logistic Regression of Mother's Characteristics with Wasting

WASTING			
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Religion			
Catholic	RC(1.00)	RC	
Protestant	0.918	0.507	[0.7131-1.182]
Muslim	5.408	**0.000**	[2.332-12.540]
Age of the Mother			
15-24	RC(1.00)	RC	
25-34	0.923	0.469	[0.743-1.146]
35-44	0.951	0.717	[0.724-1.249]
45-49	1.045	0.919	[0.449-2.429]
Marital Status			
Never Married	RC(1.00)	RC	
Married	0.890	0.469	[0.650-1.219]
Separated/Divorced/Widowed/Cohabiting	1.273	0.236	[0.854-1.897]
Education Level			
No education	RC(1.00)	RC	
Primary	0.920	0.639	[0.650-1.303]
Secondary	0.880	0.485	[0.615-1.259]
Higher	0.903	0.705	[0.532-1.533]
BMI			
Underweight	RC(1.00)	RC	
Normal Weight	0.744	0.075	[0.537-1.030]
Over weight	0.733	0.110	[0.501-1.073]
Obese	0.545	**0.022**	[0.325-0.915]
Births in last 5 years			
One	RC(1.00)	RC	
Two	1.012	0.905	[0.828-1.238]
Three	1.344	0.089	[0.956-1.889]
Four	5.011	**0.005**	[1.620-15.500]
Total children ever born			
One	RC(1.00)	RC	
Two	1.086	0.605	[0.796-1.481]
Three	1.259	0.148	[0.921-1.723]
Four and above	0.892	0.413	[0.677-1.174]
Occupation			
Not Working	RC(1.00)	RC	
Working	1.111	0.292	[0.914-1.350]
Access to Information			
Yes had access	RC(1.00)	RC	
No Access	0.871	0.303	[0.669-1.133]
Control Over Resources			
Yes had Control	RC(1.00)	RC	
No Control	1.107	0.448	[0.852-1.438]
Total	**7,544**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

Child Characteristics with Wasting

The results in Table 36 show that children in age groups 13-23, 24-45, 46-59 months [OR=0.738; 95% CI:(0.813-1.190)], [OR=0.601; 95% CI:(0.471-0.767)] and [OR=0.607;

95% CI :(0.458-0.803)] were less likely to be wasted than those in age group 0-12 months. Results were statistically significant between wasting and age of the child. On the contrary, results show that children who had fever in the last two weeks preceding the survey [OR=0.754; 95% CI :(0.550-0.963)] were significantly less likely to be wasted than children who did not have fever in the last two weeks preceding the survey. The results also show that children who received Vitamin A supplement two weeks after delivery [OR=1.385; 95% CI :(1.074-1.786)] were significantly more likely to be wasted than children who did not receive Vitamin A supplement. However, results did not show any statistical differences in wasting among under-five children in relation to sex of the child.

Table 36: Unadjusted Odds Ratios from Bivariate Logistic Regression of Child Characteristics with Wasting

	WASTING		
Variable	**Odds Ratio**	**P-Value**	**95% CI**
Sex of Child			
Male	RC(1.00)	RC	
Female	0.984	0.864	[0.813-1.190]
Age of the Child in Months			
0-12			
13-23	0.738	**0.029**	[0.563-0.969]
24-45	0.601	**0.000**	[0.471-0.767]
46-59	0.607	**0.000**	[0.458-0.803]
Child had fever in the last two weeks			
No	RC(1.00)	RC	
Yes	0.754	**0.024**	[0.550-0.963]
Received Vitamin A			
No	RC(1.00)	RC	
Yes	1.385	**0.012**	[1.074-1.786]
Total	**7,544**		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

4.8 Multivariate Logistic Regression

This section presents results from multivariate logistic regression models of the influence of birthweight, maternal health, and child, household and mother characteristics on stunting, underweight and wasting. Results from a logistic regression analysis are presented where, all variables were entered into the model and variables tested for significance at p<0.05 (95%) level in all the categories. This was done by first categorizing independent variables into main explanatory variable (Birthweight), maternal health (took anti-malarial drugs) household characteristics (place of residence, Region, wealth quintile, source of drinking water and a toilet facility shared), Characteristics of the mother (religion, age of the mother, Marital status, education level, BMI, total children ever born and access to information) and Child characteristics (Sex of the child, age of the child, and whether or not a child had fever on the last two weeks preceding the survey) and based on the conceptual framework used in the study. Birthweight was first fitted into model 1, maternal health characteristics into model 2, household characteristics into model 3, Mothers characteristics into model 4, child characteristics into model 5 and lastly Model 6 (a full model) which is a combination of model 1, 2, 3, 4 and model 5 and observations based on the behaviour of the variables were made. The log likelihood ratio statistics were also observed in model fitting. Results discussed in this section are for the final models (Model 6) under Stunting, Underweight and Wasting. However, other tables from the model building processes have been placed in the appendices as Appendix 1 to 14.

4.8.1. Birthweight, Maternal health, Household, Mother and Child Characteristics with Stunting

Table 37 shows the odds ratios from multivariate logistic regression models of the influence of Birth weight, maternal health, household, and mother and child characteristics on stunting.
The results in table 37 show that children with normal birthweight were significantly less likely to be stunted compared with the reference category (underweight). Similarly, children whose mothers took anti-malaria drugs during pregnancy were significantly less likely to be stunted compared to those who did not take anti-malaria drugs. Results also show that children in higher prevalence regions were more likely to be stunted compared with the middle and lower prevalence regions. In addition, children in middle and rich wealth quintile were significantly less likely to be stunted compared with children in poor wealth quintile. Results also show that children whose households had a shared toilet facility were significantly more likely to be stunted compared with those without shared toilet facility.

Furthermore, children whose mothers had secondary and higher education were significantly less likely to be stunted compared with those with no education and that the proportions of stunting among under-five children reduces with increase in education levels. In terms of Body Mass Index, the results show that the proportions of stunting among under-five children reduces as the nutritional status of mothers improves. Children whose mothers had a normal, overweight and Obese BMI were significantly less likely to be stunted compared with those with underweight BMI. In addition, the results show statistical significant differences in stunting among children from mothers with two or more births (total children ever born) throughout their life time. The table further shows that children in higher age groups (13-59 months) were significantly more likely to be stunted compared with those aged 0-12 months.

Table 37: Adjusted Odds ratios of Birthweight, maternal health, child, household and mother characteristics with Stunting

Variable	Odds Ratio Model 1	Model 2	Model 3	Model 5	Full Model
Birth Weight					
Underweight	RC(100)	RC (100)	RC(100)	RC(100)	RC(100)
Normal	**0.4130***	**0.4021***	**0.4288***	**0.4336***	**0.4122***
Took Anti-malaria					
No (RC)		RC (1.00)	RC(100)	RC(100)	RC(100)
Yes		**0.7401***	**0.7827***	**0.7986***	**0.7274***
Place of Residence					
Urban			RC(100)	RC(100)	RC(100)
Rural			0.9790	0.9612	0.983
Region					
Lower Prevalence			RC(100)	RC(100)	RC(100)
Middle Prevalence			0.8524	0.8520	0.8485
Higher Prevalence			**1.0591***	**1.0373***	**1.0549***
Wealth quintile					
Poor			RC(100)	RC(100)	RC(100)
Middle			**0.8139***	**0.8595***	**0.8676***
Rich			**0.6606***	**0.8158***	**0.8256***
Source of drinking Water					
Not Improved			RC(100)	RC(100)	RC(100)
Improved			0.9024	0.9265	0.9041
Toilet Facility Shared					
No			RC(100)	RC(100)	RC(100)
Yes			**1.2003***	**1.1133***	**1.1348***
Religion					
Catholic				RC(100)	RC(100)
Protestant				0.9316	0.9633
Muslim				0.4130	0.4193
Education Level					
No education				RC(100)	RC(100)
Primary				0.8619	0.8547
Secondary				**0.7357***	**0.7476***
Higher				**0.3742***	**0.3561***
BMI					
Underweight				RC(100)	RC(100)
Normal Weight				**0.6367***	**0.6527***
Over weight				**0.6504***	**0.6524***
Obese				**0.5723***	**0.5965***
Total children ever born					
One				RC(100)	RC(100)
Two				**1.1472***	**1.1614***
Three				**1.0723***	**1.0733***
Four and above				**1.0338***	**1.0144***
Access to Information					
Yes had access				RC(100)	RC(100)
No Access				0.9113	0.8613
Child had fever in the last two weeks					
No					RC(100)
Yes					0.9670
Sex of Child					
Male					RC(100)
Female					0.7267
Age of the Child in Months					
0-12					RC(100)

13-23					**3.4075***
24-45					**3.3192***
46-59					**1.5426***
n	**7388**	**7388**	**7388**	**7388**	**7388**
Logistic regression	Number of obs	=	4738.000		
	LR chi2(34)	=	172.190		
	Prob > chi2	=	0.0000		
Log likelihood = -2809.3033	Pseudo R2	=	0.0279		

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

4.8.2 Birthweight, Maternal health, Household, Child and Mother's Characteristics with Underweight

Table 38 show the odds ratios from multivariate logistic regression models of the influence of Birth weight, maternal health, household, child and mother's characteristics on underweight. The results show that children with normal birth weight were significantly less likely to be underweight compared with the reference category. Similarly, children whose mothers took Iron-tablets as food supplement during pregnancy were significantly less likely to be underweight compared to those who did not take.

Results show that children in higher prevalence region were more likely to be underweight compared with those in lower prevalence region. In addition, the results show that the proportions of underweight reduces with the increases education levels of mothers. Children whose mothers had secondary and higher education were significantly less likely to be underweight compared with those with no education. In terms of Body Mass Index, the results to show that the proportions of underweight among under-five children reduces as the nutritional status of mothers improves. Children whose mothers had a normal, overweight and Obese BMI were significantly less likely to be underweight compared with those with underweight BMI. Furthermore, results show that children whose mothers had two or more births in the past five years were significantly more likely to be underweight compared to those with one birth in the past five years. The table further shows that female children were significantly less likely to be underweight as compared with male children. In addition, the results show that children in higher age groups (13-59 months) were significantly more likely to be underweight as compared with those aged 0-12 months.

However, results did not show any statistical significant differences in underweight among under-five children in relation to wealth quintile, marital status, total children ever born and access to information.

Table 38: Adjusted Odds ratios of Birthweight, maternal health, household mother and Child characteristics with Underweight

Variable : Odds Ratio	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Full Model**
Birth Weight					
Underweight	RC(100)	RC (100)	RC(100)	RC(100)	RC(100)
Normal	**0.3207***	**0.2978***	**0.294***	**0.3109***	**0.3001***
Took Iron Tablets					
No (RC)		RC (1.00)	RC(100)	RC(100)	RC(100)
Yes		**0.5865***	**0.626***	**0.6132***	**0.6261***
Region					
Lower Prevalence			RC(100)	RC(100)	RC(100)
Middle Prevalence			1.046	1.0348	1.0478
Higher Prevalence			**1.355***	**1.3524***	**1.3389***
Wealth quintile					
Poor			RC(100)	RC(100)	RC(100)
Middle			0.8346	0.94422	0.9557
Rich			**0.7147***	1.01224	1.0690
Marital Status					
Never Married				RC(100)	RC (100)
Married				0.9745	0.9585
Separated/Divorced/Widowed/Cohabiting				1.1594	1.1734
Education Level					
No education				RC(100)	RC (100)
Primary				0.8257	0.8284
Secondary				**0.6684***	**0.6706***
Higher				**0.2700***	**0.2672***
BMI					
Underweight				RC(100)	RC (100)
Normal Weight				**0.4367***	**0.4382***
Over weight				**0.3404***	**0.3411***
Obese				**0.2510***	**0.2603***
Births in last 5 years					
One				RC(100)	RC(100)
Two				1.0207	**1.2527***
Three				1.4313	**2.1862***
Four				2.2963	3.9722
Total children ever born					
One				RC(100)	RC(100)
Two				1.35881	1.2352
Three				1.29665	1.18073
Four and above				1.09266	0.97479
Access to Information					
Yes had access				RC(100)	RC(100)
No Access				0.9028	0.877
Sex of Child					
Male					RC(100)
Female					**0.7664***
Age of the Child in Months					
0-12					RC(100)
13-23					**1.7225***
24-45					**2.1509***
46-59					1.5737*
n	**7589**	**7589**	**7589**	**7589**	**7589**

Logistic regression	Number of obs	=	5756.000
	LRchi2(25)	=	291.750
	Prob > chi2	=	0.000
	Loglikelihood	=	-2064.289
	Pseudo R2	=	0.0660

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

4.8.3 Birthweight, Household, Mother and Child Characteristics with Wasting

Table 39 show the odds ratios from multivariate logistic regression models of the influence of Birth weight, household mother and child characteristics on wasting. The results show that children with normal birthweight were significantly less likely to be wasted compared with the reference category. In terms of region, results show that, children in middle and higher prevalence regions were significantly more likely to be wasted compared with the lower prevalence region. In addition, children in middle and rich wealth quintile were significantly less likely to be wasted compared with children in poor wealth quintile.

In terms of Body Mass Index, results show that children whose mothers had obese BMI were significantly less likely to be wasted compared with those with underweight BMI. However, the results did not show any statistical significant differences in wasting among children whose mothers had two and three children in the past five years except for those with four children were significant more likely to be wasted compared with those with one birth. Similarly, results did not show any statistical significant differences in wasting among children whose mothers received Vitamin A dose in the first two weeks after delivery, age of the child and sex of the child, and among children who had fever in the last two weeks before the survey.

Table 39: Adjusted Odds Ratios of Household, mother's and Child characteristics with Wasting

Variable	Odds Ratio	Model 1	Model 2	Model 3	Full Model
Birth Weight					
Underweight		RC(1.00)	RC(1.00)	RC(1.00)	RC(1.00)
Normal		**0.7027***	**0.7053***	**0.7277***	**0.8170***
Region					
Lower Prevalence			RC(1.00)	RC(1.00)	RC(1.00)
Middle Prevalence			**1.7561***	**1.7471***	**1.4494***
Higher Prevalence			**2.4575***	**2.4267***	**2.0413***
Wealth quintile					
Poor			RC(1.00)	RC(1.00)	RC(1.00)
Middle			**0.7561***	**0.7783***	**0.7155***
Rich			**0.8075***	0.8726	0.8353
BMI					
Underweight				RC(1.00)	RC(1.00)
Normal Weight				0.7678	0.728
Over weight				0.7576	0.733
Obese				**0.5684***	**0.5313***
Births in the last 5 years					
One				RC(1.00)	RC(1.00)
Two				1.000	0.9388
Three				1.258	1.2927
Four				**4.2671***	**6.3466***
Received Vitamin A					
No					RC(1.00)
Yes					0.828
Age of the Child in Months					

0-12				RC(1.00)
13-23				0.7502
24-45				0.5873
46-59				0.5568
Sex of Child				
Male				RC(1.00)
Female				0.9667
Child had fever in the last two weeks				
No				RC(1.00)
Yes				1.4284
n	**7544**	**7544**	**7525**	**5685**
Logistic regression	Number of obs	=	5685.000	
	LR chi2(17)	=	66.610	
	Prob > chi2	=	0.000	
Log likelihood =-1281.3716	Pseudo R2	=	0.025	

Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-Reference Category: Calculated Using the 2013/14 ZDHS Data Set

CHAPTER FIVE: DISCUSION, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

The rates of malnutrition in Zambia is among the highest in the world and these rates are reducing the country's chances of achieving its aspiration to be a prosperous upper-middle-income country by 2030. The nutritional status of children under age 5 is an important proxy measure of children's health.

The percentage of stunting among under-five children in Zambia has been reducing over the years from 53% in 2001-02 to 45% in 2007 and 40% in 2013. However, despite this reduction the percentage of stunting has still remained too high for the country when compared to other African nations with similar or lower per capita income, including Kenya (35%) and Mauritania (32%) (WHO 2013:107). The Government of the Republic of Zambia recognizes malnutrition as a serious public health problem, therefore, it has partnered with other cooperating partners in promoting nutrition activities to improve nutritional status of women so that they can have babies with normal birthweight. Some of the programs include; the UN-led Scaling Up Nutrition (SUN) a global movement that unites national leaders, civil society, bilateral and multilateral organizations, donors, businesses and researchers in a collective effort to improve nutrition movement (USAID 2014:108). The government of the republic of Zambia is committed to the attainment of the SDGs and Africa agenda 2063 to be a prosperous continent, where African people have high standard of living and quality of life, sound health and wellbeing (Africa Agenda 2063:2). This also is line with the government's efforts to expand coverage of social assistance programmes to address income insecurity of the poor and vulnerable as well as support access to access to health and education, improved nutrition and human capital (7^{th} National Development Plan: 88). Government through the ministry of Health is committed to implement the aspirations to meet universal primary health care according to the National Health Strategic plan 2017 -2021. Understanding the relationship and factors associated with birth outcomes and children's nutritional status may provide a basis for developing and monitor nutritional interventions such as the 1000 most critical days of life, led by SUN, Maternal, Adolescent, Infant and Young Child Nutrition, management of severe acute malnutrition, Nutrition and HIV programme, School health Nutrition and Food and National Security programme and the implementation of nutritional sensitive agriculture products that will improve nutritional status and long-term quality of life and reduce mortality, morbidity, and health-care costs.

Therefore, this study aimed at investigating the influence of birth weight on under-five children's nutritional status. The study also sought to investigate other factors that may indirectly influence birth out come and nutritional status of under-five children. The study sought to answer the following research questions: Does birthweight influences under-five children's nutritional status in Zambia? If yes, how? What maternal health and child characteristics influence birthweight and under-five children's nutritional status? What characteristics of the household and mother influence under-five children's nutritional status?

Findings have shown that children whose birthweight was not normal were more likely to be stunted, underweight and wasted than those children with normal birth weight. In terms of maternal health characteristics, children whose mothers took anti-malaria drugs during pregnancy were less likely to be stunted, underweight and wasted.

In relation to household characteristics, the findings have shown that children in rural areas, in middle (for stunting Copper belt, Lusaka and Western, for underweight Central, Muchinga and Western, for wasting North-Western, Central, Copper belt and Eastern) and higher prevalence regions (for stunting Central, Eastern, Luapula, Muchinga and Northern, for underweight Luapula and Northern, for wasting Luapula and Lusaka) were more likely to stunted, underweight and wasted compared with those in urban and lower prevalence regions. Further, results have shown that children in middle and rich wealth quintiles, households with improved source of drinking water and those who did not share a toilet facility were less likely to be stunted, underweight and wasted.

In relation to mother's characteristics, the results have shown that children whose mothers had secondary and higher education were less likely to be stunted, underweight and wasted. In addition, children whose mothers had normal and overweight BMI were less likely to be stunted, underweight and wasted. In relation to child characteristics, results have shown that children in higher age groups were more likely to be stunted and underweight compared with those aged 0-12 months.

5.2 Discussion of Findings

5.2.1 Birthweight with Stunting, Underweight and Wasting

This study found that birthweight was significantly associated with stunting, underweight and wasted at both bivariate and multivariate level. Children who were born with normal birthweight were less likely to be stunted, underweight and wasted. The findings of this study are in line with the previous reports from Brazil by Maria. E.F.A Motta et al (2005) who found that that low birth weight was significantly associated with nutritional risk at the end of the first year of life even though the study focused only assessing children in the first year of life and not the recommended by WHO of five years. Additionally, in Bangladesh, Arifeen et al. (2000), found that children with normal birth weight gain an average of 73g more than low birth weight children during their first three months of life. This possibly makes children more vulnerable to postnatal factors (infancy growth, childhood and adolescence) which may act on them after this age. Therefore, from the findings of this research, it is evident enough to argue that birth weight influences the nutritional status of under-five children and that it is important to adopt strategies that support good birth outcomes.

5.2.2. Maternal health characteristics with Stunting, Underweight and Wasting

Findings of this study revealed that taking anti-malaria drugs during pregnancy reduces the chances of the baby being stunted. Results show that children whose mothers took anti-malaria drugs during pregnancy were less likely to be stunted. Further the results of this study suggest that maternal Iron supplementation during pregnancy reduces the likelihood of underweight in children. Children whose mothers received or bought Iron tablets/syrup as food supplement were less likely to be underweight simply because Iron helps mothers body produce more blood to support the growth of the baby (without it, it increases the risk of you having a premature birth or low birthweight). The results are consistent with previous reports from Zimbabwe Stanley Gwavuya, et al, (2014) and India Rao BT et al (2007) and Black RE, Victora CG (2013) who found that low protein intake in pregnancy was associated with low birthweight and hence nutritional status of babies. The body uses iron to make extra blood for the mother and the baby during pregnancy. Iron also helps move oxygen from the mother’s lungs to the rest of the body and the baby’s baby. Therefore, getting enough iron cat prevent a condition of too few red blood cells that can make you feel tired called iron deficiency (WHO: 2014).

5.2.3 Household characteristics with Stunting, Underweight and Wasting

The study found that children in rural areas were more likely to be stunted than those in urban areas simply because urban dwellers tend to value, and to pay for, convenience foods more than their rural counterparts and urban food environments are generally characterized by better availability of fresh fruit and vegetables, and greater diversity of other nutrient-rich foods. Furthermore, urban residents are also more exposed to highly processed and non-traditional foods than rural populations through ready access to food retail outlets, street vendors (particularly in poorer areas) and marketing campaigns (Global Panel, 2017).

The study also found that children in higher prevalence regions (Central, Eastern, Luapula, Muchinga and Northern Province) were more likely to be stunted than those in middle prevalence region (North-Western and Southern) and Lower prevalence region (Copper belt, Lusaka and Western). Similar trends were observed for underweight and wasting and found that children residing in regions where underweight and wasting is more prevalent were more likely to be underweight and wasted. Regional differences in levels of stunting, underweight and wasting have also been reported elsewhere. For example, in a study conducted in Nigeria, Ordinioha and Sawyer (2008) found that malnutrition was common in the desert region of Bhil compared to the non-desert regions of Dhodia and Kinnaura.

The study also found that children in middle and rich wealth quintile households were less likely to be stunted, underweight and wasted. These findings were in line with Bwalya Bupe Bwalya (2013) who found that mothers in the poorest wealth quintile had high chances of having moderately stunted, underweight and wasted children.

The study found that children whose households share a toilet facility were more likely to be stunted compared with children whose households do not share a toilet facility. These results are in line with the findings by Maria. E.F.A Motta et al, (2005) in Brazil that concluded that living in a household with no latrine were significantly associated with nutritional risk at the end of the first year of life. Children living in households without a flush toilet had three times the chance of nutritional risk at 12 months of life in relation to those that had a latrine with a septic tank at home. The study found no significant differences in stunting among children with improved source of drinking water and those without improved sources of drinking water.

Though results suggest that children whose households have no improved source of drinking water were more likely to be stunted.

5.2.4 Mother characteristics with Stunting, Underweight and Wasting

The study found that education level was significantly associated with stunting and underweight both at bivariate and multivariate level. The study revealed that children whose mothers had secondary and higher education were less likely to be stunted and underweight. These findings are consistent with previous reports in Zambia (Selestine H. Nzala, el tal, 2011), Ghana (Appoh and Krekling, 2005) and Hein and Kam (2008) also reported that the mother's level of education was significantly related to malnutrition in Vietnam.

The study also found that the nutritional status of the mother (Body Mass Index) was significantly associated with stunting, underweight and wasting of the child. The study revealed that children whose mothers had a BMI that was normal weight, overweight and obese were significantly less likely to be stunted, underweight and wasted. These findings are in in line with previous studies conducted on the determinants of nutrition status of women and children by measure DHS in Ethopia in November, 2002 which used body mass index (BMI) as an indicator to assess chronic energy deficiency malnutrition in women. The study revealed that the basic determinants of women nutrition presented in the UNCEF framework adapted in this study also determine the birth outcome and hence nutrition status of the child. The presence of an intergenerational link between maternal and child nutrition means a small mother will have small babies who in turn grow to become small mothers. Therefore, actions towards improving women and child nutrition should always be integrated for effective utilization of scarce resources and to reduce the intergenerational link (mother-child) of under nutrition. Furthermore, the study revealed that total children ever born and access to information was not significantly associated with stunting and underweight. Though results suggested that children whose mothers had more than one birth throughout their life time more likely to be stunted and underweight.

5.2.5 Child characteristics with Stunting, Underweight and Wasting

The findings of this study revealed that nutritional status was associated with age and sex of the child at both bivariate and multivariate. The study found that female children were less likely to be stunted and underweight and that Stunting and underweight increased with age. Children in older age groups were more likely to be stunted and underweight than children in younger ages (0-12). These findings are consistent with previous reports in Zambia ((Selestine

H. Nzala, et al, 2011) who found that being stunted, underweight and wasted was positively associated with male gender and that stunting and underweight increased with age.

Additionally, the study found that receiving Vitamin A dose in the first two weeks after delivery had no effect on wasting. These results are in line with Stanley Gwavuya, et al, (2014) who found that Vitamin A supplementation had no effect on the child growth. However, the results are in contradiction with Bwalya Bupe Bwlya (2013) who found that children whose mothers had received Vitamin A postpartum (2 months after delivery), drugs for intestinal worms and were given or bought iron tablets/syrup during pregnancy were less likely to be wasted, compared to the children whose mothers never received the three supplements. The study also found that children who had fever in the last two weeks before the survey were more likely to be stunted than children who did not have fever the last two weeks before the survey.

5.3 Conclusion

The rates of malnutrition in Zambia are still high and this poses a challenge of achieving its aspiration to be a prosperous upper-middle-income country by 2030. The Government of the Republic of Zambia recognizes malnutrition as a serious public health problem, therefore, it has partnered with other cooperating partners in promoting nutrition activities to improve nutritional status of women so that they can have babies with normal birthweight. Some of the programs include; the UN-led Scaling Up Nutrition (SUN) a global movement that unites national leaders, civil society, bilateral and multilateral organizations, donors, businesses and researchers in a collective effort to improve nutrition movement (USAID 2014:108). The government of the republic of Zambia is committed to the attainment of the SDGs and Africa agenda 2063 to be a prosperous continent, where African people have high standard of living and quality of life, sound health and wellbeing (Africa Agenda 2063:2). This also is line with the government's efforts to expand coverage of social assistance programmes to address income insecurity of the poor and vulnerable as well as support access to access to health and education, improved nutrition and human capital (7^{th} National Development Plan: 88). Government through the ministry of Health is committed to implement the aspirations to meet universal primary health care according to the National Health Strategic plan 2017 -2021. The nutritional status of Zambian children showed that 37% are stunted, 14% are underweight and 6% wasted.

Findings have shown that birthweight influences the nutritional status of under-five children. Children who are born with normal birthweight are less stunted, underweight and wasted. Findings have also shown that taking anti-malaria drugs during pregnancy reduces the chance of being stunted while taking iron tablets during pregnancy reduces chances of being underweight.

Findings have also shown that area of residence, region, wealth quintile, and improved sanitation influence birth outcome and nutrition status of under-five children. Findings have shown that education level and mother's nutritional status influence birth outcome and later nutritional status of children. Findings have also shown that stunting, underweight and wasting is associated with age of the child.

Therefore, these findings may provide a basis for developing and monitor nutritional interventions such as the 1000 most critical days of life, led by SUN, Maternal, Adolescent, Infant and Young Child Nutrition, management of severe acute malnutrition, Nutrition and HIV programme, School health Nutrition and Food and National Security programme and the implementation of nutritional sensitive agriculture products that will improve nutritional status and long-term quality of life and reduce mortality, morbidity, and health-care costs

From the findings of this study, it can be concluded that birthweight influences the nutritional status of under-five children and that maternal food supplements, BMI, residence, wealth quintile, education level, number of children a woman has in her life time (Total Children Ever Norn), age of the child, sex of the child, affect birth outcome and nutritional status of children.

5.4 Recommendations

From the findings of this study, the following are the recommendations:

i. There is need to invest in strategies that support adequate nutrition before and during pregnancy such as the 1000 most critical days of life, led by SUN, Maternal, Adolescent, Infant and Young Child Nutrition, management of severe acute malnutrition, Nutrition and HIV programme, School health Nutrition and Food and National Security programme that will improve nutritional status and long-term quality of life and reduce mortality, morbidity, and health-care costs as recommended in the National Health Strategic plan and Nutritional Strategic plan

ii. Further studies such as qualitative, cohort, case studies and longitudinal studies be carried out in Zambia on the influence of birth weight on nutritional status of children. Studies that can follow up a cohort of women while pregnant and children from birth to 5 years.

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APPENDICES

Appendix 1 :Adjusted Odds Ratios of Birthweight with Stunting

Variable	Odds Ratio		Model 1
Birth Weight			
Underweight	RC(100)	RC (100)	
Normal	**0.413***	**0.402***	
n	7383	7383	
Logistic regression	Number of obs	=	5,592
	LR chi2(9)	=	471.43
	Prob > chi2	=	0000
Log likelihood = -3419.8521	Pseudo R2	=	0.0645

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Data Set

Appendix2 :Adjusted Odds Ratios of Maternal health Characteristics with Stunting

Variable	Odds Ratio		Model 2
Took Anti-malaria			
No (RC)		RC (1.00)	
Yes		**0.7401***	
n	7383	7383	
Logistic regression	Number of obs	=	5,592
	LR chi2(9)	=	471.43
	Prob > chi2	=	00000
Log likelihood = -3419.8521	Pseudo R2	=	0.0645

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Data Set

Appendix 3: Adjusted Odds Ratios of Household Characteristics with Stunting

Variable		Odds Ratio			Model 3
Place of Residence					
Urban	RC(100)	RC (100)	RC(100)	RC(100)	RC(100)
Rural	**1.252***	**1.227***	**0.924***	0.9164	0.94407
Region					
Lower Prevalence		RC (100)	RC(100)	RC(100)	RC(100)
Middle Prevalence		0.899	**0.858***	**0.854***	0.83363
Higher Prevalence		**1.279***	**1.174***	**1.170***	1.15388
Wealth quintile					
Poor			RC(100)	RC(100)	RC(100)
Middle			**0.807***	**0.812***	**0.791***
Rich			**0.595***	**0.605***	**0.606***
Source of drinking Water					
Improved				RC(100)	RC(100)
Not Improved				1.0550	1.083
Toilet Facility Shared					
No					RC(100)
Yes					**1.222***
n	7388	7388	7388	7388	7388
Logistic regression	Number of obs	=	6,250		
	LR chi2(7)	=	104.7		

	Prob > chi2	=	0
Log likelihood = -4055.6121	Pseudo R2	=	0.0127

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Data Set

Appendix 4: Adjusted Odds Ratios of Mother's Characteristics with Stunting

Variable	Odds Ratio				Model 4
Religion					
Catholic	RC(100)	RC (100)	RC(100)	RC(100)	RC(100)
Protestant	0.936	0.942	0.952	**0.973**	0.970
Muslim	**0.265***	**0.332***	**0.348***	0.3429	0.338
Education Level					
No education		RC(100)	RC(100)	RC(100)	RC(100)
Primary		0.940	0.939	0.932	0.931
Secondary		**0.707***	**0.727***	**0.723***	**0.726***
Higher		**0.268***	**0.298***	**0.289***	**0.288***
BMI					
Underweight			RC(100)	RC(100)	RC(100)
Normal Weight			**0.683***	**0.681***	**0.677***
Over weight			**0.585***	**0.567***	**0.562***
Obse			**0.511***	**0.490***	**0.484***
Total children ever born					
One				RC(100)	RC(100)
Two				1.132	1.13669
Three				1.145	1.14579
Four and above				1.071	1.07254
Access to Information					RC(100)
Yes had access					**0.8301***
No Access					
n	**7388**	**7388**	**7388**	**7388**	**7388**

Logistic regression	Number of obs	=	7,326
	LR chi2(18)	=	298.02
	Prob > chi2	=	0
Log likelihood = -4687.1362	Pseudo R2	=	0.0308

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Dataset

Appendix 5:Adjusted Odds Ratios of Child Characteristics with Stunting

Variable			Odds Ratio		Model 5
Child had fever in the last two weeks					
No			RC(100)	RC(100)	RC(100)
Yes			**1.137***	**1.135***	**1.017***
Sex of Child					
Male				RC(100)	RC(100)
Female				**0.8124***	**0.7480***
Age of the Child in Months					
0-12					RC(100)
13-23'					**3.1394***
24-45					**2.9250***
46-59					**1.6785***
n	**7383**	**7383**	**7383**	**7383**	**7383**

Logistic regression	Number of obs	=	7373
	LR chi2(9)	=	344.3
	Prob > chi2	=	0.000
Log likelihood		=	-4694.241
	Pseudo R2	=	0.0354

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Dataset

Appendix 6:Adjusted Odds Ratios of Birthweight with Underweight

Variable	Odds Ratio	Model 1
Birth Weight		
Underweight	RC(100)	
Normal	**0.3207***	
n	**7589**	

Logistic regression	Number of obs	=	7,589
	LR chi2(9)	=	126.77
	Prob > chi2	=	0.0000
Log likelihood = -2961.4651	Pseudo R2	=	0.021

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Data Set

Appendix 7:Adjusted Odds Ratios of Maternal health Characteristics with Underweight

Variable	Odds Ratio		Model 2
Took Iron Tablets			
No (RC)		RC (1.00)	
Yes		**0.5690***	
n	5592	5592	

Logistic regression	Number of obs	=	5,592
	LR chi2(9)	=	471.43
	Prob > chi2	=	0
Log likelihood = -3419.8521	Pseudo R2	=	0.0645

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Data Set

Appendix 8: Adjusted Odds Ratios of Household Characteristics with Underweight

Variable	Odds Ratio		Model 2
Region			
Lower Prevalence	RC (100)	RC(100)	RC(100)
Middle Prevalence	**1.1721***	1.103186	1.117369
Higher Prevalence	**1.6876***	**1.5456***	**1.5569***
Wealth quintile			
Poor		RC(100)	RC(100)
Middle		**0.7450***	**0.7357***
Rich		**0.6382***	**0.6247***
n	**7579**	**7579**	**7579**

Logistic regression	Number of obs	=	7,579
	LR chi2(7)	=	74.21
	Prob > chi2	=	0.0000
Log likelihood = -2982.5866	Pseudo R2	=	0.0123

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Data Set

Appendix 9: Adjusted Odds Ratios of Mother's Characteristics with Underweight

Variable	Odds Ratio						Model 3
Marital Status							
Never Married	RC(100)	RC(100)	RC(100)	RC(100)	RC(100)	RC(100)	RC(100)
Married	1.1080	0.9692	1.0809	1.0669*	0.959	0.937	0.9610
Separated/Divorced/Widowed/Cohabiting	**1.4870***	1.2770	**1.375***	1.3396*	1.249	1.232	1.2480
Education Level							
No education		RC(100)	RC(100)	RC(100)	RC(100)	RC(100)	RC(100)
Primary		0.948	0.93866	0.9310	0.931	0.957	0.9380
Secondary		**0.670***	**0.714***	**0.7115***	**0.7052***	**0.944**	**0.7426***
Higher		**0.254***	**0.311***	**0.3085***	**0.3058***	**0.4094***	**0.3505***
BMI							
Underweight			RC(100)	RC(100)	RC(100)	RC(100)	RC(100)
Normal Weight			**0.4774***	**0.4759***	**0.4728***	**0.4714***	**0.4733***
Over weight			**0.3524***	**0.3487***	**0.3551***	**0.3575***	**0.3586***
Obese			**0.2685***	**0.26325***	**0.2715***	**0.2699***	**0.2791***
Births in last 5 years							
One				RC(100)	RC(100)	RC(100)	RC(100)
Two				**1.1875***	1.138	1.135	1.127
Three				**1.6343***	**1.6205***	**1.6168***	**1.6161***
Four				**1.3357***	1.384	1.384	1.3668
Total children ever born							
One					RC(100)	RC(100)	RC(100)
Two					1.2209	1.23405	1.2289
Three					1.2276	1.244	1.2308
Four and above					1.02139	1.03744	1.0232
Access to Information							
Yes had access							RC(100)
No Access							0.8149
n	**7568**	**7568**	**7568**	**7568**	**7568**	**7568**	**7568**

Logistic regression	Number of obs	=	7,568
	LR chi2(20)	=	168.51
	Prob > chi2	=	0.0000
Log likelihood = -2937.5073	Pseudo R2	=	0.0279

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Data Set

Appendix 10 :Adjusted Odds Ratios of Child Characteristics with Underweight

Variable	Odds Ratio		Model 5
Sex of Child			
Male		RC(100)	RC(100)
Female		**0.8287***	**0.8257***
Age of the Child in Months			
0-12			RC(100)
13-23			**1.5841***
24-45			**1.6591***
46-59			**1.3835***
n		**7589**	**7589**

Logistic regression	Number of obs	=	7,589
	LR chi2(4)	=	39.47
	Prob > chi2	=	0.000
Log likelihood = -3005.1127	Pseudo R2	=	0.0065

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Data Set

Appendix 11:Adjusted Odds Ratios of Birthweight with Wasting

Variable	Odds Ratio		Model 1
Birth Weight			
Underweight	RC(1.00)		
Normal	**0.7027***		
Female			
n	**7544**	**7544**	**7544**

Logistic regression	Number of obs	=	7,544
	LR chi2(1)	=	4.72
	Prob > chi2	=	0.0298
Log likelihood = -1708.121	Pseudo R2	=	0.0014

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Data Set

Appendix 12:Adjusted Odds Ratios of Household Characteristics with Wasting

Variable	Odds Ratio		Model 2
Region			
Lower Prevalence	RC(1.00)	RC(1.00)	
Middle Prevalence	**1.7640***	**1.7521***	
Higher Prevalence	**2.4124***	**2.4572***	
Wealth quintile			
Poor		RC(1.00)	
Middle		**0.7531***	
Rich		0.809	
n	**7544**	**7544**	

Logistic regression	Number of obs	=	7,544
	LR chi2(4)	=	39.08
	Prob > chi2	=	0
Log likelihood = -1690.9429	Pseudo R2	=	0.0114

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Data Set

Appendix 13:Adjusted Odds Ratios of Mother's Characteristics with Wasting

Variable	Odds Ratio		Model 3
BMI			
Underweight	RC(1.00)	RC(1.00)	
Normal Weight	0.744	0.737	
Over weight	0.733	0.731	
Obese	**0.545***	**0.546***	
Births in last 5 years			
One		RC(1.00)	
Two		1.0090	
Three		1.3415	
Four		**5.0300***	
n	**7525**	**7525**	
Logistic regression	Number of obs	=	7,525
	LR chi2(6)	=	14.13
	Prob > chi2	=	0.0282
Log likelihood = -1686.2454	Pseudo R2	=	0.0041

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Data Set

Appendix 14:Adjusted Odds Ratios of Child Characteristics with Wasting

Variable	**Odds Ratio**			**Model4**
Received Vitamin A				
No	RC(1.00)	RC(1.00)	RC(1.00)	RC(1.00)
Yes	**1.3849***	**1.3669***	**1.3961***	**1.3944***
Child had fever in the last two weeks				
No		RC(1.00)	RC(1.00)	RC(1.00)
Yes		0.7975	0.8187	0.8181
Age of the Child in Months				
0-12			RC(1.00)	RC(1.00)
13-23			**0.7378***	**0.7377***
23-45			**0.5721***	**0.5724***
46-59			**0.5239***	**0.5241***
Sex of Child				
Male				RC(1.00)
Female				0.9727
n	**5699**	**5699**	**5699**	**5699**

Logistic regression	Number of obs	=	5,699
	LR chi2(6)	=	30.1
	Prob > chi2	=	0
Log likelihood = -1300.5161	Pseudo R2	=	0.0114

Significant at:*P<0.05, Odds Ratios, CI-Confidence Interval, R.C- Reference Category: Calculated using 2013/14 ZDHS Data Set

Appendix 15: Measures of Fit for Logistic of Stunting

Stunting	Full Model	Model 1	Difference Model 1 & Full Model	Model 2	Difference Model 2 & Full Model	Model 3	Difference	Model 4	Difference Model 4 & Full Model	Model 5	Difference Model 5 & Full Model
Model	Logistics	Logistics		Logistics		Logistics		Logistics		Logistics	
N	4731	7388	2657.0	5600	869	6250	1519	7351	2620	7373	2642
Log-Lik Intercept Only	-3078.941	-4877.0	-1798.1	-3661.437	-582.496	-4107.964	-1029.023	-4853.015	-1774.074	-4866.393	-1787.452
Log-Lik Full Model	-2842.7	-4810.5	-1967.8	-3618.347	-775.661	-4055.612	-1212.926	-4770.41	-1927.724	-4694.241	-1851.555
D	5685 (4689)	9621(7386)	3935(2697)	7236(5595)	1551 (906)	8111(6237)	2425(1548)	9540(7333)	3855 (2644)	9388 (7364)	3703(2675)
LR	472.511	133.05	-339.46	86.181	-386.33	104.704	-367.807	165.209	-307.302	344.305	-128.206
Prob > LR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
McFadden's R2	0.077	0.014	-0.06	0.012	-0.065	0.013	-0.064	0.017	-0.06	0.035	-0.042
McFadden's Adj R2	0.063	0.013	-0.05	0.01	-0.053	0.01	-0.053	0.013	-0.05	0.034	-0.029
Maximum Likelihood R2	0.095	0.018	-0.08	0.015	-0.08	0.017	-0.078	0.022	-0.073	0.046	-0.049
Cragg & Uhler's R2	0.131	0.024	-0.11	0.021	-0.11	0.023	-0.108	0.03	-0.101	0.062	-0.069
McKelvey and Zavoina's R2	0.135	0.024	-0.11	0.019	-0.116	0.022	-0.113	0.034	-0.101	0.063	-0.072
Efron's R2	0.096	0.019	-0.08	0.016	-0.08	0.017	-0.079	0.021	-0.075	0.045	-0.051
Variance of y*	3.803	3.37	-0.43	3.353	-0.45	3.363	-0.44	3.406	-0.397	3.51	-0.293
Variance of error	3.29	3.29	0.00	3.29	0	3.29	0	3.29	0.000	3.29	0
Count R2	0.674	0.635	-0.04	0.649	-0.025	0.635	-0.039	0.629	-0.045	0.630	-0.044
Adj Count R2	0.084	0.021	-0.06	0.028	-0.056	0.004	-0.08	0.004	-0.08	0.006	-0.078
AIC	1.219	1.303	0.08	1.294	0.075	1.302	0.083	1.303	0.084	1.276	0.057
AIC*n	5769.371	9625.023	3855.65	7246.694	1477.323	8137.224	2367.853	9576.82	3807.449	9406.481	3637.11
BIC	-33992.44	-56170.6	-22178.16	-41051.076	-7058.636	-46402.256	-12409.816	-55741.884	-21749.444	-56192.21	-22199.77
BIC'	-252.501	-124.141	128.36	-68.92	183.581	-43.522	208.979	-58.377	194.124	9406.481	9658.982

In this study, Fitstat was used as a measure of fit for logistic of stunting, underweight and wasting for each model. The choice of the model adopted in this study was done by comparing the Bayesian Information Criterion (BIC) for Final model with the rest of the models. The model with a lower BIC was chosen.

For Stunting Appendix 15:

1. The difference between Model 1 and full model in BIC' is 128.36, provide a very strong support for the adoption of the full model
2. The difference between Model 2 and full model in BIC' is 183.581, provide a very strong support for the adoption of the full model
3. The difference between Model 3 and full model in BIC' is 208.979, provide a very strong support for the adoption of the full model
4. The difference between Model 4 and full model in BIC' is 194.124, provide a very strong support for the adoption of the full model
5. The difference between Model 5 and full model in BIC' is 9658.982, provide a very strong support for the adoption of the full model

For underweight in Appendix 16:

1. The difference between Model 1 and full model in BIC' is-42.54, this does not support the adoption of the full model
2. The difference between Model 2 and full model in BIC' is 76.75, provide a very strong support for the adoption of the full model
3. The difference between Model 3 and full model in BIC' is 36.841, provide a very strong support for the adoption of the full model
4. The difference between Model 4 and full model in BIC' is 54.439, provide a very strong support for the adoption of the full model
5. The difference between Model 5 and full model in BIC' is 71.56, provide a very strong support for the adoption of the full model

Appendix 16: Measures of Fit for Logistic of Underweight

Underweight	Full Model	Model 1	Difference Model 1 & Full Model	Model 2	Difference Model 2 & Full Model	Model 3	Difference	Model 4	Difference Model 4 & Full Model	Model 5	Difference Model 5 & Full Model
Model	Logistics	Logistics		Logistics		Logistics		Logistics		Logistics	
N	5756	7589	1833.0	5772	16	7589	1833	7536	1780	7589	1833
Log-Lik Intercept Only	-2210.162	-3024.849	-814.7	-2212.364	-2.202	-3024.849	-814.687	-3011.527	-801.365	-3024.849	-814.687
Log-Lik Full Model	-2064.289	-2961.465	-897.2	-2208.761	-144.47	-2987.75	-923.46	-2920.75	-856.46	-3005.113	-940.824
D	4128(5718)	5922 (7586)	1794(1868)	4417 (5769)	288(51)	5975(7582)	1846(1864)	5841 (7509)	1712.924(1791)	6010 (7582)	1882(1864)
LR	291.746	126.769	-164.98	7.206	-284.54	74.193	-217.553	181.551	-110.195	39.474	-252.272
Prob > LR	0.0000	0.0000	0.000	0.0070	0.0070	0.0000	0	0.0000	0.00	0.0000	0
McFadden's R2	0.066	0.021	-0.05	0.002	-0.064	0.012	-0.054	0.03	-0.036	0.007	-0.059
McFadden's Adj R2	0.049	0.02	-0.03	0.0000	-0.049	0.01	-0.039	0.021	-0.028	0.004	-0.045
Maximum Likelihood R2	0.049	0.017	-0.03	0.001	-0.048	0.01	-0.039	0.024	-0.025	0.005	-0.044
Cragg & Uhler's R2	0.092	0.03	-0.06	0.002	-0.09	0.018	-0.074	0.043	-0.049	0.009	-0.083
McKelvey and Zavoina's R2	0.119	0.029	-0.09	0.003	-0.116	0.023	-0.096	0.064	-0.055	0.014	-0.105
Efron's R2	0.055	0.021	-0.03	0.001	-0.054	0.011	-0.044	0.025	-0.03	0.005	-0.05
Variance of y*	3.735	3.387	-0.35	3.299	-0.436	3.369	-0.366	3.514	-0.221	3.338	-0.397
Variance of error	3.29	3.29	0.00	3.29	0	3.29	0	3.29	0.000	3.29	0
Count R2	0.871	0.863	-0.01	0.872	0.001	0.863	-0.008	0.863	-0.008	0.863	-0.008
Adj Count R2	-0.003	0.000	0.00	0.000	0.003	0.0000	0.003	0.000	0.003	0.000	0.003
AIC	0.73	0.781	0.05	0.766	0.036	0.789	0.059	0.782	0.052	0.794	0.064
AIC*n	4204.578	5928.93	1724.35	4423.521	218.943	5989.506	1784.928	5895.502	1690.924	6024.225	1819.647
BIC	-45377.855	-61853.846	-16475.99	-45546.484	-168.629	-61765.533	-16387.68	-61194.696	-15816.841	-61730.813	-16352.958
BIC'	-75.296	-117.834	-42.54	1.454	76.75	-38.455	36.841	-20.857	54.439	-3.736	71.56

Appendix 17: Measures of Fit for Logistic of Wasting

Wasting	**Full Model**	**Model 1**	**Difference Model 1 & Full Model**	**Model 2**	**Difference Model 2 & Full Model**	**Model 3**	**Difference Model 3 & Full Model**	**Model 4**	**Difference Model 4 & Full Model**
Model	**Logistics**	**Logistics**		**Logistics**		**Logistics**		**Logistics**	
N	5,685	7544	1859.0	7,544	1859	7525	1840	5699	14
Log-Lik Intercept Only	-1314.677	-1710.482	-395.8	-1710.482	-395.805	-1709.306	-394.629	-1315.565	-0.888
Log-Lik Full Model	-1281.372	-1708.121	-426.7	-1687.96	-406.587	-1702.24	-420.868	-1300.516	-19.144
D	2562 (5658)	3416(7541)	853(1883)	3375(7537)	813(1879)	3404(7516)	841(1858)	2601(5688)	38(30)
LR	66.61	4.721	-61.89	45.046	-21.564	14.132	-52.478	30.098	-36.512
Prob > LR	0.0000	0.0300	0.030	0.0000	0.0000	0.0280	0.028	0.0000	0
McFadden's R2	0.025	0.001	-0.02	0.013	-0.012	0.004	-0.021	0.011	-0.014
McFadden's Adj R2	0.005	0.000	-0.01	0.009	0.004	-0.001	-0.006	0.003	-0.002
Maximum Likelihood R2	0.012	0.001	-0.01	0.006	-0.006	0.002	-0.01	0.005	-0.007
Cragg & Uhler's R2	0.031	0.002	-0.03	0.016	-0.015	0.005	-0.026	0.014	-0.017
McKelvey and Zavoina's R2	0.057	0.003	-0.05	0.035	-0.022	0.007	-0.05	0.027	-0.03
Efron's R2	0.013	0.001	-0.01	0.006	-0.007	0.002	-0.011	0.005	-0.008
Variance of y*	3.488	3.299	-0.19	3.408	-0.08	3.315	-0.173	3.383	-0.105
Variance of error	3.29	3.29	0.00	3.29	0	3.29	0	3.29	0
Count R2	0.938	0.94	0.00	0.94	0.002	0.94	0.002	0.939	0.001
Adj Count R2	-0.003	0	0.00	0.000	0.003	0	0.003	0.0000	0.003
AIC	0.46	0.454	-0.01	0.449	-0.011	0.455	-0.005	0.460	0
AIC*n	2616.743	3422.242	805.50	3389.917	773.174	3422.48	805.737	2623.032	6.289
BIC	-46353.985	-63913.635	-17559.65	-63918.25	-17564.26	-63683.231	-17329.25	-46589.053	-235.068
BIC'	80.365	4.208	-76.16	-9.332	-89.697	39.424	-40.941	21.791	-58.574

For wasting Appendix 17

1. The difference between Model 1 and full model in BIC' is-76.16, this does not support the adoption of the full model, however, the **AIC*n** difference shows 805.5 which supports the adoption of the full model
2. The difference between Model 1 and full model in BIC' is-89.697, this does not support the adoption of the full model, however, the **AIC*n** difference shows 773.174 which supports the adoption of the full model
3. The difference between Model 1 and full model in BIC' is-40.941, this does not support the adoption of the full model, however, the **AIC*n** difference shows 805.737 which supports the adoption of the full model
4. The difference between Model 1 and full model in BIC' is -58.574, this does not support the adoption of the full model, however, the **AIC*n** difference shows 6.289 which supports the adoption of the full model