DETERMINANTS OF UNDERWEIGHT AMONG UNDER-FIVE CHILDREN IN ZAMBIA- EVIDENCE FROM 2001, 2007 AND 2014 ZAMBIA DEMOGRAPHIC AND HEALTH SURVEYS

BY
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DECLARATION

I hereby declare that all the work in dissertation is my own and has never been submitted for another degree in this or any other university or institution of higher learning.

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APPROVAL

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DEDICATION

This dissertation is dedicated to my adorable and precious gift from God, my son Tuneza Loloji who is my biggest source of motivation in life. To my dad "Grandpa George" and mom "Grandma Rhoda" for always pushing me to do better in life. To my beautiful family Mercy, Joe, Brian, Wezi and Vwambanji, my cousins, nieces and nephews and all I have not mentioned, I thank you all immensely for the selfless love, support and encouragement.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABBREVIATIONS AND ACCRONYMS

BMI	Body Mass Index
CSO	Central statistics office
SEA	Standard Enumeration Area
SUN	Scaling up Nutrition
UNICEF	United Nation Children Fund
UNZA	University of Zambia
WAZ	Weight-for-Age Z-score
WHO	World Health Organization
ZDHS	Zambia Demographic and Health Survey
BMI	Body Mass Index

ABSTRACT

Over the past ten years, underweight levels in Zambia have remained static at 15%. Literature has shown that the mortality risk of children who are even mildly underweight is increased and this risk increases for those children who are severely underweight. The main objective of the study was to assess the determinants of underweight in under-five children over the last two decades in Zambia.

This was a cross sectional study using data from the 2001, 2007 and 2013-14 Zambia Demographic and Health Survey's. The study included a pooled estimate of about 26,735 under-five children, 6877 in the 2001 survey, 6401 in the 2007 survey and 13, 457 children in the 2013-14 survey. Multiple logistic regression showed that female children were 25% less likely to be underweight than male children [0R=0.75, 95% CI (0.69-0.82), p<0.0001]. Children from rural areas had reduced odds of being underweight than those from urban areas [OR=0.77, 95%CI (0.68-0.89), p<0.0001], Children aged 13-24 and 25-36 months had increased odds of being underweight [OR=1.71, 95% CI (1.48-1.98), p<0.0001] and [OR=1.90, 95% CI (1.64-2.20), p<0.0001] respectively than children aged 0-12 months. Having had diarrhoea [OR=1.33, 95% CI (1.18-1.50), p<0.0001] or fever [OR=1.19, 95% CI (1.07-1.32), P=0.001] increased the odds of a child below five being underweight. The odds of underweight in under-five children reduced with an increase in the mother's education and wealth index. Children whose mothers had tertiary education, came from the richest wealth quintile and children who were large at birth had the lowest odds of being underweight [OR=0.41 95% CI (0.27-0.64), p<0.0001], [OR=0.40, 95%CI (0.32-0.50), p<0.0001] and [OR=0.38, 95%CI (0.33-0.44), p<0.0001] respectively.

The study established that mothers with higher education, from the richest wealth index, an average sized child at birth, being female and residing in rural area were protective factors for underweight in children. On the other hand having had diarrhoea and fever was a disadvantage to the child as this promoted being underweight. In addition, older children were more likely to be underweight.
Key words: Underweight, Under-nutrition, Determinants, Under-five

CHAPTER ONE: BACKGROUND

1.1 Introduction

Over the past couple of years, underweight levels among under-five children in Zambia have remained static at 15 %(14.6% in 2007 and 14.8% in 2014) as compared to other indicators of under-nutrition such as stunting and wasting (Central Statistical Office (CSO) [Zambia] et al., 2014). This is a source of concern. Despite the different nutrition interventions that have been introduced by the government and other organizations, underweight levels have remained the same.

According to UNICEF 2017, nearly half of all deaths in children under five are attributable to under nutrition. This translates to a loss of about three million young lives a year. Under nutrition puts children at greater risk of dying from common infections, increases the frequency and severity of such infections, and contributes to delayed recovery. In addition, the interaction between under nutrition and infection can create a potentially lethal cycle of worsening illness and deteriorating nutritional status (UNICEF, 2017).

A report by WHO (2016) articulates that in 2015, about 15%, or 92 million children under five years of age in less developed regions globally were underweight. Underweight prevalence is highest in the Southern Asian region (27%), followed by Western Africa (20%), Oceania and Eastern Africa (both 18%), South-Eastern Asia and Middle Africa (15%), and Southern Africa (11%).

Underweight in Zambia reduced from about 28% in 2002 to 15% in 2007 (Central Statistical Office (Zambia) et al., 2003, Central Statistical Office (CSO) et al., 2009). The 2013-14 ZDHS reports that there was a slight increase in the proportion of underweight children between 2007 and 2013-14 of about 0.2 %. The survey also reports that three percent of under-five are severely underweight. Luapula province has the highest percentage of underweight children (21%), followed by Northern Province at 19 % while Lusaka province has the lowest at 11% (Central Statistical Office (CSO) [Zambia] et al., 2014).

Underweight continues to remain an important factor in improving the overall health of a child. Therefore it is important to explain factors that are contributing to the static status of underweight so as to inform policy and implement evidence based interventions.

1.2 Statement of the Problem

The prevalence of underweight among under-five children remained static between 2007 and 2014. Zambia has one of the highest rates of under nutrition in the world; stunting is at 40.1 %, underweight at 14.8% while wasting is at 6.2% (Central Statistical Office (CSO, et al., 2014). The World Health Organization recommends that underweight levels should be below 10% (WHO, 2006). At 15%, Zambia’s prevalence for underweight is higher than the recommended percentage. It is also higher than the average prevalence for southern Africa which stands at 11% (WHO 2016). This is despite all the nutrition interventions that have taken place such as maternal, adolescent, infant and young child nutrition, nutrition in emergencies, school health and nutrition, food and nutrition and the scaling up nutrition programs among others. This is therefore a source of concern.

Researchers have found that underweight, stunting and wasting are highly interrelated. A study by Safari et al (2015) showed a significant correlation between underweight and stunting and between underweight and wasting. This suggests that a child is likely to suffer more than one form of under nutrition. Therefore a better understanding of underweight and its associated risk factors is necessary not only to reduce underweight levels but also to reduce levels of stunting and wasting in the country.

High levels of underweight lead to an increase in child morbidity and mortality. In Zambia, there is limited information on the subject. Therefore, to shed light on the problem within the Zambian context, a study on the trends and determinants of underweight was carried out in 2017.

1.3 Justification

Zambia’s prevalence for underweight has been at the same level for the last ten years. Evidence has shown that the mortality risk of children who are even mildly underweight is increased and this risk increases for those children who are severely underweight (WHO, 2010). It is therefore imperative to monitor trends of underweight levels in children and the associated determinants.

This research may inform nutrition policies and support interventions aimed at reducing the static level of underweight in Zambia. This would in turn contribute to reducing the risk of mortality and morbidity.

Identifying factors associated with underweight which reflects either chronic or acute malnutrition or a combination of both may aid in the reduction of stunting (chronic malnutrition) and wasting (acute malnutrition) ((Central Statistical Office (CSO) [Zambia] et al., 2014). In addition, reviewing the different risk factors associated with underweight among children will add to the body of knowledge on this topic and find solutions that may help in the reduction of under nutrition.

1.4 Research Question

What factors are associated with being underweight among children below five years of age in the past 15 years in Zambia?

1.5 Research Objectives

1.5.1 General Objective

The general objective of the study was to explore the risk factors associated with underweight status among under-five children in Zambia.

1.5.2 Specific Objectives

i. To determine the trend of underweight prevalence in under five children from 2001 to 2013.
ii. To ascertain the socio-economic, demographic and nutritional factors associated with underweight in under-five children in Zambia.

CHAPTER TWO: LITERATURE REVIEW

Under-nutrition is defined as the outcome of insufficient food intake and repeated infectious diseases. It includes being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted) (UNICEF, 2006). Of the nutritional status measures for children, underweight and stunting were responsible for the largest disease burden (Black et al., 2008). Stunting and underweight have the highest proportions of attributable child deaths, about 14%-17% while wasting accounts for 11.5-12·6% of child death.

To curb the levels of under-nutrition, the World Health Organization (WHO) introduced new child growth standards in 2006 for use in defining indicators of nutritional status, such as stunting, wasting and underweight (WHO, 2010). These standards replaced the previously recommended international growth reference devised by the National Center for Health Statistics (WHO, 2006). Underweight is a composite form of undernutrition that includes elements of stunting and wasting. It is defined as the percentage of children aged 0 to 59 months whose weight for age is below minus two standard deviations (moderate and severe underweight) and minus three standard deviations (severe underweight) from the median of the WHO Child Growth Standards (WHO, 2010)

Countries are classified according to the prevalence of underweight using WHO growth standards (Table 1). The world health organization recommends that underweight levels should be below 10%.

Table 1: Classification for assessing severity of underweight for under-five children

Indicator	Severity of malnutrition by prevalence ranges (%)			
	Low	Medium	High	Very high
Underweight	<10	10-19	20-29	>30

Source: WHO, 2006

2.1 Trends in underweight

According to a study by Stevens et al (2012) children's anthropometric status as measured by underweight and stunting improved in developing countries between 1985 and 2011 but did not reach optimum nutritional status as envisioned by the WHO growth standards. However, there were major differences across regions and countries in trends and in present nutritional status. In 1985, globally 46% with mild-to-severe underweight lived in south Asia while Sub-Saharan Africa had the second largest number. Sub-Saharan Africa experienced a period of increasing undernutrition until the late 1990s, when anthropometric status began to improve and the pace of improvement accelerated in south Asia. Despite these positive trends, children in some countries in sub-Saharan Africa and south Asia remain alarmingly undernourished whereas in the Latin America and Caribbean region; central Asia, Middle East, and north Africa; and increasingly east Asia, children are largely fulfilling their growth potential. Improvements in southern and tropical Latin America slowed down after 2000 perhaps because some countries approached a state of having almost no undernutrition, with improvements only in the small remaining tail of the distribution (Stevens et al., 2012).

Another study by De Onis et al (2004) on the estimates of global prevalence of childhood underweight between 1990 and 2015 found that the trend in the prevalence of underweight worldwide was projected to decline from 26.5% in 1990 to 17.6% in 2015.In developed countries, the prevalence was estimated to decrease from 1.6% to 0.9 while in developing regions, the prevalence was forecasted to decline from 30.2% to 19.3%. Globally, the number of underweight children was projected to decline from 163.8 million in 1990 to 113.4 million in 2015. In Africa, the prevalence of underweight was forecasted to increase from 24% to 26.8. Numbers were projected to decrease in all sub regions except those of sub-Saharan, Eastern, Middle and Western Africa, which were expected to experience substantial increases in the number of underweight children (De Onis et al., 2004). Contrary to this projection, underweight levels in Africa have been decreasing. Masibo and Makoka (2012) in Kenya found that the levels of underweight showed a slight decline of about 2.7 between 1993 and 2009. In Zambia, according to the CSO report, the prevalence of underweight decreased from 21% in 1992 to about 19% in 1996. It then increased to about 23% in 2002. The prevalence dropped to 15% in

2007 and there have been no changes in the proportion of underweight children in 2007 and 2014 (Central Statistical Office (CSO) [Zambia] et al., 2014).

2.1.1 Factors Associated with Underweight

Factors such as food insufficiency, poor water and sanitation, and restricted access to high-quality primary care, all associated with household and community poverty lead to poor growth outcomes such as underweight. Children's growth is adversely affected by infection and suboptimal nutrition. However, interventions such as complementary feeding and diarrhoea case management can mitigate underweight (Stevens et al., 2012).

Age and Sex

The age and sex of the child has been argued to be associated with underweight levels. Studies have shown that male children are more likely to be underweight than their female counterparts (Babatunde et al., 2011, Kabubo-Mariara et al., 2008, Hien and Kam, 2008). A study on the prevalence and factors associated with child malnutrition by Safari et al (2015) in Tanzania found that compared to girls, boys are more likely to be underweight. This could probably be due to the increased attention paid to female children as compared to their male counterparts (Kishoyian et al., 2017). In addition, there is more energy expenditure in boys because of they tend to play more which may cause a higher prevalence of underweight in boys than girls (Nzala et al., 2011). It could also be that boys are more vulnerable to disease than girls which predispose them to being underweight. A study done in Hong Kong on gender disparities in pediatric hospital admissions shows a consistent excess of male admissions for most disease categories (Kam-lun and Nelson, 2006). Other studies however have not found any significant association between sex and underweight (Kishoyian et al., 2017; Habaasa, 2015).

In Zambia, the proportion of underweight children is highest among those aged 9-11 months at 17% and 18-23 months at 18% (Central Statistical Office (CSO) [Zambia] et al., 2014). Findings from nutritional studies have shown that there is an association between the age of the child and underweight. An investigation on factors associated with malnutrition among under-five children by Habaasa (2015) in Uganda reported that children aged 37–59 months were found less likely to be underweight than their counterparts who were aged 12 months. A study by Muchina and

Waithaka (2010) in Kenya found that underweight increased with age and was more prevalent among children aged 13 to 24 months of age. Similar finding have been noticed in studies done in Vietnam which suggest that underweight increases with age (Hien and Kam, 2008). This finding could possibly be associated with the fact that when children are weaned especially after exclusive breastfeeding in the first six months, some women go back to their work places and devote less time to the care of their children which then leads to underweight (Habaasa, 2015). It could also be as a result of increased interaction of the older child with the environment which may lead to increased exposure to childhood diseases either through consumption of contaminated foods, drinking water from unimproved sources or poor environmental sanitation (Akombi et al., 2017b).

Literature has shown maternal age to be associated with underweight. Akombi et al (2017a) found that mothers below the age of 20 years were associated with child underweight. Another study by (Nyaruhucha et al., 2006, Rikimaru et al., (1998) found that underweight children tended to have high percentage of younger or teenage mothers. Current literature indicates that there are concerns associated with adolescent maternal nutrition. Adolescent mothers have a particularly high risk of delivering premature and low birth weight babies (Wallace et al., 2004).During pregnancy physiological needs of pregnant adolescents are met first at the expense of the growing fetus. Impaired fetal nutrient supply results in inappropriate utero growth and reduced size at birth. This increases the risk of mortality and morbidity (Akombi et al., 2017a).

Nyaruhucha et al., 2006 argues that a young mother who is having a baby for the first time may experience breast-feeding difficulties, which may result into underfeeding of her child. Also, different socio-economic factors (such as low levels of education and occupational status) related to the age of the mother and her experience in raising children may affect child nutrition and health conditions. . These conditions may contribute to their being less financially secure and having poorer child-care practices. The high unemployment rate in adolescents may mean they have less or no income. This may lead to low quality and insufficient food for the household. However, other studies have found no significant association of maternal age with underweight (Gupta et al., 2016). The higher levels of underweight among children of mothers aged below 20 years clearly support the prevention of early marriage of females.

Maternal nutrition

Maternal nutrition and care practices have been demonstrated to be valuable factors in determining the child's nutritional status. Maternal nutrition is the main contributing factor to low birth weight, which is the first sign of underweight when a child is born. Studies have established maternal nutritional status to possess a significant association with underweight (Gupta et al., 2016). Other researchers also found Body Mass Index (BMI) to be associated with child underweight (Akombi et al., 2017a; Aheto et al., 2015; Babatunde et al., 2011).

According to Akombi et al (2017a) BMI is an important determinant of child underweight and is influenced by maternal nutrition, therefore proper nutrition for the mothers during the prenatal and postnatal period is essential in order to improve child growth. The prenatal causes of child suboptimal growth are closely related to maternal under nutrition, and are evident through low maternal BMI which predisposes the fetus to poor growth leading to intrauterine growth retardation; this in turn is strongly associated with small birth size and/or low birth weight. However, the effect of the prenatal causes of under nutrition can be addressed during the postnatal period through the introduction of appropriate child feeding practices and improved environmental conditions, which if not addressed could predispose a child to the postnatal causes of underweight such as low resistance to infection (Akombi et al., 2017a).

In addition, mothers as primary care-givers of their children safeguard the health of the child, are critical in promoting supportive feeding practices and play a pivotal role in child development. Poor feeding practices can adversely impact the health and nutritional status of children, which in turn has dire consequences for their mental and physical development. Nutritional knowledge is associated with underweight. A study by Gupta et al (2016) found that the prevalence of underweight was relatively low for mothers possessing high nutritional knowledge.

Breastfeeding practices

Breastfeeding plays a critical role in supporting children to minimize children who suffer from underweight. Globally an estimated 1.3 million lives are lost each year due to inadequate exclusive breastfeeding and another 600 thousand from lack of continuation of breastfeeding with proper complementary feeding (WHO/UNICEF, 2003). According to literature, there is an association between duration of breastfeeding and/or initiation of breastfeeding, child feeding

Practices and underweight. Studies found that the risk of underweight was significantly higher among children who received breastfeeding after 1 hour of birth as compared with children who received breast-feeding within 1 hour of birth (Meshram et al., 2015). Muchina and Waithaka (2010) found significant association between continuing breastfeeding for a child less than 24 months and underweight. Children who had discontinued breastfeeding were more than four times likely to be underweight compared to those continuing breastfeeding. In addition, children who had not been exclusively breastfed for six months were more than twice as likely to be underweight than those who had.

A study in India found risk factors for underweight were initiation of breastfeeding after six hours of birth, deprivation from colostrum and improper complementary feeding (Kumar et al., 2006). Bloss et al (2004) found having food introduced within the first 6 months of life were associated with underweight. For optimal growth, WHO recommends infants are exclusively breastfed for the first six months of life. Breastfeeding is also associated with lower incidence of child morbidity. This could be due to the immunological, hygienic and nutritional advantages of breastfeeding. In addition, improper infant and young child feeding cause one third of malnutrition. Studies have shown that inappropriate breastfeeding practices are associated with severe malnutrition in the under five children, lack any advantage in terms of weight gain and are associated with growth faltering (Onayade et al., 2003 cited by Muchina and Waithaka., 2010).

However, a study in Nigeria showed that children who had a prolonged period of breastfeeding of more than 12 months were more likely to be underweight and severely underweight compared with those who were breastfed for less than 12 months (Akombi et al., 2017b). Another study in Ghana found longer breastfeeding duration to be a risk factor for underweight (Aheto et al., 2015). This finding may be because mothers who prolong breastfeeding might not pay as much attention when introducing complimentary feeding.

Birth weight

Underweight is a problem that may be observed at birth. A child's low weight at birth is the first sign of child underweight and, if not addressed, puts the child at risk of morbidity and mortality. Meshram et al (2015) found that the probability of underweight was higher among low-birth-weight babies. Children who were perceived to be small at birth were more susceptible to being underweight compared with those perceived to be large (Akombi et al., 2017b; Aheto et al., 2015). Low birth weight babies have a higher probability for morbidity and mortality.

Child Illnesses

A study by Mgongo et al., (2017) found that child illness increased the odds ratio of the child being underweight. Another study done in Ghana and Zambia found having had diarrhoea to be associated with underweight (Aheto et al., 2015; Nzala et al., 2011). Bloss et al (2004) found diarrhoea and upper respiratory infection to be associated with child underweight. Blessings Akombi et al (2017a) found diarrhoea and fever to be positively associated with underweight. According to Dewey and Mayers (2011) infections are very common in the first 2 years of a child's life. Even when there are no obvious symptoms, physiological conditions associated with infections can impair growth by; suppressing appetite, impairing absorption of nutrients and increasing nutrient losses and diverting nutrients away from growth. It is therefore important to treat infections early to avoid the risks of child underweight.

Socio-economic factors

Many socio-economic factors may contribute to the problem of undernutrition. These may include mother's level of education, occupation, residence, and accesses to income. A research by Gupta et al (2016) in India evaluated the effect of various maternal factors on nutritional status of under-five children and found that underweight levels of under-five children reduced with increasing educational status of mothers. Most researchers have found mothers education to have a protective effect against underweight in children (Akombi et al., 2017a; Mgongo et al., 2017; Masibo and Makoka, 2012). A higher maternal education translates into greater health care utilization, including formal prenatal and postnatal visits (Akombi et al., 2017b). This could also be because educated mothers might have a better income and maternal education might be an essential factor in proper infant feeding practices (Mgongo et al., 2017).

Wealth index or socio economic status of the mother is associated with child underweight. Results from a study done on the trends in socioeconomic inequalities in child malnutrition in Vietnam by Kien et al (2016) showed that having a mother belonging to a lower socioeconomic status group were statistically associated with child underweight. Other studies done in Ghana and Zambia had similar findings of an inverse relationship between underweight and wealth status (Aheto et al., 2015; Masiye et al., 2010). This may be attributed to the fact that with less income to spend on proper nutrition, children with a low socio-economic status are more susceptible to growth failure due to insufficient food intake (Akombi et al., 2017b).

Type of residence has been cited in literature as a risk factor for child underweight. Some studies have shown a positive association between children living in rural areas and underweight. Studies that were done in India, Zambia and Vietnam found living in rural areas to be predictors of child underweight (Meshram et al, 2015; Masiye et al., 2010, Nguyen and Sin Hon, 2008). However, another study done in Zambia by Nzala et al (2011) found that children living in rural areas were less likely to be underweight. The significant difference of underweight between rural and urban areas can be explained by socio-economic variables, particularly household expenditure. Nguyen and Sin Hon, (2008) stipulates the difference may have occurred due to differences in economic level, and cultural and social security which results in poor accessibility to education and health services influencing child underweight.

Environmental factors such as; type of house, house structure, type of latrine and sources of water are associated to with underweight. A study by Nzala et al (2011) in Zambia found type of toilet to be associated with underweight. Another study by Babatunde et al (2011) established that access to clean water reduced the probability of child underweight. Furthermore, Bloss et al (2004) found being exposed to untreated water to be associated to underweight. This may be because most environmental factors are interrelated with socio economic status of the household which is a risk factor for underweight. In addition, poor access to sanitation predisposes children to water-borne diseases, such as diarrhoea which is associated with underweight. However, other researchers have found no association between environmental factors and underweight. A study done in Zambia found that access to safe drinking water and sanitation to be insignificant predictors for underweight (Masiye et al., 2010).

Current literature in Zambia on the risk factors associated with underweight, more specifically on the static status of underweight levels is limited. This research will therefore provide a better understanding on the topic by identifying the specific risk factors that are associated with static prevalence of underweight over the last two decades. Underweight is a composite form of stunting and wasting therefore identifying factors that contribute to underweight by implications enhances opportunities for reducing all three forms of under nutrition.

2.2 Conceptual Framework

Under weight is an indicator of the current under-nutrition status. Figure 1 presents an adaption of the UNICEF conceptual framework on malnutrition which epitomizes a general understanding of the different factors that affect underweight (Adamu et al., 2016). The framework identified three levels on causes of under nutrition; basic, intermediate and immediate factors. According to the conceptual model, basic factors include socioeconomic and environmental factors such as mother’s education status, employment status, mother’s age, household income and place of residence which may affect an individual either directly or indirectly. Intermediate factors may include maternal and child care factors or food security of the household. These factors in turn affect the immediate factors such as weight at birth, time of initiation of breast-feeding and duration of exclusive breast feeding and disease. The immediate factors directly influence the nutritional status of children which may lead to a child being underweight.

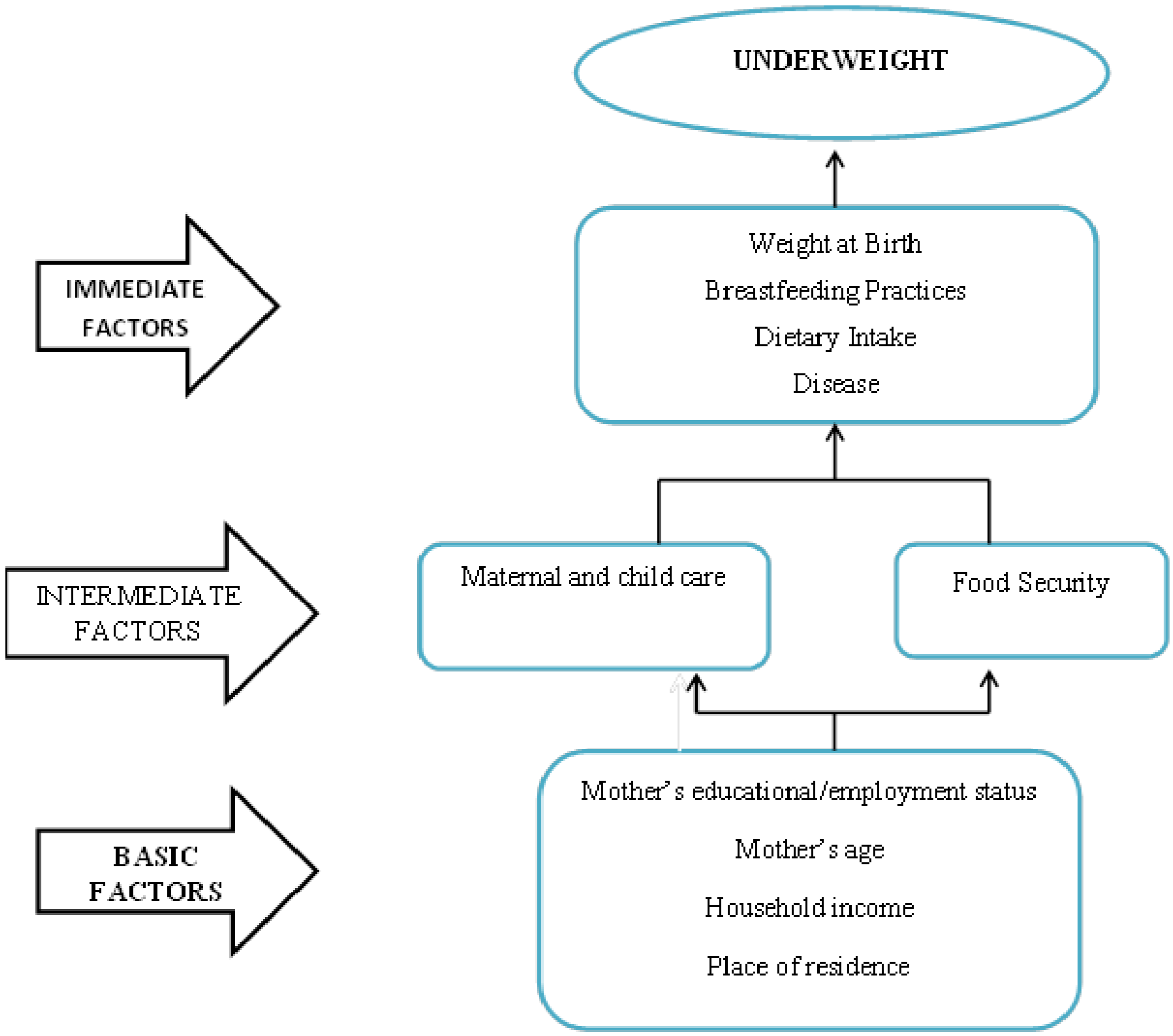

Figure 1: Conceptual Framework showing factors associated with underweight

Source: Adapted and modified from Adamu et al., 2016.

CHAPTER THREE: METHODOLOGY

3.1 Study Design

This was a cross sectional study using data from the last three Zambia Demographic and Health Survey's, which include 2001-2002, 2007 and 2013-2014. This study design was used because it simultaneously provided a snapshot of underweight and its associated risk factors.

3.2 Study Site and Population

The research setting for this study was Zambia because the study aimed to understand the overall static picture of underweight prevailing in the country. It currently comprises of 10 provinces (Central, Copperbelt, Eastern, Luapula, Lusaka, Muchinga, Northern, North Western, Southern, and Western). Zambia is a land-locked country in Sub-Saharan Africa. However, up until 2011, the country was divided into nine provinces and 72 districts. In line with this, the analysis comprised of the nine provinces for comparability among the different datasets. Of the ten provinces, two are predominantly urban, namely Lusaka and Copperbelt provinces. The remaining provinces are mostly rural provinces.

The research included all underweight children under the age of five that had valid and complete measurements of height and weight. Children who were below -3 standard deviations (SD) from the International Reference Population median (severely underweight) were also included in the study.

3.3 Sampling Method and Sample Size

The research was nested in the 2001, 2007 and 2014 ZDHS therefore the sampling design used was based on that of the ZDHS. The ZDHS uses a two-stage stratified cluster sample design, with Enumeration Areas (or clusters) selected during the first stage and households selected during the second stage. The final stage of selection involves the systematic sampling of households from a list of all households that was prepared for each of the selected SEAs. The sampling frame for the 2002 and 2007 ZDHS was adopted from the 2000 Census of population and Housing (CPH) of Zambia while that of the 2013-2014 from the 2010 CPH.

The analysis included total enumeration of all children <5 years of age whose weight and height/length measurements were taken and whose mothers were interviewed. Although problems related to poor nutrition affect the entire population, women and children are especially vulnerable because of their unique physiology and socioeconomic characteristics (CSO, 2014). In this study, the focus was on the static trend of underweight in children under the age of five.

The study included a complete analysis of data from responses of women who answered the study questions of interest in the 2001, 2007 and 2014 ZDHS. The 2001-2002 ZDHS study file included a sample of about 5784 under five children , the 2007 ZDHS study file included about 5602 under five children while the 2013-14 ZDHS study file included about 12, 328 under five children.

3.4 Data Collection

The ZDHS's are nationally representative population based cross sectional surveys of women and men in the reproductive ages. The questionnaire includes information such as background characteristics (age, education, literacy, etc.), reproductive history, fertility preferences, maternal health (antenatal, delivery, and postnatal care), breastfeeding and infant feeding practices, child immunization and childhood illnesses, child mortality, women's work, husbands' background characteristics and maternal mortality among other variables. Three questionnaires are used in the ZDHS: The Household Questionnaire, the Woman's Questionnaire, and the Man's Questionnaire. Information on children aged 0-5 is collected, including data on weight and height. The ZDHS collects data on a number of variables that have been found to be risk factors associated with underweight. This made it feasible to use the data for analysis to realize the study objectives. For this study, the child file was extracted from the ZDHS data set. The women's and household questionnaire were used to extract variables associated with underweight in under-five children as reported by women of child bearing age in the ZDHS.

3.5 Identification of Variables

As shown in Table 2 below, the following variables were extracted from the ZDHS using a checklist (Appendix 11). Underweight was defined according to WHO standards, that is a child whose weight for age was minus two (-2) standard deviations from the median weight of the reference standards for children of the same age and sex of the reference population.

Table 2: List of Variables

Type of Variable	**Variable**	**Measurement Scale**
Dependent Variable	Underweight	Binary
Independent Variables	Sex of the child	Binary
	Age of the child	Continuous
	Size of the child at birth	Ordinal
	Age of the mother	Continuous
	Mothers Education	Nominal
	Wealth Index	Ordinal
	Mothers work Status	Binary
	Residence	Binary
	Province	Nominal
	Source of drinking water	Binary
	Type of toilet facility	Binary
	Diarrhoea	Binary
	Fever	Binary

3.6 Data Analysis Plan

Data was analyzed using Stata version 15 (Stata Corp, College Station, Texas, USA). The ZDHS assigns weights to variables. Analysis was therefore weighted according to already existing weights of the surveys. Descriptive analysis was performed to summarize the basic demographic and socio-economic distribution of the data.

Pearson's Chi-Square test for trend was used to explore relationships between underweight and independent variables for categorical variables. T-test was used to test the association between the continuous variables categorised by underweight for normally distributed variables while Man-Whitney was used for those variables that were not normally distributed.

For inferential statistics, the data was firstly analyzed according to each survey year and then on the appended dataset (combination of the three survey years). Univariable and multivariable logistic regression was carried out on each survey year and on the appended dataset. Logistic regression was used because the outcome variable (underweight) was binary. Univariable logistic analysis was done to understand the relationship between the dependent variable (underweight) and each independent variable. Investigator led stepwise multiple logistic regression was carried out to determine the best fit model using the likelihood ratio test that explained the relationship between underweight and the demographic and socio-economic variables. Odds ratios, P-values and their 95% Confidence interval were reported.

3.7 Dissemination of Findings

The findings will be made available for publication in a peer reviewed journal as part of my academic contribution to the body of knowledge. A copy will be made available for the University of Zambia Public Health Library. The report will also be shared with relevant stakeholders such as UNZA, Ministry of Health, Nutrition Association of Zambia, and CSO among others.

3.8 Ethical Consideration

Ethical clearance to conduct the study was sought from University of Zambia Biomedical Research Ethics Committee (UNZABREC) and granted (REF. NO 034-06-17). The research was a low risk study that did not involve direct contact to human participants as it made use of secondary data. The datasets provided were already de-identified and cannot be linked to the original files as identifier numbers are used in place of actual names. Permission was obtained from CSO to use the 2001-2002, 2007 and 2013-14 ZDHS datasets. An information sheet was sent to CSO to explain the purpose of the study.

The datasets obtained were kept on a computer accessible only by a password. The dataset were kept safe from unauthorized access, accidental loss or destruction.

3.9 Limitations

The study did not assess all the potential factors that could explain the differences in prevalence of underweight largely because secondary data were used. Some factors found in literature such as type of foods, and nutritional knowledge was not collected in the ZDHS and was therefore not part of the analysis. Another limitation of the study was that data collected was for a specific point in time which does not guarantee it to be representative. Cause and effect are hard to establish as data on underweight and the risk factors were collected simultaneously.

Regardless of the limitations, a major strength of the study was that this was a nationally representative study therefore provides a national picture on underweight and forms a basis for policy dialogue. In addition, the sample size was large enough and therefore the study had enough power to for valid estimates.

CHAPTER FOUR: FINDINGS

4.1 Characteristics of Study Participants

The study had a pooled total of 26,735 under-five children. This total included 6,877 children from the 2001 survey, 6401 from the 2007 survey and the highest number of 13, 457 from the 2014 survey (Table 3). Table 3 shows the distribution of children under-five years of age in 2001, 2002 and 2014 ZDHS. There were slightly more male children under-five in 2001 (50.3%) and 2014 (50.7%) than female children while in 2007 there were slightly more females (50.3%) than male children. In 2001, there were more children aged 13-24 months (22.2%) followed by those aged 0-12 months (21.8%) while the age group 37-48 months had the least number of children (17.5%). In 2007, the age group 0-12 and 13-24 months had an equal number of children at 21.7% whereas the age group 37-48 and 49-60 months had an equal number of children at 18.5%. In 2014, there were more children aged 49-60 months at 20.7%, followed by those aged 13-24 months (20.3%). Over half of the children were of medium size at birth across the three surveys. In 2001, 20.5% children had diarrhoea two weeks preceding the survey, while in 2007 and 2014, 15.6% and 16.1% children below five years had diarrhoea respectively. About one-fifth of the children had fever two weeks preceding the survey in 2007 (17.7%) and 2014 (21.6%) while about 43.6% children had fever in 2001.

Across the three survey period, more people were predominantly living in rural than urban areas, 74.9% in 2002, about 67.6% in 2007 and 62.9% in 2014. The highest number of under-five children was found in Northern Province in 2001 (16.5%) and 2014 (20.7%) while in 2007, eastern province had the highest number (14.1%). Children from the richest wealth quintile represented the lowest proportion with about 13% in 2001 and 12.6% in both 2007 and 2014. In 2007, the highest number of children came from the middle wealth quintile while in 2014; they came from the poor wealth quintile (Table 3).

There were fewer mothers who had attained tertiary education in all the surveys, representing only 1.4% in 2001, about 2.3% in the 2007 survey and 3.5% in the 2014. The majority of the women across the survey years had attained primary education; 64.6% in 2001, 62.4% in 2007 and 55.6% in 2014. In 2001, there were more women aged 20-24 years (29.5%) while in 2007

Table 3: Distribution of background characteristics of underweight in under-five children in 2001, 2007 and 2014

Background Characteristic's	**2001 n(%)**	**P-value χ^2**	**2007 n(%)**	**P-value χ^2**	**2014 n(%)**	**P-value χ^2**
Sex of the child						
Male	3461(50.3%)	0.818	3181(49.7%)	<0.0001	6828(50.7%)	<0.0001
Female	3416(49.7%)		3220(50.3%)		6629(49.3%)	
Age of the child(months)						
0-12	1307(21.8%)	<0.0001	1268(21.7%)	<0.0001	2496(19.6%)	<0.0001
13-24	1329(22.2%)		1266(21.7%)		2580(20.3%)	
25-36	1175(19.6%)		1149(20.0%)		2518(19.8%)	
37-48	1051(17.5%)		1083(18.5%)		2490(19.6%)	
49-60	1135(18.9%)		1078(18.5%)		2630(20.7%)	
Size at birth						
Small	934 (13.6%)	<0.0001	721(11.4%)	<0.0001	1536(11.6%)	<0.0001
Medium	4247 (61.9%)		3551(56.2%)		7840(59.3%)	
Large	1678 (24.4%)		2050(32.4%)		3836(29.1%)	
Had Diarrhoea						
Yes	1228 (20.5%)	<0.0001	909(15.6%)	<0.0001	2045(16.1%)	<0.0001
No	4766 (79.5%)		4935(84.5%)		10653(83.9%)	
Had Fever						
Yes	2611(43.6%)	<0.0001	1034(17.7%)	<0.0001	2745(21.6%)	<0.0001
No	3383(56.4%)		4810(82.3%)		9944(78.4%)	
Residence						
Urban	1725 (25.1%)	<0.0001	2073(32.4%)	0.001	4998(37.1%)	<0.0001
Rural	5152 (74.9%)		4328(67.6%)		8459(62.9%)	
Province						
Central	796 (11.6%)	<0.0001	610(9.5%)	<0.0001	1171(8.7%)	<0.0001
Copperbelt	648 (9.4%)		623(9.7%)		1176(8.7%)	
Eastern	859 (12.5%)		902(14.1%)		1635(12.2%)	
Luapula	629 (9.2%)		715(11.2%)		1559(11.6%)	
Lusaka	637 (9.3%)		644(10.1%)		1181(8.8%)	
Northern	1135 (16.5%)		783(12.2%)		2780(20.7%)	
North-western	887 (12.9%)		713(11.1%)		1381(10.3%)	
Southern	664 (9.7%)		740(11.6%)		1488(11.1)	
Western	622 (9.0%)		670(10.5%)		1086(8.1%)	
Wealth Index						
Poorest	1994(28.1%)	0.001	1385(21.6%)	<0.0001	3199(23.8%)	<0.0001
Poor	1471(21.2)		1390(21.7%)		3215(23.9%)	
Middle	1486(21.3)		1467(22.9%)		3064(22.8%)	
Rich	1286(17.0)		1355(21.2%)		2282(17.0%)	
Richest	939(12.4)		804 (12.6%)		1697(12.6%)	
Mothers Education						
No education	1067 (15.5%)	<0.0001	844(13.2%)	<0.0001	1509(11.2%)	<0.0001
Primary	4445 (64.6%)		3997(62.4%)		7481(55.6%)	
Secondary	1272 (18.5%)		1415(22.1%)		3981(29.6%)	
Tertiary	93 (1.4%)		145(2.3%)		475(3.5%)	

Table 3 continued

Background Characteristic's	**2001 n(%)**	**P-value χ²**	**2007 n(%)**	**P-value χ²**	**2014 n(%)**	**P-value χ²**
Mothers age						
15-19	558(8.1%)	0.375	416(6.5%)	0.089	962(7.2%)	0.832
20-24	2026(29.5%)		1656(25.9%)		3215(23.9%)	
25-29	1810(26.3%)		1830(28.6%)		3497(26.0%)	
30-34	1168(17.0%)		1292(20.2%)		2804(20.8%)	
35-39	799(11.6%)		750(11.7%)		1856(13.8%)	
40-45	390(5.7%)		350(5.5%)		905(6.7%)	
45-49	126(1.8%)		107(1.7%)		218(1.6%)	
Mothers work status						
Yes	4197(61.1%)	0.776	3301(51.6%)	0.474	7752(57.8%)	0.004
No	2674(38.9%)		3100(48.4%)		5663(42.2%)	
Breastfeeding Practices						
0-12	760(11.3%)	<0.0001	614(9.9%)	<0.0001	793(6.4%)	0.006
13-24	3101(46.1%)		3078(49.6%)		6656(53.9%)	
25-36	380(5.7%)		300(4.8%)		493(4.0%)	
Still breastfeeding	2477(36.9%)		2209(35.6%)		4416 (35.7)	
Source of drinking water						
Unclean	5306(77.2%)	<0.0001	4854(75.8%)	<0.0001	7196(53.5%)	<0.0001
Clean	1571(22.8%)		1547(24.2%)		6245(46.5%)	
Type of toilet facility						
Improved	707(10.3%)	0.003	961(15.0%)	0.059	2756(20.5%)	<0.0001
Non-improved	6161(89.7%)		5440(85.0%)		10681(79.5%)	

X^2- Chi-square

and 2014 more women were aged 25-29 years (28.6% and 26% respectively). The least number of women were aged 45-49 years; 1.8% in 2001, 1.7% in 2007 and 1.6% in 2014. There were more mothers who worked than those who did not across the three survey years representing about 61.1% in 2001, about 51.6% in 2007 and 57.8% in 2014. 46.1%, 49.6% and 53.9% women breastfed their children up to 13-24 months in 2001, 2007 and 2014 respectively.

According to Table 3, the majority of households in the 2001 (77.2%) and 2007 (75.8%) and 2014 (53.5%) surveys had access to unclean drinking water. There were more households with non-improved toilet facilities, about 89.7% in 2001, 85% in 2007 and 79.5% in the 2014 survey.

Table 4 shows a cross tabulation of underweight in under-five children and background characteristics reporting p-values for chi square test for trends. The prevalence for underweight

Table 4: Cross Tabulation of underweight in under-five children and background characteristics of pooled data

Background Characteristic's	Not Underweight n(%)	Underweight n(%)	P-value χ^2
Residence			
Urban	7738(87.9%)	1058(12.1%)	<0.0001
Rural	15033(83.8%)	2906(16.2%)	
Province			
Central	2205(85.6%)	372(14.4%)	0.580
Copperbelt	2093(85.5%)	354(14.5%)	
Eastern	2939(86.5%)	457(13.5%)	
Luapula	2390(82.3%)	514(17.7%)	
Lusaka	2190(89.0%)	272(11.0%)	
Northern	5161(82.2%)	1137(17.8%)	
North-western	2425(87.1%)	360(12.9%)	
Southern	2430(87.4%)	350(12.6%)	
Western	938(86.4%)	148(13.6%)	
Wealth Index			
Poorest	3839(83.8%)	745(16.3%)	<0.0001
Poor	3981(86.5%)	624(13.6%)	
Middle	4008(88.5%)	523(11.5%)	
Rich	3270(90.0%)	367(10.1%)	
Richest	2330(93.2%)	171(6.8%)	
Source of drinking water			
Clean	15536 (89.0%)	3871(11.0%)	0.005
Unclean	14385 (85.9%)	4226(14.1%)	
Type of toilet facility			
Improved	4505(92.3%)	1251(7.7%)	0.925
Non-improved	9635(86%)	2446(14%)	
Sex of the child			
Male	11347(84.2)	2123(15.7)	<0.0001
Female	11424(86.1)	1841(13.9)	
Age of the child(months)			
0-12	2260(90.5%)	236(9.5%)	0.002
13-24	2198(85.2%)	382(18.8%)	
25-36	2119(84.2)	399(15.8%)	
37-48	2148(86.3)	342(13.7%)	
49-60	2286(86.9%)	344(13.1%)	
Size at birth			
Small	2685(89.6%)	821(10.4%)	<0.0001
Medium	13,247(84.7%)	2391(15.3%)	
Large	6763(78.3%)	748(21.7%)	

Table 4 continued: Cross Tabulation of underweight in under-five children and background characteristics of pooled data

Background Characteristic's	Not Underweight n(%)	Underweight n(%)	P-value χ^2
Had Diarrhoea			
No	17,330(84.8%)	3024(15.2%)	0.851
Yes	3246(77.6%)	936(22.4%)	
Had Fever			
No	15,584(85.6%)	2550(14.4%)	0.016
Yes	4982(78.0%)	1408(22.0%)	
Mothers age			
15-19	1640(84.7%)	296(15.3%)	0.693
20-24	5878(85.2%)	1019(14.8%)	
25-29	6086(85.3%)	1051(14.7%)	
30-34	4502(85.5%)	762(14.5%)	
35-39	2898(85.1%)	507(14.9%)	
40-45	1389(84.4%)	256(15.6%)	
45-49	378(83.8%)	73(16.2%)	
Mothers Education			
No education	2780(81.3%)	640(18.7%)	<0.0001
Primary	13,410(84.2%)	2513(15.8%)	
Secondary	5894(88.4%)	774(11.6%)	
Tertiary	676(94.8%)	37(5.2%)	
Mothers work			0.006
status	12,898(84.6)	1606(15.4%)	
Yes	9831(86%)	2352(14%)	
No			

was higher in rural areas as compared to urban areas and this association was statistically significant (p<0.0001). Underweight levels were highest in Northern Province at 17.8% followed by Luapula province at 17.7 %. Lusaka reported the lowest prevalence at 11%. However, this association was not statistically significant (p= 0.580) at provincial level.

Male children had a higher underweight prevalence of about 15.7% as compared to female children who had a prevalence of about 13.9% and this association was statistically significant at p<0.0001. Underweight prevalence was lowest for children aged 0-11 (9.5%) months and was highest for children aged 13-24 months (18.8%). Prevalence then decreased for children aged 25-36months (15.8%), 37-38 months (13.7%) and 39-60 months (13.1%). This association was statistically significant at p= 0.02.

Underweight levels were highest in children whose mothers were aged 45-49 years (16.2%), followed by those whose mothers were aged 40-45 years (15.6%). Prevalence for teenage mothers was 15-19 years (15.3%), however this association was not statistically significant at p= 693. Children whose mothers worked had a higher prevalence (15.4%) when compared to children whose mothers did not work (14%) and this association was statistically significant at p= 0.006.

4.2 Trends of Underweight

The study found that there was a statistically significant association between underweight and residence, wealth index, sex and age of the child, whether the child had a fever in the two weeks preceding the survey's, mothers education and work status using a chi square test for trends (Table 4).

4.3 Analysis of 2001, 2007 And 2014 Data

Table 5 shows unadjusted and adjusted determinants of underweight in under-five children in 2001. Taking into account other variables, a child who was aged 12-24 months was three times more likely [OR= 3.66, 95% CI (3.01-4.45), p <0.0001] to be underweight while a child aged 48 to 60 months was two times more likely [OR= 2.07, 95% CI (1.66-2.57), p <0.0001] to be underweight when compared to a child who was aged 0 to 12 months. A large sized child at birth was 57% less likely [OR= 0.43, 95% CI (0.35-0.53), p <0.0001] to be underweight while an average sized child at birth was 34% less likely [OR= 0.66 95% CI (0.56-0.78), p <0.0001] to be underweight when compared to a small sized child at birth when adjusted for background characteristics. A child who came from a home with a clean source of drinking water was 34% less likely [OR= 0.66, 95% CI (0.56-0.77), p <0.0001] to be underweight when compared to a child who had an unclean source of drinking water.

A child who had diarrhoea two weeks preceding the survey was 68% more likely [OR= 1.68, 95% CI (1.45-1.94), p <0.0001] to be underweight while a child who had fever two weeks preceding the survey was 39% more likely [OR= 1.39, 95% CI (1.23-1.58), p <0.0001] to be

Table 5: Determinants of underweight in under-five children of pooled data in 2001(Unadjusted and Adjusted odds ratio)

	UOR (95% CI)	P-value	AOR (95% CI)	P-value
Child age				
0-12	1		1	
12-24	3.78(3.12-4.58)	<0.0001	3.66(3.01-4.45)	<0.0001
24-36	2.79(2.29-3.41)	<0.0001	3.03(2.47-3.72)	<0.0001
37-48	1.92(1.55-2.37)	<0.0001	2.25 (1.81-2.79)	<0.0001
48-60	1.66(1.34-2.05)	<0.0001	2.07(1.66-2.57)	<0.0001
Size at birth				
Small	1		1	
Average	0.74(0.63-0.87)	<0.0001	0.66(0.56-0.78)	<0.0001
Large	0.54(0.44-0.64)	<0.0001	0.43(0.35-0.53)	<0.0001
Source of drinking water				
Unclean	1		1	
clean	0.69(0.60-0.80)	<0.0001	0.66(0.56-0.77)	<0.0001
Had diarrhoea				
No	1		1	
Yes	1.93(1.68-2.21)	<0.0001	1.68(1.45-1.94)	<0.0001
Had Fever				
No	1		1	
Yes	1.65(1.47-1.86)	<0.0001	1.39(1.23-1.58)	<0.0001

underweight than a child who did not have diarrhoea and fever respectively two weeks preceding the survey taking into account other background characteristics (Table 5).

Table 6 shows the unadjusted and adjusted determinants of underweight in under-five children in 2007. A female child was less likely to be underweight when compared to a male child by about 32% [OR=0.68, 95% CI (0.58-0.80), p<0.0001] when adjusted for other background characteristics. A child aged 24-36 and 48-60 months was two times more likely to be underweight than one aged 0-12 months [OR=2.02, 95% CI(1.54-2.64), p<0.0001] and [OR=2.07, 95% CI (1.57-2.72), p<0.0001] respectively.

When adjusted for background characteristic's, a large sized child at birth was 56% less likely [OR= 0.44, 95% CI (0.34-0.56), p<0.0001] to be underweight than a small sized child at birth. A child who had diarrhoea two weeks preceding the survey was 44% more likely [OR=1.44, 95% CI (1.16-1.77), p=0.001] to be underweight than one who did not have diarrhoea when adjusted for background characteristics while a child who had fever two weeks preceding the survey was

30% [OR= 1.30, 95% CI(1.06-1.58), p=0.01] more likely to be underweight than those who had no fever when adjusted for background characteristics as shown in Table 6.

Table 6: Determinants of underweight in under-five children of pooled data in 2007(Unadjusted and Adjusted odds ratio)

	UOR (95% CI)	**P-value**	**AOR (95% CI)**	**P-value**
Sex of the child				
Male	1		1	
Female	0.72(0.62-0.85)	<0.0001	0.68(0.58-0.80)	<0.0001
Child age				
0-12	1		1	
12-24	2.07(1.59-2.68)	<0.0001	1.96(1.51-2.55)	<0.0001
24-36	2.00(1.53-2.60)	<0.0001	2.02(1.54-2.64)	<0.0001
37-48	1.72(1.31-2.26)	<0.0001	1.80 (1.37-2.39)	<0.0001
48-60	1.91(1.45-2.50)	<0.0001	2.07(1.57-2.72)	<0.0001
Size at birth				
Small	1		1	
Average	0.60(0.48-0.74)	<0.0001	0.54(0.43-0.67)	<0.0001
Large	0.50(0.39-0.63)	<0.0001	0.44(0.34-0.56)	<0.0001
Source of drinking water				
Unclean	1		1	
clean	0.67(0.55-0.81)	<0.0001	0.65(0.53-0.79)	<0.0001
Had diarrhoea				
No	1		1	
Yes	1.51(1.24-1.83)	<0.0001	1.44(1.16-1.77)	0.001
Had Fever				
No	1		1	
Yes	1.42(1.18-1.72)	<0.0001	1.30(1.06-1.58)	0.011

Table 7 shows the unadjusted and adjusted determinants of underweight in 2014. A female child had a 21% reduced odds of being underweight [OR=0.79, 95% CI (0.70-0.87), p<0.0001] than a male child when adjusted for background characteristic's. A child aged 24 to 36 months was 86% [OR=1.86, 95% CI (1.56-2.22), p<0.0001] more likely to be underweight than a child aged 0 to 12 months while a child aged 48 to 60 months was 51% [OR=1.51, 95% CI (1.26-1.81)), p<0.0001] more likely to be underweight than a child aged 0 to 12 months when adjusted for background characteristics.

A medium sized child at birth was 46% [OR=0.54, 95% CI (0.47-0.63) p<0.0001] less likely to be underweight while a large sized child was 65% [OR=0.35, 95% CI (0.30-0.42), p<0.0001] less likely to be underweight when compared to a small sized child at birth when adjusted for

Table 7: Determinants of underweight in under-five children of pooled data in 2014(Unadjusted and Adjusted odds ratio)

2014	**UOR (95% CI)**		**AOR (95% CI)**	**P-value**
Sex of the child				
Male	1		1	
Female	0.83(0.75-0.92)	<0.0001	0.79(0.70-0.87)	<0.0001
Child age				
0-12	1		1	
12-24	1.66 (1.40-1.98)	<0.0001	1.61(1.35-1.92)	<0.0001
24-36	1.80(1.52-2.14)	<0.0001	1.86(1.56-2.22)	<0.0001
37-48	1.52(1.28-1.82)	<0.0001	1.59 (1.33-1.90)	<0.0001
48-60	1.44(1.21-1.72)	<0.0001	1.51(1.26-1.81)	<0.0001
Size at birth				
Small	1		1	
Medium	0.57(0.50-0.66)	<0.0001	0.54(0.47-0.63)	<0.0001
Large	0.36(0.30-0.42)	<0.0001	0.35(0.30-0.42)	<0.0001
Mothers education			1	
No education	1		0.86(0.73-1.01)	0.059
Primary	0.81(0.69-0.94)	0.005	0.78(0.64-0.94)	0.009
Secondary	0.59(0.50-0.70)	<0.0001	0.44(0.27-.0.74)	0.002
Tertiary	0.22(0.14-0.35)	<0.0001		
Wealth Index				
Poorest	1		1	
Poor	0.77(0.67-0.88)	<0.0001	0.79(0.69-0.91)	0.001
Middle	0.58(0.51-0.68)	<0.0001	0.58(0.49-0.68)	<0.0001
Rich	0.56(0.48-0.66)	<0.0001	0.53(0.43-0.65)	<0.0001
Richest	0.33(0.27-0.41)	<0.0001	0.36(0.28-0.49)	<0.0001
Residence				
Urban	1		1	
Rural	1.29(1.16-1.44)	<0.0001	0.75(0.65-0.87)	<0.0001
Type of toilet facility				
Unimproved	1		1	
Improved	0.64(0.56-0.74)	<0.0001	0.85(0.72-0.99)	0.039
Had diarrhoea				
No	1		1	
Yes	1.36(1.19-1.54)	<0.0001	1.30(1.13-1.49)	<0.0001
Had Fever				
No	1		1	
Yes	1.29(1.14-1.45)	<0.0001	1.14(1.01-1.30)	0.034

background characteristics. A child whose mother had tertiary education was 56 % less likely [OR=0.44, 95% CI (0.27-.0.74), p=0.002] to be underweight while a child whose mother had primary education was 14% less likely [OR=0.86, 95% CI (0.73-1.01), p=0.059] to be underweight when compared to a woman with no education when adjusted for background characteristics.

A child who came from a house with an improved toilet facility was 15% less likely [OR=0.85, 95% CI (0.72-0.99), p=0.039] than one who came from a house with unimproved toilet facility. A child who had was 30% more likely [OR=1.30, 95% CI (1.13-1.49), p <0.0001] to be underweight when compared to a child with who did not have diarrhoea. A child who had fever was 14% more likely [OR=1.14, 95% CI (1.01-1.30), p=0.034] to be underweight than a child who did not have a fever when adjusted for background characteristics as shown in Table 7.

4.4 Logistic Regression Analysis of Pooled Data

Results from the best fit model (Table 8) indicated that, taking into account other explanatory variables, a female child had 25% reduced odds of being underweight than their male counterparts [OR=0.75, 95% CI (0.69-0.82), p <0.0001]. Children who lived in rural areas had reduced odds of about 23% compared to those who lived in urban areas [OR=0.77, 95% CI (0.68-0.89) p <0.0001]. A child who was of medium size and large size at birth was 46% less likely [OR=0.54, 95%CI (0.48-0.61), p <0.0001] and 62% less likely [OR=0.38, 95% CI (0.33-0.44) p <0.0001] to be underweight when compared to those that were small at birth.

The odds of being underweight reduced as the level of education and wealth index increased. Children whose mothers had primary education were 14% less likely to be underweight than those with mothers who had no education [OR=0.86, 95 %CI (0.75-0.97), p=0.02] while those who had tertiary education were 59% less likely to be underweight [OR=0.41, 95% CI (0.27-0.64), p <0.0001] than children whose mothers had no education. Children who came from the poor wealth index had the highest odds [OR=0.82, 95% CI (0.73-0.93), p=0.002] of being underweight when compared to those from the poorest wealth index. On the other hand children from the richest wealth index had the lowest odds [OR=0.40, 95%CI (0.32-0.50), p <0.0001] of being underweight when compared to those from the poorest wealth index as shown in Table 8.

Table 8: Determinants of underweight in under-five children of pooled data (Crude and Adjusted odds ratio)

	UOR (95% CI)	P-value	AOR (95% CI)	P-value
Sex of the child				
Male	1		1	
Female	0.86(0.81-0.92)	<0.0001	0.75(0.69-0.82)	<0.0001
Child age				
0-12	1		1	
13-24	2.30(2.06-2.59)	<0.0001	1.71(1.48-1.98)	<0.0001
25-36	2.10(1.86-2.35)	<0.0001	1.90(1.64-2.20)	<0.0001
37-48	1.65(1.46-1.86)	<0.0001	1.65 (1.42-1.92)	<0.0001
49-60	1.57(1.39-1.78)	<0.0001	1.64(1.42-1.91)	<0.0001
Size at birth				
Small	1		1	
Medium	0.63(0.57-0.69)	<0.0001	0.54(0.48-0.61)	<0.0001
Large	0.42(0.38-0.47)	<0.0001	0.38(0.33-0.44)	<0.0001
Mothers education				
No education	1		1	
Primary	0.81(0.74-0.90)	<0.0001	0.86(0.75-0.97)	0.020
Secondary	0.57(0.51-0.64)	<0.0001	0.72(0.62-0.84)	<0.0001
Tertiary	0.24(0.17-0.33)	<0.0001	0.41(0.27-0.64)	<0.0001
Wealth Index				
Poorest	1		1	
Poor	0.81(0.72-0.91)	<0.0001	0.82(0.73-0.93)	0.002
Middle	0.67(0.60-0.76)	<0.0001	0.67(0.59-0.76)	<0.0001
Rich	0.58(0.51-0.66)	<0.0001	0.55(0.46-0.65)	<0.0001
Richest	0.38(0.32-0.45)	<0.0001	0.40(0.32-0.50)	<0.0001
Residence				
Urban	1		1	
Rural	1.41(1.31-1.52)	<0.0001	0.77(0.68-0.89)	<0.0001
Had diarrhoea				
No	1		1	
Yes	1.65(1.52-1.79)	<0.0001	1.33(1.18-1.50)	<0.0001
Had Fever				
No	1		1	
Yes	1.73(1.60-1.85)	<0.0001	1.19(1.07-1.32)	0.0001

Table 8 also showed that children aged 12- 24, 25-36 and 49-60 months had increased chances of being underweight when compared to those aged 0-12 months [OR=1.71, 95% CI (1.48-1.98), p <0.0001] , [OR=1.90, 95% CI (1.64-2.20)), p <0.0001] and [OR=1.64, 95% CI (1.42-1.91) p <0.0001] respectively. Children who had fever and diarrhoea were 19% [OR=1.19, 95% CI

(1.07-1.32), P-0.0001] and 33% [OR=1.33, 95% CI (1.18-1.50), p <0.0001] more likely to be underweight when compared to those without fever and diarrhoea. Table 8 shows that the best fit models with statistically significant factors were residence, sex, and wealth index, age of the child, education, diarrhoea and size at birth.

CHAPTER FIVE: DISCUSSION

The results of this study indicate that demographic (age, sex) and socio economic factors (mothers education, wealth index, size at birth) and illnesses were associated to a child being underweight. The prevalence of underweight in under-five children decreased in 2007 from 2002 and slightly increased in 2014 from 2007. Children in 2007 had 6% reduced odds of being underweight than in 2014. This implies that a child was more likely to be underweight in 2014 than in 2007. The decrease in the prevalence of underweight in 2007 from 2002 by almost 50% may be attributed to the efforts made to achieving the first Millennium Development Goal, in particular, eradicating extreme poverty and hunger by 2015.One of the targets of the first goal was to halve between 1990 and 2015, the proportion of people who suffer from hunger and the indicator for monitoring this progress was the prevalence of underweight children below the age of five years (UNICEF, 2014).

In keeping with global concerns, Zambia has made efforts to reduce underweight. According to the Zambian living conditions, a number of interventions to improve the health of children were scaled up between 2006 and 2010. These interventions include promotion of breastfeeding, frequency of feeding complimentary foods and immunisations (CSO, 2012). It is likely that this focus may have contributed to the reduction in underweight among children below the age of five years in Zambia (CSO, 2012). It is difficult however to explain the slight increase in the prevalence of underweight in 2014 from 2007 because there has been an increase in nutrition interventions to promote maternal and child health nutrition. The scaling up nutrition program which started in 2010 has put in place 14 interventions to support pregnant women and children under two in an effort to reduce underweight(NFNC, 2011).

The decrease in 2007 and slight increase in the odds of a child being underweight might also suggest that the problem of underweight may be influenced by conditions present in the environment of the child that need to be addressed. For example, if a child lives in an unsanitary environment, he/she may suffer from diarrheal diseases which in turn may predispose a child to being underweight. This can be seen from the drop in diarrhoea cases from 20% in 2002 to 16% in 2007 and were static at 16% in 2014 (CSO, 2002, 2007, 2014). This may then suggest that the static nature of underweight may be due to prevailing environmental conditions which if not addressed underweight levels might increase or remain static.

The current study showed that an increase in the education level of the mother reduced the odds of an under-five child being underweight. This finding is similar with that of other studies (Gupta et al., 2016, Kien et al., 2016, Nzala et al., 2011, Olusanya et al., 2010) The effect of higher levels of education or literacy decreased the odds of underweight in children. This may suggest better employment opportunities which then translate to better income. An income improves the socio-economic standing of the household leading to improved nutrition. It might also be that mothers with a higher level of education have more nutritional knowledge which improved nutritional outcomes of the child.

An inverse association between wealth status of the mother and underweight levels was observed in the current study. Similarly, another study conducted in Zambia found poverty to be associated with child underweight (Masiye et al., 2010). These findings are consistent with what was found in Ghana (Aheto et al, 2015) and Kenya (Kien et al, 2016; Masibo and Makoka, 2012). Mothers with a lower wealth status had higher odds of having underweight children than those of a higher wealth status. This may be attributed to the low quality and insufficient food intake, poor living conditions, greater exposure to diseases, and inadequate or complete lack of access to basic health services for poor households (Aheto et al, 2015). Underweight can be relatively easy to correct just by providing appropriate feeding practices (Kien et al, 2016), as long as there are no underlying environmental factors that may affect the health of the child.

Similarly to findings by Nzala et al 2011, this study also found that children who lived in the rural areas of Zambia had decreased odds of being underweight when compared to children who lived in urban settings. This might be due to the fact that rural settings in Zambia are predominantly agricultural communities and might therefore have easier access to more nutritious food than households in urban settings. In addition, there has been an increase of rural-urban migration in Zambia leading to overcrowding in urban settings (CSO, 2012). Most peri-urban areas in Zambia have poor sanitation and unclean drinking water which other studies have found to be associated with underweight (Babatunde et al ., 2011, Bloss et al., 2004). Coupled with the high unemployment rates where households do not have assured incomes, poor living conditions in urban areas could result in poor food security for the households. This may lead to children receiving poor quality foods and consequently being underweight.

In this study, male children had higher chances of being underweight when compared to female children. This is similar to findings in Tanzania and Zambia, where it was indicated that boys had greater chances of being underweight than girls (Safari et al., 2015; Nzala et al., 2011). Other studies have found no statistical associations between gender and underweight (Kishoyian et al, 2017, Meshram et al, 2015). It is suspected that male children are more influenced by environmental stress than female children (Mandefro et al, 2015). Female children are less likely to be underweight because they may have easier access to food in the household. Zambian culture demands that female children help their mothers in the preparation of food, therefore giving them access to more food while male children wait to be served. Nzala et al (2011) argued that male children eat with a father which may mean fewer meals than a female child who is always with a mother. The mother may pass on to the female child whatever left-over food is available in the household. Male children also tend to engage in higher intense physical activities than their female counterparts thereby using up large amounts of energy meant for proper growth and development (Akombi et al., 2017a, Nzala et al., 2011). Generally, female children are culturally expected to perform lower intense physical activities which includes staying at home with their mothers near food preparation thereby conserving and channeling more energy to growth and development.

The size of the child at birth was significantly associated with whether a child was underweight or not and this was a constant factor across the three surveys. An average sized child at birth had the lowest odds; this was followed by a large child at birth while a small sized child at birth had the highest chance of being underweight. According to Mgongo et al (2017), low birth weight is usually caused by poor maternal health nutrition during conception or pregnancy. Studies have shown that micronutrient supplementation with iron and folic acid reduces the risk of low birth weight and helps reduce underweight (Mgongo et al., 2017). This is in line with different studies that have shown that a child who is either low or high birth weight may experience nutritional problems and is more prone to morbidity and mortality (Masibo and Makoka, 2012).

As observed in other studies (Habaasa et al., 2015, Hien and Kam, 2008), our study found that children aged 37-48 months were less likely to be underweight than their counterparts who were aged 12-24 months. Muchina and Waithaka (2010) also found that underweight increased with age and was more prevalent among children aged 13 to 24 months of age. The increased odds of a child being underweight as they grow can be explained by the information that most mothers wean their children by one year. This finding could possibly be associated with the fact that when children are weaned especially after exclusive breastfeeding in the first six months, some women go back to their work places and devote less time to the care of their children which then leads to underweight (Habaasa, 2015). It could also be as a result of increased interaction of the older child with the environment which may lead to increased exposure to childhood diseases either through consumption of contaminated foods, drinking water from unimproved sources or poor environmental sanitation (Akombi et al., 2017b).

Child illness that is having had a fever or diarrhoea in the two weeks preceding the survey showed a significant positive association with underweight. Current literature explains that infections can suppress appetite and directly affect nutrient metabolism, leading to poor nutrient utilization. This is common in illnesses such as diarrhoea and fever which are associated with underweight in children (Mgongo et al., 2017, Bloss et al., 2015, Tumwine et al., 2002). In the current study, diarrhoea and fever were associated with underweight. However, temporal sequence, criteria for causality is difficult to establish because of the type of study.

CHAPTER SIX: CONCLUSION AND RECCOMENDATION

6.1 Conclusion

Under-nutrition is a common rife among children in Zambia and contributes to the high mortality and morbidity rates. It is therefore important to study the determinants associated with underweight, an indicator of undernutrition so as to have evidence driven interventions that will help curb it. The study identified that the likelihood of underweight in under-five children increased slightly in 2014 when compared to 2007 regardless of the static underweight prevalence.

The study also established that mothers with higher education, from the richest wealth index, an average sized child at birth and residing in rural area were protective factors for underweight in children. On the other hand, the higher the number of children who are under five living with the number, having had diarrhoea and fever was a disadvantage to the child as this promoted being underweight. These findings support the nutritional interventions that target disadvantaged groups and areas as a strategy to improve child nutrition. Success in managing underweight levels can therefore be achieved through strategies that focus on the demographic and socio-economic factors determinants that have an effect on underweight while diseases such as diarrhoea and fever.

6.2 Recommendations

The findings from this study have important implications for health policy and the interventions that can be put in place to reduce underweight in Zambia. Reducing underweight inevitably reduces stunting and wasting levels as it is a composite form of the two. It is imperative therefore to educate the public of the findings of in this paper and come up with practical and sustainable policies to help curb underweight in under-five children in Zambia. The study therefore recommends;

1. There is need for improved access to services that capture children early before they are underweight. These interventions include growth monitoring and promotion which identify children who are underweight and provide them with targeted support.

2. Care givers should be supported to ensure that sick children particularly those with diarrhoea and fever are treated early before they lose weight and become underweight.
3. To help improve the size of the child at birth, it's important that expectant mothers attend antenatal sessions where they are counseled on the importance of maternal nutrition and the effect of on their nutritional status of the child.

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APPENDICES

Appendix 1: Permission Letter

The Data manager,
Central Statistical Office,
P.O. Box 31908,
Lusaka, Zambia.

25th March 2017.

The University of Zambia,
School of Public Health,
P.O Box 50110,
Lusaka, Zambia.

Dear Sir/Madam

Re: PERMISSION TO HAVE ACCESS TO THE 2001-2002, 2007 AND 2013-2014 ZAMBIA DEMOGRAPHIC HEALTH SURVEY (ZDHS) DATA SET.

I am a postgraduate student currently pursuing a Master's of Science in Epidemiology and Biostatistics at the University of Zambia under the School of Public health. I am carrying out an academic research on the trends and determinants of underweight in under-five children in Zambia using evidence from the 2001-2002, 2007 and 2013-2014 ZDHS.

Purpose of the study

The study will therefore investigate the risk factors associated with underweight in Zambia which have been static over the last ten years. The findings will help with the reviewing and designing of new and targeted/appropriate nutrition policies and programs/projects aimed at reducing levels of under nutrition.

Benefits and Risks

The study will be able to add to the existing body of knowledge on underweight which will help policymakers come up with the evidence based interventions. The study poses no harm to participants or the institution and data is de-identified. The analysis however will validate the data which may identify some errors, inconsistencies and missing values.

Dissemination of findings

The findings of the research will be shared with the University of Zambia and relevant stakeholders such as Ministry of Health, CSO and UNICEF among others. The report will also be made available for publication as part of my academic contribution to the body of knowledge.

In line with the above, I am requesting for access to the 2001-2002, 2007 and 2013-2014 datasets. The datasets will be kept as encrypted files on a computer accessible only by a password. Although the datasets may be shared with the research team, it will be kept safe from unauthorized access, accidental loss or destruction.

Your positive and timely response will be highly appreciated.

Yours Faithfully,

Nakawala Tamika S

Computer #: 2016144740.

Appendix 11: Data Extraction Tool

The child file will be extracted from the ZDHS using Stata and the following variables will be pulled out from the dataset.

No	Variables	Questions from ZDHS questionnaire	Response expected	Number of respondents
1	Underweight	Weight for age		
2	Sex of the child	How many sons or daughters live with you?	Sons, Daughters	
3	Age of the child		Yes or No	
4	Size of the child at birth	What size was your child at birth	Very small, small. Average, large, very large	
5	Age of the mother	How old were you at your last birthday?	Age in years Categorized in the dataset into five year age groups/	
6	Mothers Education	Have you ever attended school? What is the highest level of school you attended?	Primary, secondary, or higher?	
7	Wealth Index	Wealth index as described by ZDHS dataset	Wealth index factor score.	
8	Mothers work Status	Do you work	Yes No	
9	Residence	Categorized in the dataset	Urban Rural	
10	Province	Categorized in the dataset		
11	Source of drinking water	What is the main source of drinking water for members of your household?	Piped water, Tube well or borehole dug well,	

			Protected well unprotected well ,water from spring, rainwater, tanker truck, cart with small tank, surface water, bottled water	
12	Type of toilet facility	What kind of toilet facility do members of your household usually use? (	Flush or pour flush toilet , flush to piped sewer system , flush to septic tank, flush to pit latrine, flush to somewhere else, flush, don't know where, ventilated pit latrine, improved pit latrine, pit latrine with slab, pit latrine without slab/open pit, composting toilet, bucket toilet, hanging toilet/hanging latrine, no facility/bush/field	
13	Diarrhoea	Did the child have diarrhoeas in the last two weeks preceding the survey?	Yes No	
14	Fever	Did the child have diarrhoeas in the last two weeks preceding the survey?	Yes No	