FACTORS ASSOCIATED WITH STUNTING AMONG CHILDREN BELOW FIVE YEARS OF AGE IN ZAMBIA: EVIDENCE FROM THE 2014 ZAMBIA DEMOGRAPHIC AND HEALTH SURVEY

By

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DECLARATION

I hereby do declare that the work presented in this report is for the award of Master of Public Health in Population Studies and has not been presented wholly or in part for any other degree nor is it being submitted for any other course.

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CERTIFICATE OF APPROVAL

The University of Zambia approves this dissertation of Bubile Mzumara as fulfilling part of the requirements for the award of the degree in Master of Public Health in Population Studies.

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ABSTRACT

Stunting continues to be a major public health problem globally. Stunting is a manifestation of many factors including inadequate food intake and poor health conditions. However, poor quality nutritional diets during pregnancy, infancy and early childhood lead to inadequate nutrient intake. The prevalence of stunting at 40% remains unacceptably high in Zambia. To better understand factors contributing to the high stunting levels, the 2013/14 Zambia Demographic and Health Survey (ZDHS) data was analysed in order to identify factors that are associated with stunting. Data was extracted using a data extraction tool and analysed using Stata version 13. Sample data of 12, 328 children aged 0-59 months was analysed. Logistic regression was used to analyse risk factors of stunting. From the 4,937 children who were stunted, stunting was higher in male children than female children (42.4% and 37.6% respectively). Other analysis revealed that children whose source of drinking water was piped (33.7%) were less likely to be stunted compared to children whose source of drinking water was from a river/spring (47.7%). The study further showed that stunting was associated with factors such as sex and age of a child, mother's education and age, residence, wealth, source of drinking water and duration of breastfeeding at 95% CI and $p<0.05$. For instance, mother's level of education had an inverse relationship with stunting. Children whose mothers had higher education were 0.35 times less likely to be stunted compared to those whose mothers had no education (AOR=0.35, 95%CI: 0.22, 0.54; $p<0.05$). Similarly, wealth status also showed an inverse relationship. Children who came from rich households were 0.67 times less likely to be stunted compared to those who came from poor households (AOR=0.68, 95%CI: 0.57, 0.82; $p<0.05$). The study determined that the major predictors of stunting among children under five years old in Zambia were sex and age of the child, mother's age and level of education, wealth status, source of drinking water, duration of breastfeeding and residence. Measures targeted at reducing child stunting should, therefore not be taken in isolation but should include a multidimensional approach to influence policy and programmes.

DEDICATION

To the Lord God almighty who is my strength and tower of refuge. To the living memories of my late father Mr. D Mzumara that encouraged and inspired me. To my beautiful family, Mrs. Mzumara and all my siblings, I am filled with heartfelt gratitude for the love and support you showered me with during my studies.

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ABREVIATIONS

BMI	Body Mass Index
CSO	Central statistics office
HAZ	Height-for-Age Z-score
HIV	Human Immuno Virus
SUN	Scaling up Nutrition
UN	United Nations
UNICEF	United Nation International Children Fund
UNZA	University of Zambia
WHO	World Health Organization
ZDHS	Zambia Demographic Health Survey

CHAPTER ONE

INTRODUCTION

1.1 Background

Stunting continues to be a major public health problem worldwide. Globally, about 161 million children under age of five years are stunted, 51 million do not measure enough for their height (wasted), and are not in healthy state (UNICEF/WHO/World Bank, 2012). Although the prevalence of stunting has globally declined from 165 million to 161 million children under age of five, overall progress is insufficient and many children under the age of five are still at risk (Black et al, 2013). The prevalence of stunting is highest mostly in developing countries, that is, in Asia and Africa where stunting is more prevalent than underweight or wasting. According to UNICEF (2013), 40 percent of children in Eastern and Southern Africa under five years of age are stunted. Zambia has not been spared from this problem. According to the recent Zambia Demographic and Health Survey, it was reported that 40 percent of children under age five are stunted with Northern Province having the highest prevalence at 49 percent (CSO, 2014).

Stunting is a consequence of long term and cumulative inadequacies of health and nutrition (Deshmukh, 2013). A child is considered 'stunted' if his or her height is more than two standard deviations below the World Health Organization standard (WHO Multicentre Growth Reference Study Group, 2006). In other words it is referred to as low-height-for- age (HAZ) less than minus two standard deviations of the WHO growth standard. Table 1 below shows the average heights of normally growing children.

Table 1: Average height of normally growing children

Age	**Boys**	**Girls**
Birth	51 cm	50 cm
6 months	68 cm	67 cm
1 year	76 cm	73 cm
2 years	88 cm	85 cm
3 years	95 cm	95 cm
4 years	103 cm	103 cm
5 years	110 cm	108 cm

Source: http:// www.webhealthcentre.com (WHO growth standards)

Poor quality nutritional diets during pregnancy, infancy and early childhood lead to

inadequate nutrient intake. It is important to note that stunting may be as a result of chronic restriction of a child's potential growth brought about by inadequate food intake and poor health conditions. Furthermore, poor socioeconomic conditions and increased risk of frequent exposure to certain conditions, such as illness or inappropriate feeding practices may give rise to high levels of stunting (Chirande et al, 2015). Therefore, adequate intake of nutrients is essential for growth and mental development and long term health. Therefore, stunting can be used as an indicator for evaluating nutritional status of young children.

Dewey and Begum (2011) argue that many families, health workers and policy makers are unaware of the consequences of stunting such that it may not be viewed as a public health problem. Consequences of stunting include short adult height, affects health and affects economic development over time (Dewey and Begum, 2011). Stunting has long-term effects on individuals and societies, including: diminished cognitive and physical development, reduced productive capacity and poor health, and an increased risk of degenerative diseases such as diabetes (UNICEF, 2013). For instance, short adult height among women has an impact on the health and survival of their children while for men it may even result in poor economic productivity. According to Devin (2016) stunted children are more vulnerable to disease, tend to do poorly in school, and earn less as adults than their well-nourished peers. For some reasons stunting may be deemed normal and may even go unrecognised especially in communities where short stature is common. For this reason stunting generally does not receive the same attention as underweight or wasting (low weight for height), especially if height is not routinely measured.

Although stunting levels remain unacceptably high in Zambia, there is limited information to explain why levels continue to be high. Stunting is underlined by numerous factors. To contribute to the understanding of the problem of stunting, this study took advantage of the Zambia Demographic and Health Survey data base. The data was obtained to investigate factors that may be responsible for the high levels of stunting in the country.

1.2 Statement of the Problem

Stunting remains a major public health concern especially in Zambia. In developing countries, stunting is more prevalent than underweight (low weight for age, 20%) or wasting (low weight for height, 10%) possibly because height gain is even more sensitive to dietary quality than is weight gain (Dewey, 2011). However, there is limited information on factors associated with stunting. There is also little known that explains why some locations have

higher stunting levels than others. According to the Zambia Demographic Health Survey, 40 percent of children under the age of five years are stunted. Figure 1 below shows the trends of stunting in Zambia among children under five years old from 1992 to 2014. The prevalence of stunting showed an increase but after 2001/02 it started to decline. Despite the slight decline in the prevalence of stunting it remains unacceptably high.

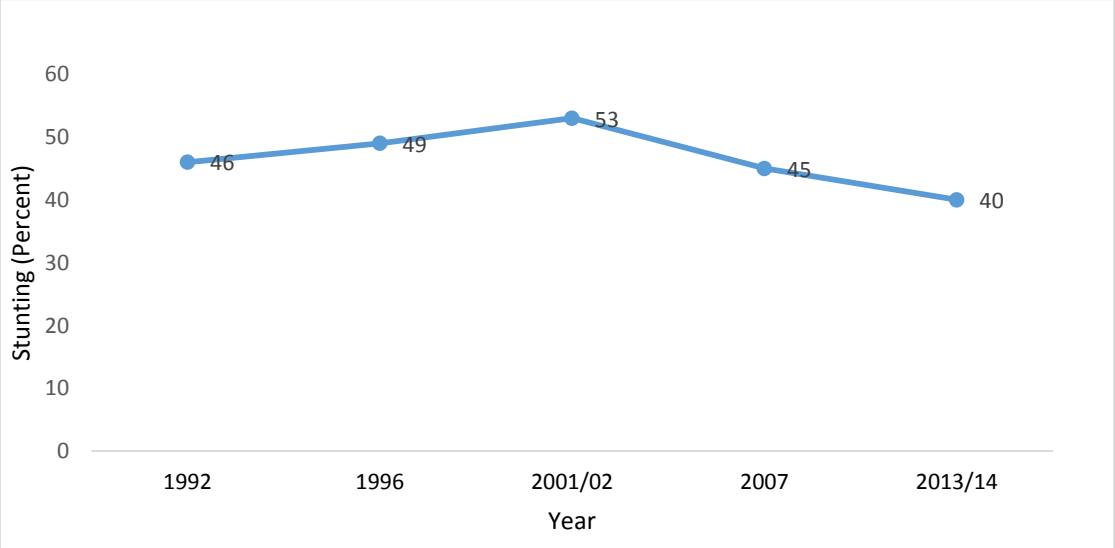

Figure 1: Trends in Stunting in Children under five in Zambia, 1992-2014, *CSO 2014*

The government has put in place measures to address the high levels of stunting through child nutrition programmes and Policies such as National Food and Nutrition Strategic Plan. Some of these nutrition programmes include infant and young child feeding, management of acute malnutrition, micronutrient deficiency control and hygiene, water and sanitation. UNICEF supports programmes dealing with stunting which include adequate maternal nutrition during pregnancy and lactation, early initiation of breastfeeding, exclusive breast feeding for the first six months, continued breastfeeding and adequate complementary feeding from 6 to 24 months, and increased micronutrient intakes during the critical 1,000 days (http://www.unicef.org/zambia/publications). Despite the commitments, stunting still remains considerably high among children aged under five years in Zambia considering WHO standard. WHO classification for assessing the severity of malnutrition (stunting) by prevalence ranges from 20 percent as being low and 40 percent which is classified as very high (WHO, 2006).

Factors associated with stunting range from social to economic and demographic. These factors are not adequately explained to shed light on why Zambia still has the high levels of stunting. Considering the many implications that stunting may have on children and nations

there is need for further research. Therefore, this study identified factors that are associated with stunting in Zambia so as to get a better understanding of the phenomenon.

1.3 Justification

Stunting is still a burden in Zambia especially among children under five years. A better understanding of which factors influence stunting is important. In Zambia, information about factors associated with stunting at is still limited. Zambia continues to have a high stunting prevalence level in the last ten years and still remains affected by undernutrition. There may be unexplained determinants that affect child's stunting risk. Therefore, it is of importance to understand why stunting prevalence levels are still high in the country. Further research to examine factors associated with stunting is critical to addressing the problem. Therefore, the study will contribute to more effective policy responses to reduce stunting and improve programmes to better prevent stunting and support stunted children. Furthermore, as an academic study it is expected to contribute to the existing body of knowledge about stunting. It is hoped that the findings from this study will be able useful towards informing, reshaping and redesigning new interventions to reduce stunting.

1.4 Objectives

1.4.1 Research Question

What factors are associated with stunting among children below the age of five in Zambia?

1.4.2 Objectives

General Objective

To explore factors associated with stunting among children below age of five years in Zambia.

Specific Objectives

1. To determine the relationship between socio-demographic characteristics and under five stunting.
2. To investigate the relationship between socio-economic characteristics and stunting.
3. To assess environmental characteristics in relation to child stunting.

CHAPTER TWO

LITERATURE REVIEW

2.1 Literature Review

Stunting (low height for age) is also referred to as chronic undernutrition and is of particular concern due to its many problems. Although it is preventable, it is irreversible if not corrected within the first two years of life. The developing world continues to face a number of challenges including a harsh health reality which may impact nutrition. Furthermore, global pressures such as climate change, transitioning diets, population growth, urbanization, communicable and non-communicable disease threats, continuing poverty and humanitarian crises may have a direct or indirect effect on nutrition which impacts stunting. Therefore, this means that good nutrition, particularly in infancy, is now more important than ever (UNICEF, 2014).

The international community now places more emphasis on stunting as the indicator of choice for measuring progress towards reducing undernutrition (UNICEF, 2013). With this knowledge The World Health Assembly, which is the decision making body of the World Health Organization (WHO), agreed on a new target: reducing the number of stunted children under the age of five by 40 percent by 2025. The UN Secretary-General has included elimination of stunting as a goal in his Zero Hunger Challenge, launched in June 2012. The emphasis on stunting has led to reviews of national programmes and strategies. The initiation of the SUN movement in 2010 brought about much-needed change. The SUN movement seeks to build national commitment to accelerate progress to reduce stunting and other forms of undernutrition, as well as overweight.

Problems due to stunting include irreversible damage to growth, development and cognitive abilities. Stunted children are more likely to start school later and drop out, and are less able to learn due to compromised brain and mental development at a young age (UNICEF, 2012). Childhood stunting leads to a reduction in adult size which in turn may have an impact on economic activity through reduced work capacity. These consequences have an impact later in life and on the national economic status. For instance, it is estimated that stunting can reduce a country's gross domestic product by up to three percent (World Bank, 2006). Studies have shown that a one percent increase in height is associated with a 2.4 percent increase in wages (Thomas, 1997 & Hunt, 2005). Compounded over an entire lifetime,

malnutrition can reduce a child's earning potential by as much as 10 percent (ibid; 1997, 2005).

Stunting is associated with increased morbidity and mortality from infections, in particular pneumonia and diarrhoea (Kossmann et al., 2000; Black et al., 2008 & Olofin et al., 2013). Other diseases include sepsis, meningitis, tuberculosis and hepatitis, suggesting a generalized immune disorder in children with severely stunted growth (Olofin et al., 2013).Other implications due to stunting include decreased immunity, anemia and their learning is affected. The result of stunting is that growth slows down and common childhood infections last longer and are more recurrent and serious. Infection increases the risk of stunting in that a sick child is likely to eat less, absorb fewer nutrients and easily lose nutrients (diarrhoea). Research shows that when undernourished children become adults, they are more likely to suffer from high blood pressure, diabetes, heart disease, and obesity (The Lancet, 2008).

When a child is stunted, it means essential physical and mental growth processes are affected. Research shows that if the root causes of stunting are not addressed during the first two years of life, the impact of the growth restriction prevail through adulthood (Martorell et al., 1994 and Victoria et al, 2010). Therefore, it is of importance that stunting is managed in the first two years of life. According to Ozaltin et al.,2010) children under the age of five born to the shortest mothers i.e. less than 145 centimetres have a 40 percent risk of mortality. Furthermore, stunted women are at a higher risk of maternal mortality and are likely to have small and underweight babies leading to cycle poor nutrition and poverty (UNICEF, 2014).

Literature from around the world has presented different factors associated with stunting. A number of determinants that have been identified as being of importance for studying stunting range from social, economic, demographic and environmental factors among others. Generally, these factors tend to have a direct or indirect impact on childhood stunting as they influence the parents social status, nutrition security and access to health care services. Others have argued that environmental and even genetic factors may also have an influence on stunting. The importance of socio-demographic factors on stunting among children below five years of age has become of great importance as it may reflect the social economic status of a country. Maternal factors such as mother's level of education, occupation, employment status and mother's age are usually argued to a major influence stunting. Other factors include the number of children in the household, sex of the child, age of the child and residence among others (Chirande, 2015 and Fenske, 2013).

A study by Menon et al. (2000) pooled DHS datasets from 11 countries and found that residence (urban/rural) of a child appeared to be a major factor in influencing nutrition and stunting. The study further argued that certain comparisons might actually mask large differentials that exist between socio-economic groups within urban and rural areas. The study revealed the risk of stunting was up to 10 times higher for urban children of low social-economic status (SES) than children from rural areas. Menon further argues that strong socio-economic gradients found in urban areas implies that average statistics to allocate resources between rural and urban areas could be misleading. This is contrary to other research that have shown that children in rural areas are more likely to be stunted than their counterparts in urban areas. According to a study by the National Institute of Population Research and Training (NIPORT et al, 2009), in Bangladesh found that, stunting in children less than five years of age was in one-fourth of the richest households. In Indonesia, a study highlighted that child's age, sex, number of family meals and income were significantly linked to stunting (Ramli et al., 2009).

Deshmukh et al. (2013) in a study in rural India found the prevalence of stunting at about 52 percent. The study showed a significant association between child's age, father's education, fathers' occupation, low income, not receiving Vitamin-A supplement during last 6 months, having anemia and stunting. The study further argued that there factors such as sex, caste, mother's education and mothers' occupation did not contribute significantly to the stunting. This is in contrast to other studies conducted in Indonesia and Sub-Saharan Africa (Ramli et al., 2009 and Wamani et al., 2007) which found that sex of a child was associated with stunting. That is, male children were more at risk of being stunted as compared to female children.

Education has been noted as a factor that plays an important role in shaping the future as it influences the decisions people make and widens resource base thus may have a direct influence on stunting. Particularly, schooling makes it possible for women to be more knowledgeable about health issues, and makes their use of healthcare services more effective. Mother's level of education has an effect on the health of the child as well as improved feeding practices which then lead to improved growth outcomes. A systematic review analysis by Lassi et al. (2013) found that education had a significant impact on growth and also significant increase in height gain, however rates of stunting reduced non-significantly. It was concluded that education should be combined with provision of complementary foods that are affordable, particularly for children in food insecure countries. Education improves

the economic position of women in societies through employment, better informed about health issues and good health seeking behaviour. A study by Kimhi (2004) in Ethiopia found that the economic position of women had a positive effect on the relative nutritional status of children.

In India, similarly a study by Fenske et al. (2013) revealed that, stunting was associated with the level of maternal education. The study also further determined that the broad range of causes of child stunting, encompass maternal, household socio- economic and regional characteristics. While more proximate determinants included environmental, nutrition, infection-related and healthcare-related determinants. The study's analysis confirmed the importance of child age and sex as non- modifiable determinants. While household wealth, greater maternal education and greater maternal BMI are major protective factors. On the other hand the study did not detected statistically significant effects of religion of household head, partner's occupation, sex of household head, urban/rural location, number of household members, drinking water, and frequency of meals by age, or iron supplementation. On the contrary, another study revealed that there was no association between stunting and maternal education as well as access to drinking water (Cruz et al, 2007).

In Latin America an evaluation of a program that provided good-quality complementary food to infants, found that the wages of males in adulthood increased by 46%, compared to peers who did not participate in the program (UNICEF, 2009). A study conducted by Hoddinott et al. (2013) showed the associations between stunting and shorter adult stature as well as labour–market outcomes such as lower earnings and poorer productivity. An increase in purchasing power increases dietary diversity which has an impact on stunting. According to a study by Ricci et al. 1996 cited by Bloem et al. (2013), showed that the relationship between socio-economic status and stunting emerged after the age of 6 months, suggesting a relationship with nutritional quality of complementary foods. Another study conducted in Kenya looked at the relationship between food insecurity and stunting (Shinsugi et al., 2015). The study revealed that animal rearing and social economic status (SES) were factors significantly associated with stunting in non-severe food insecure groups. While in the severely food insecure group tea or porridge and child age were significantly associated with stunting. Similarly, a study by de Menezes et al. (2011) in Brazil showed socioeconomic variables (such as per capita family income, maternal education, number of people living in the household and access to consumer goods), maternal height and birth weight were associated with stunting in children under five.

It should be noted that there is a likely interconnectedness between multiple risk factors within the system thus factors vary from place to place. According to a study by Tiwari (2014) in Nepal, socio economic and demographic factors were closely associated with stunting. Tiwari identified place and mode of delivery (home delivery), prolonged breastfeeding (more than 12 months), perceived size of baby (small babies), household wealth (poorest households) as the major risk factors for stunting. While in in Sri Lanka (Rannan-Eliya et al., 2013), a study revealed the main determinants of stunting as income, low birth weight, length of breastfeeding and maternal height.

The causes of stunting are infinite and numerous thus stunting may even be affected by environmental factors throughout childhood. Environmental factors may include unimproved water, unimproved sanitation, and use of biomass fuel. The likelihood of children being affected by environmental contamination increases when they start crawling, walking, exploring and putting objects in their mouths which puts them at risk of ingesting faecal bacteria from both human and animal sources (Rah et al., 2015). The study concluded that stunting was associated with poor conditions of sanitation and hygiene practices. In the same way, another study looked at childhood stunting from 137 developing countries and classified risk factors into five clusters that is maternal nutrition and infection, teenage motherhood and short birth intervals, fetal growth restriction (FGR) and preterm birth, child nutrition and infection, and environmental factors (Danaei et al., 2016). The study revealed that the leading risk factors for stunting were fetal growth restriction and unimproved sanitation.

Sub-Sahara Africa continues to be mostly affected by stunting, this is mainly due to issues such as poverty, governance and accountability which have in one way or another impacted on the capacity in dealing with stunting. In Kenya a study revealed age of a child as a non-modifiable factor and children aged 2-3 years were at greater risk of stunting compared to those 0-5 months old (Shinsugi et al., 2015). Similarly a study conducted in Ghana (Darteh et al., 2014) also revealed a significant association between child's age and stunting. In contrast, the study revealed that children aged between 36 and 47 months were mostly stunted. Other factors that were associated with stunting included, mother's age and number of children in household. The study found that children in households with 5 to 8 children, were 1.3 times more likely to be stunted as compared to those with 1 to 4 children. This may be due to the fact that when there are many children in the household, there may be less income to spend on each child as compared to a family with fewer children. Likewise, Kravdal & Kodzi

(2011) in their study conducted in sub-Sahara Africa showed that there was a positive relationship between the number of siblings and chances of a child being stunted.

In Libya, a study highlighted that father's low educational level and poor psychosocial stimulation were significantly linked to a child being stunted or not (Taguri, 2007). Other studies have also looked at stunting even among adolescents. One such study was conducted in Abeokuta, Nigeria (Senbanjo et al., 2011) which determined that the risk factors associated with stunting among urban school children and adolescents were age, sex, low maternal education and public school attendance.

According to a study by Chirande et al. (2015), in Tanzania, the main risk factors for stunting were age of the child, a child's sex, maternal level of educational, perceived size of the child at birth, mother's age at child's birth, place of delivery, type of birth delivery assistance, maternal BMI and breastfeeding status of a child. Also, according to Aoun et al. (2014) in his study in Rwanda it was revealed that there was an association between stunting and mothers' education and time to health center. In South Africa (Mamabolo et al., 2005) a study among three year old black South African children, revealed an association between stunting and household size, having a mother who was working or a student mother.

Girls and boys are almost equally likely to be stunted globally, but in sub-Saharan Africa stunting afflicts more boys (42 per cent) than girls (36 per cent) (UNICEF, 2013). Wamani et al. (2007) in his study conducted using pooled data from 16 sub-Saharan African countries revealed that male children were more likely to be stunted than female children. He further argues that the sex differences in stunting were more pronounced in the lowest social economic status groups. Similarly, a study in Mozambique (Cruz et al., 2017), revealed that sex of a child was a strong determinant of childhood stunting. Male children were more likely to be stunted as compared to female children. This is in contrast to a study conducted in Kenya by Ndiku (2011) that revealed that girls were more stunted, underweight and wasted than boys and this was attributed to lower food intake. Cruz et al. (2007) further noted that age of a child was significantly associated with stunting and childhood stunting increased as age increased up to 24 months. Other factors that were associated with stunting included undernourished mothers, low birth weight, number of under five children in households and higher wealth status.

The literature surrounding stunting demonstrates that factors are inexhaustible and vary from place to place. Prendergast et al. (2014) in his study conducted in Zimbabwe revealed that

stunting was influenced by both maternal and infant factors. The study highlighted that at antenatal, maternal nutritional and inflammatory status may impact fetal growth, leading to intrauterine stunting and low birth weight while at postnatal, low-grade inflammation early in life was associated with stunting. The study was a case control study among HIV-unexposed infants who were stunted (cases) or non-stunted (controls). He further noted that stunting began in utero and was also influenced by poor maternal health. In Malawi, a study highlighted that childhood stunting was significantly associated with low circulating essential amino acids (Semba et al., 2015). Children who were stunted had lower levels of serum concentrations of essential amino acids as compared to children who were not stunted.

Stunting is a chronic condition which reflects poor growth and is more difficult to treat than acute forms of undernutrition like wasting. It continues to be a worldwide phenomenon affecting growth potential in children. In Zambia the prevalence of stunting among children below five years of age is 40 percent which is unacceptably high. The government is working towards the prevention of stunting in children through nutrition policies such as the National Health policy and the National Food and Nutrition policy. There are also nutrition programmes such as Scaling up Nutrition Programme, which was launched in 2010 and which calls for intensive efforts to improve global nutrition in the period leading up to 2015 (http://scaling upnutrition.org/sun-countries/zambia). Other programmes include the First 1,000 Most Critical Days Program and the Nutrition and HIV programme among others. All these efforts aim to improve nutrition in the country.

Despite these efforts the prevalence of stunting is still high. The question remains as to what continues to drive the high levels of stunting among under-five children in the country. In Zambia, a few studies have highlighted risk factors of stunting among children below five years of age. According to a study by Bwalya et al. (2015), stunting was closely associated with mothers' age, birth weight, mothers taking iron tablets whilst pregnant and breastfeeding. This study only included children aged six to twenty-three months from the 2007 ZDHS. According to Nzala et al. (2011) his study revealed a significant association between stunting and male gender, older age and mothers' education. The study also highlighted that children from rural areas were more likely to be wasted and less likely to be stunted and underweight.

Since nutrition has now been recognised as one of the key strategies to global development this calls for a better understanding of issues surrounding stunting. With changes in weather

patterns for instance the current El Nino, droughts, slow economic growth which may in turn affect nutrition therefore, there is still need to understand risk factors of childhood stunting. There is limited information on factors associated with stunting in Zambia. Therefore, to be able to deal with stunting there is still need to understand major factors that are associated with stunting as factors are diverse and may vary with country or geographic location.

2.2 Conceptual Framework

UNICEF developed a conceptual model of the causes of malnutrition characterized by three levels of causes (UNICEF 1990). The model shows that the causal factors for understanding how malnutrition is the outcome of certain problems related directly to dietary intake and health status of the individual. These determinants vary and are linked to each other. For instance, food security and healthy household environment play important roles in preventing stunting in the long run.

The United Nations Children's Fund (UNICEF) conceptual framework of the determinants of the nutritional status represents a generalised understanding of how undernutrition is the outcome of specific development problems related directly to the dietary intake and the health status of the individual. The framework was adopted for this study to provide guidance concerning which factors to include in the adapted framework. Figure 2 below shows the adapted framework from what was presenting in the literature and uses an explanatory model and possible interactions of different risk factors associated with stunting among under-five children.

Figure 2 shows that Factors interact from basic determinants such as sex of a child and poverty influence underlying determinants (residence and family size). These underlying determinates could then influence immediate determinants such as disease burden and weight at birth which have a more direct influence on stunting. The framework further shows that socio-economic settings can have an influence on demographic, environmental factors which ultimately may determine whether a child is stunted or not. Figure 2 further shows that there is interplay of factors, as such it is difficult to attribute one single factor as to why a child is stunted or not, thus the importance of this study is to determine among the various factors which ones are associated with the stunting in Zambia.

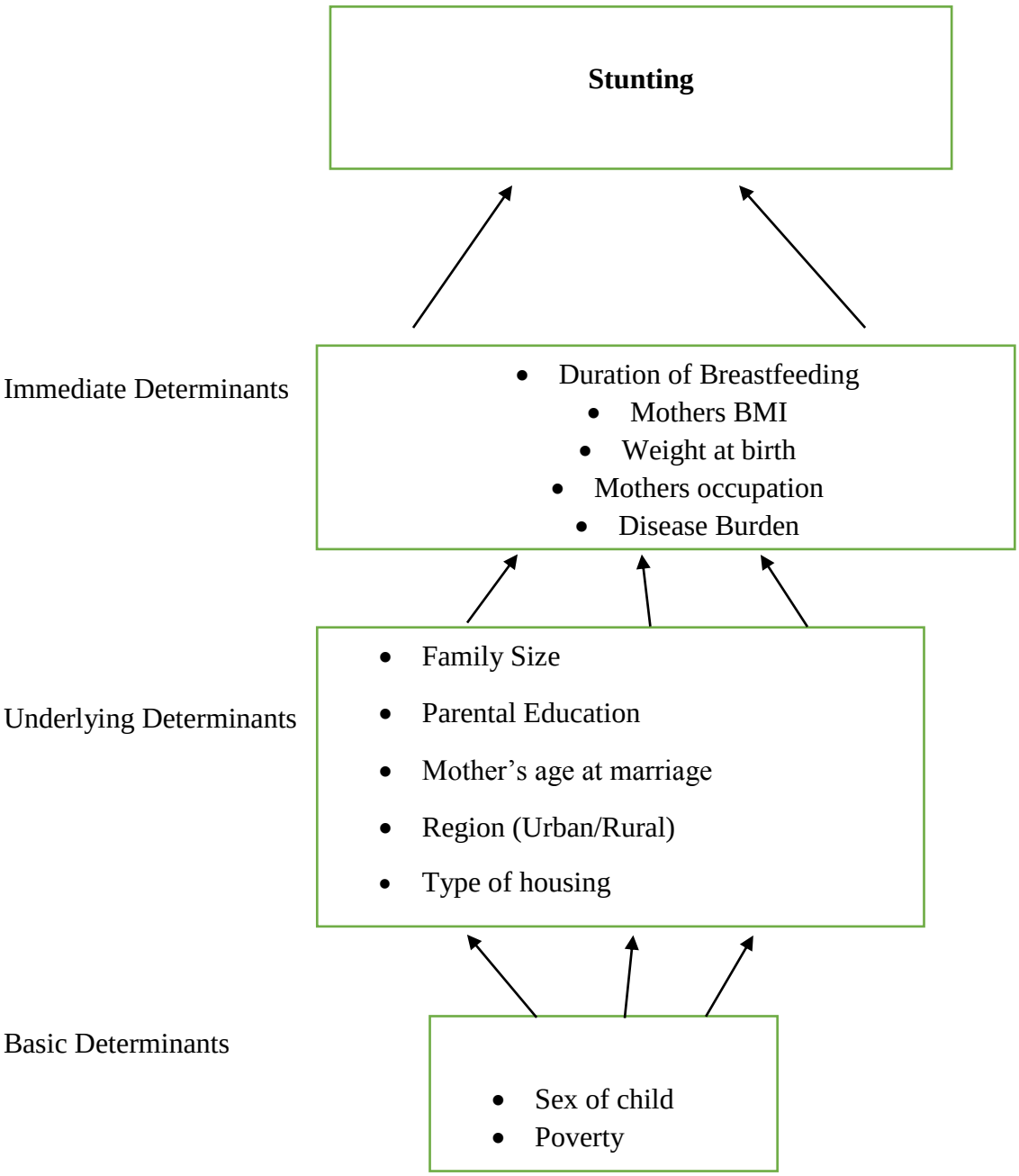
Stunting
Immediate Determinants
Duration of Breastfeeding
Mothers BMI
Weight at birth
Mothers occupation
Disease Burden
Underlying Determinants
Family Size
Parental Education
Mother's age at marriage
Region (Urban/Rural)
Type of housing
Basic Determinants
Sex of child
Poverty

Figure 2: Conceptual Framework adapted from UNICEF (1990)

CHAPTER THREE

METHODOLOGY

3.1 Study Design

The research used a quantitative approach considering the nature of the research problem. The study was a cross sectional study. The study aimed at providing an analysis of factors associated with stunting in Zambia. It used already available data collected through the 2013/2014 Zambia Demographic and Health Survey (ZDHS). The ZDHS was a cross sectional survey which gathered information on levels and trends in fertility, childhood mortality, use of family planning methods, and maternal and child health indicators including HIV and AIDS (CSO, 2014). The survey is a nationally representative probability sample survey of women and men of reproductive age 15 to 49 and 15 to 59 respectively. The ZDHS provides information on levels and trends in fertility, childhood mortality, use of family planning methods, and maternal and child health indicators including HIV and AIDS at national level for both rural and urban areas of the country. The ZDHS covered a broad range of health related issues including stunting which made this data source suitable for a comprehensive analysis of factors associated with stunting.

3.2 Study Site

The study site for this study was Zambia. The country is divided into 10 provinces of which two are predominantly urban, namely Lusaka and Copperbelt. The remaining province, Central, Eastern, Muchinga, Northern, Luapula, North Western, Western, and Southern are predominantly rural. The capital city is Lusaka, in the south-central part of the country.

3.3 Study Population

The study used secondary data from the 2013/2014 ZDHS. The study population included all children under five years who had their height and weight measured during the survey as well as women (aged 15-49 years). These were participants who were usual residents of the selected households, or who slept in the households the night before the survey.

3.4 Sampling Frame

The Zambia Demographic and Health Survey adopted the sampling frame from the 2010 Census of population and Housing of Zambia. The census divided the provinces into districts, constituencies and then wards. In addition, each ward was subdivided wards into census supervisory areas (CSAs) and in turn subdivided into standard enumeration areas (SEAs). Each SEA has boundaries and information on landmarks, size of households or

people. The list of SEAs was used as the sampling frame for the 2014 ZDHS. The sample consisted of 722 SEAs from which a probability sample of 18,050 households were selected. The survey interviewed a total of 16, 411 women age 15-49 and a total of 14773 men age 15-59. A total of 13, 554 children were captured. Of these 12, 328 children under-five had their height and weight measurements taken.

3.5 Sample Design and Sampling Procedure

The 2013/14 ZDHS adopted a two stage stratified–cluster sample design where enumeration areas (EAs) where the first stage units and households were selected during the second stage units. In the second stage an average of 25 households per cluster/EA were selected. Only pre-selected households were interviewed, no replacements or changes were allowed. This was important in order to maintain the known probabilities of selection of households. All women aged 15-49 and men aged 15-59 who were either permanent residents of the households or visitors in the households the night before the survey were eligible to be interviewed.

3.6 Inclusion and Exclusion Criteria

Based on secondary data from 2013/2014 ZDHS the study only included data for Children aged 0 – 59 months of age whose age and height were taken and Women aged 15 – 49 years of age. The study excluded data that had missing values for height and age of children below five years. Thus in sampling terminology they were treated as blanks.

3.7 Data Collection

The ZDHS collected information on the variables in question thus the study only extracted data pertaining to each variable. Data was collected on anthropometric measurements for children (0–59 months) using a proxy adult/reference person respondent who reported on behalf of the children. Also various bio-demographic and socio-economic variables were collected from the women. For this study the data was extracted using Stata version 13 and a data extraction tool. Questions considered in answering the objectives of the study focused on the determinants under study were included in the data extraction tool. These included background characteristics (education, age, residence, etc.) and economic characteristics among others. The study then further reviewed the ZDHS data to check if any inconsistencies were not identified in the ZDHS original editing and document the missing data for record purposes. This was conducted systematically and logically to ensure consistency.

VARIABLES

The dependent variable in this study was stunting. It was constructed as a discrete binary variable coded as (1) if the child was reported to have a height-for-age Z score more than -2 standard deviations from the mean and (0) otherwise. The independent variables included social, economic, environmental and demographic variables. The following were considered:

1. Sex of child
2. Age of the child
3. Mothers Education
4. Age of Mother
5. Number of children under-five in the household
6. Duration of breastfeeding
7. Residence (Urban/Rural)
8. Place of delivery
9. Type of delivery assistance
10. Wealth Status
11. Source of drinking water

3.8 Data Analysis

The data analyses was performed using Stata version 13 (StataCorp, College Station, Texas, USA). The data was imported into the software programme which was used to clean the data before analysis. The data was checked for all incomplete and inconsistent entries and excluded from the analysis. Then the analysis assigned weights to variables according to the weights of the ZDHS survey. The main analysis was done in three steps. The step involved descriptive statistics such as proportions to summarise characteristics of participants. The data was assumed to be normally distributed as the sample size was relatively representative of the population. In this case the researcher invoked the Central Limit Theory. The second stage used Pearson's Chi-Square tests to explore relationships between stunting and independent variables for categorical variables. That is if the assumptions of the chi-squared are satisfied. Reported p-values<0.05 were considered statistically significant that is suggesting strong evidence of an association between stunting and an independent variable.

The third stage of data analysis used simple and multiple logistic regression for both unadjusted and adjusted estimates respectively. Predictors with significant p-values (that is $p<0.05$ and 95% confidence interval) were considered for multiple logistic analysis. Multiple logistic regression was then performed to determine the strength of association between the significant independent variables and stunting. Firstly, the full model included all variables

and then began to remove variables that were not associated with stunting using the backward selection criteria. The variables that were insignificant at $p>0.05$ (95%) were removed until all those remaining in the model contributed significantly. This allowed for adjusting for confounders such as sex and residence as there are more than one explanatory variable. Odds ratios from the model were then presented for the predictor variables. The Odds ratios determined the odds of being stunted or not.

3.9 Ethical Consideration

First and foremost, Institutional authorization was obtained from the University of Zambia Biomedical Research Ethics Committee to conduct the research. In this context the researcher read through the required terms and the research was conducted in accordance with the rules and regulations of UNZABREC. Permission was also obtained from CSO to use the 2013/14 ZDHS dataset for the study. The information sheet explained to CSO the nature of the study and what the dataset was used for. The information sheet also explained that the dataset was kept as encrypted files on a computer accessible by a password. The dataset was kept as encrypted files on a computer accessible by a password by the researcher. The study ensured that the dataset was kept safe from unauthorized access, accidental loss or destruction. The dataset was not kept for no longer than was necessary for the research purpose as per university regulations. The study ensured that further analysis of the data was conducted professionally and appropriately. By adhering to the fundamental principles of the anonymity and confidentiality, the researcher rendered no harm to the institution.

CHAPTER FOUR

RESULTS

4.1 Results

A general summary of some variables is presented below in Table 2. The dataset had a total of 12408 children aged 0-59 months. A total of 80 observations were not included in the analysis due to missing height and age data. Therefore, the final analysis of the study was conducted on 12328 children whose height and age were measured. Results are presented below.

4.2 Demographic Characteristics

This section gives a brief summary of some background characteristics such as age and residence among others. The survey data had anthropometric measurements for children (0–59 months) using a proxy adult or reference person respondent who reported on behalf of the children. The description of the population is summarized in Table 2 below. The results showed that 34 % resided in urban areas while 66% resided in rural areas. The results also showed that majority of the respondents' source of drinking water was from a well at 56% followed by piped water with 26% and river or spring with 17%.

From the findings the majority of women delivered at a government facility at 63% while 31% delivered at home. The other women delivered at a private hospital at 5 %. The remaining 1% delivered at other places not captured in the specific categories (which are government, private, mission hospitals or home). With regards to type of delivery assistance, the results showed that 65% of the respondents were assisted by a health professional during delivery while 17% were assisted by a traditional birth attendant. In addition, about 15% were assisted by a relative while 3% had no delivery assistance. At the time of the survey, the results showed that majority of the children were still breastfeeding at 36% followed by 31% of the children being breastfed for 19 to 24 months. In addition, about 21% of the children were breastfed for 13 to 18 months. The results showed that majority of the children belonged to households with one or two under five children at 79% while 21% belonged to households with three to five under five children. Approximately 22% of the children were aged 48 to 59 months while 6 to 13 to 23, 25 to 35 and 36 to 47 each had a distribution of 20%. Children aged below six months and 6 to 11 had a distribution of 8% and 10 respectively.

About 47% of the children belonged to poor household, 32% of the children belonged to rich households while 21% belonged to middle income households. Furthermore, majority of the proxy respondents were aged between 25 and 29 years old that is about 26% while 24% were aged 20-24 and 21% were aged 30-34. Age group 45-49 was the smallest comprising of 2% of the population. Percent distribution shows that about 56% of the respondents had at least attended primary school, while only 4% had attended higher education. Approximately 29% had attended secondary school and 11% had never attended school at all.

Table 2: Description of background characteristics

Characteristics	Number	%
Sex of Child		
Male	6188	51
Female	6140	49
Age of Mother		
15-19	962	7
20-24	3215	24
25-29	3497	26
30-34	2804	21
35-39	1856	14
40-44	905	7
45-49	218	2
Mother's Level of Education		
No Education	1307	11
Primary	6518	56
Secondary	3334	29
Higher	407	4
Residence		
Urban	4140	34
Rural	8188	66
Wealth Index		
Poor	5819	47
Middle	2516	21
Rich	3938	32
Source of Drinking Water		
Piped Water	3122	26
Well	6781	56
river Spring	1996	17
Tanker	31	0.3
Bottled water	26	0.2
Other	54	0.4
Place of Delivery		
Home	3828	31
Gov public sector	7702	63

Private mission Hospital	599	5
Other	123	1
Type of delivery assistance		
Health Professional	7889	65
TBA	2056	17
Relative or Other	1874	15
No One	414	3
Duration of Breastfeeding		
0-6	183	2
7-12	574	5
13-18	2543	21
19-24	3741	31
24+	500	4
Never Breast fed	165	1
still Breast feeding	4407	36
don't Know	16	0.1
U5 children in H/H		
1 or 2	9562	79
3-5	2427	21
6+	64	0.5
Child age		
<6	1032	8
6-11	1191	10
13-23	2506	20
24-35	2450	20
36-47	2496	20
48-59	2653	22

Source: ZDHS 2013/14, own computation

4.3 Background Characteristics and Stunting

This section presents the results of the relationship between stunting and background characteristics. Table 3 below shows the distribution of stunting by the independent variables (age and sex of the child, mothers' age and education, residence, duration of breastfeeding, source of drinking water, place of delivery, type of assistance during delivery, wealth status and number of under five children in the household).

4.3.1 Socio-demographic characteristics and Stunting

Socio-demographic characteristics have been identified as factors that may affect children's nutrition status. Table 3 presents socio-demographic factors such as mother's age and education, sex of the child, residence and number of under five children in the household among others.

The results presented in Table 3 below show the Person's Chi-square test results. The study found that male children (42%) were significantly more likely to be stunted compared to female children (38%) at $p<0.05$, indicating a strong relationship between stunting and sex of a child. Mother's level of education displayed an inverse relationship with childhood stunting, in that as the level of education increased the prevalence of being stunted decreased (from44% to 18%). Stunting was highest among children whose mothers had no education (44%) while children whose mothers had higher education was at 18%. The distribution of stunting by level of education is shown in Figure 2 below.

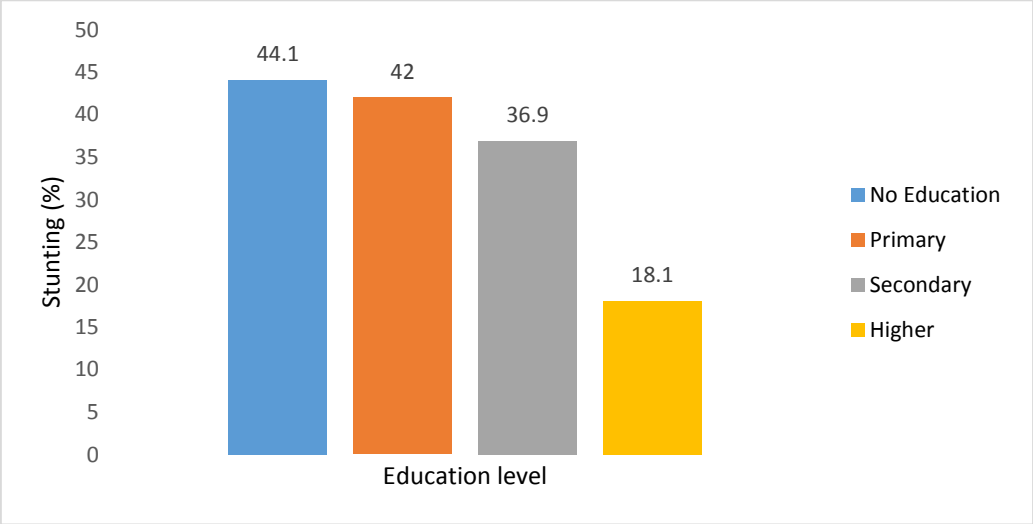

Figure 2: Distribution of stunting by level of education

Duration of breastfeeding was also reported. Stunting was more prevalent among children who had breastfed for a duration of less than six months (47%) compared to children who had breastfed for at least more than seven months (40%). The prevalence of children with stunting by type of delivery assistance was higher among women who had no assistance (45%) and lowest among women had assistance from a health professional (38%). While women who were either assisted by a traditional birth attendant and a relative/other were both at 44%. The study results show that 44% of the mothers delivered at home or other while 38% and 37% delivered at a government and private mission hospital respectively.

Age of a child also had a significant association with stunting. In the present study prevalence of stunting was observed to be increased as age increased and reaches a peak between ages 24-35 months after which it starts to decline. Stunting was highest (51%) in the age group 24-35 months. It was 14%, 32%, 48%, 42% and 35% in age groups of 0-5, 6-11, 13-23, 36-47 and 48-59 months respectively. Stunting was also highest in children whose mothers were

aged 15-19 years old (44%) while it was lowest among children whose mothers were age 45-49 years old. Overall, prevalence of stunting increased with mothers' age.

With respect number of under five children in household, stunting was higher among children from households with six or more children (53%), while children from households with three to five and one to two are 41% and 40% respectively. Overall, majority of the children came from households that had one or two under five children. The distribution of stunting by age is shown in Figure 3 below.

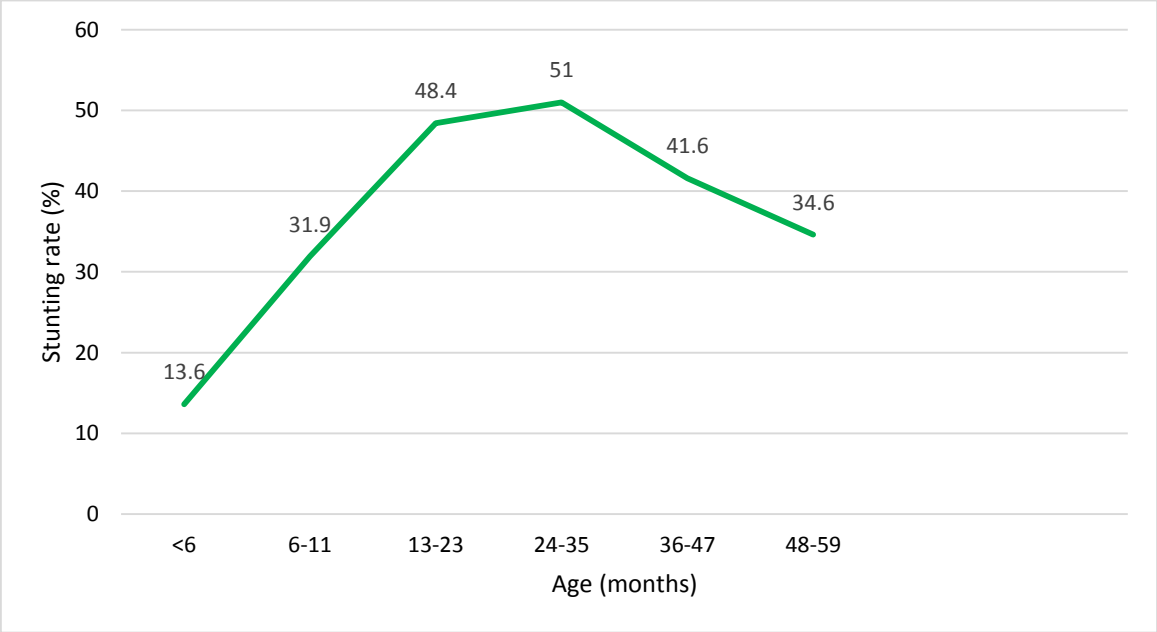

Figure 3: Distribution of stunting by child's age

Children from rural areas were significantly more likely to be stunted compared to those from urban areas. Further analysis by province depicted the same trend in all provinces except in Lusaka province, where stunting was higher among children in urban areas as compared to children in rural areas (37% and 30% respectively). Other analysis, as shown in Table 3, revealed that children who came from households that had more than six under five children in the household were more likely to be stunted, but this was not statistically significant at $p<0.05$. There was also no significant difference or association in child stunting distribution according to age of the mother.

4.3.2 Environmental Characteristics and Stunting

Stunting is the outcome of multiple risk factors therefore, environmental characteristics have also been identified as factors that may affect stunting. In this study, source of drinking was identified as a key variable that may affect stunting. According to Table 3 below, the analysis

revealed that children whose source of drinking water was a river or spring were more likely to be stunted (47%) compared with those children whose source of drinking water was piped water (34%). This difference in child stunting was statistically significant at $p<0.05$ indicating a strong relationship.

Table 3: Distribution of stunting by characteristics of children (n=4937)

Characteristics	Children with stunting	Children without stunting	p- value
Sex of Child			
Male	2626 (42.4)	3562 (57.6)	<0.001
Female	2311 (37.6)	3828 (62.4)	
Age of Mother			
15-19	343 (43.9)	438 (56.1)	
20-24	1200 (41.8)	1531 (58.2)	
25-29	1154 (39.4)	1777 (60.6)	
30-34	944 (39.4)	1453 (60.6)	0.146
35-39	601 (37.9)	984 (62.1)	
40-44	308 (38.5)	491 (61.5)	
45-49	65 (35.1)	119 (64.9)	
Mother's Level of Education			
No Education	585 (44.1)	725 (55.4)	
Primary	2738 (42.0)	3780 (58.0)	<0.001
Secondary	1230 (36.9)	2104 (63.1)	
Higher	74 (18.1)	333 (81.9)	
Residence			
Urban	1491 (36.0)	2649 (64.0)	<0.001
Rural	3447 (42.1)	4741 (57.9)	
Wealth Status			
Poor	2566 (44.6)	3192 (55.4)	
Middle	1047 (40.2)	1557 (59.8)	<0.001
Rich	1325 (33.4)	2641 (66.6)	
Source of Drinking Water			
Piped Water	1064 (33.7)	2094 (66.3)	
Well	2843 (40.7)	4144 (59.3)	
river Spring	968 (47.3)	1078 (52.7)	<0.001
Tanker	15 (47.2)	16 (52.8)	
Bottled water	10 (37.5)	16 (62.5)	
Place of Delivery			
Home	1572 (44.1)	1996 (55.9)	
Government/public sector	2687 (38)	4391 (62.0)	<0.001
Private mission Hospital	196 (36.8)	336 (63.2)	
Other	49 (44.0)	603 (56.0)	

Type of delivery assistance			
Health Professional	2726 (37.7)	4507 (62.3)	
TBA	842 (44.1)	1068 (55.9)	<0.001
Relative or Other	762(43.5)	989 (56.5)	
No One	170 (45.1)	207 (54.9)	
Duration of Breastfeeding			
0-6	78 (47.1)	87 (52.9)	
7-12	212 (40.2)	315 (59.8)	
13-18	955 (40.9)	1381 (59.1)	<0.001
19-47	1711 (43.3)	2242 (56.7)	
Never Breast fed	1777 (43.3)	2324 (56.7)	
Still Breastfeeding	1415 (35.0)	2622 (65.0)	
U5 children in H/H			
1 or 2	3794 (39.8)	5741 (60.2)	
3-5	1060 (40.6)	1550 (59.4)	0.3937
6+	33 (53.3)	29 (46.7)	
Child's age in months			
<6	141(13.6)	891(86.4)	
6-11	380(31.9)	811(68.1)	
13-23	1212(48.4)	1294(51.6)	<0.001
24-35	1249(51)	1201(49)	
36-47	1038(41.6)	1459(58.4)	
48-59	919 (34.6)	1734(65.4)	

4.4 Logistic Regression Analysis

Simple logistic regression was used to analyze relationships between the dependent variable (stunting) and explanatory variables (age and sex of the child, mothers' age and education, residence, duration of breastfeeding, source of drinking water, place of delivery, type of assistance during delivery, wealth status and number of under five children in the household). The model allowed to estimate the probability that a child could be stunted or not. Table 4 below shows both unadjusted and adjusted estimates.

In unadjusted analysis, a number of the independent variables showed significant associations with stunting. Female gender (OR=0.85, 95%CI: 0.78, 0.92; p<0.001) showed a reduced likelihood of stunting compared to male gender. Similarly, secondary and higher maternal education (OR=0.74, 95%CI: 0.63, 0.87; p<0.001 and OR=0.26, 95%CI: 0.18, 0.38; p<0.001 respectively) showed reduced likelihood of stunting than mothers with no education. Decreased likelihood of stunting was seen in children born to mothers aged 35 to 39 (OR=0.80, 95%CI: 0.66, 0.98; p<0.03) in comparison with those born to mother's aged 15 to 19 years old. Rural residence (OR=1.32, 95%CI: 1.18, 1.47; p<0.001) and rich wealth

(OR=0.61, 95%CI: 0.54, 0.69; p<0.001) status were also significantly associated with stunting. Other factors that showed significant associations include source of drinking water, duration of breastfeeding and child's age. Other variables such as place of delivery and type of delivery assistance showed increased likelihood of stunting but were no longer significant after adjusting for all variables in the model. Number of under five children in the household showed no significant association with stunting both at simple and multiple logistic regression analysis.

Odds ratios for stunting from multiple regression model were adjusted for all variables in the model. The results indicate that children born to mothers who had higher education had a reduced likelihood of stunting compared to those whose mothers had no education (AOR= 0.35, 95%CI: 0.23, 0.55; p<0.001). Increased maternal age had reduced likelihood of stunting compared to children born to mothers aged 15 to 19. Other factors that were associated with stunting included male gender, age of the mother and residence, child age, duration of breastfeeding, and source of drinking water and wealth. Therefore, in order to have best predictors in the model only factors that were statistically significant remained in the model.

Table 4: Crude and adjusted measures of the effect of independent variables on stunting in children aged 0-59 months

Characteristics	Crude Odds Ratio (95%CI)	Unadjusted P-value	Adjusted Odds Ratio (95%CI)	Adjusted P-value
Sex of Child				
Male	1		1	
Female	0.85 (0.78-0.92)	<0.001	0.80 (0.73-0.88)	<0.001
Age of Mother				
15-19	1		1	
20-24	0.95 (0.79-1.12)	0.533	0.83 (0.69-1.00)	0.045
25-29	0.85 (0.71-1.02)	0.078	0.73 (0.60-0.89)	0.002
30-34	0.86 (0.72-1.04)	0.121	0.73 (0.60-0.89)	0.002
35-39	0.80 (0.66-0.98)	0.03	0.64 (0.52-0.80)	<0.001
40-44	0.85 (0.68-1.05)	0.138	0.65 (0.51-0.83)	<0.001
45-49	0.74 (0.50-1.09)	0.133	0.60(0.40-91)	0.015
Mother's Level of Education				
No Education	1		1	
Primary	0.93 (0.8-1.08)	0.343	0.93(0.79-1.10)	0.422
Secondary	0.74 (0.63-0.87)	<0.001	0.84 (0.70-1.02)	0.08
Higher	0.26 (0.18-0.38)	<0.001	0.35 (0.23-0.55)	<0.001
Residence				
Urban	1		1	
Rural	1.32 (1.18-1.47)	<0.001	0.78 (0.68-0.92)	0.003
Wealth Index				

Poor	1		1	
Middle	0.84 (0.75-0.95)	0.005	0.84(0.74-0.96)	0.009
Rich	0.61 (0.54-0.69)	<0.001	0.69(0.57-0.82)	<0.001
Source of Drinking Water				
Piped Water	1			
Well	1.37 (1.21-1.56)	<0.001	1.14 (0.94-1.38)	0.175
River Spring	1.77 (1.52-2.07)	<0.001	1.44 (1.16-1.80)	<0.001
Tanker	1.82 (0.67-4.95)	0.241	1.52 (0.60-3.86)	0.381
Bottled water	1.28 (0.4-4.10)	0.683	1.24 (0.33-4.74)	0.751
Other	1.75 (0.82-3.7)	0.145	1.49 (0.67-3.30)	0.328
Place of Delivery				
Home	1		1	
Gov public sector	0.77 (0.7-0.85)	<0.001	0.88 (0.68-1.15)	0.349
Private mission Hospital	0.71 (0.57-0.88)	0.002	0.84 (0.60-1.17)	0.296
Other	0.96 (0.63-1.47)	0.853	0.94 (0.60-1.48)	0.799
Type of delivery assistance				
Health Professional	1		1	
TBA	1.31 (1.16-1.48)	<0.001	0.98 (0.77-1.25)	0.872
Relative or Other	1.29 (1.14-1.46)	<0.001	0.98 (0.74-1.32)	0.915
No One	1.30 (1.03-1.65)	0.025	1.04 (0.72-1.51)	0.817
Duration of Breastfeeding				
0-6	1		1	
7-12	0.75 (0.51-1.12)	0.165	0.67 (0.44-1.01)	0.058
13-18	0.77 (0.52-1.12)	0.173	0.65 (0.44-0.96)	0.033
19-47	0.86 (0.59-1.28)	0.462	0.69 (0.46-1.04)	0.077
Never Breast fed	0.86 (0.59-1.28)	0.464	0.97 (0.55-1.70)	0.912
Still breastfeeding	0.60 (0.41-0.89)	0.01	0.65 (0.42-1.00)	0.050
U5 children in H/H				
1 or 2	1		1	
3-5	1.04 (0.94-1.17)	0.411	1.1 (0.96-1.22)	0.2
6+	1.45(0.67-3.13)	0.339	1.71(0.79-3.71)	0.17
Child age				
<6	1		1	
6-11	2.22 (1.63-3.01)	<0.001	3.22 (2.44-4.25)	<0.001
13-23	4.31 (3.2-5.8)	<0.001	4.52 (5.03-8.84)	<0.001
24-35	5.16 (4.04-6.61)	<0.001	5.88 (5.26-9.75)	<0.001
36-47	7.84 (6.09-10.1)	<0.001	8.97 (3.76-7.20)	<0.001
48-59	6.85 (5.42-8.65)	<0.001	8.3 (2.76-5.18)	<0.001

P-value in the parenthesis; p<0.05, Ref: Reference

The analysis also revealed that mothers who delivered at a private mission hospitals (AOR=0.84, 95%CI: 0.60, 1.17; p>0.296) and a government hospital or clinic (AOR=0.88, 95%CI: 0.68, 1.15; p>0.349) had decreased odds of having stunted children than women who

delivered at home. However, these differences were not statistically significant. Similarly, odds of stunting increased if a woman had no one to assist her during delivery compared to a woman who was assisted by a health professional (AOR= 1.04, 95%CI: 0.72, 1.51; p>0.817) but was not statistically significant.

Other factors that displayed similar associations include number of children in a household. Children who came from households that had more than six children were about 1.7 times more likely to be stunted compared with those from households that had one or two under five children. However, these differences were not statistically significant (AOR=1.71, 95%CI: 0.79, 3.71; p>0.17).

4.5 Predictors of Stunting

This section presents the results from the backward stepwise multiple regression model of stunted children and the independent variables. At first all variables were included in the model after which variables that added least to stunting that were insignificant at p>0.05 were removed. Therefore, only predictors that were significant were incorporated into the regression model and these included child age in months, sex of the child, age of the mother, wealth status, mothers' level of education, residence, source of drinking water and duration of breastfeeding. The results of the analysis are presented in Table 5 below.

From the analysis the study revealed that female children aged 0-59 months had 20% less stunting compared with male children and this difference was statistically significant (AOR=0.80, 95%CI: 0.73, 0.88; p<0.001). Children who lived in rural areas were about 0.8 times less likely to be stunted than children who lived in urban areas (AOR=0.81, 95%CI: 0.70, 0.95; p<0.009). Other factors that had similar tendencies of associations were mother's education and wealth index. These two factors both displayed an inverse relationship with stunting. Children whose mothers' had higher education level had reduced odds of being stunted compared to children whose mothers had no education (AOR=0.35, 95%CI: 0.22, 0.54; p<0.001). Similarly, as wealth status increased, stunting declined. The association with stunting for children from a rich wealth category was significant compared with children from poor households (AOR=0.68, 95%CI: 0.57, 0.82; p<0.001). In addition, children from middle income households had lower odds of stunting compared to poor households (AOR=0.85, 95%CI: 0.74, 0.97; p<0.013). This study also revealed that mother's age was significantly associated with stunting. An increase in mothers' age predicted less chance of a child being stunted For instance, children whose mothers' were aged 45 to 49 years old had

39% less stunting compared with children whose mothers were aged 15 to 19 (AOR=0.61, 95%CI: 0.41, 0.92; p<0.018).

Similarly, increased child age was statistically associated with stunting. The odds of being stunted increased as age of the child increased and reaches a peak between ages 24 and 35 months after which it starts to decline. Children aged 24-35 months had the highest odds of being stunted compared with children aged below six months old (AOR=7.08, 95%CI: 5.2, 9.65; p<0.001). Source of drinking water was another factor that showed a significant association with stunting. The analysis revealed that children whose source of drinking water was a river or spring were at increased likelihood of stunting compared with children whose source of drinking water was piped water (AOR=1.46, 95%CI: 1.17, 1.82; p<0.001).

Table 5: Predictors of Stunting using Backward Step Multiple Regression

Characteristics	Adjusted Odds Ratio (95%CI)	Adjusted P-value
Sex of Child		
Male	1	
Female	0.80 (0.73-0.88)	<0.001
Age of Mother		
15-19	1	
20-24	0.83 (0.69-1.00)	0.046
25-29	0.74 (0.60-0.90)	0.002
30-34	0.73 (0.60-0.89)	0.002
35-39	0.65 (0.52-0.81)	<0.001
40-44	0.65 (0.51-0.83)	<0.001
45-49	0.61 (0.41-0.92)	0.018
Mother's Level of Education		
No Education	1	
Primary	0.93(0.79-1.10)	0.411
Secondary	0.83 (0.69-1.00)	0.055
Higher	0.35 (0.22-0.54)	<0.001
Residence		
Urban	1	
Rural	0.81 (0.70-0.95)	0.009
Wealth Index		
Poor	1	
Middle	0.85(0.74-0.97)	0.013
Rich	0.68(0.57-0.82)	<0.001
Source of Drinking Water		
Piped Water	1	
Well	1.15 (0.95-1.39)	0.151
river Spring	1.46 (1.17-1.81)	<0.001
Tanker	1.53 (0.61-3.82)	0.366

Bottled water	1.22 (0.33-4.55)	0.767
Other	1.48 (0.68-3.28)	0.334
Duration of Breastfeeding		
0-6	1	
7-12	0.66 (0.44-1.01)	0.054
13-18	0.65 (0.44-0.97)	0.034
19-47	0.69 (0.46-1.04)	0.075
Never BF	0.96 (0.54-1.69)	0.883
still BF	0.65 (0.42-0.99)	0.045
Child age		
<6	1	
6-11	3.23(2.46-4.26)	<0.001
13-23	6.77 (5.24-8.75)	<0.001
24-35	7.08 (5.2-9.65)	<0.001
36-47	5.18 (3.74-7.16)	<0.001
48-59	3.76 (2.74-5.16)	<0.001

The analysis revealed that there are a number of socio demographic and socio-economic factors that have an influence on stunting either directly or indirectly. For multiple logistic regression the model was fitted to determine which factors were the best predictors of stunting. All variables were included in the model and selected by backward stepwise regression at $p<0.05$ and 95% significance level. The stepwise regression model removed variables one by one starting with the variables making the least contribution that is the one with the highest p-values. Finally the model only included predictors that were statistically significant. The analysis showed that the best predictors of stunting were sex of a child, age of a child, residence, mothers' level of education, wealth status, mothers' age, duration of breastfeeding and source of drinking water.

CHAPTER FIVE

DISCUSSION OF FINDINGS

5.1 Discussion

This thesis aimed to identify factors associated with stunting among children aged five years and below in Zambia. The main risk factors that were associated with stunting in the study were: sex of a child, wealth status, mother's education, mother's age, place of delivery, mode of delivery, source of drinking water, duration of breastfeeding, number of under five children in household and residence. All these factors influence stunting either directly or indirectly.

The findings of this study determined that male sex was a determinant of childhood stunting. Male children were more likely to be stunted than female children. This is in line with the findings of other studies conducted around the world that have also documented higher prevalence of stunting in boys than in girls (Ramli et al., 2009, Wamani et al., 2007 and Cruz et al., 2017). Although it may be argued that male children may be given extra foods earlier and fed larger quantities compared to female children. According to Wamani, girls are more recognized due to the fact that they are seen as an investment, especially among lower socio-economic statues thus may lead to more care and dietary preferential treatment. These sex differences could also be attributed to behavioural patterns of communities for instance, favouritism towards daughters (Chirande et al., 2015). However a study by Schoenbaum (1995) argues otherwise in that feeding patterns among infant may have existed previously but have now been eliminated through successful public health intervention, rising levels of education and economic development. Additionally, epidemiological evidence depicts boys to be biologically more vulnerable to morbidity (Elsmen et al., 2004 & Kilbride 1997), and in a Zambia, morbidity incidences are still high. For instance the ZDHS reports that diarrhoea cases were higher among male children than female children and this probably exerts considerable effects on boys (CSO, 2014). Therefore, it is possible that boys are more vulnerable to health inequalities than their female counterparts in the same age groups. However, differences in stunting between males and females may also be due to biological make-up though therefore there is need for research as regards to genetics.

With regards to residence, children living in rural areas had decreased odds of developing stunting compared with those children living in urban areas. The findings of this study support those of some previous studies (Menon, 2000 & Nzala et al., 2011). Menon in his study argues that large differentials may exist between socio-economic groups within urban and rural areas. It was found that the risk of stunting among urban children of low social-economic status (SES) was up to 10 times higher than those in rural areas. Similarly, Nzala in his study found that children in rural areas were more like to be wasted and less likely to be stunted. This may be because children in urban areas are likely to have decreased contact time due to work schedules of working mothers that may bring about short period of breastfeeding, early cessation of breastfeeding and improper complementary food, which have a largely negative effect on the growth of the children. According to the ZDHS, median duration of breastfeeding is higher in rural areas as compared to urban areas, 21.2 and 17.5 respectively indicating a higher contact time and duration of breastfeeding in rural areas. However, the findings of this study are inconsistent with the results of a study conducted in India by Fenske et al. (2013) which revealed that there was no significant association between urban or rural location. Bwalya et al. (2015) in his study using the 2007 Zambia Demographic and Health Survey indicated that children from rural areas were less likely to be stunted than children in urban areas however this association was not statistically significant. Children in urban areas are also still at risk of stunting as there could be distinct groups of highly vulnerable children who should be high on the list of national priorities for nutrition-oriented interventions.

Education continues to be an essential step towards preventing stunting. The results reveal that mother's level of education had an inverse relationship with stunting. The likelihood of stunting was increased among children whose mothers had no education compared with children whose mothers had higher education. A number of studies have shown maternal education to provide protective effects against all under-nutrition indicators in children (Fenske et al., 2013, Chirande et al., 2015, Van den Broeck, 2007 and Eliya et al., 2013). This may be so because mothers who are more educated would be likely to be more conscious about their children's health as they are more exposed to media and may have better child and healthcare knowledge of nutrition leading to better feeding practices. Additionally, these mothers have more health seeking behaviours, today's world educated mothers tend to have greater improved authority in the home through higher paying jobs and increased contribution to family income and access to better medical care. Though, it should be noted that maternal employment has a complex relationship with childhood stunting. It may bring about early

cessation or interruption of exclusive breastfeeding which may have a large negative effect on the growth of infants (Ukwuani, 2003). Other studies have found contrary results in that there was no significant association between stunting and maternal education (Fikadu et al., 2014 & Khan et al., 2016). While maternal education is seen as a determinant of a child's nutritional status, other studies have actually indicated that father's education is an important factor rather than mothers' education for child nutrition (Deskmurkh, 2013 & Kamal, 2011). Therefore, the importance of maternal education might vary from country to country and the difference may be probably due to difference in study design and geographical difference. Overall it can be argued that mother's education plays an important role in regards to the development of healthy children.

Children who came from poor households were found to have a significantly higher risk of being stunted compared with children from middle income and rich households. A similar trend has been reported in a number of studies (Aguayo et al., 2016, Devkota et al., 2016 & Kamal 2011) which identified socioeconomic inequality as a key factor in childhood stunting. According to Aguayo, he indicated that the odds of stunting in children from lower wealth quintiles was 70-90% higher than in children from the highest quintile. This relationship may be described by the fact that rich households may afford the purchase of food and consumer goods that promote and protect the health of children. It is for this reason that increase in income may positively influence food security and quality of diets. Poverty as we all know is multidimensional and is linked to undernutrition. It affects nutrition due to food insecurity, unsafe water, poor sanitation and environmental hygiene (Das et al. 2016, Correia, 2014, Victoria et al., 2011 & Hoddinott et al., 2013). According to Hoddinott he noted that being stunted at 2 years old was associated with less schooling, a lower test performance, a lower household per capita expenditure, and an increased probability of living in poverty. Therefore, poverty and food insecurity have to be addressed to achieve greater reductions in stunting.

Childhood stunting was found to progressively decrease with an increase in the mother's age. The odds of stunting were higher among children born to relatively younger mothers (below 20 years old). There is no clear explanation as to why this is so but may be attributed to the differences in experience or knowledge in providing the child with proper care between younger and older mothers. The findings of this study are in line with other studies from Ghana, Tanzania and Zambia (Darteh et al., 2014, Chirande et al., 2015, Martorell & Young, 2012, and Bwalya et al., 2015). According to Martorell, early age at first delivery increased

the risk of stunting. This may could be because young mothers require adequate nutrition to fully grow into adults thus food is shared in small proportion between the infant and the mother. However other studies have showed no significant association between mothers' age and stunting (Mamabolo, 2005, Reyes 2004 & Willey, 2009).

Breastfeeding is something which is a norm and is quite universal in Zambia. The ZDHS (CSO, 2014) reports that 98% of children born in the two years preceding the survey had been breastfed. The study findings depicted duration of breastfeeding to be a determinant of childhood stunting. Children who breastfed for less than 12 months and more than 19 months were more likely to be stunted than children who breastfed for 13 to 18 months. The results are consistent studies that have reported a protective effect of breastfeeding and child nutritional status (Black et al. 2013, Fikadu, 2014). Fikadu notes that decreased contact time to the child through short periods of exclusive breast feeding, early cessation of breast feeding, increase exposure to bottle feeding and improper complementary food, may have a large negative effect on the growth children. In addition, introduction of complementary foods especially at a young age and under unhygienic conditions may affect a child's nutritional status because his or her digestive and immune systems are not yet mature. However, the results of this study are contrary to a study conducted in Nepal (Tiwari, 2014) that found stunting was correlated with prolonged duration of breastfeeding that is more than 12 months. These disparities maybe related to different contributing factors such as culture, time of initiation of complementary feeding and socioeconomic underlying forces. Therefore, proper education on feeding habits of complementary foods for children at two years old children can help prevent childhood stunting.

Another risk factor for stunting was source of drinking water. This study revealed that children whose source of drinking water was either a river or spring were more likely to be stunted compared to children whose source of water was piped water. The study showed that the other categories of source of drinking water did not demonstrate a statistically significant relationship with stunting. Therefore, these results indicate that childhood stunting may be affected by type of source drinking of water from a river or spring. This may be attributed to the fact that river or spring water may be contaminated and thus may increase risk of infection such as diarrhoea. Childhood infections may increase the risk of stunting in that a sick child is likely to eat less, absorb fewer nutrients and easily lose nutrients. The study finding is consistent with other studies (Tiwari et al.2014, Monteiro et al. 2010, Willey et al. 2009 & Yasmin et al. 2014). The benefits of improved water, sanitation and hygiene

(WASH) have mostly been evaluated in terms of reducing diarrhoea (Fewtrell, 2005) and soil-transmitted helminth infections (Strunz, 2014) as cited by Prendergast and Humphrey (2014). It has been argued that the potential of WASH on stunting has been undervalued. According to previous studies (Broeck et al. 2007, Fikadu et al. 2014, Milman, 2014 & Smith et al. 2004) there was no significant association between source of drinking water and stunting. Milman, in his study actually revealed that improvements in safe water was associated with increases in rates of stunting but a possible explanation is that safe water is a proxy variable for a healthy environment. Meaning once there is a health environment, any improvements would contribute insignificantly to child health.

Child age is a non-modifiable determinant and this study found a significant association with stunting. Children aged between 24 and 35 months significantly reported a higher risk of stunting than those in the younger age groups. There was a rapid increase in stunting between ages 6 and 35 months (from 14 to 51%). The findings of this study regarding child age mirror those in the literature (Darteh et al. 2014, Shinsugi et al. 2015, Senbanjo et al. 2011 & Torlesse at al.2016). These differences in stunting may be due to the protective effect of breastfeeding in younger age groups as most children are at least breastfed up to two years old or complimentary fed with breast milk. However, as the children grow, the mother stops giving them breast milk and may shift to improper feeding practices. For instance, providing tea or porridge as a meal and reduced number of meals. Children then become chronically undernourished at around this age. In addition, age above one is exploration age and the likelihood of children being affected by environmental contamination is high. This is because when children start crawling, walking, exploring and putting contaminated objects in their mouths it puts them at risk of ingesting bacteria and cause disease (Rah et al. 2015).

A household that had more than two under five children was associated with higher odds of childhood stunting. However, these differences were not statistically significant. This finding is contrary to other studies (Darteh et al. 2014, Kravdal and Kodzi 2011, Ikeda et al. 2013, Cruz et al. 2017) which observed a significant relationship between stunting and number of under five children in a household. It is thought that children with many siblings are likely to suffer from malnutrition which may lead to stunting. This is so because food portions for each child may be reduced which in turn leads to less intake of nutrients and adequate nutrition required for normal child growth. From the analysis conducted in this study the odds of stunting in relation to number of under five children in a household may be due to other factors.

With regards to place of delivery, mothers who delivered at a home were more likely to have stunted children as compared to those mothers who delivered at a health facility. However this association was not statistically signification. Similarly, type of delivery assistance showed that women who had some sort of assistance during delivery had reduced odds of having stunted children. While those women who had no assistance at delivery were more likely to have stunted children. This may be due to late initiation of breastfeeding as a woman may be very tired after delivery. Nevertheless, this association was also not statistically significant. It should be noted that some discrepancies in findings may be because of differences in cultural practices, socioeconomic characteristics and nutritional factors among various communities.

The prevalence of stunting in Zambia is still considerably high even after so many years through periods of economic growth. Study findings confirmed that stunting continues to be a multidimensional issue and has a number of important determinants. Similar to previous studies, childhood stunting increased with age and was prominent in males. The finding from this study have some relevant program intervention in that nutrition programs should be organized, particularly for women with little or no education. There is also need to target children in urban areas but more need should be focused on regions with a high rate of childhood stunting.

CHAPTER SIX

CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

6.1 Conclusion

It is clear that stunting remains a major public health problem in Zambia and will continue to negatively impact the society. Results from this study have shown that the major determinants of childhood stunting include male sex and age of a child, age of the mother, mothers' level of education, residence, wealth, duration of breastfeeding and source of drinking water. These factors often not only influence stunting but also influence nutritional status of a child. Therefore, measures aimed at reducing childhood stunting should not be taken in isolation but should include a multidimensional approach.

From the study findings, it can be argued that current efforts to prevent stunting may be threatened by social economic status especially in urban areas where odds of a child being stunted are higher. This study found that childhood stunting was strongly associated with residence in that children from urban areas were more likely to be stunted. This actually implies that children in urban areas are at risk of stunting despite having access to information and access to better health facilities. Therefore, this indicates that actions towards preventing childhood stunting should not entirely overlook children in urban areas. Thus there is need for programmes to respond to the growing numbers of urban poor and undernourished children and measures should be optimized according to evidence observed in each community.

One major challenge continues to be maternal education. There is still need to invest in maternal education and women's empowerment. From the study findings, higher maternal

education statistically influenced stunting among children under five years of age. Majority of the women in the survey only reached primary education and thus only a few women furthered their education to tertiary level. Women with higher education tend to have children with less odds of stunting because they may have access to information in relation to food and nutrition, access to better health services and access to nutritious foods. In addition, they may be in a better position to utilize available health services for instance, under five check-ups, child health week and immunization among others. Furthermore, women still need to be sensitized on the importance of nutrition and good feeding practices to protect their children from malnutrition.

Stunting affects health status and productivity later in adult life. Thus, the consequences of socio-economic inequalities in childhood nutritional status are likely to go on and on. Evidently, the study showed that wealth status is a predictor of childhood stunting. Hence, wealth status may have a greater positive impact on childhood stunting in that higher economic status means more access to purchase adequate nutritious foods. The study also revealed that age (months) and sex of a child are among the determinants of stunting among children aged under five years of age. This suggests that interventions targeted at reducing childhood stunting should also be age and sex sensitive.

The study further revealed that source of drinking water and duration of breastfeeding were also predictors of stunting in children aged five years and below. Children whose source of drinking water was a river or spring were more likely to be stunted as compared to those whose source of drinking water was piped. Therefore, the improvements in preventing childhood stunting also requires improvements in access to clean and safe drinking water. The study findings imply that efforts aimed at addressing stunting should also focus on development outcomes such as maternal education, income generating activities and WASH programmes

Therefore, with more information on factors associated with stunting, this information can be used to help shape policy and come up with new strategies aimed at managing stunting in Zambia. Dealing with stunting will require certain actions to be taken by policy makers and those responsible for the design and implementation of programmes. Stunting has far reaching consequences which are irreversible after the age of two years of life. Thus for childhood stunting to significantly improve there is need for improved maternal education, improved social-economic status and improved water, sanitation and hygiene practices.

6.2 Limitations

Firstly, the use of secondary data from the Zambia Demographic and Health Survey has its own limitations. An in-built limitation of cross-sectional data is that their snapshot nature makes establishing a temporal sequence of events and drawing causal inferences difficult. The study was limited to variables that the ZDHS relied upon to collect data and classify. Therefore, it was not possible to breakdown certain classifications. For instance, residence is only classified in two categories that is rural or urban. It does not consider the classification of peri-urban which is a sub-population of the urban population. Peri- urban populations are usually characterized by highly densely populated areas, poor social-economic status and poor health outcomes. Therefore results as regards to residence might mask these differentials. The ZDHS often has a delay in publishing their report which implies that information might not be a true reflection of the current situation. Thus the researcher is calling for more recent and frequent statistical data.

6.3 Recommendations

The following section provides recommendations for policy and suggestions for future research in an attempt to address the issue of childhood stunting. From the above findings, it is clear that the issue of stunting is diverse across socio-demographic, economic and environmental factors. The risk factors of childhood stunting in this study have shown that they are cross cutting thus affecting many areas. For instance, education and wealth both showed an inverse relationship with stunting. Therefore, promoting maternal education as far as tertiary education can contribute to reduce stunting. In the long run it would translate to better wellbeing of mothers and their children. Thus there is need to increase sensitization as far as translating nutrition into local languages. Educational messages should also lay emphasis on the importance of appropriate home prepared foods, hygiene and high energy foods.

Efforts should also be made to improve economic status of communities especially those in urban areas from poor socio-economic status without neglecting those in rural areas. Realizing the need for safe water can promote the nutrition of children. From the study it can be argued that there is still a need to improve access to clean and safe drinking water for all. This in turn may reduce childhood infections and improve nutritional status of mothers and children.

Climate change affects agricultural productivity and food security and later has an impact on nutrition. Therefore, there is a growing urgency to promote diverse adaptive measures

towards climate change. For instance, improved agricultural practices to help ensure food security. There is need to scale up dissemination of information on how to prevent stunting to all parts of the country.

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APPENDICES

7.1 Information Sheet

Title of Research: Factors associated with stunting among children below five years of age in Zambia: Evidence from the 2014 Zambia Demographic and Health Survey.

Researcher: Bubile Mzumara

Supervisor: Dr. P Bwembya

INTRODUCTION:

My name is Bubile Mzumara. I am a student at the University of Zambia pursuing a Master of Public Health, specializing in Population Studies. I am conducting a research titled factors associated with stunting among children below five years of age in Northern Province.

I am requesting for your permission to use part of the 2013/14 ZDHS dataset.

PURPOSE OF THE STUDY:

The aim of the research project is to identify factors associated with stunting among children below five years of age in Zambia. This research project is part of my Masters programme at the University of Zambia. It is my hope that the research will provide useful information for

Healthcare professionals in helping improve nutrition programming in Zambia generally and Northern Province in particular.

RISKS AND BENEFITS:

The research poses no harm to participants or the institution. Though, the analysis will include data validation which may identify inconsistencies and missing errors. In addition, through geographic triangulation the study might identify small groups of particular interest. There may be no personal benefits to the institution but the information obtained may provide vital information which can contribute to improved data collection and future development of improved nutrition programmes. The research will be able to add to the body of knowledge on stunting which can help other researchers.

CONFIDENTIALITY:

The dataset collected from the institution will be treated with outer most confidentiality. The data obtained will be strictly for academic purposes. All the information obtained will not be shared with anyone other than the research team. The dataset will be stored on a locked computer with a password protection. Copies will be stored on CDs in case I have a problem with the computer. The dataset will only be stored for three years as per university regulations, after which it will be discarded.

Who do I call if I have questions or problems?

Bubile Mzumara,

Tel: 0977358981

Email:bubilemzumara@yahoo.com

7.2 Data Extraction Tool

STUDY TITLE:

Factors associated with stunting among children below five years of age in Zambia: Evidence from the 2014 Zambia Demographic and Health Survey.

The following will be data that will be extracted from the women's questionnaire to answer the research question on the factors associated with stunting among children below five years in Zambia. Data on source of drinking water will be extracted from the household questionnaire.

The questionnaires from the ZDHS are internationally validated data collection tools on demographic and health information on men, women and children.

	Variables	Questions from ZDHS questionnaire	Response expected	Number of respondents
1.	**Respondent's Background**			
	Age of the mother	How old were you at your last birthday?	Age in years	
	Maternal Education	Have you ever attended school?	Yes or No	
		What is the highest level of school you attended?	Primary, secondary, or higher?	
	Sex of Child	How many sons or daughters live with you?	Sons, Daughters	
	Age of the Child	How old was (Name) at his/her last birthday?	Age in years	
	Number of under five children in the household	Number of children born in 2008 or later living with the respondent	Specific Number	
	Residence	Categorized in the dataset	Rural or urban	
	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	
		What do you usually do to make the water safer to drink?	Boil ,strain through a cloth, Use water filter, solar disinfection, Let it stand and settle Add bleach/chlorine	
2.	**Postnatal care, Breastfeeding and Wealth Status**			
	Place of delivery	Where did you deliver the baby (last birth for those who had more than one birth in last five years prior to the survey)?	Health facility (public or private) or home, other place.	
	Mode of delivery	Who assisted with the delivery of (NAME)?	Doctor, nurse, midwife, Clinical Officer, TBA or other.	
	Duration of Breastfeeding	For how many months did you breastfeed (NAME)?	Specific months	
	Wealth status	Wealth index as described by ZDHS dataset	Wealth index factor score.	