ASSOCIATION BETWEEN DIETARY INTAKE, HEALTH STATUS AND NUTRITIONAL STATUS OF CHILDREN AGED 6-23 MONTHS IN NAMWALA AND MKUSHI DISTRICTS OF ZAMBIA

By

Bubala Thandie Hamaimbo

A dissertation submitted in partial fulfilment of the requirements of the degree of Master of Science in Human Nutrition

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DECLARATION

I declare that this dissertation represents my own work and that it has not previously been submitted for a degree to this or any other university.

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Name: Bubala Thandie Hamaimbo (Candidate)

CERTIFICATE OF APPROVAL

This dissertation of Bubala Thandie Hamaimbo has been approved as fulfilling the partial fulfilment of the requirements for the award of Master of Science in Human Nutrition by the University of Zambia.

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ABSTRACT

Children with multiple measures of anthropometric failure are at a high risk of morbidity and mortality as a result of malnutrition. Some of the factors that contribute to the high levels of malnutrition which is described in forms of stunting, underweight, overweight and wasting in children 6-23 months include poor infant stimulation and nurturing, inadequate dietary nutrients and recurrent illnesses/infections which result in poor absorption of nutrients, poor cognitive development, growth failure and weight loss. These factors are common in developing countries such as Zambia where only 11% of children in this age group are fed appropriately according to WHO recommendations. Based on this background, this cross sectional study was done with the aim of investigating the association between dietary intake, prevalence of illnesses and nutritional status of children aged 6-23 months in Namwala and Mkushi districts of Zambia. A total of 213 children were enrolled, 108 and 105 from Namwala and Mkushi, respectively. A detailed questionnaire, anthropometric assessment as well as a complete stool analysis was done. Anthropometric, dietary intake, socioeconomic and demographic data collected was analysed using Anthroplus, NutriSurvey and SPSS version 23 software, respectively. The study revealed that none of the children were infected with intestinal parasites. However, 65.7% of the children presented with an illness two weeks prior and/or during the study. Illnesses identified in the study group included fever, diarrhoea, vomiting and coughs. In the two sites combined, 5.2% of the children did not meet the minimum dietary diversity requirements for this age group. Overall in Namwala district, the prevalence of stunting was 11%, 3.7% wasting, 3.7% underweight, 6.5% overweight while Mkushi district had 19% stunting, 3.8% wasting, 10.5% underweight and 5.7% overweight among children aged 6-23 months. The mean Height-for-age Z scores between Namwala (-0.51 ± 1.40) and Mkushi (-1.04 ± 0.95) were significantly different ($t_{0.05}$ 3.245). Using multiple regression, the variables independently associated with HAZ scores in this study are child's age (months), household non-food expenditure and consumption of *mabisi* (fermented milk). Health status was not significantly associated with nutritional status while dietary diversity showed a weak positive association with child nutritional status.

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LIST OF ACRONYMS AND ABBREVIATIONS

7NDP	Seventh National Development Plan
ANOVA	Analysis of Variance
CI	Confidence Interval
DF	Degrees of freedom
HAZ	Height-for-Age Z-score
IPI	Intestinal Parasitic Infections
IYCF	Infant and Young Child Feeding
NFNC	National Food and Nutrition Commission
RNI	Recommended Nutrient Intake
SD	Standard Deviation
SOP	Standard Operating Procedure
SPSS	Statistical Package of Social Science
SSA	Sub-Saharan Africa
TDRC	Tropical Diseases Research Centre
UNICEF	United Nations Children’s Fund
UNZA	University of Zambia
WAZ	Weight-for-Age Z-score
WHO	World Health Organization
WHZ	Weight-for-Height Z-score

CHAPTER ONE: INTRODUCTION

1.1 Background

Worldwide, malnutrition has been known to cause or indirectly contribute to 45% of the deaths recorded annually among children under the age of 5 years (UNICEF et al., 2019). Malnutrition is often described separately in forms of stunting, underweight, overweight and wasting. However, children with multiple measures of anthropometric failure are at a high risk of morbidity and mortality. Some of the factors that contribute to the high levels of malnutrition in children include but not limited to poor infant stimulation and nurturing, inadequate dietary nutrients and recurrent infections (Prendergast and Humphrey, 2014).

Globally, diarrhoea related illnesses contribute to a large proportion of deaths among children under 5 years old. When combined with undernutrition, such illnesses are the second-leading causes of death in this age group in sub-Saharan Africa (Liu et al., 2016). In Zambia, the 2013-14 demographic health survey described diarrhoea, malaria and pneumonia as the leading contributors to the high mortality rate recorded among children under the age of 5 years in the country. During the period of the survey alone, 16% and 21% of the children had diarrhoea and fever respectively (Central Statistical Office et al., 2015). This situation has since lead to the rolling out of various programs across the country such as vaccination and other infection prevention programs which are in line with the Integrated Management of Childhood Illness (IMCI) developed by UNICEF and WHO for the improvement of child health and wellbeing. If not managed early the illnesses have both long-term and short-term consequences thus calling for various interventions to reduce the burden on children. Diarrhoea and vomiting for example contribute to undernutrition through a number of pathways which include reduced energy intake, nutrient loss and malabsorption (Sinharoy et al., 2016). Resultant long-term consequences of poor growth and cognitive development (Chhagan et al., 2014) have also been reported.

Dietary intake has also been known to contribute to nutritional status. Food intake in children under the age of 5 years is influenced mainly by factors such as family environment, societal trends in infant and young child feeding, illness or disease.

Depending on the severity of the factor, malnutrition risk is either increased or decreased (Mahan and Escott-Stump, 2008).

According to UNICEF et al., (2019), nutrition related factors such as inappropriate feeding in the first year of life of a child is directly associated with deaths recorded annually among children under 5 years of age worldwide. In children 6 months or older, complementary foods introduced to these children is often nutritionally inadequate and unsafe which leads to malnutrition and related lifelong developmental consequences. In Zambia, only 69% of the children 6-24 months receive food from at least three food groups as complementary food (National Food and Nutrition Commission, 2011). However, of critical importance to ensuring adequate feeding is the consistence, frequency, quantity and quality of the food provided (Mallard et al., 2014).

As a result of these malnutrition pathways among others, Zambia has recorded high levels of malnutrition in children of this age group. For example, the proportion of children that are stunted, underweight and wasted is 53.9%, 11.4% and 5.6% in Central province and 43.7%, 10.2% and 5.8% in Southern province, respectively (Central Statistical Office, 2016).

Based on this background, this study investigated consumption of foods from the World Health Organization recommended food groups and prevalence of illnesses in children aged 6-23 months in two districts of Zambia. Consequently, the effect of dietary intake and these illnesses on the nutritional status of the study population was assessed.

1.2 Statement of the problem

In Zambia, only 11% of children aged 6-23 months are fed appropriately based on WHO recommended infant and young child feeding (IYCF) practices thus contributing to the high prevalence of micronutrient deficiencies and high levels of stunting (40%), wasting (6%) and underweight (15%) among children in this age group countrywide (National Food and Nutrition Commission, 2011). Furthermore, a high prevalence of infectious diseases among children in this age group such as intestinal parasites and/or dysentery has been recorded by the Central Statistical Office et al., (2015) which tend to compete for nutrients with the host (Harhay et al., 2010).

Children in countries such as Zambia where there is warm temperature, poverty and poor sanitation conditions have been known to have a high prevalence of intestinal parasites and other infections

Diseases when coupled with malnutrition in children under the age of 5 years produce risk factors which include illness, energy and micronutrient deficiencies (Wirth et al., 2016) which when coupled with poor quality foods and feeding practices is strongly associated with poor nutritional wellbeing. Depending on the child's baseline nutritional status, this phase of early childhood gives a window for reversal of growth stunting effects caused by morbidity (Olds, 2013) through improved feeding practices, reduced reoccurrence of infections.

The double burden of malnutrition has also resulted in increased number of children who are overweight/obese. This has largely been caused by rapid diet and physical activity changes in low and medium income countries in sub-Saharan Africa in recent years (Kimani-Murage et al., 2015).

In Zambia, some studies have been conducted on the benefits of dietary intake, adherence to infant and young child feeding practices (Mallard et al., 2014) and consumption of fermented foods and its relation to improved gastrointestinal function (Schoustra et al., 2013) and the burden of infections and illness in children (Mwale and Siziya, 2015a). However, there is a gap in linking presence of illnesses, dietary intake and nutritional status in children 6-23 months of age in Zambia. Therefore, this study sought to fill this knowledge gap.

1.3 Justification of the study

A study on the dietary intake and nutritional status of children aged 6-23 months provides current information on whether or not the mothers or caregivers adhere to some of the WHO recommended infant and young child feeding practices in Central and Southern province of Zambia. The study assessed food consumption patterns and dietary diversity of the study population.

The government through the Ministry of Health has for a number of years now been implementing countrywide deworming and nutrition programmes for children under the age of 5 years (National Food and Nutrition Commission, 2011). Therefore, the study provides data on the prevalence of illnesses and intestinal parasites which is influenced by nutrition education of caregivers, disease control and/or deworming of children aged 6-23 months in Namwala and Mkushi district.

The study sites are two different agro-ecological zones which have different rainfall patterns, agricultural activities and consequently difference in food consumption patterns and socioeconomic characteristics hence comparison of the districts. Namwala district is in zone I while Mkushi district is in zone II (Ministry of National Development and Planning, 2017).

Finally, some studies relating nutritional status to presence of illnesses have been conducted in hospital settings (Mwale and Siziya, 2015). However, this study establishes the association between dietary intake, health status and nutritional status of children aged 6-23 months in the study sites thus contributing to the pool of knowledge. `

1.4 Conceptual framework

The conceptual framework underlying this study identified some of the determinants of child nutritional status and is adapted from the UNICEF framework for the causes of malnutrition in children (Smith and Haddad, 2015). It outlined three levels of causes of malnutrition which include immediate, underlying and basic causes. The immediate determinants of the child’s nutritional status manifest themselves at the individual stage where a child with inadequate dietary intake is more susceptible to disease and if disease is present, appetite and nutrient absorption are inhibited. For example, presence of gastrointestinal parasites in a host is associated with more morbidity than death and is primarily related to malnutrition and impaired growth (Ruth et al., 2014).

Dietary intake of macro and micronutrients and health status are interdependent factors that affect individual child nutritional status and consequently malnutrition when inadequate (Haddad et al., 2015). Therefore, a child with inadequate dietary intake is more susceptible to disease which in turn depresses appetite, inhibits the absorption of nutrients in food and competes for the child’s energy. Some foods such as fermented foods and beverage which constitute one of the main dietary components in developing countries (Mokoena et al., 2016), have been linked to alleviation of diarrhoea and general improved gastrointestinal function due to presence of probiotics (Kort et al., 2015).

Underlying causes of malnutrition manifest at household level where limited access to clean water, limited health services (access to deworming program or nutrient supplements), household has food insecurity and/or the caregiver ability to implement child IYCF practices. Finally, basic causes relate to community or country level where there is cultural limitations, limited access to human resources and technology (Haddad et al., 2015).

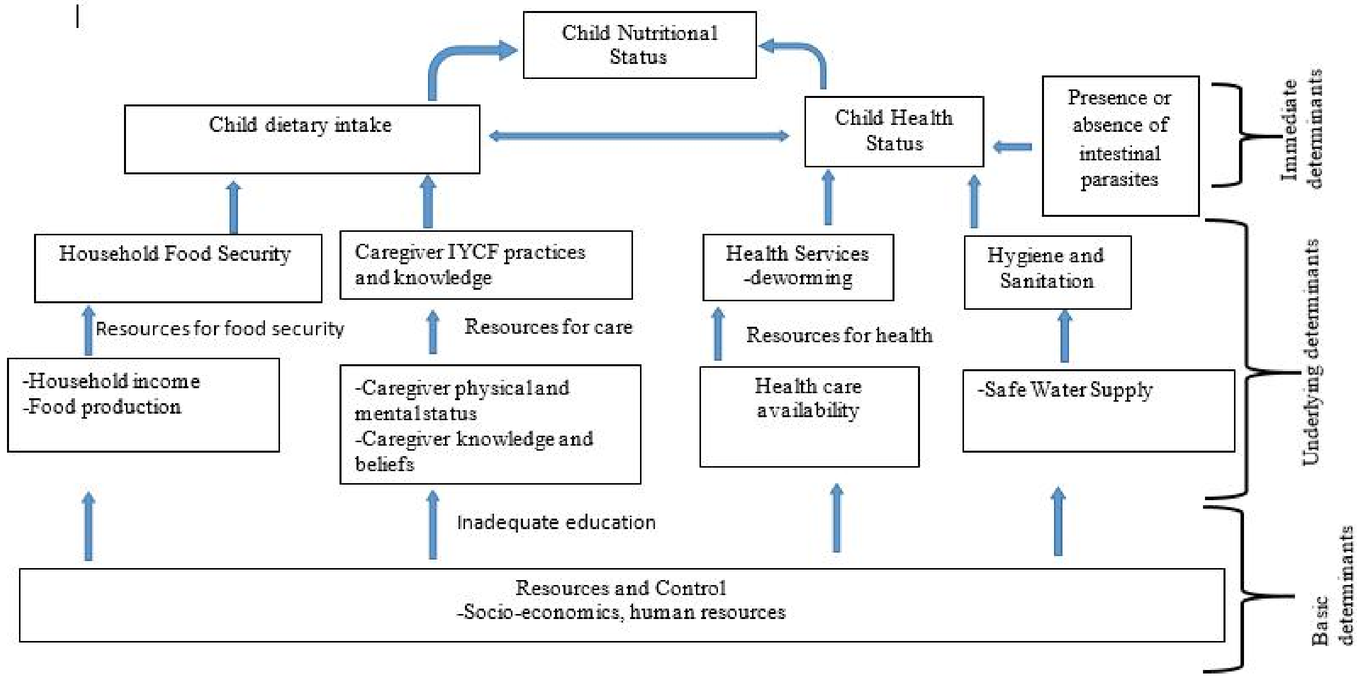

Figure 1: Conceptual framework on the determinants of child nutritional status

Adapted from Smith and Haddad, (2015)

1.5 Objectives

1.5.1. General objective

To determine the association between dietary intake, health status and nutritional status of children aged 6-23 months in Namwala and Mkushi districts of Zambia.

1.5.2. Specific objectives

The specific objectives of the study were;

i. To determine the dietary and nutrient intake of children aged 6-23 months in the study population.
ii. To establish the prevalence of illnesses among children aged 6-23 months.
iii. To assess the nutritional status of children aged 6-23 months.
iv. To compare the nutritional status of children aged 6-23 months in Namwala district to those in Mkushi district.

1.6 Hypotheses

The study is based on the following hypotheses:

1.6.1. There is no association between dietary intake and nutritional status among children aged 6-23 months in both Namwala and Mkushi districts of Zambia.

1.6.2. Health status is not associated with the nutritional status of the study population.

1.6.3. There is no significant difference in nutritional status of children in Namwala and Mkushi districts of Zambia.

CHAPTER TWO: LITERATURE REVIEW

2.1 Growth and nutritional requirements of children aged 6-23 months

Nutritional requirements of a child change with age. Once an infant turns 6 months old, the nutritional requirements begin to exceed what is provided by the breast milk. Therefore, complementary feeding becomes necessary to fill in the nutritional gap. The period of 6-23 months is the time of peak incidence of growth faltering, micronutrient deficiencies and infectious diseases thus in most countries, complementary feeding is targeted for this age (World Health Organization, 2009). However, even if food has been introduced to the child, breastfeeding remains critical as a source of nutrients for the infant as it supplies higher quality nutrients and protective components compared to most of the complementary foods provided. Energy gaps increase with age even if the child is being breastfed as depicted in Figure 2. On the other hand, Figure 3 captures nutritional gaps to be filled by complementary foods as the child grows from 12-23 months.

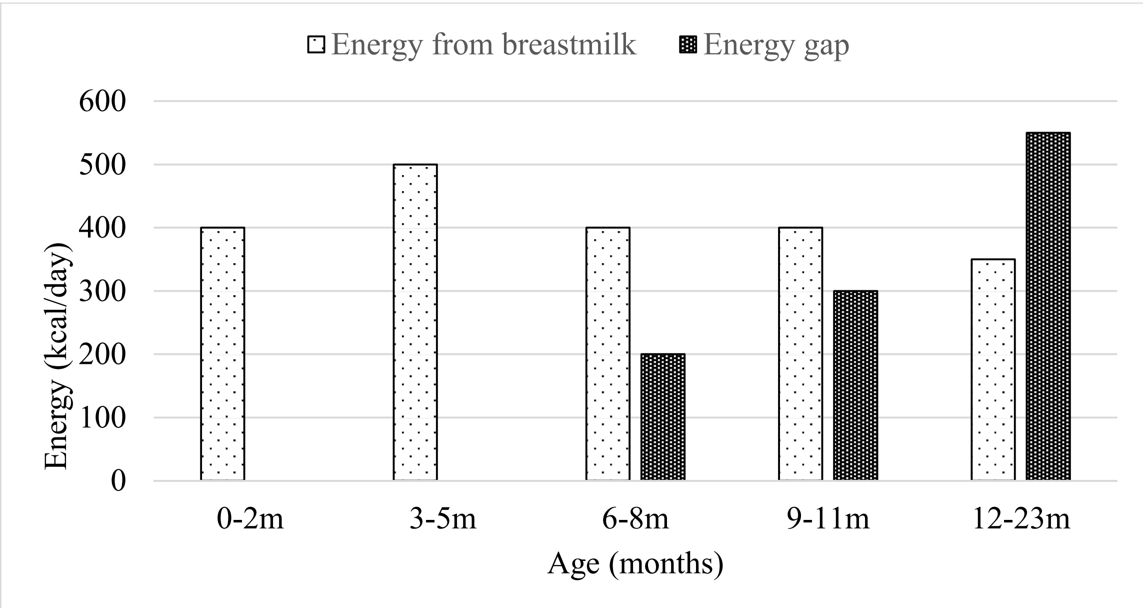

Figure 2: Energy gaps by age and the amount from breast milk

Source: World Health Organization, (2009)

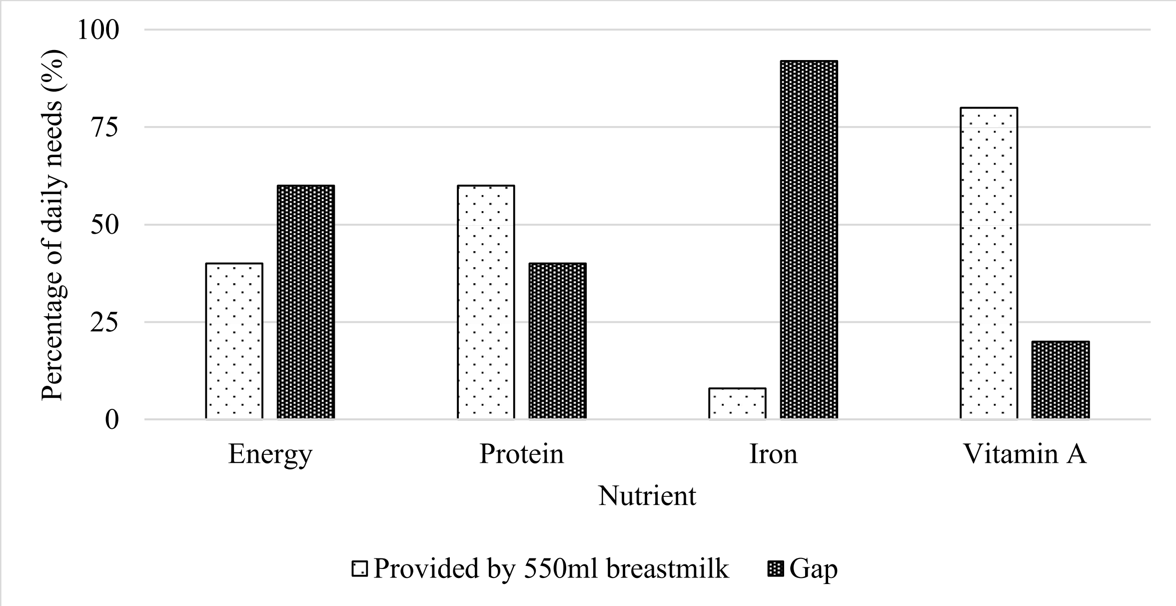

Figure 3: Complementary food required for a breastfed child 12-23 months

Source: World Health Organization, (2009)

To fill the nutrient gap, there is need for adequate dietary intake of both macro and micronutrients. Protein requirements during the rapid growth phase of infancy are higher per kilogram body weight than those for adults. Therefore, breast milk provides adequate amounts of protein in the first 6 months of the infant's life but as the child grows, complementary sources containing high quality protein sources such as yoghurt or cereal/legume blends are needed in addition to the breast milk. The total amount of protein required for children below the age of 2 years months is 9.1-13g/day (Mahan and Escott-Stump, 2008). On the other hand, a macronutrient such as fat has a recommended dietary intake of 30g/day for children under the age of 2 years while water requirement for this age group is 115-155 ml/kg/day (Mahan and Escott-Stump, 2008). The amount of water required is determined by the amount lost from the skin, lungs, faeces and urine in addition to the amount needed for growth. Dietary carbohydrates provide a significant amount of energy. In order to maintain body size, body composition and physiological function, the recommended energy intake is 825-1230 kcal/day (FAO et al., 2001). However, this dietary energy intake cannot be considered in isolation of other nutrients in the diet of the children.

Micronutrients include vitamins and minerals that contribute to child growth and optimal health and when absent result in deficiencies and changes in nutritional state when intake is insufficient.

It is also important to avoid consequences of excess intake of most of these micronutrient. In this age group, recommended intake per day of these vitamins and minerals include vitamin A (350-400µg), vitamin B1 (0.3-0.5mg), vitamin B2 (0.4-0.5mg), vitamin B6 (0.3-0.73mg), vitamin C (20mg), folic acid (80-150µg), calcium (400mg), iron (5.8mg) and zinc (4.1mg) (Michaelsen et al., 2000; FAO and WHO, 2004). Other nutrients of importance are vitamin D, iodine and sodium.

There is need to frequently check if the complementary food given to the child meets the nutritional requirements. Nguyen et al., (2012) explains that globally, one of the key indicators of a child's well-being is growth. Irregular growth patterns in children are associated with underlying risk factors such as household income and resources, inadequate food consumption, increased burden of diseases, inadequate sanitation and poor hygienic conditions.

2.2 Nutritional status of under 5 children in Zambia

The World Health Organization (2010a) outlines poor nutritional status indicators for children under five years of age as follows:

- Underweight: proportion of children less than 5 years of age with weight for age < -2 Z-scores of the median WHO child growth standards.
- Stunting: proportion of children less than 5 years of age with length or height for age < -2 Z-scores of the median WHO child growth standards.
- Overweight: proportion of children less than 5 years of age with weight for length or height > +2 Z-scores of the median WHO child growth standards.

Based on these classifications, in Central province, 53.9% of children under the age of 5 years are stunted, 11.4% are underweight and 5.6% are wasted while 43.7% are stunted, 10.2% are underweight and 5.8% are wasted in Southern province of Zambia (Central Statistical Office, 2016). A study on nutritional status of under 5 children in Zambia reveal that malnutrition is still prevelent (Marinda et al., 2018).

2.3 Recommended infant and young child feeding practices

The World Health Organization (2008) outlines a number of recommended appropriate feeding practices for infants and young children. Breast feeding is of supreme importance in the first 6 months of life and beyond. Between 6-23 months infants are to receive nutritionally adequate and safe complementary foods while breastfeeding continues.

This allows for optimal growth, development and health of the child. Adequate infant feeding information provided through trained health workers and/or lactation consultants is equally important to ensure sufficient infant feeding. Knowledge and skills in subjects such as feeding time, nutritional adequacy of meals, hygienic preparation and storage of infants foods and consistent feeding to meet child's appetite and satiety signals are associated with improved child's nutritional well-being (Katepa-Bwalya et al., 2015; UNICEF et al., 2019). Complementary foods prepared using locally available ingredients especially in community settings are encouraged for infant and young child feeding. Fortification and targeted micronutrient supplementation is also important in ensuring infants receive adequate micronutrients.

Some of the infant and young child feeding specifications by World Health Organization (2008) for children aged 6-23 months are as follows:

- Introduction of complementary foods covers the proportion of children aged 6-8 months who consume solid, semi-solid and/or soft foods where;

$$\frac{Infants\ 6-8\ months\ of\ age\ who\ received\ solid, soft\ foods\ the\ previous\ day}{Infants\ aged\ 6-8\ months}$$

- Minimum dietary diversity describes proportion of children 6-23 months of age who receive foods from 4 or more food groups which includes both breastfed and non-breastfed children where;

$$\frac{Chidren\ aged\ 6-23\ months\ who\ received\ foods\ from\ 4\ or\ more\ food\ groups\ the\ previous\ day}{Children\ aged\ 6-23\ months}$$

Table 1 shows the status of implementation of the IYCF recommendations in Zambia which is a developing country where bottle feeding is limited compared to continued breastfeeding.

Table 1: Infant and young child feeding indicators in Zambia

Indicator	**Percentage**
Introduction of semi-solid, solid or soft foods	90.3
Minimum dietary diversity (all children)	22
Minimum meal frequency (breastfed children)	46
Minimum acceptable diet (breastfed children)	12
Children ever breastfed	97.9
Bottle feeding	8

Year of survey: 2013-14 Source: Central Statistical Office et al., (2015)

2.4 Relationship between dietary intake and nutritional status

According to World Health Organization (2008), one of the critical windows of opportunity for ensuring a child's appropriate growth and development through optimal feeding are the first two years of life. Adequate complementary feeding practices have potential to cause a 6% reduction in under five mortality (Kipp et al., 2016) thus improving the child's health status. On the other hand, the socio-economic characteristics at household level have been known to influence on the feeding patterns and dietary diversity (Beyene et al., 2015; Eshete et al., 2018). Furthermore, consumption of diverse nutrient dense foods has been linked to greater nutrient adequacy and improved child nutritional status (Arimond and Ruel, 2004; Schmaelzle et al., 2014; Marinda et al., 2018). Literature shows that dietary intake has an impact on the double burden of malnutrition among children under the age of 5 years. For example, Mazarello Paes et al., (2015) reveal that obesogenic dietary intake is associated with obesity in childhood and later in life. In contrast, iron deficiency anaemia was associated with poor dietary iron intake and undernutrition in children (Woldie et al., 2015) while poor dietary diversity was associated with stunting of children in rural Kenya (M'Kaibi et al., 2017).

Therefore, adequate dietary intake has been used as a tool to mitigate negative nutritional effects. According to World Health Organization (2008), the recommended food groups for children aged 6-23 months include; grains, roots and tubers, legumes and nuts, dairy products (milk, yoghurt, cheese), flesh foods (meat, fish, poultry and organ meats), eggs, vitamin A rich fruits and vegetables and other fruits and vegetables. To acquire the minimum dietary diversity required for this age group, the child should have food from 4 or more of these food groups.

Dairy products such as milk is known to deliver high quality proteins, micronutrients, vitamins and energy containing fat. Therefore, across sub-Saharan Africa the total annual consumption and demand for milk is increasing due to population growth and changes in lifestyle such as urbanization (Jans et al., 2017). These milk products are usually consumed fresh or as traditional fermented products for extended shelf life and/or microbiota benefits.

In Zambia, the local name for fermented milk is *mabisi* which normally has a pH of 4.0-4.5 and predominantly composed of lactic acid bacteria (LAB) as follows: *Acinetobacter ursingii, Citrobacter freundii, Lc. lactis, S. equinus and S. thermophiles.* In addition to *mabisi*, other fermented products such as *munkoyo* and *chibwantu* are produced in Zambia (Schoustra et al., 2013). These are non-alcoholic beverages composed of cereal based raw based raw materials such as maize, millet and/or sorghum. *Munkoyo* is commonly made in the copperbelt and northern parts of Zambia while *chibwantu* is mainly found in southern and some parts of Lusaka province of Zambia.

Other complementary foods from the other food groups are also given to children aged 6-23 months in Zambia. Examples include cereal blends, flesh foods, pureed vegetables and fruits. Complementary feeding indicators used in Zambia are captured in Figure 4 where majority of children below 8 months are often introduced to complementary foods. However, there are limitations in meeting minimum dietary diversity and acceptable diet requirements in children 6-23 months of age which require multi-sectorial interventions.

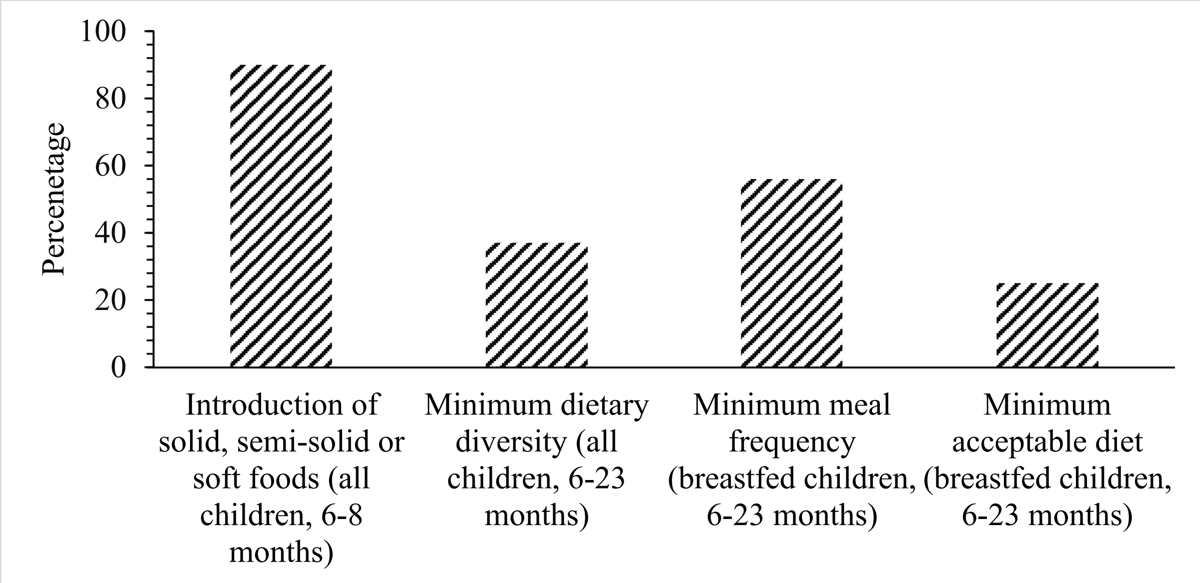

Figure 4: Complementary feeding indicators (%) in Zambia.

Source: World Health Organization, (2010a)

2.5 Common illnesses in children under the age of 5 years

Annually in developing countries around the world, about 6.6 million children die before the age of 5 years and majority of these deaths are caused by preventable illnesses such as diarrhoea, malaria and malnutrition in general (World Health Organization, 2014). There are a number of ailments that are common among children aged 6-23 months in Zambia. The Zambian 2013-14 Demographic Health survey reports that 51%, 21% and 16% of children under the age of five showed symptoms or had acute respiratory infection, fever and diarrhoea respectively two weeks before the national demographic health survey was conducted (Central Statistical Office et al., 2015). According to the Zambian Living Conditions Monitoring survey report, the prevalence of illness in Central province is 15.4% and 13.3% in Southern province. This data gives a picture of the burden of infection related disease in the country.

When one or more illnesses are present, there is a strong likelihood that the child will also be undernourished thus calling for multiple sectorial interventions (World Health Organization, 2014). For example, illnesses that are related to enteric infections lead to enteric dysfunction, a subclinical condition that results in impaired nutrient absorption resulting in poor growth and cognitive development in children overtime (Kaur et al., 2017). In a study done by Akombi et al., (2017) it was reported that some of the factors associated with stunting, wasting and underweight in sub-Saharan Africa include no healthcare use, inappropriate child feeding practices and lack of immunization/vaccination. In addition to these factors, fever was found to be mostly associated with wasting and underweight with only a few studies reporting it as a determinant of stunting. On the other hand, coupled with unhealthy environmental conditions, inadequate dietary intake increases a child's susceptibility to diarrhoea, infections and fever which result in depressed appetite, inhibited nutrient absorption and increased need for caloric availability.

In addition to these ailments, intestinal parasites are also a burden in this age group. Harhay et al., (2010) explains that intestinal protozoa are a category of gastrointestinal parasites that cause significant morbidity in children especially immunosuppressed children who are either malnourished, have limited access to quality health services and/or have opportunistic infections relating to HIV/AIDS. In a study conducted by Mwale and Siziya (2015) in Zambia where the prevalence of intestinal infections was 19.6%, it was evident that the prominent modes of transmission of intestinal parasitic infection in children under the age of 5 include eating soil, contaminated water and improperly cooked meat and vegetables.

Affected children often present with repeated severe diarrheal episodes which result in decreased nutritional wellbeing of the child or fatality.

2.6 Methods used to assess intestinal parasites in human beings

Investigations of the occurrence of intestinal parasites in children often include the collection of stool samples which are then examined macroscopically and microscopically (Kumar et al., 2014). Other than stool samples, blood is also often assessed. Consenting parents or guardians are instructed to collect a tablespoon of stool into sterile leak-proof wide-neck sealable containers.

One of the methods used to detect the presence of intestinal parasites is the use of formol-ether concentration technique where an applicator stick and about 1 gram of stool is emulsified in about 7 ml of 10% formol water in a screw cap tube (Njunda et al., 2015).

Another method used to examine vegetative and other forms of intestinal parasites was used in a study conducted by Mulatu et al., (2015) on the assessment of intestinal parasitic infections among children under five years of age presenting with diarrhoeal diseases to public health facilities in Ethiopia. It involved microscopic analysis of direct wet mounted stool sample. The sample was mixed with a drop of physiological saline using an applicator stick, covered with a slip and examined under a microscope.

2.7 Relationship between intestinal parasites and nutritional status

When present in a host, intestinal parasites produce a number of symptoms such as diarrhoea, abdominal pain, general malaise and weakness. Hookworms specifically cause chronic intestinal blood loss that result in anaemia. As a result, it has recently been estimated that more than 880 million children around the world are in need of treatment for these parasites (World Health Organization, 2012). Nutritional status of the affected children is directly related to the magnitude of the worm burden (Gedle et al., 2017). Therefore, the more the number of worms in the child, the greater the severity of disease and consequently the poorer the nutritional status of the child.

According to Harhay et al., (2010) the cases are associated with increased intestinal bleeding which leads to loss of iron and protein, loss of appetite, diarrhoea or dysentery, worms competing for nutrients such as Vitamin A (reduced absorption of micronutrients) with the host and/or damage of mucosa tissue resulting in mal-absorption of nutrients which negative affect nutritional status as shown in Table 2 below for specific gastrointestinal parasites.

Table 2: Comparison of major gastrointestinal helminths and protozoa

Organism	Reservoir	Clinical manifestations
Protozoa		
Entamoeba histolytica	Infected humans	Bloody diarrhoea, intestinal and/or liver abscesses, asymptomatic intestinal infection
Giardia intestinalis	Infected humans and other mammals	Watery diarrhoea, malabsorption and steatorrhea
Cryptosporidium parvum	Infected human and a variety of other animals	Watery diarrhoea, intractable diarrhoea in patients with HIV/AIDS
Cyclospora cayetanensis	Unknown	Watery diarrhoea
Helminths		
Ascaris lumbricoides	Infected humans	Intestinal or biliary obstruction
Hookworms	Infected humans	Iron deficiency anaemia from chronic gastrointestinal blood loss
Trichuris trichiura	Infected humans	Damage to intestinal mucosa; malnutrition and/or anaemia
Cestodes	Pigs, cattle and fish	Malabsorption and related mineral and vitamin imbalances
Trematodes	Aquatic plants and animals	Intestinal obstruction, ulceration and haemorrhage

Source: Harhay et al., (2010)

CHAPTER THREE: RESEARCH METHODS

3.1 Research design

A descriptive cross sectional survey was used to determine the association between dietary intake, health status and nutritional status of children aged 6-23 months in two districts of Zambia. Overall, the study was quantitative in nature

3.2 Study site and target population

The study was conducted in two provinces of Zambia namely, Central and Southern and involved both male and female children aged 6-23 months in rural and urban areas. This period is considered as one of the most critical periods for linear growth and a phase of peak stunting prevalence in most developing countries (Prendergast and Humphrey, 2014).

According to Central Statistical Office (2016), Southern and Central provinces represent 12% and 9.8% of the Zambian population, respectively. However, despite the difference in population size the rural and urban percentage share in both provinces is very similar at 74% and 26% respectively. A common characteristic to both regions is agriculture with potential for agro processing. However, Southern province is known for its high livestock potential thus increasing the populations access to dairy products and fermented milk products (Ministry of National Development and Planning, 2017). The difference in agro-ecological activities contributes to differences in dietary consumption of *mabisi* and cereal based non-alcoholic beverages *chibwantu* and *munkoyo.* These are fermented products that have been associated with improved gastrointestinal function and limiting intestinal parasite proliferation (Schoustra et al., 2013). *Munkoyo* is commonly prepared in Central province while *mabisi* and *chibwantu* are commonly prepared and consumed in Southern province (Schoustra et al., 2013).

3.3 Sample size

The sample size for this study was determined using the following equation:

$$n = \frac{Z^2 p(1-p)}{\delta^2}$$

Where:

n - Sample size

Z - Z Score value for 95% Confidence level which is 1.96

p - Proportion of underweight children under the age of 5 years in Zambia (15%) (Central Statistical Office et al., 2015)

δ – Margin of error set at 95% Confidence level which is 5%

Based on this formula and factoring in attrition at 10% (Bruce et al., 2009) the sample size was 213 of which 108 children were drawn from Namwala district and 105 from Mkushi district.

3.4 Sampling technique

The Ministry of Health (2013) lists all the health facilities which also serve as growth monitoring centres in the country and has specifically categorized them into facility level, urban and rural set up. In both Namwala and Mkushi district, growth monitoring centres were drawn from the nation-wide list and therefore used as entry points for the study. Thereafter, multistage sampling was employed in the selection of study participants as follows:

i. Southern province has 13 districts while Central province has 11. From each of the purposively selected provinces, one district was randomly selected, that is, Namwala and Mkushi district respectively.
ii. Health facilities that serve as growth monitoring centres were identified and drawn from the Ministry of Health list in both Namwala and Mkushi district. In each of the two districts, 6 facilities were randomly selected. In Namwala district, 4 of these facilities were rural and 2 were urban while in Mkushi district, 5 were categorised as rural and 1 as urban. Therefore, these served as entry and data collection points.

iii. With the help of the local community health workers attached to the respective centres, a sampling frame was developed which ensured that children aged 6-23 months who met the set criteria were captured.

iv. Further division into two strata based on sex of the child (boys and girls) was applied. From each strata, simple random sampling was used to arrive at the target sample size.

3.5 Inclusion and exclusion criteria

The children included in the study were male and female between the ages of 6-23 months in Namwala and Mkushi districts of Zambia. Only those whose parents or legal guardians had given written consent were included in the study.

The exclusion criteria involved children whose parents confirmed presence of chronic health conditions with dietary prescription such as diabetes, chronic renal disease, sickle cell anaemia and/or cancer. Children with such conditions require special diets, have to adjust to the limits of foods allowed, have decreased appetite and limited food intake (Mahan and Escott-Stump, 2008) thus not included in the study.

3.6 Data collection techniques

3.6.1 Collection and processing of stool samples: To check for intestinal parasitic infection in the selected children. Stool was collected and investigated macroscopically and microscopically. Each child's parent or caregiver was provided with a clean, dry and labelled plastic container for the collection of 5-10g of stool which were preserved by freezing at temperatures below -10ºc and taken to TDRC department of biomedical sciences parasitology laboratory for macroscopic and microscopic analysis according to the technical SOP-T-PARA-3.05 (Allen and Ridley, 1970 and Tropical Diseases Research Centre, 2016). The procedure involved separates helminths in form of ova, cysts and larvae, and protozoa in form of cysts from faecal debris respectively. Both of which are common gastrointestinal parasites in children of this age group.

3.6.2 Anthropometric assessments: The height and the weight of the child was measured using a height board (ShorrBoard) and calibrated weight scale (SECA S-876) respectively. The measurements were then categorized into Weight-for-Length, Length-for-Age/Height-for-Age and Weight-for-Age.

3.6.3 Dietary assessment: A repeat 24 hour dietary recall and food frequency questionnaire written in English and verbally translated into a local language (Tonga and Bemba) where necessary were employed to assess the dietary intake of the children 6-23 months. A 24 hour dietary recall was used to determine nutrient intake for each child while the food frequency assessment was used to ascertain the dietary diversity and consumption patterns of the study population. For the 24 hour recall, probing for all foods consumed by the child in the last 24 hours was done. Caregivers/mothers estimated the food consumed by the children using spoons and a graduated measuring cup. In addition, the minimum dietary diversity of children for this age group was part of the indicators for assessing adequacy of infant and young child feeding and used as standard score against the dietary diversity data that was collected in the study (World Health Organization, 2008). Therefore, the complementary foods and beverages consumed by the child were itemized under the respective IYCF food groups as follows; grains, roots and tubers (food group 1), legumes, pulses and nuts (food group 2), vitamin A rich vegetable and fruits (food group 3), other fruits and vegetables (food group 4), dairy products (food group 5), eggs (food group 6) and flesh foods (food group 7) (World Health Organization, 2010b). On the other hand, dietary intakes of nutrients were estimated based on Zambian Food Composition Tables (Nyirenda et al., 2007), food product labels and Tanzanian Food Composition Tables (Lukmanji et al., 2008) due to some similarities in the local foods consumed in Zambia and Tanzania. Thereafter, the observed nutrients intake in the study population were compared with WHO recommended nutrient intakes for this age group

3.6.4 Socio-economic, demographic characteristics and health status: The age of the child was obtained from the particular child's under 5 clinic card. For children who did not present with clinic cards, their age was obtained from their parents or caregivers. Using the questionnaire, socio-economic and demographic characteristics of the child and his/her family was collected. Furthermore, information on the morbidity and health care related characteristics of the child was collected using the questionnaire. This encompassed sections on illnesses and infections that are common to children of this age group such as but not limited to intestinal parasitic infection, presence of malaria, iron deficiency anaemia, diarrhoea, fever and/or dysentery.

3.7 Pre-test

The questionnaire was pre-tested on children in Chongwe district which was a randomly selected district with urban and rural community setting. A total of 23 children who met the set criteria were assessed. Thereafter, necessary modifications were made to the tool and a final copy made available for use.

3.8 Data analysis

3.8.1 Anthropometric data was analysed using WHO AnthroPlus version 1.0.4 software. Anthropometric indicators including Height-for-Age Z scores (HAZ), Weight-for-Height Z scores (WHZ) and Weight-for-Age Z scores (WAZ) were categorized according to World Health Organization and UNICEF, (2009) classifications as follows:

- The HAZ index as an indicator of linear growth retardation and cumulative growth deficits. Children whose Height-for-Age Z-score was below minus two standard deviations (-2 SD) from the median of the WHO reference population was considered short for their age (stunted), or chronically malnourished. Those who were below minus three standard deviations (-3 SD) from the reference median were considered severely stunted.
- In this case, the WHZ index was applied on body mass in relation to body height or length to describe current nutritional status. Therefore, children with Z-scores below minus two standard deviations (-2 SD) from the reference population median were considered thin (wasted) or acutely malnourished while children with a Weight-for-Height index below minus three standard deviations (-3 SD) from the reference median were considered severely wasted. Finally, children more than two standard deviations (+2 SD) above the Weight-for-Height median were considered overweight or obese.
- Weight-for-Age, a composite index of Height-for-Age and Weight-for-Height was used to take into account both chronic and acute undernutrition. Children whose WAZ was below minus two standard deviations (-2 SD) from the reference population median were classified as underweight while those whose score was below minus three standard deviations (-3 SD) from

the reference median were considered severely underweight (Central Statistical Office et al., 2015).

3.8.2 Furthermore, NutriSurvey software was used to analyse dietary intake information that was collected. The complementary foods consumed by the children were assessed for adequacy in comparison to World Health Organization, (2010b) guidelines for IYCF for children aged 6-23 months. Information generated from the analysis was also used to establish micro and macro nutrient gaps in the study group.

3.8.3 Using SPSS version 23 software, the rest of the data was analysed as follows:

- Use of descriptive and inferential statistics for the demographic, socio-economics, nutritional and health status of the children.
- Counting the food groups consumed by the children in the study group and determining the dietary diversity score. The dietary diversity scores were classified into groups of those that met the recommended WHO dietary diversity score and those that do not. Those that meet the dietary diversity score are characterised by proportion of children 6-23 months who met the minimum dietary diversity score by having food from four or more food groups and those who had food from less than four food groups did not meet the requirements (World Health Organization, 2010b).
- To assess any significant difference in the mean HAZ, WAZ and/or WHZ of the children in the two study sites and by gender of the child, t-test was used.
- One way Analysis of Variance (ANOVA) was applied for group comparison of dietary intake and prevalence of illnesses of study participants in Namwala and Mkushi districts.
- Multiple regression was employed to determine the relationships between diet, health status, socio-economics and/or demographic characteristics and child nutritional status. The dependent variable was HAZ scores while the independent variables was dietary intake, presence or absence of intestinal parasites, caregivers' education level, presence or absence of illness and/or household income.

The following model was applied in the estimation:

$$\gamma = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_n X_n + \ldots + \varepsilon$$

Where;

γ = Dependent variable stunting

X_1 = Dietary intake

X_2 = Parents education level

X_3 = Presence of absence of illness

X_4 = Household food expenditure

X_n = Other independent variables of the study

B_1 - β_n = Coefficients that were estimated

ε = Error term

3.9 Ethical considerations

Firstly, ethical clearance was obtained from the University of Zambia Biomedical Research Ethics Committee (Ref. No. 002-04-18) and later permission was sought from the respective provincial and district health offices to use the community growth monitoring centres. Secondly, information sheets and consent forms were presented to the parents of the children invited to participate in the study which clearly indicates the goals and procedures involved in the study for their written consent. The only foreseeable risk as a result of the study was discomfort during anthropometric assessments of the children. Therefore, the research was of low risk. Additionally, children found to have malnutrition were brought to the attention of the relevant health personnel at the respective health centre for medical and/or nutritional intervention. These steps were for the purpose of ensuring strict compliance with regulatory requirements relating to consent process and human safety.

CHAPTER FOUR: RESULTS

4.1 Socio-economic and demographic characteristics of the study population

A total of 213 children were sampled and included in the analyses, from this group, 108 were from Namwala while 105 were from Mkushi district. The mean age of the caregivers and children were 26.2 years ± 7.6 and 13.6 months ± 5.2, respectively. Overall, using independent t-test and confidence interval at 95%, there was no significant difference in age of the child's caregiver and child's age in the two districts.

Socio-economic and demographic attributes of the study population are presented in Table 3 where there were more children from rural areas compared to urban areas in both districts. More than 70% of the caregivers were married. In both districts 4% of the caregivers had not enrolled in school, however, most caregivers in Mkushi had secondary or higher education Compared to Mkushi district, more households spend less than ZMW500 per month on food in Namwala district. A large proportion (>70%) of the children live in mud houses compared to their counterparts in Mkushi. Using chi square test, it was established that there was a significant difference in the number of caregivers who were married (X^2 = 7.965, df = 3, p = 0.047) and the level of education they have attained (X^2 = 12.515, df = 3, p = 0.006) between the two districts. There was no significant difference in the selection of the study participants based on sex and area setting. Between the two sites, there was a significant difference in the household monthly food expenditure (X^2 = 7.963, df = 3, p = 0.047), source of their drinking water (X^2 = 31.792, df = 5, P = 0.000) and material of the house wall (X^2 = 22.243, df =4, p = 0.000)

Table 3: Socio-economic and demographic characteristics of the study population

Characteristic	Namwala n (%)	Mkushi n (%)	p-value
Gender of the child			0.449
Female	56 (52)	49 (47)	
Male	52 (48)	56 (53)	
Geographic setting			0.401
Rural	79 (73.1)	82 (78.1)	
Urban	29 (26.9)	23 (21.9)	
Marital status of caregiver			0.047
Married	71 (66)	83 (79)	
Not married	37 (34)	22 (21)	
Level of education of caregiver			0.006
None	4 (4)	4 (4)	
Primary	55 (51)	31 (30)	
Secondary	48 (44)	64 (61)	
Tertiary	1 (1)	6 (6)	
Household monthly food expenditure (ZMW)			0.047
<500	72 (67)	52 (50)	
501-1000	28 (26)	35 (33)	
1001-2500	6 (6)	12 (11)	
>2500	2 (2)	6 (6)	
Household monthly non-food expenditure (ZMW)			0.334
<500	82 (75.9)	69 (65.7)	
501-1500	21 (19.4)	25 (23.8)	
1501-3000	5 (4.6)	9 (8.6)	
3001-4500	0 (0)	1 (1)	
>4500	0 (0)	1 (1)	
Material of the house wall			0.000
Mud	71 (65.7)	42 (40)	
Wood	3 (2.8)	0 (0)	
Concrete	33 (30.6)	60 (57.1)	
Other	0 (0)	3 (2.9)	
Source of drinking water			0.000
Stream	4 (4)	18 (17)	
Well	36 (33)	26 (25)	
Borehole	48 (44)	21 (20)	
Tap	19 (18)	35 (33)	
Other	1 (1)	1 (1)	

4.2 Food consumption patterns of the study participants

To describe food consumption patterns, commonly consumed foods were listed as individual food while infrequently consumed foods and with various preparation options were aggregated by similarity as summarized in Table 4. Foods consumed frequently include maize, *chibwantu* and groundnuts (more than once per day). Most of the children in the study population only had foods such as rice, beans, chicken and red meat 1-4 times/week.

Table 4: Food consumption patterns (%) of the study population

	Frequency of consumption						
Foods	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Maize	2.8	0.5	1.9	1.9	1.9	64.8	25.8
Rice	36.9	22	30.8	1.9	6.1	1.4	0.5
Chibwantu	60.6	6.1	7.5	1.4	5.6	13.6	4.7
Munkoyo	69	12.7	9.9	1.4	2.3	3.8	0.9
Sweet potato	74.6	10.8	8.9	3.3	1.9	0.5	0
Irish potato	51.2	16.9	26.8	3.3	1.9	0	0
Cassava	88.3	7	3.3	0.5	0.9	0	0
Wheat based foods	33.3	21.1	25.4	5.2	14.6	0.5	0
Beans	9.4	38	50.2	1.4	0.5	0.5	0
Soy beans	70.9	15.5	12.7	0.5	0.5	0	0
Groundnuts	18.8	16.4	22.5	4.2	16.9	20.7	0.5
Cowpeas	83.1	6.1	9.9	0.5	0.5	0	0
Green leafy vegetables	24.9	20.2	34.3	7.5	10.8	2.3	0
Other vegetables	30	30.5	29.6	3.3	5.6	0.9	0
Fruits	37.1	15.5	17.8	6.6	16.4	5.6	0.9
Fresh milk	58.7	7.5	19.7	0.9	10.3	2.8	0
Powdered milk	87.8	4.2	2.8	0.9	3.8	0.5	0
Yoghurt/smoothies	77.5	9.9	8	1.4	2.8	0.5	0
Mabisi	57.1	11.3	16.5	2.8	9.4	2.8	0
Chicken eggs	23.8	16	45.5	2.8	10.8	0.9	0
Other eggs	72.8	5.2	14.6	1.9	5.6	0	0
Fish	24.4	25.4	41.3	5.6	2.8	0.5	0
Chicken	23.8	51.2	21.6	2.3	0.5	0.5	0
Red meat	39.4	38.5	18.3	3.3	0.5	0	0
Organ meat	62.4	27.2	9.9	0.5	0	0	0
Sugary food/drinks	48.8	19.7	16.4	5.6	8	1.4	0
Fats and oils	73.2	8	12.2	3.3	3.3	0	0

(1=none, 2=once/week, 3=2-4 times/week, 4=5-6 times/week, 5=once/day, 6=2-3 times/day, 7=4-5 times/day or more)

Figure 5 summarises study participants' consumption of food from food groups recommended by the World Health Organization. In both districts, the most consumed foods were grains, roots and tubers (97.6% in Namwala and 100% in Mkushi), and legumes, pulses and nuts (93.4% in Namwala and 98.2% in Mkushi). A high proportion, 95.4% in Namwala and 98.1% in Mkushi had confectioneries, sweetened beverages and fatty foods. At district level, there was a variation in foods consumed the least as children in Namwala consumed less fruits and vegetables (75.7%) and their counterparts in Mkushi had less of the dairy products (57.9%).

Although children aged 6-23 months in the study consumed foods from the seven food groups as observed in Figure 5, chi square test revealed that there was a significant difference in the consumption of fruits and vegetables ($X^2 = 5.333$, df = 1, p = 0.021) and dairy products ($X^2 =28.137$, df = 1, p = 0.000) between the two districts. Furthermore, the distribution was characterised by no significant difference in the consumption of grains, roots and tubers, legumes, pulses and nuts, vitamin A rich vegetables and fruits and flesh foods. One of the indicators used to assess infant and young child feeding practices in the study population was dietary diversity. The mean ± SD dietary diversity score for Namwala was 4.5 ± 1.1 while Mkushi had 4.3 ± 0.9. Finally, it was also observed that more than 90% of the children in the two sites meet the minimum dietary diversity requirements while 5.6% (Namwala) and 4.8% (Mkushi) did not meet the recommended minimum dietary diversity requirements (consumed food from less than four food groups) respectively.

In addition, Spearman correlation test showed a weak positive association between dietary diversity and level of education of caregiver (rho = 0.110, p = 0.112) and HAZ scores (rho = 0.233, p = 0.001). The same trend was observed between dietary diversity and household monthly food expenditure (rho = 0.071, p = 0.305) in the study population.

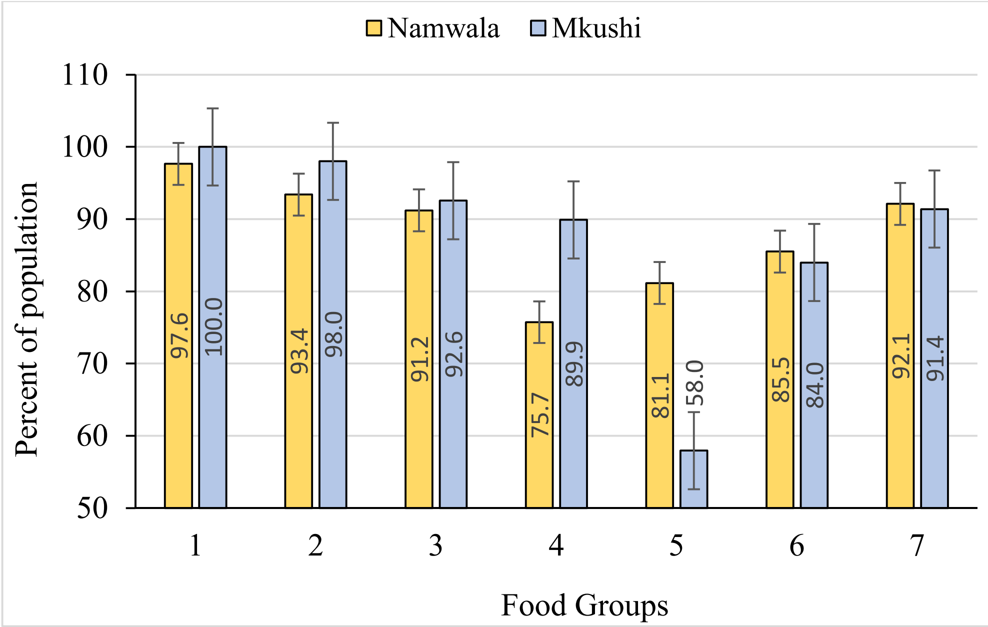

Figure 5: Food groups consumed by children in Namwala and Mkushi district

(1=Grains, roots and tubers, 2=Legumes, pulses and nuts, 3=Vitamin A rich fruits and vegetables, 4= Other fruits and vegetables, 5=Dairy products, 6=Eggs, 7=Flesh foods)

The foods consumed by the children in rural and urban areas of the two districts are also summarised in Figure 6. In both rural and urban areas of Namwala (98.7% rural and 96.6% urban) and Mkushi (100% rural and urban) district, the foods consumed the most were from food group 1 (grains, roots and tubers). The least consumed foods among children in rural Namwala were from food group 4 (other fruits and vegetables) as only 72.2% of this population had foods from this food group. In urban areas of Namwala district, children had less of food group 5 (dairy products). In Mkushi district on the other hand, the least consumed foods by the children in both rural and urban areas were dairy products at 46.3% and 69.6% respectively.

It was established using chi square test that there was a significant difference in the consumption of foods from food group 4 (dairy products) between children in rural and urban areas of Namwala ($X^2 = 5.124$, df = 1, p = 0.024) and Mkushi district ($X^2 =$ 3.878, df = 1, p = 0.044).

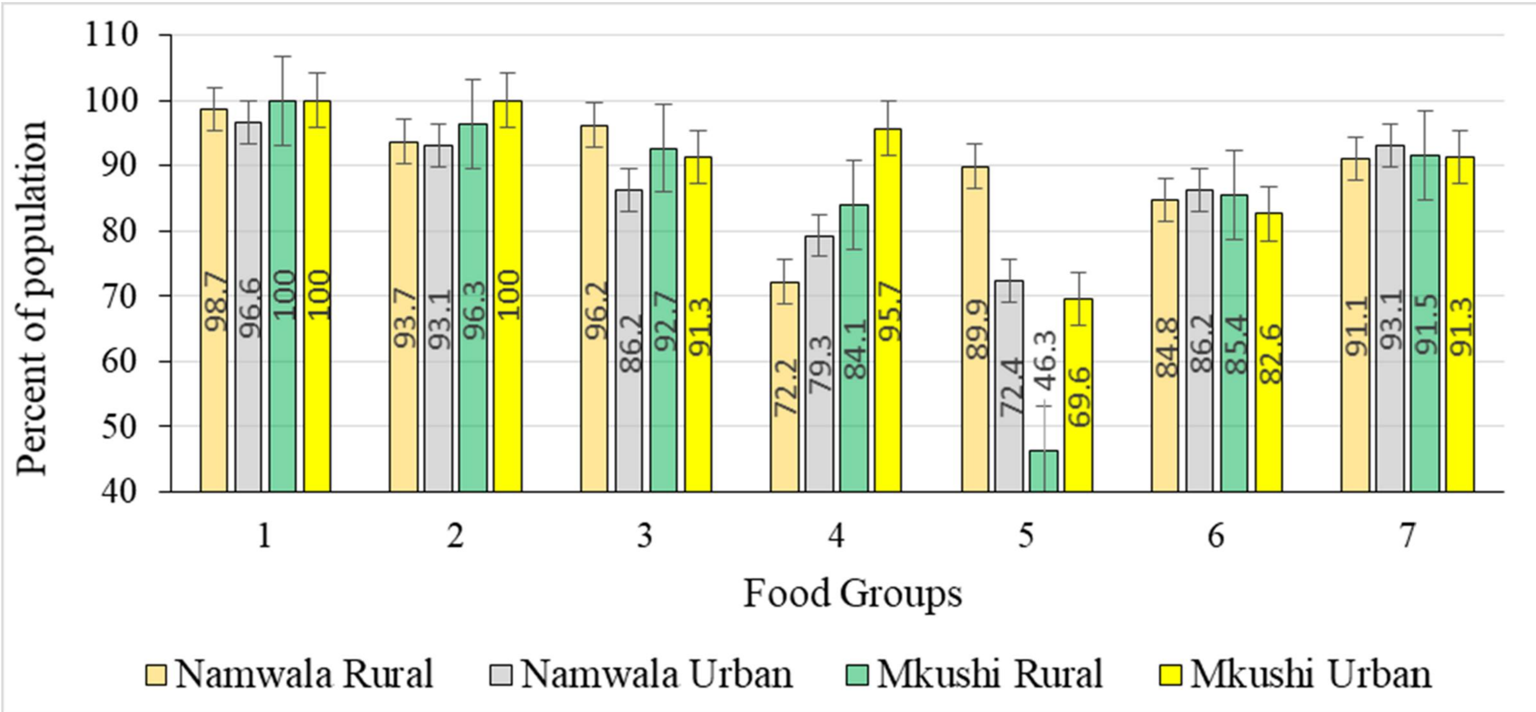

Figure 6: Food groups consumed by children in rural and urban areas

1=Grains, roots and tubers, 2=Legumes, pulses and nuts, 3=Vitamin A rich fruits and vegetables, 4=Other fruits and vegetables, 5=Dairy products, 6=Eggs, 7=Flesh foods

In the study sites, chi square test showed that there was a significant difference (p = 0.000) between the two districts in the consumption of fermented foods which include *chibwantu, munkoyo* and *mabisi* as seen in Figure 7. Compared to Namwala district, those in Mkushi had more *munkoyo* (60%) while children in Namwala district consumed more *chibwantu* (69.4%) and *mabisi* (66.7%).

Spearman correlation coefficient showed a significant association between HAZ score (rho = 0.198, p = 0.004), WAZ score (rho = 0.142, p = 0.039) and consumption of *mabisi.* There was no significant association between HAZ, WAZ and WHZ scores and the consumption of *chibwantu* and *munkoyo*.

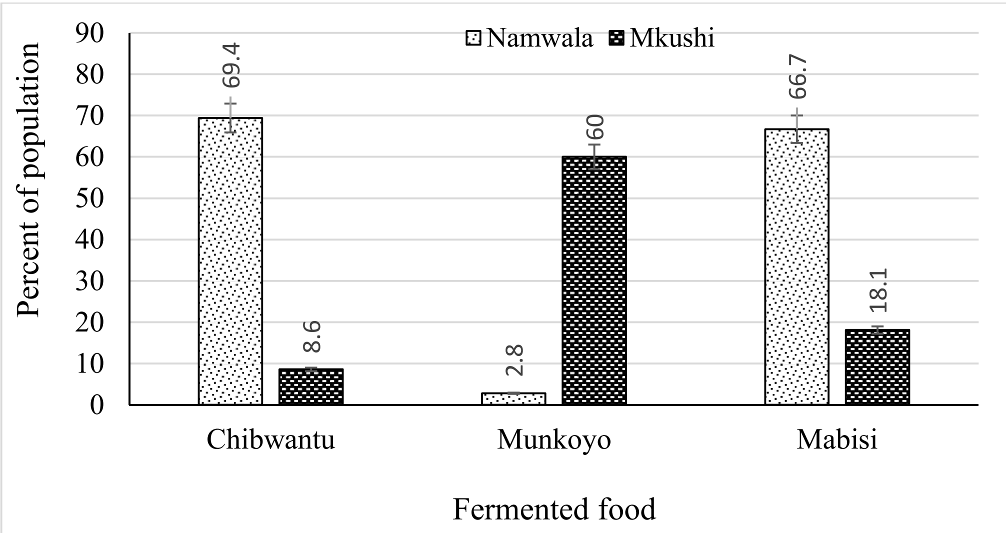

Figure 7: Fermented foods consumption in the study population

4.3 Nutrient intake of children in Namwala and Mkushi district

Table 5 presents the mean nutrient intake ± SD of children 6-23 months in Namwala and Mkushi district. Recommended nutrient intakes are age specific hence nutrient intake of study participants was separated into two categories, 6-12 months and 13-23 months. Compared to FAO/WHO recommendations, the mean intake of energy, vitamin A, vitamin C, calcium and zinc were low among children in the two age categories in both Namwala and Mkushi district. However, the mean intake of protein, vitamin B1, vitamin B2 and vitamin B6 was within recommended requirements in both districts.

Table 5: Mean nutrient intake of the study population

Nutrient	Namwala Mean intake	Mkushi Mean intake	p-value	Recommended intake
Energy (kcal)			0.040	
6-12 months	489 ± 40.6	746.5 ± 97.4		604
13-23 months	739.9 ± 46.9	739.7 ± 52.6		850
Carbohydrates (g)			0.031	
6-12 months	75.8 ± 6.8	114.4 ± 16.5		95
13-23 months	117.9 ± 7.4	124.8 ± 9.4		130
Fat (g)			0.152	
6-12 months	14.2 ± 1.5	20.3 ± 2.3		30
13-23 months	20.8 ± 1.7	17.4 ± 1.6		30
Protein (g)			0.039	
6-12 months	14.9 ± 1.3	22.6 ± 2.9		10.5
13-23 months	24.5 ± 1.7	24.7 ± 1.7		13.7
Vitamin A (µg)			0.443	
6-12 months	155.3 ± 24.6	177.4 ± 24.9		400
13-23 months	238.4 ± 33.3	261.3 ± 48.1		400
Vitamin B1 (mg)			0.018	
6-12 months	0.2 ± 0.0	0.4 ± 0.1		0.3
13-23 months	0.2 ± 0.0	0.3 ± 0.0		0.5
Vitamin B2 (mg)			0.448	
6-12 months	0.3 ± 0.0	0.5 ± 0.1		0.4
13-23 months	0.6 ± 0.1	0.4 ± 0.1		0.5
Vitamin B6 (mg)			0.197	
6-12 months	0.4 ± 0.1	0.6 ± 0.1		0.3
13-23 months	0.6 ± 0.1	0.6 ± 0.0		0.5
Vitamin C (mg)			0.920	
6-12 months	18.5 ± 3.1	24.7 ± 6.1		30
13-23 months	24.1 ± 4.4	21.9 ± 3.1		30
Folic acid (µg)			0.012	
6-12 months	65.7 ± 8.2	113.5 ± 20.8		80
13-23 months	81.8 ± 6.9	93.9 ± 7.1		150
Calcium (mg)			0.019	
6-12 months	110.2 ± 13.9	218.1 ± 38.2		400
13-23 months	164.3 ± 14.1	179.5 ± 20.5		400
Iron (mg)			0.133	
6-12 months	2.9 ± 0.5	6.1 ± 1.3		5.8
13-23 months	4.9 ± 0.7	4.2 ± 0.6		5.8
Zinc (mg)			0.021	
6-12 months	1.2 ± 0.1	2.3 ± 0.4		4.1
13-23 months	2.1 ± 0.2	2.1 ± 0.2		4.1

Recommended intake data source: FAO et al., (2001); FAO and WHO, (2004); FAO/WHO/UNU et al., (2007) The proportion of children that were breastfeeding was 85.2% and 73.3% in Namwala and Mkushi district respectively. However, data on frequency and quantity of breast milk consumed was not collected.

The FAO/WHO specifications for child nutrient intake were used to identify children who had adequate or inadequate dietary intake of vitamin A, B1, B2, B6, C, folic acid, calcium, iron, zinc, protein, and energy as shown in Table 6.

In both Namwala and Mkushi district, majority of the children had adequate dietary intake of protein (75% Namwala and 87% Mkushi) and vitamin B6 (64% Namwala and 72%). However, a large proportion of the children in both districts had inadequate dietary intake of energy, vitamin A, B1, B2, C, folic acid, calcium, iron and zinc.

One way analysis of variance (ANOVA) showed that there was a significant difference in the mean dietary intake of energy ($p = 0.040$), carbohydrates ($p = 0.031$), proteins ($p = 0.039$), vitamin B1 ($p = 0.018$), folic acid ($p = 0.012$), calcium ($p = 0.019$) and Zinc ($p = 0.021$) between children in Namwala district and those in Mkushi. No significant difference was observed in the dietary intake of fat, iron, vitamin A, vitamin B2, B6 and vitamin C.

In both rural and urban areas of Namwala district, a large proportion of the children had inadequate intake of zinc (72% rural and 26% urban), calcium (67% rural and 25% urban), iron (57% rural and 20% urban), vitamin A (66% rural and 20% urban) and vitamin B1 (67% rural and 19% urban) as shown in Figure 8. On the other hand, there was a higher proportion of children who had adequate protein (51% rural and 24% urban) and vitamin B6 (42% rural and 22% urban) intake compared to those whose intake of the two nutrients was inadequate.

Independent t-test established that there was a significant difference mean intake of carbohydrate ($t = -3.079$, $p = 0.003$), energy ($t = -3.018$, $p = 0.003$), Vitamin B1 ($t = -3.469$, $p = 0.001$), vitamin B2 ($t = -3.035$, $p = 0.003$), vitamin B6 ($t = -2.367$, $p = 0.02$) and folic acid ($t = -3.506$, $p = 0.001$) between the children in rural and urban areas of Namwala district. There was no significant difference in the nutrient intake adequacy of vitamin A, vitamin C, calcium, iron and zinc between rural and urban Namwala.

Table 6: Proportion of children with adequate/inadequate nutrient intake

Nutrient	Namwala n (%)	Mkushi n (%)	p-value
Energy			0.040
Adequate	38 (35.2)	41 (39)	
Inadequate	70 (65.8)	64 (61)	
Carbohydrate			0.031
Adequate	90 (83.3)	88 (83.8)	
Inadequate	18 (16.7)	17 (16.2)	
Fat			0.450
Adequate	70 (64.8)	59 (56.2)	
Inadequate	38 (35.2)	46 (43.8)	
Protein			0.039
Adequate	81 (75)	91 (86.7)	
Inadequate	25 (23.1)	13 (12.4)	
Vitamin A			0.443
Adequate	15 (13.9)	18 (17.1)	
Inadequate	93 (86.1)	87 (82.9)	
Vitamin B1			0.018
Adequate	14 (13)	25 (23.8)	
Inadequate	94 (87)	80 (76.2)	
Vitamin B2			0.448
Adequate	50 (46.3)	39 (37.1)	
Inadequate	58 (53.7)	66 (62.9)	
Vitamin B6			0.197
Adequate	69 (63.9)	76 (72.4)	
Inadequate	39 (36.1)	29 (27.6)	
Vitamin C			0.920
Adequate	31 (28.7)	22 (21)	
Inadequate	77 (71.3)	83 (79)	
Folic acid			0.012
Adequate	27 (25)	40 (38.1)	
Inadequate	81 (75)	65 (61.9)	
Calcium			0.019
Adequate	9 (8.3)	11 (10.5)	
Inadequate	99 (91.7)	94 (89.5)	
Iron			0.133
Adequate	25 (23.1)	22 (21)	
Inadequate	83 (76.9)	83 (79)	
Zinc			0.021
Adequate	2 (1.8)	10 (9.5)	
Inadequate	106 (98.2)	95 (90.5)	

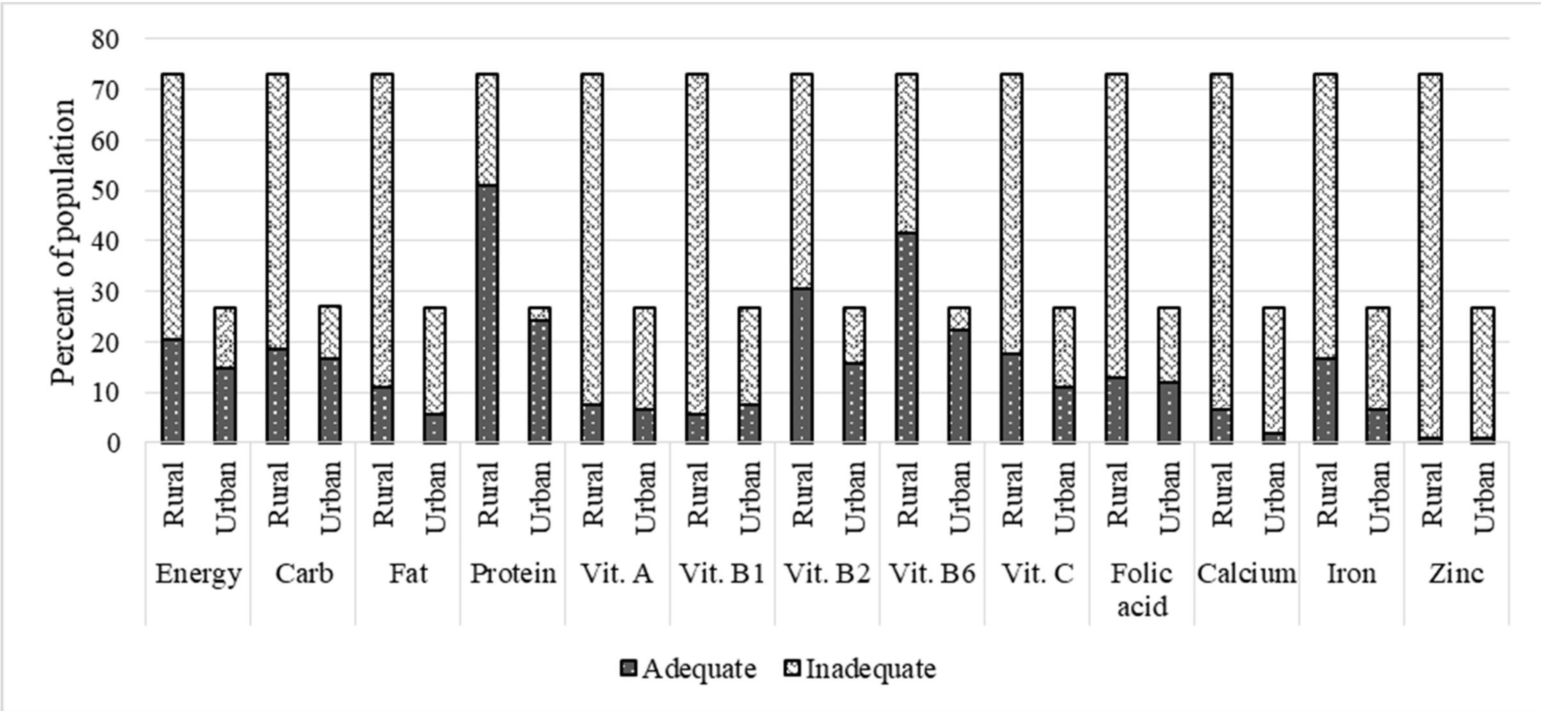

Figure 8: Nutrient adequacy/inadequacy among children in rural and urban Namwala

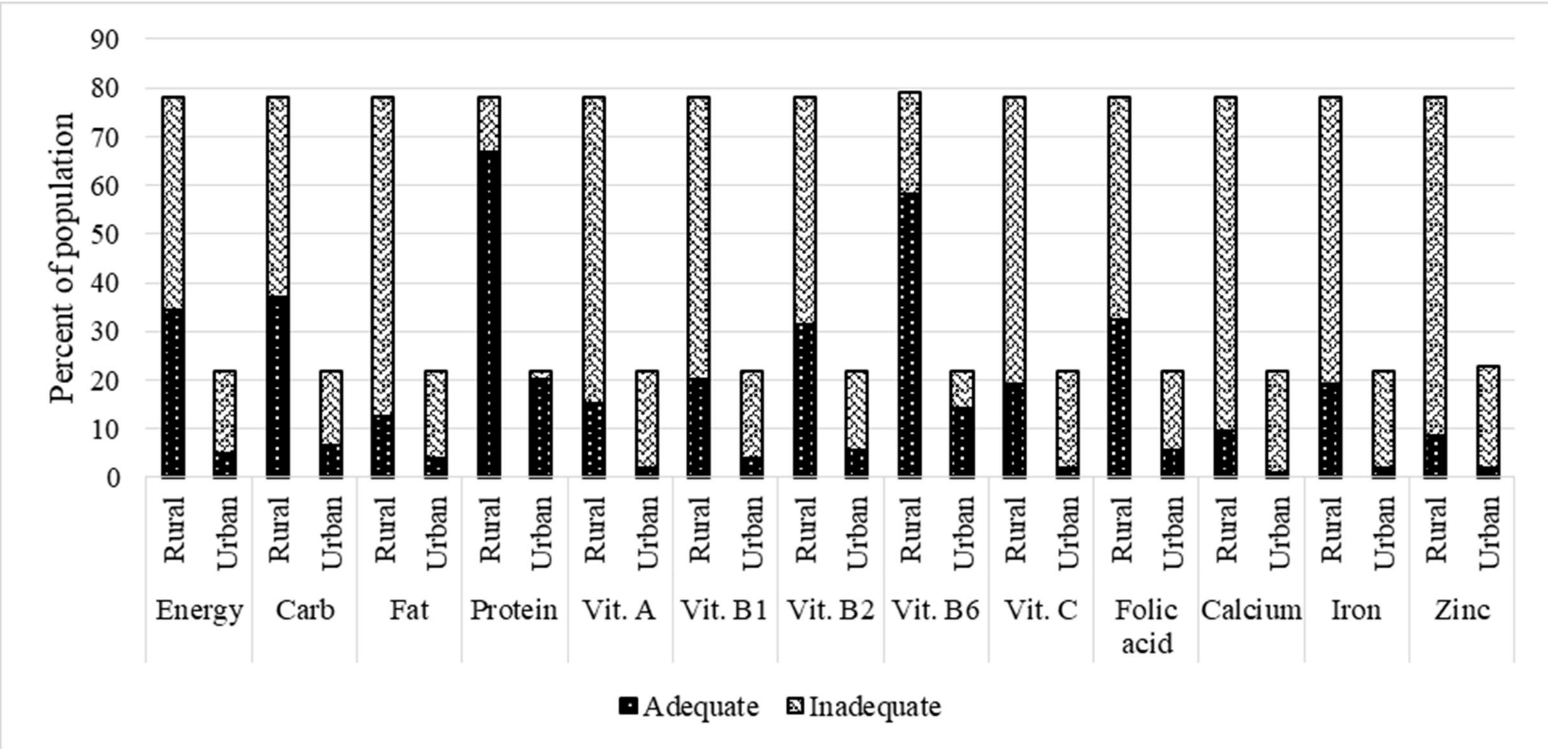

Figure 9: Nutrient adequacy/inadequacy among children in rural and urban Mkushi

Figure 9 shows that a high proportion of children in Mkushi had inadequate intake of zinc (70% rural and 21% urban), calcium (69% rural and 21% urban), iron (59% rural and 20% urban) and vitamin A (63% rural and 19% urban) among others. There was no statistically significant difference in the mean nutrient intake of energy, fat, protein, vitamin A, vitamin B1, vitamin B2, vitamin B6, vitamin C folic acid, iron and zinc between rural and urban areas of the district. However, a significant difference in the mean nutrient intake of carbohydrate was observed ($t = 2.186$, $p = 0.031$).

4.4 Prevalence of illnesses in the study population

Using the stool samples collected from only 60% of the study population, laboratory analysis results revealed that none of the children were infected with intestinal parasites.

However, 72% of the children in Namwala and 58% in Mkushi presented with illnesses which include diarrhoea, vomiting, fever, coughs and malaria as shown in Table 7. Data on illnesses was documented based on the caregivers' report of illness two weeks prior to the study and those that presented with one or more illnesses during the period of the study.

Common in both rural and urban areas of Namwala and Mkushi were cases of coughs/common flu, vomiting, fever and diarrhoea in children aged 6-23 months. Common in both districts was the presence of diarrhoea as more than 30% presented with the illness. In this study group, only 6% in Namwala and 30% in Mkushi had received deworming medication. Overall, using chi square test it was established that there was no significant difference in the proportion of children who presented with diarrhoea, vomiting, cough/common flu, and malaria between the two districts. However, there was a significant difference in the proportion of children with fever ($X^2 = 8.142$, $df = 1$, $p = 0.004$) and those who had received deworming medication ($X^2 = 20.625$, $df = 2$, $p = 0.000$) in the two sites.

Comparison of the children's health status was also done based on area of residence (rural or urban setting). Figure 10 illustrates that diarrhoea and fever were more common in both rural and urban areas as more than 35% of the children presented with the respective illnesses.

Table 7: Prevalence of illnesses in children aged 6-23 months in the study sites

Characteristic	Namwala n (%)	Mkushi n (%)	p-value
Child dewormed	7 (6)	31 (30)	0.000
Disease/illness present	78 (72)	61(58)	0.069
Diarrhoea	34 (31.5)	33 (31.4)	0.993
Vomiting	16 (14.8)	8 (7.6)	0.097
Fever	58 (53.7)	36 (34.3)	0.004
Cough/common flu	20 (18.5)	29 (27.6)	0.115
Malaria	19 (17.6)	10 (9.5)	0.086

Comparison of prevalence of illness in rural and urban set ups of the two districts using chi square test revealed that there was no significant difference in the proportion of children with diarrhoea, vomiting, fever, coughs and malaria. Spearman correlation showed that presence or absence of illness was not significantly associated with HAZ scores (rho = -0.105, p = 0.126)

It was established using Phi correlation that there was a negative association between consumption of *mabisi* (Phi = -0.007, p = 0.921) and the presence of diarrhoea in the study population. The same trend was observed between the consumption of *munkoyo* (Phi = -0.046, p = 0.503) and vomiting. However, weak positive associations were observed between consumption of *chibwantu* and *munkoyo* and the presence of diarrhoea. Similarly, consumption of *chibwantu* and *mabisi* showed a weak positive association with vomiting.

4.5 Nutritional status of children in Namwala and Mkushi district

Table 8 presents findings on the nutritional status of the study population where most of the children (>80%) in the two districts were neither stunted, wasted, overweight nor underweight. Overall, from the children sampled in Namwala district, 3.7% were underweight, 11% stunted, 3.7% wasted and 6.5% overweight. In Mkushi district, 10.5% of the children were underweight, 19.1% were stunted, 3.8% were wasted and 5.7% were overweight.

The prevalence of underweight, stunting and wasting was higher in rural Namwala (2.8% underweight, 8.3% stunted and 3.7% wasted) compared to urban areas (0.9% underweight, 2.7% stunted and none were wasted) of the district.

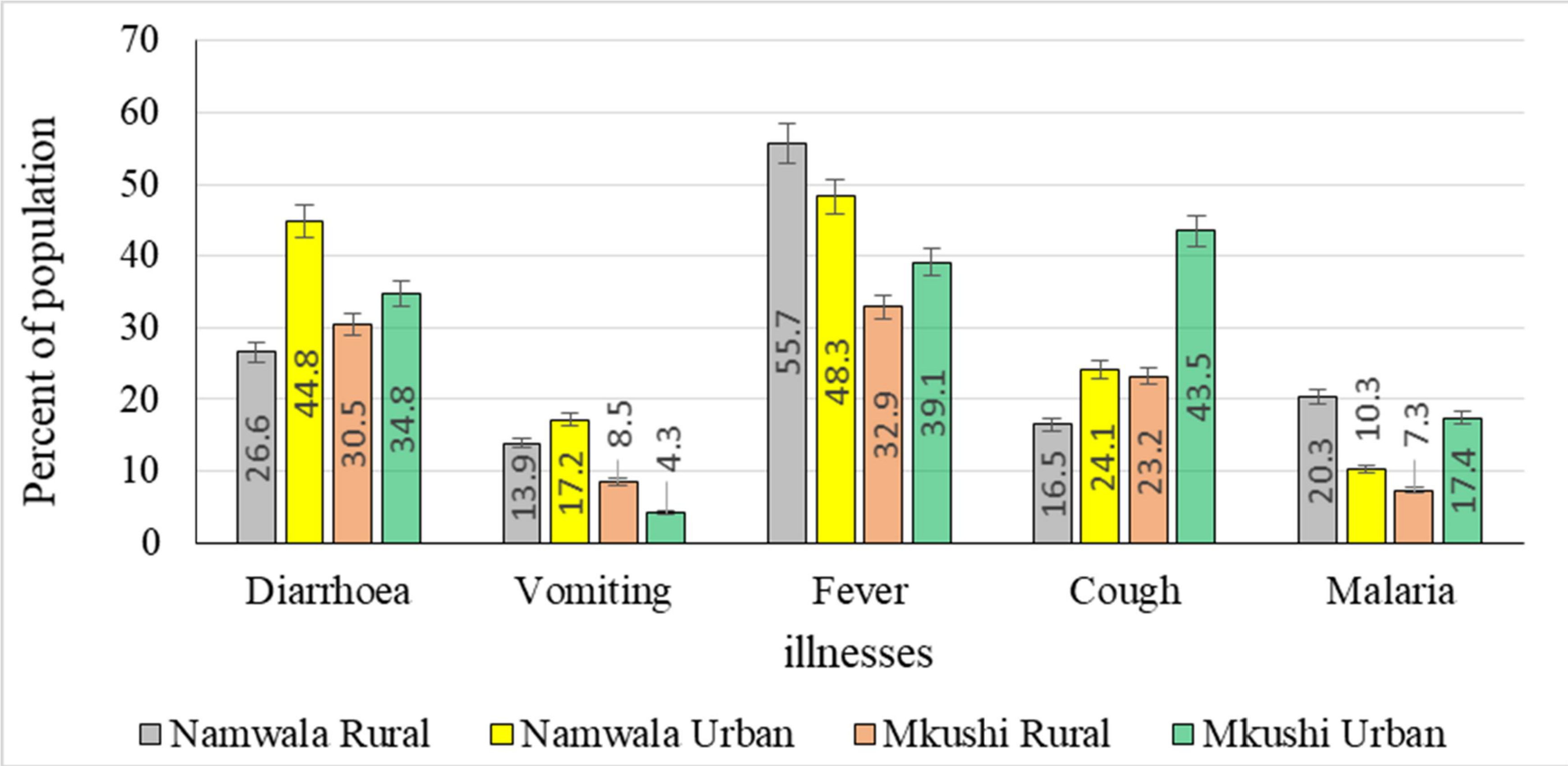

Figure 10: Prevalence of illnesses in rural and urban areas of the study sites

Likewise, underweight and stunting was higher in rural Mkushi (7.7% underweight and 16.3% stunted) in comparison to urban Mkushi (2.9% underweight and 2.9% stunted). However, the opposite was the case for wasting in the district where a higher proportion of children aged 6-23 months in urban (2.9%) were wasted compared to their rural (0.95%) counterparts.

Furthermore, a higher proportion boys of was underweight (3.7%), stunted (7.3%) and wasted (2.8%) compared to girls who were stunted (3.7%), wasted (0.9%) and none were underweight. Similarly, undernutrition was high in boys compared to girls in Mkushi district. The proportion of boys that were underweight was 6.7%, stunted (9.95%) and wasted (3.8%) while the girls who were underweight were 3.8%, stunted (9.55%) and none were wasted in this district. Based on geographic setting.

At district level, independent t-test showed that there was a significant difference in the mean HAZ scores (t = 3.245, p = 0.001) and WAZ scores (t = 2.556, p = 0.011) between Namwala and Mkushi and no significant difference in the WHZ scores were observed.

Table 8: Nutritional status of the study population

Category	**Namwala**	**Mkushi**	**p-value**
HAZ	**n (%)**	**n (%)**	0.001
Normal	96 (88.9)	85 (81.6)	
Moderately stunted	9 (8.3)	19 (18.1)	
Severely stunted	3 (2.8)	1 (1)	
Total	108 (100)	105 (100)	
WHZ	**n (%)**	**n (%)**	0.477
Normal	97 (89.8)	95 (90.5)	
Moderately wasted	3 (2.8)	3 (2.9)	
Severely wasted	1 (0.9)	1 (1)	
Overweight	7 (6.5)	6 (5.7)	
Total	108 (100)	105 (100)	
WAZ	**n (%)**	**n (%)**	0.011
Normal	104 (96.3)	94 (89.5)	
Moderately underweight	4 (3.7)	8 (7.6)	
Severely underweight	0 (0)	3 (2.9)	
Total	108 (100)	105 (100)	

Independent t-test was used to assess mean differences in HAZ ± SD, WHZ ± SD and WAZ ± SD based on district and area of residence as summarized in Table 9.

There was no significant difference in the mean HAZ, WHZ and WAZ between children in rural and urban areas and between boys and girls of Namwala district. On the contrary, there was a significant difference (t = 2.722, p = 0.008) in the mean WHZ scores in rural and urban Mkushi. No significant difference was observed between boys and girls in Mkushi district with regards to HAZ, WHZ and WAZ.

Table 9: Mean HAZ, WHZ and WAZ scores of children in the study population

	Area of residence	**Mean HAZ**	**Mean WHZ**	**Mean WAZ**
Namwala	Rural	-0.62 ± 1.41	0.17 ± 1.26	0.24 ± 1.16
	Urban	-0.20 ± 1.37	-0.15 ± 0.98	-0.02 ± 1.06
p-value	Rural/urban	0.166	0.947	0.369
Mkushi	Rural	-1.09 ± 0.92	0.21 ± 1.15	-0.49 ± 1.09
	Urban	0.86 ± 1.02	0.54 ± 1.24	-0.88 ± 1.23
p-value	Rural/Urban	0.289	0.008	0.145

4.6 Relationship between dietary intake, health status, socio-demographic variables and nutritional status

Multiple regression was used to identify factors that were significantly associated with nutritional status of children aged 6-23 months in Namwala and Mkushi district of Zambia as shown in Table 10. The dependent variable used in the analysis were HAZ scores. The model summary included $R^2 = 0.220$ and F = 1.814. Statistically, the factors that were significantly associated with the nutritional status of the study population were the child's age where adjusted B = -0.21; 95% CI [-0.092-(0.006)]; p = 0.025, caregivers education level where B = 0.389; 95% CI (0.009-1.916; p = 0.048, household non-food expenditure of ZMW 1501-3000 where B = 0.168; 95% CI (0.036-0.949); p = 0.035, household monthly non-food expenditure more than ZMW 4500 where adjusted B = - 0.16; 95% CI (-5.352-0.287); p = 0.029 and consumption of *mabisi* by the children where B = 0.234; 95% CI (0.160-0.989); p = 0.006.

Table 10: Regression results for factors that affect HAZ scores of children

Variable	**B**	**95% C.I.**	**p-value**
Childs's age (months)	-0.21	-0.092-(-0.006)	0.025
Sex of the child	0.094	-0.107-0.565	0.18
Area of residence (urban/rural)	0.146	-0.051-0.875	0.081
Caregiver's age (years)	0.019	-0.023-0.029	0.806
Caregiver's marital status	-0.024	-0.456-0.332	0.757
Number of people in the household	0.121	-0.009-0.083	0.118
Caregiver's education level (none)- Reference	1.000	-	1.000
Caregiver's education level (primary)	0.389	0.009-1.916	0.048
Caregiver's education level (secondary)	0.369	-0.052-1.851	0.064
Caregiver's education level (tertiary)	0.08	-0.904-1.981	0.462
Household food expenditure (<K500)- Reference	1.000	-	1.000
Household food expenditure (<K1000)	-0.015	-0.45-0.375	0.859
Household food expenditure (K1001-2500)	-0.019	-0.808-0.64	0.819
Household food expenditure (>K2500)	-0.089	-1.54-0.415	0.258
Household non-food expenditure (<K500)- Reference	1.000	-	1.000
Household non-food expenditure (<K1500)	0.168	0.036-0.949	0.035
Household non-food expenditure (<K1501-3000)	0.015	-0.68-0.83	0.846
Household non-food expenditure (K3001-4500)	-0.16	-5.352-(-0.287)	0.029
Household non-food expenditure (>K4500)	0.062	-1.64-3.81	0.433
Source of drinking water (other)- Reference	1.000	-	1.000
Source of drinking water (stream)	-0.371	-4.022-1.083	0.257
Source of drinking water (well)	-0.524	-3.978-1.177	0.285
Source of drinking water (dam)	-0.167	-4.119-1.468	0.35
Source of drinking water (borehole)	-0.534	-3.957-1.183	0.288
Source of drinking water (council supply)	-0.435	-3.741-1.294	0.339
Child breastfeeding (0=No, 1=Yes)	-0.085	-0.788-0.276	0.343
Dietary diversity	0.041	-0.665-1.182	0.582
Consumption of fermented foods			
Consumption of *mabisi*	0.234	0.166-0.989	0.006
Consumption of *munkoyo*	-0.037	-0.533-0.341	0.665
Consumption of *chibwantu*	0.06	-0.291-0.588	0.506
Child dewormed 4 weeks prior to study (0=No, 1=Yes	0.103	-0.139-0.729	0.181
Disease present 4 weeks prior to study (0=No, 1=Yes)	-0.114	-0.622-0.07	0.117
(Constant)	-0.789	-4.25-2.672	0.653

Where B is the adjusted beta coefficient and C.I is the confidence interval

CHAPTER FIVE: DISSCUSION

The main objective of this study was to determine the association between dietary intake, health status and nutritional status of children aged 6-23 months in Namwala and Mkushi district. The study showed that an increase in dietary intake resulted in an increase in HAZ scores while presence of illness was not significantly associated with HAZ scores. The cross sectional study was conducted in 2018. The findings are consistent with a study conducted on dietary diversity and infant growth in Zambia (Mallard et al., 2014). Similarly, study involving 11 countries across Africa, Asia and Latin America showed that dietary diversity was significantly associated with HAZ scores of children in this age group where positive associations were reported in 7 of the countries (Arimond and Ruel, 2004).

On the other hand, studies such as the one conducted by Chasekwa et al.,(2015) in Zimbabwe showed consistent evidence, acute illness was associated with suppressed growth and nutritional wellbeing of infants while frequent infections contributed to stunting in children in developing countries even though the casual pathways are not known. A number of studies have shown evidence linking childhood illnesses to malnutrition (Kedir Seid, 2013; Abeshu et al., 2016; Gari et al., 2018). The present study collected data at one point in time not frequency of infections or health status as a longitudinal exposure, factors which can be attributed to differences in observed results.

Dietary diversity is considered as one of the integral components in combating malnutrition. As a result, this study adopted dietary diversity as one of the indicators to assess infant and young child feeding practices in the study population. More than 90% of the children in the two districts combined had food from four or more food groups as recommended by the World Health Organization, (2008) for this age group. Dietary diversity indicator from the WHO guidelines was adopted because it takes into account both breastfeeding and non-breastfeeding children. However, 5.58% and 4.85% in Mkushi and Namwala did not meet the minimum dietary diversity requirement.

The 2013-2014 Zambia demographic health survey report shows that only 14.9% from Central province and 27.9% from Southern province of children 6-23 months of age met the minimum dietary diversity requirement (had food from 4 or more food groups) during the course of the survey (Central Statistical Office et al., 2015). Similarly, a study by Marinda et al., (2018) observed lower (35.6%) dietary diversity in children aged 6-23 months in Lusaka province of Zambia.

Therefore, results observed in this study show improvement in dietary diversity and consequently infant and young child feeding in the two regions. This phenomenon could be attributed to timing of data collection for this study and its influence on dietary habits which are associated with seasonal availability of some foods.

There was a positive association between caregiver’s level of education and the child’s dietary diversity. This finding is consistent with a study conducted in Ethiopia by Solomon et al., (2017) where caregiver’s educational attainment was significantly associated with minimum dietary diversity in comparison to those that had no formal education. Therefore, this phenomenon suggests that parents or caregivers see the importance of varying their child’s diet below the age of 2 years. Furthermore, it was observed that the more the monthly food expenditure, the more the dietary diversity among the children in the study population.

In rural and urban areas of the study sites, the most consumed foods were starchy foods comprising of grains, roots and tubers while the least consumed foods were dairy products and other fruits and vegetables for Mkushi and Namwala respectively. However, there were some differences between the two districts in the consumption of foods from the various food groups. This can be attributed to difference in agro-ecological location and resultant socio-economic characteristics. Namwala district of Southern province for example, is known for livestock production compared to Mkushi district in Central province (Ministry of National Development and Planning, 2017). This can therefore be linked to the observed high intake of dairy products by the study participants in Namwala compared to those in Mkushi district. It was also observed that children in rural Namwala consumed more dairy products compared to their urban counterparts.

This is because livestock production is higher in rural Namwala compared to urban areas of the district thus increasing availability of dairy products. Seasonality and limited availability of some fruits and vegetables in food group 4 contributed to the low intake observed in the study for both rural and urban areas of Namwala district.

Grains such as maize are a staple food countrywide thus a common factor contributing to the high intake in the two study sites. The findings are consistent with what was observed in the nation-wide survey as well as in the food consumption study in Lusaka by Central Statistical Office et al., (2015) and Marinda et al., (2018), respectively. Another study carried out in Ethiopia showed that grains, roots and tubers were one of the most consumed foods by children in this age group (Eshete et al., 2018). Similar to this study, this shows that caregivers feed their children the most accessible food.

Furthermore, of interest in the study was the consumption of fermented products such as *mabisi* (sour milk), and *chibwantu* and *munkoyo* (cereal based products). Children in Namwala had more *mabisi* and *chibwantu* while those in Mkushi had more *munkoyo*. In the present study, consumption of *mabisi* was negatively associated with presence of diarrhoea in the study population. Consumption of m*unkoyo* was also observed to be negatively associated with vomiting among the children. Furthermore, consumption of *Mabisi* and *chibwantu* was positively associated with HAZ scores of the study population. This is in agreement with findings on studies involving fermented foods and their nutritional and health potential (Laurent-Babot and Guyot, 2017; Gille et al., 2018). Schoustra et al., (2013), established that fermented products promote improved gastrointestinal tract function. Likewise, children in the study did not present with intestinal parasites as more than half of the study population in both Namwala and Mkushi consume one or more of these fermented products.

The study also assessed some of the nutrients important for child development and growth as summarised by Michaelsen et al., (2000) namely, protein, fat, carbohydrates, energy, vitamin A, vitamin B1, vitamin B2, vitamin B6, vitamin C, folic acid, calcium, iron and zinc. Comparison of the nutrient intake in the two sites revealed that there was a statistically significant difference in the intake of energy, protein, vitamin B1, calcium and zinc among the children. The study was also characterised by a high proportion of children who did not meet minimum nutrient intake requirements (inadequate intake) of energy, vitamin A, vitamin B1, vitamin B2, vitamin C, folic acid, calcium, iron and zinc.

The National Food and Nutrition Commission, (2011) reports prevalence of vitamin A deficiency in the country to be 53.3%, and 53% iron deficiency among others. Other studies on nutritional adequacy of local foods consumed by children aged 6-23 months in Tanzania shows evidence of nutrient intake inadequacy of iron, zinc and calcium (Raymond et al., 2017) while a study on dietary intake of children in Malaysia shows inadequacies in the intake of, vitamin A, energy and calcium (Poh et al., 2013). Differences in the actual nutrients that are adequate/inadequate in the present study to that of other studies can be attributed to quantity and types of food consumed by study participants. For example, although children in Namwala consumed more dairy products, a high proportion had inadequate calcium intake. On the other hand, a small proportion of children consumed fruits and vegetables which can be associated with the high proportion of children who had inadequate intake of vitamin C.

Consumption of local foods has the potential to contribute in achieving recommended dietary intake of macro and micronutrients (Caswell et al., 2015; Zhang et al., 2016) especially for children in this age group.

The study participants in both Namwala and Mkushi district did not present with intestinal parasites thus its effect on nutritional status was not established. However, a study on intestinal infections in under 5 children in Zambia showed that the prevalence of intestinal infections was 19.6% (Mwale and Siziya, 2015b). Despite these findings in the present study, only 18% of the participants were dewormed 2 weeks prior to the study. Overall, the Central Statistical Office et al., (2015), disclosed that only 60.6% of children aged 6-59 months were dewormed in the country during the 2013-14 nation-wide. The absence of worms could be linked to other factors such as improved sanitation. Child deworming was positively associated with HAZ scores of the children.

In the study population, 65.7% of the children presented with one or more illnesses. In this particular study, a higher proportion of children in urban areas of both Namwala and Mkushi districts presented with one or more illnesses compared to their rural counterparts. The 2015 Zambian living conditions monitoring survey reported that the proportion of children aged 0-4 years who presented with similar illnesses two weeks to and/or during the survey was 24.6% of the population with Central province (15.4%) having a higher distribution compared to Southern province (13.3%). On the other hand, the report stipulates that illnesses are more prominent in people living in rural areas compared to those in urban areas (Central Statistical Office, 2016). A high prevalence of illness among children under the age of 5 years in Zambia has also been reported in previous studies such as the one on the burden of fever by Yeboah-Antwi et al., (2010) and the burden of flu by Theo et al., (2018).

In Zambia, malnutrition continues to be a challenge among children in this age group. Anthropometric measurements conducted on the children allowed for evaluation and determination of the children's nutritional status. Stunting, underweight and wasting, prevalence rates at provincial level was found to be 53.9%, 11.45 and 5.6% for Central province while southern province had 43.7%, 10.2% and 5.8% in the recent Zambian living conditions monitoring survey report respectively (Central Statistical Office, 2016). However, results obtained at district level indicate that stunting, underweight and wasting were 11.1%, 3.7% and 3.7% for Namwala and 19%, 10.5% and 3.8% in Mkushi respectively. It is therefore evident that malnutrition is high even at district level. The findings at district level were consistent with the literature which shows that stunting levels are higher in Central province in comparison to Southern province. Some of the factors that have been attributed to the difference in stunting levels between the two provinces include but not limited to differences in agricultural activities involving fisheries, livestock and crop production (Ministry of National Development and Planning, 2017) and consequently dietary diversity and level of education of the mother and poverty status (Central Statistical Office, 2016). Overweight and obesity have mainly been associated with developed countries. Unfortunately, some developing countries such as Zambia have been affected and children are not an exception. In Zambia for instance, 1% of children under the age of 5 years are overweight (National Food and Nutrition Commission, 2011). This has also been observed in this study where 6.5% of the study participants in Namwala and 5.7% in Mkushi were overweight, and this most likely may be attributed to the high intake of sugary foods, fats and oils observed in the study.

The study was not without limitations, a cross sectional design was used for this study thus limiting its use to establish casual relationships. Therefore, only associations could be described. The study assumed that all the mothers or caregivers of the children identified in both the rural and urban setting of the two districts would provide stool samples and dietary related information in a timely, detailed and honest manner. Furthermore, most parts of the questionnaire in the study required good memory of the parent/caregiver thus making the study open to recall bias. In addition, questions that were considered sensitive to the caregivers were susceptible to responses that were socially acceptable. Therefore, caregivers were interviewed individually in privacy and requested to repeat responses for consistency in data provided. In addition, the dietary recall tool used in the study was applied at one point in time due to the cross sectional nature of the study thus limiting collection of usual food and nutrient intake information.

Despite having a large proportion (72%) of children that were breastfeeding in the study population, data on the quantity of breast milk consumed was not collected. These children may therefore have had higher nutrient intake than documented in the study as a result of additional nutrients obtained from the breast milk.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The study established that dietary intake assessed using dietary diversity, had a weak positive association with child nutritional status. On the other hand, results show no association between health status and child nutritional status. Despite having a large proportion of children meeting the minimum dietary diversity requirement in both districts, they had inadequate dietary intake of zinc, calcium, iron, folic acid, vitamin C, vitamin B1 and vitamin A. Furthermore, consumption of fermented products such as *mabisi* and *munkoyo* was negatively associated with diarrhoea and vomiting respectively. HAZ scores of the study population were also negatively associated with consumption of *mabisi*.

A large proportion (>60%) of children in the study presented with illness such as coughs, diarrhoea, malaria, vomiting and fever. On the other hand, none of them had intestinal parasites thus its effect on nutritional status was not established.

The prevalence of undernutrition was higher among children in Mkushi compared to their counterparts in Namwala district. Conversely, a higher proportion of children in Namwala district were overweight compared to those in Mkushi district. The null hypothesis that there was no significant difference in the nutritional status of children in Namwala and Mkushi district is rejected due to a statistically significant difference in the HAZ scores of children in the two districts.

6.2 Recommendations

Macronutrient and micronutrient intake gaps were identified in both Namwala and Mkushi district thus the need for children to frequently consume nutrient dense foods from all the WHO recommended food groups in order to improve their nutritional wellbeing.

Despite study results indicating that health status was not significantly associated with child nutritional status, a large proportion of children presented with one or more illnesses. It was also observed that, consumption of fermented products was negatively associated with presence of diarrhoea and vomiting. Therefore, children in this age group should consume more *mabisi*, *chibwantu* and *munkoyo* for improved gastrointestinal function. In addition, government and development partners need to intensify disease prevention programs for children in this age group.

The government through the ministry of health needs to provide improved access to refined prevalence and trend information in relation to child nutrition wellbeing, illness, parasitic infections and/or dietary intake. This will aid in development and improvement of targeted interventions to mitigate child malnutrition and fill existing knowledge gaps.

Factors that contribute to nutrition status of children in this age group are complex and difficult to completely measure in a cross sectional study thus need for further research in this subject in the two districts. Considering the scope of the study was limited to two districts, further studies assessing factors that contribute to nutrition status of children need to be conducted at national level.

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APPENDICES

APPENDIX A: INFORMATION SHEET

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF FOOD SCIENCE AND NUTRITION

Effect of dietary intake and intestinal parasites on the nutritional status of children aged 6-23 months in Namwala and Mkushi districts of Zambia.

INFORMATION SHEET

This information sheet is for parents or legal guardians of children aged 6-23 months in the study site who will be invited to participate in the research study.

Introduction

My name is Bubala Thandie Hamaimbo. I am currently an MSc Human Nutrition student at the University of Zambia and is conducting this research as part of the requirements for the master's program. You and your child aged between 6-23 months are being invited to take part in this research study. Therefore, it is important for you to understand why the research is being conducted and what it would involve for you and your child.

What is the purpose of the study?

The purpose of this study is to determine the dietary intake, check for presence of intestinal parasites, and consequently understand the effect of the two parameters on the nutrition status of the child. This involves speaking to the parent or legal guardian of the child, collecting stool samples and conducting nutrition based physical assessments on the child. The stool specimen collected will checked for presence of intestinal parasites only.

Why has my child been invited?

Your child has been invited to participate in this research because he/she is between the age of 6-23 months and lives in an area of interest for this research. We believe the findings of this study will add to the body of knowledge in understanding some of the factors affecting the nutritional wellbeing of children in this age group in Zambia.

Do we, my child and I, have to take part in the study?

No, you and your child do not have to take part in the study. As a legal guardian, you can choose whether he/she should participate and can also withdraw at any point without giving any reason and without penalty.

What are the possible disadvantages and risks of taking part?

As the questionnaire is being administered, some questions might touch on too sensitive issues for you and your child, you can skip any question that you do not wish to answer.

Continuous observation for signs of distress will made by the researcher during the assessment. If any, then the assessment will stop or be continued at a later time with the parent's permission.

What will happen to my child's information?

Information obtained about you and your child during the course of the study will be handled with strict confidentiality. We do not intend to share the information with anyone outside the research team. However, the knowledge that we will get from this research will be shared with the University of Zambia and other related stakeholders.

Who can I contact?

For more information about the study, you can contact:

The researcher: Bubala Thandie Hamaimbo
C/O The University of Zambia
School of Agriculture Sciences
Department of Food Science and Nutrition
Great East road campus, Lusaka.
Mobile: +260979506528
Email: thandiehamaimbo@gmail.com

The Chairperson
University of Zambia
Biomedical Research Ethics Committee
P.O Box 50110
Ridgeway, Lusaka
Tel: +260-211-256067
Email: unzarec@zamtel.zm

APPENDIX B: PARENTAL CONSENT FORM

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF FOOD SCIENCE AND NUTRITION

Parental Consent form

I understand that participation in this study is entirely voluntary, my identity and that of my child will not be revealed and that we can withdraw from the study at any point with no penalty. Instructions and scope of the study have clearly been explained to me. As a legal guardian to this child, I hereby give consent for my child to participate in this study titled "*Effect of dietary intake and intestinal parasites on the nutritional status of children aged 6-23 months in Namwala and Mkushi districts of Zambia.*" Additionally, I have willingly decided to provide all necessary information relating to the child that is required for the study.

Name of legal guardian: ………………………………………………………………………..

Signature/thumbprint of study participant: ………………………… Date: ………………..

Witnessed by: ……………………………………………………… Date: …………………

Signature of researcher: …………………………………………… Date: …………………

Bubala Thandie Hamaimbo

C/o University of Zambia,

School of Agriculture Sciences,

Department of Food Science and Nutrition,

Mobile: +260979506528 Email: thandiehamaimbo@gmail.com

APPENDIX C: STUDY QUESTIONAIRE

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF FOOD SCIENCE AND NUTRITION

Effect of dietary intake and intestinal parasites on the nutritional status of children aged 6-23 months in Namwala and Mkushi districts of Zambia.

STUDY QUESTIONNAIRE

Instructions

This questionnaire shall be administered to parents or legal guardians of selected children aged 6-23 months in Namwala and Mkushi districts of Zambia. The researcher shall introduce herself and clearly explain the scope of the study and type of information required. Before proceeding to administer the questionnaire, the consent form will be given to the participant for review and then signed by both parties.

Identification

District: …………………………………

Township: ………………………………

Participant designated ID Number: …………………………….

Date of interview/assessment: ……………………………..

SECTION A

Socio-economic, demographic and health characteristics

Questions for the parent or legal guardian of the child. Cross out appropriate answer or equation by marking it with "X" and fill in the spaces provided accordingly.

Stool sample collected	Yes….. No……

1. How old are you?	…………… Years
2. What is your relationship to the child?	i. Mother ii. Father iii. Other, specify ………………
3. Are you married?	i. Yes ii. No iii. Other, Specify ……………….
4. What is your level of education?	i. None ii. Primary level (Grade 1-7) iii. Secondary level (Grade 8-12) iv. Tertiary level (College, University)
5. What is the level of education of the father to the child?	i. None ii. Primary level (Grade 1-7) iii. Secondary level (Grade 8-12) iv. Tertiary level (College, University)
6. What is your estimated food and non-food expenditure per month?	Monthly food expenditure (ZMW) i. < 500 ii. 501-1000 iii. 1001-2000 iv. 2001-3000 v. >3000 Monthly non-food expenditure (ZMW) i. < 500 ii. 500-1500 iii. 1501-3000 iv. 3001-4500 v. >4500
7. How many people live in your household?	0-5 years: …….. 6-10 years: ……. 11-15 years: …….. 16 years and above: ………. Total: ……….
8. What is the source of your drinking water?	i. Stream ii. Well iii. Dam iv. Borehole

	v. Tap water (from local water supply company) vi. Other, specify ………………………
9. Main material of the housing floor	i. Cement ii. Earth iii. Dung iv. Tiles v. Other, specify ………..
10. Main material of the housing walls	i. Mud ii. Wood iii. Concrete iv. Other, specify ………
11. Has the child been dewormed in the last 2 weeks?	i. Yes ii. No
12. Has the child presented/been diagnosed with any of the following illnesses in the last 2 weeks or at present?	i. Malaria: Yes ……. No ……. ii. Diarrhoea: Yes …… No ……. iii. Vomiting: Yes ……. No ……. iv. Fever: Yes …… No ……. v. Anaemia: Yes …… No …….. vi. Other, specify ………………..
13. Do you keep any domestic animals/pets?	i. Yes ii. No

SECTION B

Child anthropometry assessment

14. What is the sex of the child?	i. Female ii. Male
15. Date of birth (DOB) on clinic card	DD/MM/YEAR
16. Weight (kg)	
17. Height (cm)	
18. Mid upper arm circumference (cm)	
19. Body Mass Index (BMI)	

SECTION C

Diet recall and food frequency assessment

20. Is the child currently being breast fed?	i. Yes ii. No
21. Is the child taking any complementary food?	i. Yes ii. No

Instructions: Diet recall

- Look at the table below and request the participant to think about the food that they fed their child in the last 24 hours.
- Indicate food taken by the child for the respective meal. Record ingredient(s) used in the food preparation and their estimated quantity in grams or cup size.
- Repeat the diet recall on another day

Diet recall

MEAL	Day 1		Day 2	
	Food item	**Quantity**	**Food item**	**Quantity**
Breakfast				
Snack				
Lunch				
Snack				
Dinner				
Snack				
Supplements: **Comment (s):**				

Instructions: Food Frequency

- Read the food item list (column 1)
- Ask the participant to think back carefully over the past week and determine how often they fed specific food items from each food category to the child. If the child has not had the food listed in the past week or does not consume the food at all, mark "No" in column 2.
- If the child does eat/drink the food more regularly, take note of how often he/she eats/drinks it per week, or per day and mark "X" in the box under the corresponding food item heading.
- Only make one cross "X" for each item in the list e.g. for each row in the table.
- Encourage and probe the participant to answer each question as best as they can; he or she can estimate if not sure.

FOOD CATEGORY	Food Consumed Yes/No	Once a week	2-4 /week	5-6 /week	Once a day	2-3 /day	4-5 /day	6+ /day	Comment(s)
a. Grains, roots and tubers-porridge, mash									
Maize									
Millet									
Sorghum									
Rice									
Cereal blend. Specify….									
Chibwantu									
Mukonkyo									
Maheu									
Sweet potato									
Irish potato									
Cassava									
Other, specify ………..									
b. Legumes, pulses and nuts									
Beans									
Soy beans									
Cow peas									
Bambara nuts									
Peanuts									
Other, specify ……….									
c. Vitamin A rich vegetables and fruit- whole, blend or pureed									
Rape									

Spinach									
Chibwabwa(pumpkin leaves)									
Carrots									
Bondwe(Amaranth)									
Sweet potato leaves									
Other vegetables. Specify,……..									
Examples of fruits: mango, guava, papaya									
d. Other fruits and vegetables, specify ……									
Banana									
Pineapple									
Other. Specify, ….									
e. Dairy products									
Fresh milk									
Sour milk (mabisi)									
Powdered milk(cowbell, nido)									
Milk drinks- drinking yoghurt, smoothies,									
Cheese									
Other, specify ………									
f. Eggs									
Chicken eggs									
Duck eggs									
Other. Specify,……									
g. Flesh foods									
Fish									

Chicken									
Beef									
Sausage									
Pork									
Organ meat									
Insects (eg Mopani worms, termites)									
Other, specify ………									
h. Other foods									
Oils									
Fats (butter, lard)									
Confectionary (sweets)									
Beverages (tea, sugar solution, sweetened drinks)									

APPENDIX D: COMMUNITY HEALTH WORKERS ENROLLED

List of community health workers enrolled in the study

Name	NRC number	Location
1. Miyoba Mweemba	637660/11/1	Namwala
2. Billy Chirwa	143410/72/1	Namwala
3. Victor Kaacha	166356/72/1	Namwala
4. Racheal Chizongo	133931/72/1	Namwala
5. Angelina Muchindu	219138/73/1	Namwala
6. Mainza Muteteka	353030/16/1	Namwala
7. Reuben Kanene	267225/31/1	Namwala
8. Eunice Mungubwe	171552/42/1	Mkushi
9. Lina Nawakwi	200605/13/1	Mkushi
10. Dembo Lubwika	230763/13/1	Mkushi
11. Wynfred Musonda	182625/13/1	Mkushi
12. Esneya Chanda	211451/61/1	Mkushi
13. Charity Luneta	197218/76/1	Mkushi

APPENDIX E: ETHICAL CLEARANCE

THE UNIVERSITY OF ZAMBIA

BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
Fax: + 260-1-250753
E-mail: unzarec@unza.zm
Assurance No. FWA00000338
IRB00001131 of IORG0000774

Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia

8th June, 2018. Ref: **002-04-18.**

Ms. Bubala T. Hamaimbo,
The University of Zambia,
Department of Food Science and Nutrition,
P. O. Box 32375,
Lusaka.

Dear Ms. Hamaimbo

RE: "EFFECTS OF DIETARY INTAKE AND INTESTINAL PARASITES ON THE NUTRITIONAL STATUS OF CHILDREN AGED 6-23 MONTHS IN NAMWALA AND MKUSHI DISTRICTS IN ZAMBIA" (Ref. No. 002-04-18)

The above-mentioned research proposal was presented to the Biomedical Research Ethics Committee (UNZABREC) on 25th April, 2018. The proposal is approved. The approval is based on the following documents that were submitted for review:

a) **Study proposal**
b) **Questionnaires**
c) **Participant Consent Form**

APPROVAL NUMBER : REF. 002-04-18

This number should be used on all correspondence, consent forms and documents as appropriate.

- **APPROVAL DATE : 7th June 2018**
- TYPE OF APPROVAL : Standard
- **APPROVAL EXPIRATION DATE: 6th June 2019**
  After this date, this project may only continue upon renewal. For purposes of renewal, a progress report on a standard form obtainable from the UNZABREC Offices should be submitted one month before the expiration date for continuing review.
- **SERIOUS ADVERSE EVENT REPORTING**: All SAEs and any other serious challenges/problems having to do with participant welfare, participant safety and study integrity must be reported to UNZABREC within 3 working days using standard forms obtainable from UNZABREC.
- **MODIFICATIONS**: Prior UNZABREC approval using standard forms obtainable from the UNZABREC Offices is required before implementing any changes in the Protocol (including changes in the consent documents).
- **TERMINATION OF STUDY**: On termination of a study, a report has to be submitted to the UNZABREC using standard forms obtainable from the UNZABREC Offices.
- **NHRA:** Where appropriate, apply in writing to the National Heath Research Authority for permission before you embark on the study.
- **QUESTIONS**: Please contact the UNZABREC on Telephone No. 256067 or by e-mail on unzarec@unza.zm
- **OTHER:** Please be reminded to send in copies of your research findings/results for our records. You're also required to submit electronic copies of your publications in peer-reviewed journals that may emanate from this study.

Yours sincerely,

Dr. S.H Nzala