NUTRITION STATUS OF PRESCHOOL CHILDREN DURING HARVEST AND LEAN SEASONS IN A HIGH AGRICULTURAL PRODUCTION REGION: THE CASE OF URBAN AND RURAL RESOURCE POOR HOUSEHOLDS IN TRANS NZOIA COUNTY, KENYA

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DECLARATION

I, Evans Kosgei Toroitich, hereby declare that this research study is my original work and to my knowledge has not been submitted to any other institution of higher learning

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Dr Alice Mbogaine Mwangi Date

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DEDICATION

I dedicate this work to my parents, Mr and Mrs Chepkonga for their investing in my education and my wife, Lucy Kibuthi for her encouragement in seeing that I complete the study.

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I wish to acknowledge the following people who enabled me complete this study.

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ACRONYMS AND ABBREVIATIONS

CDC: Center for Disease Control

ENA: Emergency Nutrition Assessment

FGD: Focus Group Discussion

IDDS: Individual Dietary Diversity Score

KNBS: Kenya National Bureau of Standards

MOA: Ministry of Agriculture

MOPHS: Ministry of Public Health and Sanitation

SPSS VERSION 16, 2007: Statistical Package for Social Scientists

OPERATIONAL DEFINITION OF TERMS

Seasonality: Variation of factors affecting household food security and nutritional status of children 6-59 months between pre-harvest and post-harvest seasons

Residence: Rural households or Urban Households

Preschool children: Children aged 6-59 months

Household: Individuals who are considered during preparation of meals in a house i.e. eat from the same pot.

Resource-poor household: persons residing in mud-walled houses and located in the informal settlement in the urban area and persons residing in mud-walled houses in the rural area who rely absolutely on subsistence farming.

Positive Deviance/Hearth: the observation that in most settings a few at risk individuals follow uncommon, beneficial practices and consequently experience better outcomes than their neighbours who share similar risks (Berggren and Wray, 2002)

ABSTRACT

High agricultural production regions are assumed to be food secure and thus overlooked in regards to food and nutrition security interventions. However, resource-poor households in such regions are likely to suffer malnutrition and be negatively affected by seasonal food availability variations. The main objective of this study was to assess the relationship between nutritional status and season among preschool children from resource-poor households in rural and urban Trans Nzoia County.

The study employed an observational longitudinal study design on 90 children under five years from resource-poor households in Kipsongok informal settlement, Kitale town (urban) and Chepsiro sub-location (rural), in Trans Nzoia County. Their nutrition status was assessed using anthropometric measurements before and after the harvest season of the County's major crop, maize. The education level, occupation and marital status of household heads and primary care givers was obtained and associated with the nutrition status of the preschoolers to determine the degree to which they influenced nutrition status. The dietary diversity of the preschoolers in both seasons was also investigated. The influence of season and residence on nutrition status was tested using statistical procedures of student's t-test and 2-way ANOVA, at 95% confidence interval.

A significantly higher proportion ($p=0.019$) of care givers in the urban area were married (83.3%) compared to their rural counterparts (65.1%). Rural household heads were more schooled with 33.7 % having completed secondary education compared to 7 % of urban household heads ($P=0.013$). Similarly, 64% of the urban female care givers completed their primary education compared to 80.2% of their rural counterparts.

A significantly higher proportion (P=0.047) of urban children were stunted (40%) during the pre-harvest period compared to rural children (19%). There was a significant difference in the wasting rates of urban (21%) and rural preschoolers (9%) (P=0.038) within the pre-harvest season. Significant reduction in the wasting rates of both urban and rural preschoolers was noted after harvest (9% and 6% respectively). In the pre-harvest season, the mean dietary diversity score of urban preschoolers was higher than rural preschoolers (7.1 over 6.1). However, in the post-harvest season, rural preschoolers exhibited a higher mean dietary diversity score (7.5 over 6.6). There was no significant difference in the dietary diversity score of the children between seasons (P=0.09). Furthermore, there was no significant interaction between season and residence in relation to the nutritional status of the children (P=0.343).

The study concludes that malnutrition is high among preschoolers from resource-poor households in the high agricultural production area of Trans Nzoia with urban children being more affected than their rural counterparts irrespective of the season. In addition, season has no influence on the dietary diversity score of the children.

Hence, it is recommended that food and nutrition security interventions be considered for resource poor households in high agricultural production zones.

CHAPTER ONE: INTRODUCTION

1.1 Background

Food Security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO 1996). Several studies have shown that wealth, ownership of assets such as land or livestock, and income are good predictors of food security (Iram and Butt 2004; Babatunde et al., 2008). Furthermore, high agricultural productivity and low food prices have also been linked with food security (Nyangweso et al., 2007). However, even in areas where there is high agricultural production, pockets of food and nutrition insecurity may be existent. This is attributed to inability of households to withstand external shocks such as spikes in food prices. In Mexico, it was shown that an increase in maize prices affected the living standards of urban and rural households with the poorest net buyers being the most vulnerable group (Dávila 2010). Among such poor households, it is the nutrition status of preschool children and the elderly that is most at risk.

Preschool children are the most vulnerable age group to acute nutritional stress (KNBS and MOPHS, 2008). Hence, in most food security and nutrition interventions, they are used as a benchmark for action. They are also usually chosen for nutrition assessment surveys to give an indication of the nutritional status in the whole population. Furthermore, there are often baseline data for this age group, considerable experience in conducting surveys of its nutritional status and defined criteria for interpretation of results (KNBS and MOPHS, 2008).

Malnutrition in preschool children manifests as stunting, underweight or wasting. Studies done in Trans Nzoia County between June 1989 and July 1989 among 300 household farm

labourers showed that 23 % of children under five were stunted, and 10% were wasted (Foecken and Tellegen, 1992).

It has been established that even in areas with favourable climates for agriculture, shortages in food supply usually occur three to four months before the main harvest (Wandel and Holmboe-Ottesen, 1992). During this period, a weight loss among vulnerable groups of population such as preschool children and lactating mothers is common. For example in Rukwa Tanzania, an area with a favourable unimodal rainfall pattern for grain cultivation, weight loss of up to 3% was reported among women (Wandel and Holmboe-Ottesen, 1992). In a study that was carried out among low income smallholder rural households in the former Nakuru district, Kenya, it was found that a unimodal climatic pattern influenced food production and hence household food availability during most months within the production cycle. This subsequently influenced food consumption and the nutritional status of the vulnerable groups in the study which included preschool children (Kigutha 1994). The energy and nutrient intakes of the children depended more on diet diversity rather than on household food availability per se.

Considering that Trans Nzoia county has a bimodal rainfall pattern, seasonality might have an effect on the nutritional status of preschool children especially on wasting (weight-for-height) which is an indicator of acute undernourishment. Furthermore, the nutrition status of preschool children might differ between rural and urban areas as revealed in the Kenya Demographic Health Survey of 2008-09 (KNBS and ICF Macro, 2010). Investigation of interaction between seasonality and residence formed a focal part of this study.

1.2 Statement of the Problem

Between 2005 and 2009, the former Rift Valley province accounted for 13,225,039 ninety kg bags of maize produced of the total 27,142,475 ninety kg of maize in the country-a 48.72 % contribution (MOA, 2010). In 2012, Kenya produced ≈38 million bags of maize. Of this total production, Trans Nzoia County contributed ≈4.6 million bags of maize, a 12% contribution of Kenya's maize production (MOA, 2012). This high production of maize in Trans Nzoia County, a major food security crop in Kenya, has seen the County overlooked in regards to food and nutrition security interventions based on the assumption that the County is always food secure.

The fact that the beneficiaries of this high productivity are mostly well to do large scale farmers and that resource-poor households are likely not to realise the benefits of the high maize productivity is overlooked. This study was an attempt to show that even in high agricultural production areas, there may be pockets of food and nutrition insecurity especially among resource poor households irrespective of whether it harvesting season or not.

1.3 Justification of the Study

The Kenya Demographic Health Survey of 2008-2009 revealed that there were significant differences between the nutritional status of preschool children in urban and rural residences (KNBS and ICF Macro, 2010). Despite the causes not being investigated, the survey associated the difference with education level of the primary care givers-the higher it was, the less likely that their children were malnourished.

Although there have been few studies conducted recently on the influence of season on nutrition status, the few that have been conducted in high agricultural production regions such as Rukwa in Tanzania and Bushenyi in Uganda, revealed that the nutritional status of preschool children, especially of lower socio-economic status, differed between seasons (Wandel and Holmboe-Ottesen, 1992; Kikafunda and Bambona, 2005).

Another study conducted in the Kenyan Coast, revealed that the region is a net importer of food and food requirements may be influenced by incidences of diseases such as Malaria and diarrhoea which commonly occur during the rainy season (Klaver and Mwadime, 1998). The study also found that peaks in household dietary intake occurred in the pre-harvest period (May-June; November-December). This anomaly was explained by two factors namely the local food base, whereby low own food production complemented by high purchasing of food and seasonal variation of food requirements e.g. increased energy needs just before commencement of pre-harvest period.

Such studies show that household income, household size, food security, water, sanitation and hygiene, access to health services and caloric intake interact to impact nutritional status of preschool children between seasons and rural or urban areas. It is therefore evident that there is need for studies in specific high agricultural production areas like Trans Nzoia

County, to inform Food and Nutrition interventions because high food production does not necessarily equate to household food and nutrition security.

1.4 Aim of the Study

To contribute towards the improvement of nutritional status of preschool children in Kenya

1.5 Purpose of the Study

To generate information on the influence of seasonality and residence on the nutritional status of preschool children in areas of high agricultural production for informed nutrition action and policy

1.6 Objectives

1.6.1 General objective

To assess the relationship of nutritional status of preschool children from resource-poor households with season and urban or rural residence in Trans Nzoia County, Kenya

1.6.2 Specific objectives

I. To determine the demographic and socio-economic characteristics of rural and urban households
II. To assess the nutritional status of rural and urban preschoolers during pre-harvest and post-harvest seasons
III. To assess the dietary diversity of rural and urban preschoolers during pre-harvest and post-harvest seasons
IV. To determine whether season and place of residence interact to influence nutritional status and dietary diversity of the preschoolers

1.7 Study Hypothesis

I. There is no significant difference in the demographic and socio-economic characteristics of rural and urban households in Trans Nzoia County

II. Household demographic and socio-economic characteristics have no significant association with the nutrition status and dietary diversity of pre-school children in Trans Nzoia County

III. There is no significant difference in the nutritional status and dietary diversity of preschool children residing in rural and urban environments of Trans Nzoia County within and between pre-harvest and post-harvest periods

IV. There is no interaction between pre-harvest and post-harvest season and residence and therefore no significant influence on nutritional status and dietary diversity of preschool children in Trans Nzoia County

1.8 Scope and Limitation of the Study

The study was conducted in Trans Nzoia County and targeted preschool children. Due to time and resources constraints, the study focused only on the 2013/2014 season. Comparisons in the nutritional status of preschool children in rural and urban environments were made before harvest and after harvest of the maize crop for the year 2013/2014 season.

CHAPTER TWO: LITERATURE REVIEW

2.1 Nutritional Status of Preschool Children

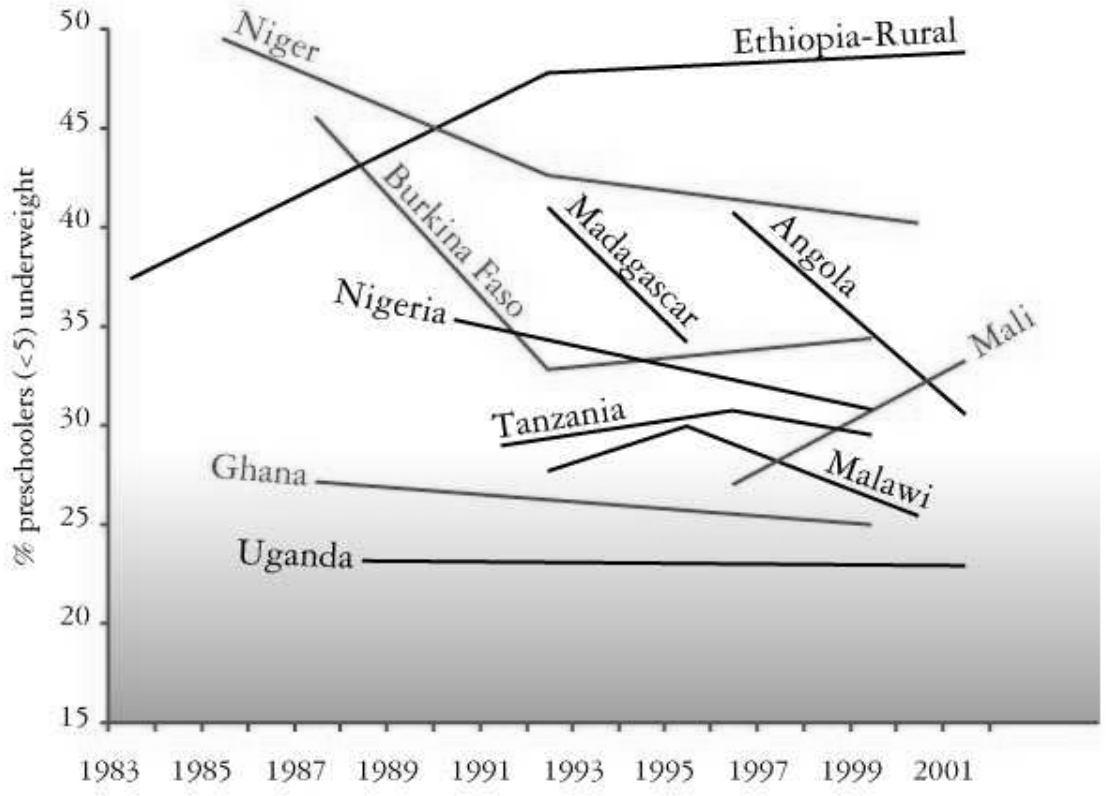
Preschool years are perhaps the most important as food practices and choices made during these years affect the nutrition status of the concerned individuals later in life. Assessment of nutritional status of preschool children has been carried out extensively in many areas globally. These assessments include anthropometric, biochemical, clinical or dietary methods (Gibson, 2005). In the United States of America, little was known about the nutritional status of this group in the mid 1960s (Owen et al, 1974). Studies that were conducted among various groups of the population at the time were limited in scope and sample size (Owen et al, 1974). A study conducted in 1968 in Lincoln, Nebraska among two groups of 40 preschool children aged between 3.5 and 5.5 years and differing in their socio-economic status, found that the mean dietary intakes for both groups compared favourably with recommended dietary allowances except for iron and calories (Kerrey et al, 1968).

In Santo Andre, Brazil, a study conducted in 14 day-care centres on the growth and nutritional status of preschool children between 2 and 6 years old from low income families, found that there was no undernourishment as results for mean z scores of Height, Weight and Basal Metabolic Index (BMI) were above the median of the CDC/NCHS reference (Shoeps et al, 2011). However, the children presented evidence of prevalence of overweight and obesity of 16.8% and 10.8%, respectively.

A large scale nutrition monitoring project among poor rural areas in seven provinces in China of nearly 10, 000 preschool children monitored between 1986 and 1989 revealed that > 40 % of them were stunted and about 14% severely stunted (Chang et al, 1994).

This prevalence was considerably higher than the national average for China (32% below -2 SD of the international reference median value) and also higher than the national average for rural areas (36%), as estimated in the 1987 national growth survey. The prevalence of wasting was within the range expected for the reference population (<3% for all 4 study years), indicating that there was no significant level of acute malnutrition. The prevalence of low weight-for-age was 24-28% for all study years, which was higher than the national average for China (21.3%) and also somewhat higher than the average for rural areas (23.7%); also the prevalence of children <-3 SD of the median of the international reference population was about 4% (Chang et al, 1994).

The 5th report on the world nutrition situation by the United Nations Standing Committee on Nutrition (UN-SCN, 2004) gives significant comparisons of the nutrition status of preschool children in different regions. Underweight is an official indicator of progress towards achieving the Millennium Development Goal (MDG) 1. By the year 2001, Latin America and Caribbean region were seen to be progressing towards achieving this goal, Asia was also relatively at pace, but Africa lagged behind (UN-SCN, 2004). Underweight prevalence in sub Saharan Africa had increased with East Africa leading in number of underweight children which was estimated to have increased by 36% from 1990 to 2001 (UN-SCN, 2004). However, a few African countries such as Nigeria and Ghana had shown substantial decreases in underweight prevalence. This is evidenced in the Figure 1 below derived from available data of 1983-2001.

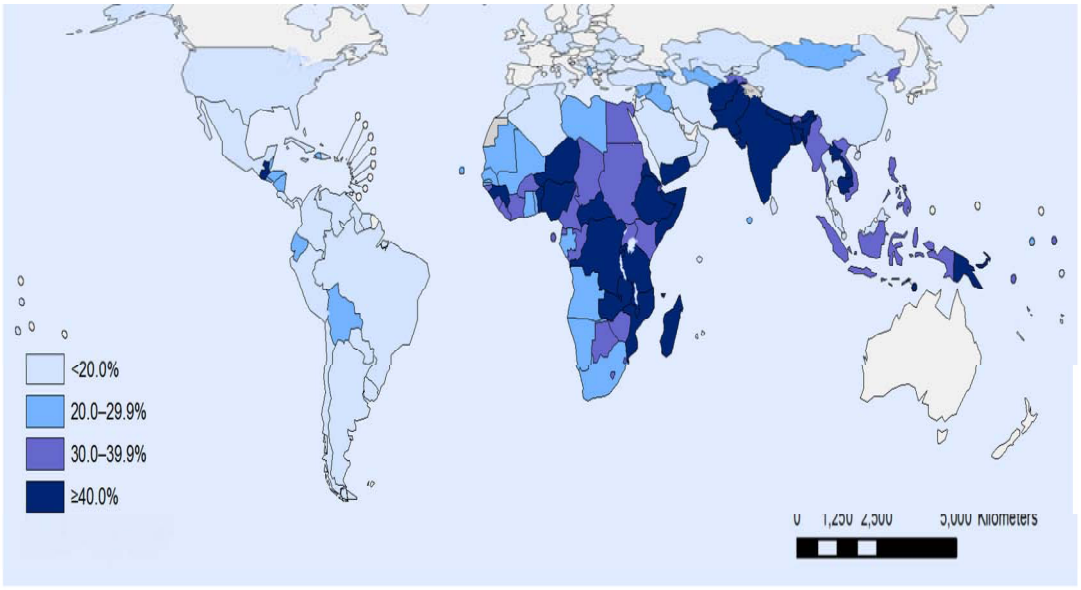


Source: WHO, 2003.

Figure 1: Trends in underweight rates of sub-Saharan African countries

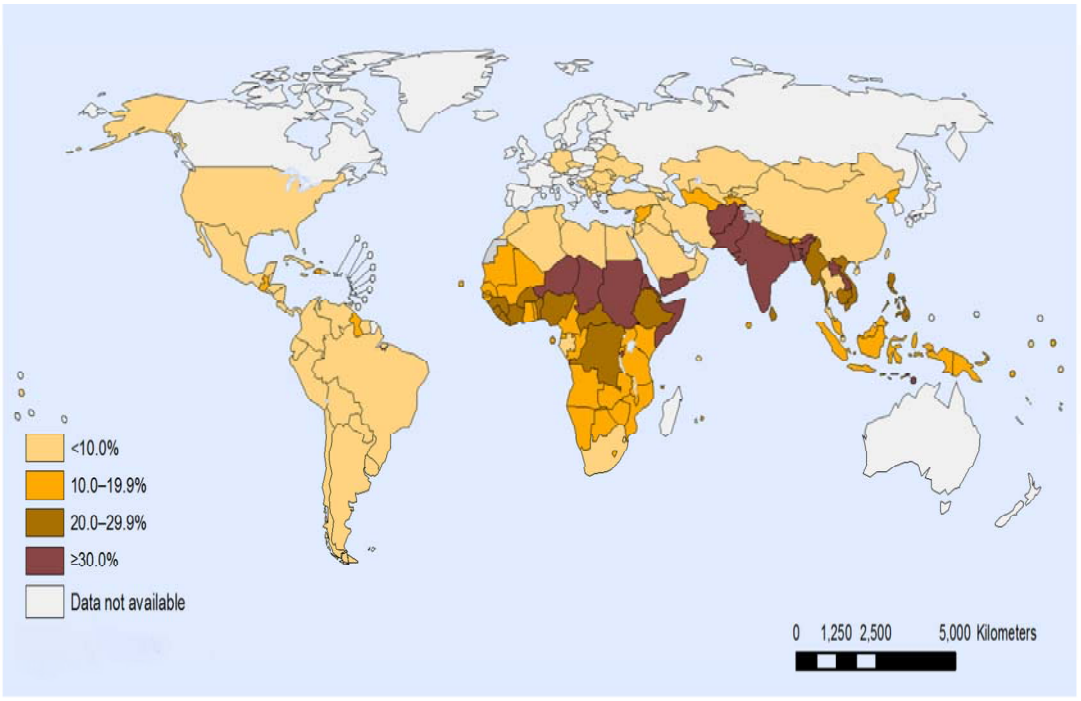
As of 2011, the global prevalence of stunting had decreased by 14%, from an estimated 40% (95% confidence limits: 38%, 42%) in 1990 to 26% (CI: 24%, 28%) in 2011 with an average annual rate of reduction of 2.1% during this period. The global prevalence of underweight has declined by 37% from 25% (CI: 23%, 28%) in 1990 to 16% (CI: 13%, 18%) in 2011 with an average annual rate of reduction of 2.2%. The global prevalence of wasting in 2011 was at 8%, an 11% decrease from 1999. (UNICEF et al, 2012).

A distribution of the global prevalence of stunting, underweight and wasting by country for children under five is shown in the Figures 2, 3 and 4.



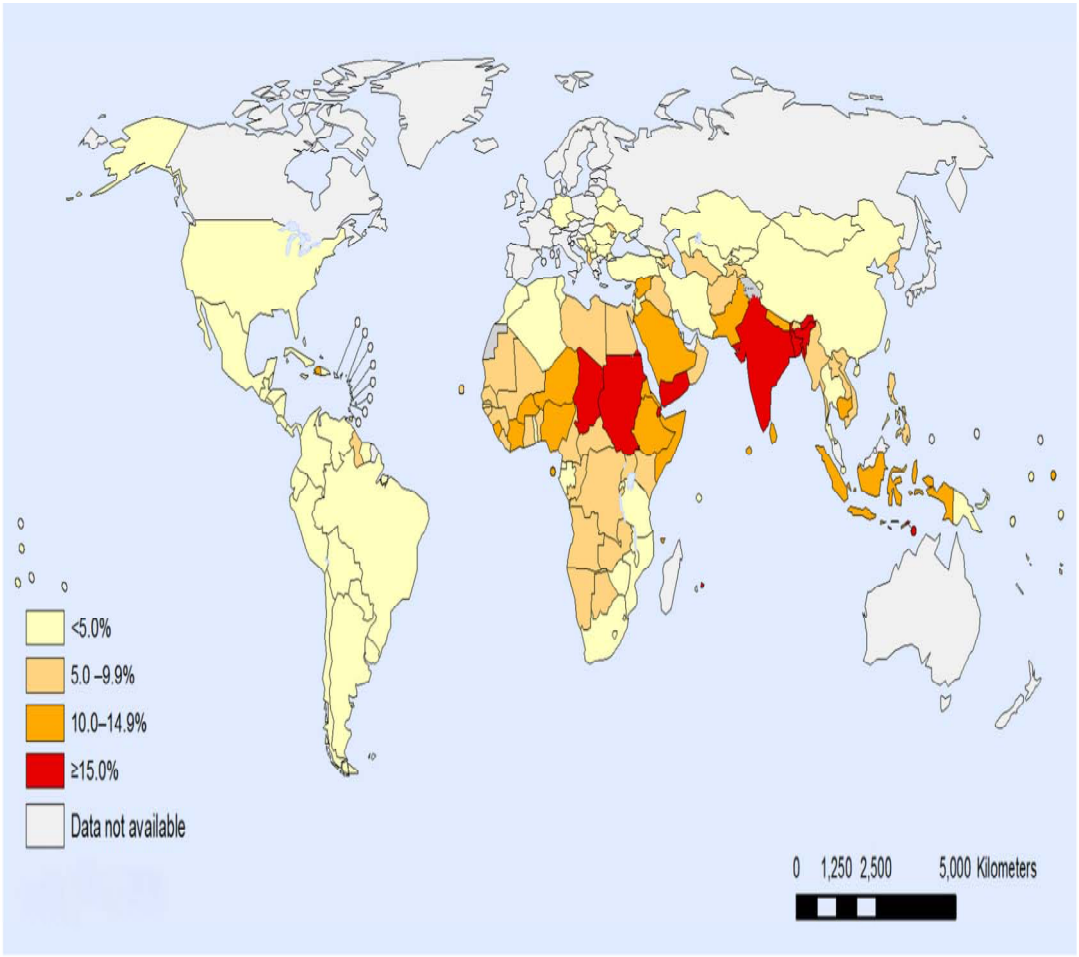
Source: UNICEF, WHO, WB, 2012

Figure 2: Country prevalence of stunting in children under-five as of 2012



Source: UNICEF, WHO, WB, 2012

Figure 3: Country prevalence of underweight children under-five as of 2012

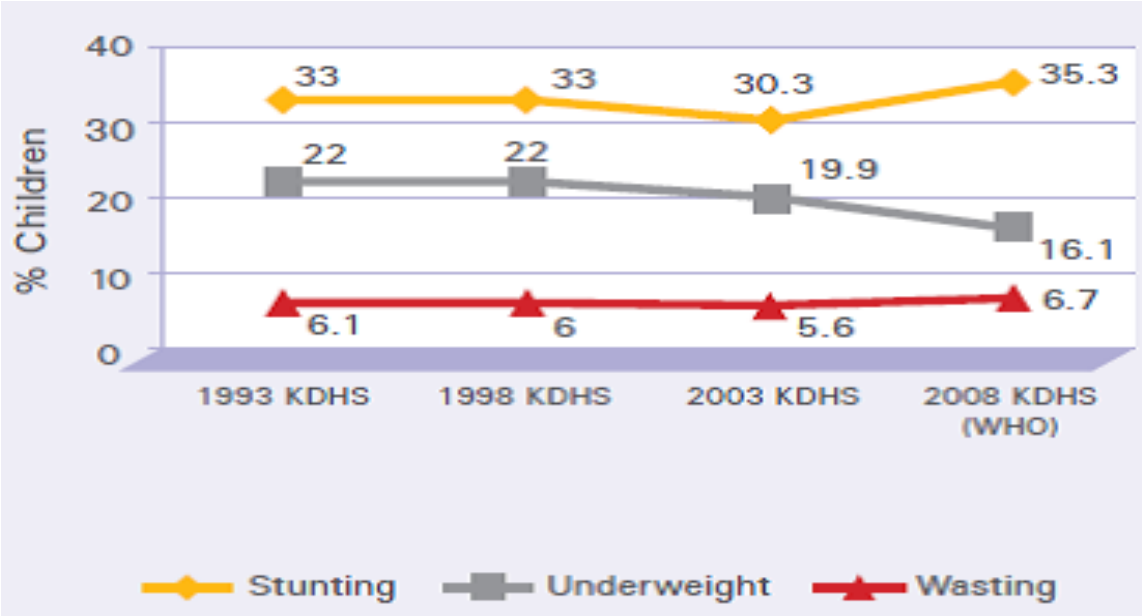


Source: UNICEF, WHO, WB, 2012

Figure 4: Country prevalence of wasting in children under-five as of 2012

In Kenya, 35.3 % of children under five are stunted (low height-for-age), while 6.7 % of them are wasted (low weight-for-height) and 16.1 % are underweight (low weight-for-age) (KNBS and ICF Macro, 2010). As evidenced in figure 5, the levels of stunting, underweight and wasting have been relatively stagnant between 1993 and 1998. However, between 1998 and 2003, stunting and underweight levels decreased while wasting only decreased very slightly. Between 2003 and 2008, stunting levels increased considerably (30.3% to 35.03%) while underweight levels decreased considerably (19.9% to 16.1%) and wasting levels increased slightly (UNICEF, 2011).

These changes can be largely attributed to a global change in paradigm in nutrition programming from community based approach that prevailed between 1985 and1995 and later, the micronutrient malnutrition paradigm that took effect from 1995 to 2005 (Jonsson, 2010). While the community based approaches focused on proper infant and young child feeding, control of major infections and infestations, and adequate access to food, the micronutrient approach focused on deficiencies particularly iodine, vitamin A and iron. Meanwhile, interest in protein-energy malnutrition decreased.



Source: UNICEF, 2011

Figure 5: Trends of stunting, underweight and wasting in Kenya 1993-2008

An analysis of the above indicators show that stunting is highest (46 percent) in children age 18-23 months and lowest (11 percent) in children age less than 6 months; wasting is highest (11 percent) in children age 6-8 months and lowest (4 percent) in children age 36-47 months and underweight is highest (19 percent) in the age groups 24-35 and 48-59 months and lowest (8 percent) for those less than six months of age (UNICEF, 2011). This is probably attributed to poor transition from exclusive breast feeding (0-6 months) to complementary feeding (>6 months).

2.2 Consequences of Malnutrition

Malnutrition is defined as "a state in which the physical function of an individual is impaired to the point where he/she can no longer maintain adequate bodily performance processes such as growth, pregnancy, lactation, physical work, and resisting and recovering from disease." (The Sphere Project, 2004). The consequences of malnutrition are immediate and far-reaching. Immediate causes is evidenced by presence of disease while the far reaching consequence include reduced scholastic performance in children and hence, a lower productivity in adult life. These consequences are elaborated in the following sections 2.2.1-2.2.4

2.2.1 Imbalances and deficiencies of macro-nutrients

Macronutrients are composed of proteins, fats and carbohydrates (Ministry of Health, 2009). In resource poor populations, carbohydrates make up for close to 80 % of the diet while fats, another essential component of the diet, make up for about 10% of the diet in resource poor populations (Ministry of Health, 2009).

Imbalance and deficiencies in macronutrients manifest as either acute or chronic malnutrition (Ministry of Health, 2009). Acute malnutrition is further categorised as either moderate or severe, as determined by the child's degree of wasting i.e. low weight-for-height. All cases of bilateral oedema are classified as severe acute malnutrition. Chronic malnutrition reflects undernourishment over a long time and is determined by the degree of stunting, low height-for-age. Severe acute malnutrition is further classified into two categories: Marasmus and Kwashiorkor. Patients may present with a combination, known as Marasmic Kwashiorkor. Signs of Marasmus and Kwashiorkor are given in the Table 1.

Table 1: Signs of marasmus and kwashiorkor

Marasmus	Kwashiorkor
Severe weight loss and wasting	Bi-lateral oedema and fluid accumulation
Ribs prominent	Loss of appetite
Limbs emaciated	Brittle thinning hair
Muscle wasting	Hair colour change
May have good appetite	Apathetic and irritable
With correct treatment, good prognosis	Face may seem swollen
	High risk of death

Source: Ministry of Health, 2009

2.2.2 Micro-nutrient deficiencies

There are about forty micronutrients that are essential to health of children under five years old. They are classified as type I or type II. Type I nutrients are those whose deficiencies do not affect growth and thus cannot be reflected through anthropometric measurements (Ministry of Health, 2009). Most micronutrients comprise of type I such as iron, vitamin A, iodine and vitamin C. However, they do have adverse effects as shown in the Table 2.

Table 2: Deficiency disorders of main type I micronutrients

Nutrient	**Deficiency disorder**
iodine	Goiter, hypothyroidism, iodine deficiency disorders, increased risk of stillbirth, birth defects infant mortality, cognitive impairment
Iron	Iron deficiency, anemia, reduced learning and work capacity, increased maternal and infant mortality, low birth weight
Vitamin A	Night blindness, xerophthalmia, increased risk of mortality in children and pregnant women
Vitamin C	Scurvy (fatigue, hemorrhages, low resistance to infection, anemia)

Source: Adapted from Allen et al, 2006

Type II micronutrients comprise of magnesium, sulphur, nitrogen, essential amino-acids, phosphorus, zinc, potassium, sodium and chloride. Unlike, type I micronutrients, these micronutrients are essential for growth and repair. Anthropometric measurements especially for stunting and wasting may reflect a deficiency of type II micronutrients although biochemical tests are needed to verify which micronutrients are deficient in the patient's diet. It should be noted that Type II micronutrients are required only in small quantities, but the correct balance is essential for good health. Effects of the main type II micronutrients deficiency are shown in the Table 3.

Table 3: Deficiency disorders of main type II micronutrients

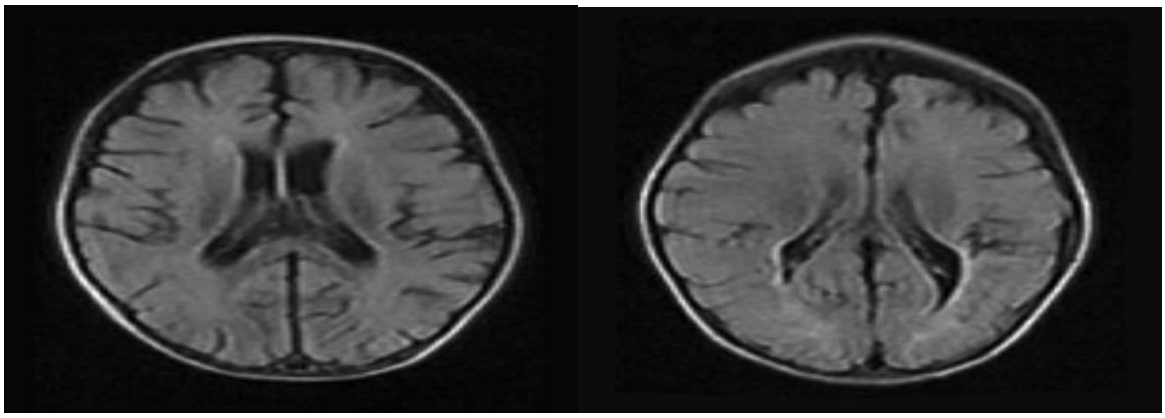
Nutrient	Deficiency disorder
Zinc	Poor pregnancy outcome, impaired growth (stunting), genetic disorders, decreased resistance to infectious diseases
Selenium	Cardiomyopathy, increased cancer and cardiovascular risk
Vitamin D	Rickets, osteomalacia, osteoporosis, colorectal cancer
Calcium	Decreased bone mineralization, rickets, osteoporosis
Folate	Megaloblastic anemia, neural tube and other birth defects, heart disease, stroke, impaired cognitive function, depression

Source: Adapted from Allen et al, 2006

2.2.3 Effects of malnutrition on education outcomes

Malnutrition in the first 1,000 days (from the start of a woman's pregnancy until her child's second birthday) has a devastating impact on children's education outcomes (Prado and Dewey, 2012). It restricts their cognitive development, that means they are more likely to be sick and miss out on school, and reduces their ability to learn.

The first 1000 days have been identified as a critical period for structural brain development. Maternal nutrition has been identified as pivotal to intra-uterine brain development (Georgieff and Rao, 1999). Moreover, even after birth, nutrition has been identified as a key factor in ensuring that brain development continues properly (Georgieff, 2007). Studies of young children with protein–energy malnutrition show brain atrophy – a shrinking of brain cells due to a lack of nutrients (El-Sherif, 2012) as shown in Figure 6.



Source: El-Sherif, 2012

Figure 6: Images of the basal ganglia of a malnourished child before and after treatment of acute malnutrition

The image on the left shows the bottom part of the brain of a 10-monthold child suffering from severe protein energy malnutrition. Cerebral atrophy, the shrinking of neurons due to lack of nutrients, can be seen as the white areas shrink away from the skull and blood vessels. The image on the right shows the same brain after 90 days of treatment, from which the problem can be seen to be resolved.

Insufficient calories continue to affect children's brain development in the first months after birth. This is a time of rapid neurodevelopment, including the establishment of the parts of the brain crucial for memory (the hippocampal-prefrontal connections (Georgieff,1999) and the density of dentrites that connect nerve impulses to the nerve cell body in the hippocampus (Blatt et al,1994).

A study commissioned by Save the Children Fund in four countries namely Ethiopia, India, Peru and Vietnam, revealed that children who are malnourished during the start of their lives are severely disadvantaged in their ability to learn (Fund, 2013). Stunted compared to non-stunted children: score 7% lower on math tests, are 19% less likely to be able to read a simple sentence by the age of 8 years, 12% less likely to be able to write a simple sentence, and are 13% less likely to be in the appropriate grade for their age at school.

2.2.4 Effects of malnutrition on the economy

In the longer term, malnutrition can have a negative impact on earnings when children reach adulthood. The effects of malnutrition on physical stature, the ability to do physical work, and on cognitive development, can lock children into poverty and entrench inequalities (Fund, 2013).

In the study conducted by Save the Children, it was revealed that children who are malnourished go on to earn 20% less as adults than the children who are well nourished (Grantham, 2007). However, other studies show that this figure could be much higher, for example a study which examined the impact over the life course of early childhood growth failure estimated this earning deficit for malnourished children at 66% (Hoddinott et al, 2011).

It is quite evident that malnutrition can be a pivotal impediment to economic growth. Estimates from low and middle income countries suggest that malnutrition can decrease an economy's gross domestic product by about 2-11%. This is partly attributed to the impact of malnutrition on education development, physical productivity and health (WFP and UN-ECLAC, 2007).

In the new report *Food for Thought* by Save the Children UK, it is estimated that today's malnutrition could cost the global economy as much as $125 billion when today's children

reach working age in 2030 (Horton, 2010) This was arrived at by extrapolating a 20% reduction in earnings attributed to malnutrition as aforementioned to a global level.

2.3 Effect of Season on Nutritional Status

Studies on effect of seasonality in food supply and nutritional status have been largely carried out in areas with extreme climatic conditions (Wandel and Holmboe-Ottesen, 1992). However, a study carried out in the Rukwa region in Tanzania, with a climate favourable for grain cultivation, revealed that the larger population faced shortages in food supply three to four months before the main harvest (Wandel and Holmboe-Ottesen, 1992). It was found that women lost about 3% of their weight in the pre-harvest period as compared to the post harvest period and the nutritional status of preschool children declined in lower socio-economic groups. However, this decline was not statistically significant.

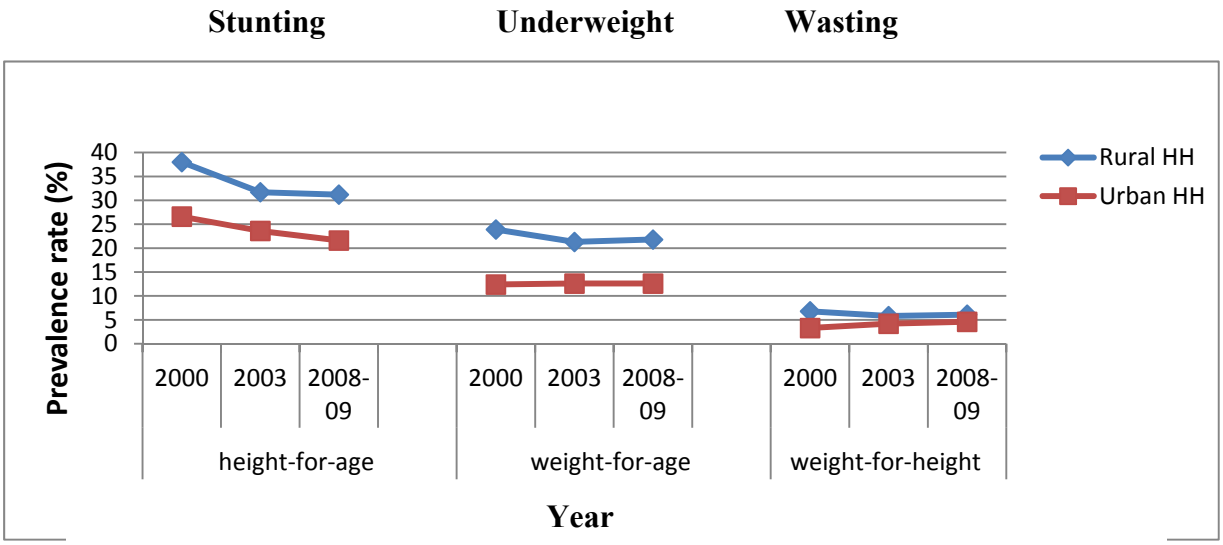
Three climatic characteristics have been identified as the determinant factors of extent and duration of seasonal nutritional dimensions: rainfall modality, the distinctness of the seasons, and the length of the dry period(s) (Chambers et al., 1981). Trans Nzoia County in Kenya has a bimodal rainfall pattern with the long rains occurring between the months of March and May and short rains between the months of October and December (Downing et al, 1987). In a study conducted in 25 villages in Africa, seasonality was found to affect dietary intakes in areas with a unimodal rainfall pattern (Schofield, 1974). However, in areas with a bimodal rainfall pattern, the fulfilment of calorie requirements was not significantly different in the wet and dry season.

In a study carried out among low income smallholder rural households in the former Nakuru district, it was found that a unimodal climatic pattern influenced food production and hence household food availability during most months within the production cycle.

This subsequently influenced food consumption and the nutritional status of the vulnerable groups in the study which included preschool children (Kigutha, 1994). It was further noted that while there was no weight losses in the children, weight gains were minimal during the lean season but improved slightly during the postharvest period. The energy and nutrient intakes of the children depended more on diet quality rather than on household food availability per se.

2.4 Effect of Place of Residence on Nutritional Status

There are significant differences in the nutritional status between children living in urban and rural residences. It has been revealed that children living in rural areas are moderately and severely stunted to a greater extent (37 percent), when compared with urban children (26 percent) (KNBS and ICF Macro, 2010). Furthermore, children in the rural areas exhibit higher underweight rates as compared to their counterparts in the urban areas. Changes in the nutritional status of preschool children between the year 2000 and 2008/09 are shown in the Figure 7.



Source: Adapted from KNBS and ICF Macro, 2010

Figure 7: Trends in the nutritional status of preschoolers in Kenya 2000-2008/09

In the recent past, Western Uganda has exhibited the highest levels of stunting in the country despite its being considered the food basket of Uganda. An investigation of the region using Bushenyi District as case study revealed that almost half of the children 46.0% below five years were stunted (Kikafunda and Bambona, 2005). This high level of stunting was attributed to several factors:

a) household size; those with household size greater than 5 had significantly ($P<0.05$) more stunted children than those with fewer than 5 people in the household;
b) Income flow: Households with a steady income flow had significantly ($P<0.05$) less malnourished children compared to those households which had less steady income flow;
c) Age of introducing supplementary foods: Households which introduced supplementary foods to their infants earlier than the recommended 6 months had significantly ($P<0.05$) more stunted children than those who introduced supplementary foods later than 6 months;
d) Information on child care: Mothers who had not received information on child care and feeding had significantly ($P<0.05$) more stunted children than those mothers who had received the information and;
e) Treatment of water: Households that did not boil their drinking water, had significantly ($P<0.05$) more stunted children than those boiled their drinking water.

2.5 Assessment of Nutritional Status

Several methods of assessing nutritional status exist ranging from observation of signs to body size and composition measurements (Gibson, 2005). Each of these measurements has its merits and limitations. Anthropometric measurements of body size are simple, safe and non-invasive.

The equipment is relatively inexpensive and relatively unskilled persons can be trained to perform the measurement procedures. However, the measurements cannot identify any specific nutrient deficiency and, therefore, unable to distinguish disturbances in growth and body composition induced by nutrient deficiencies as opposed to those caused by imbalances in protein and energy intake. Nonetheless, this study focused on disturbances attributed to protein and energy intake thus anthropometric measurement of body size sufficed. Several of these exist such as head circumference, weight, height, gestational age, knee height, lower leg length in infants, arm length and elbow breadth. However, this study employed raw measurements of weight, height and records of age in the calculation of growth indices that was used to determine the nutritional status of the study children. These indices are listed below.

2.5.1 Weight-for-height

Weight for height measures body weight relative to height. Low weight for height in children is described as “thinness” and reflects a pathological process referred to as “wasting”. It arises from a failure to gain sufficient weight relative to height or from losing weight. Wasting reflects a recent acute food shortage. High Weight-for-height in children is termed “overweight” and arises from gaining excess weight relative to height (WHO 1995). Wasting develops rapidly but can be reversed quickly with an appropriate intervention. Thus it is not the ideal measurement to use for populations that are chronically malnourished. Rather it is preferred for identifying young children who are most likely to benefit from a feeding program or for evaluating the benefits of intervention programs. This is because it is more sensitive to changes in nutritional status than height-for-age.

2.5.2 Height-for-age

This is a measure of achieved linear growth that can be used as an index of past nutritional or health status. A low height-for-age is defined as "shortness" and reflects either a normal variation or a pathological process involving failure to reach linear growth (Gibson, 2005). The outcome of this process is called "stunting" or the gaining of insufficient height relative to age (WHO, 1995).

One of the major critiques poised against this index is that deficit in height (or length for children below 24 months) takes time to develop. Thus, when used solitarily, it is not a good estimate of acute malnutrition; height-for-age alone may result in gross underestimation of malnutrition especially among infants. Height is also influenced by genetic and ethnic differences that may result in the misclassification of children as malnourished when they are not (Gibson, 2005).

2.5.3 Weight-for-age

This reflects body mass relative to chronological age. Low weight for age is described as "lightness" and reflects a pathological process known as "underweight," resulting from gaining insufficient weight relative to age or losing weight (WHO 1995).

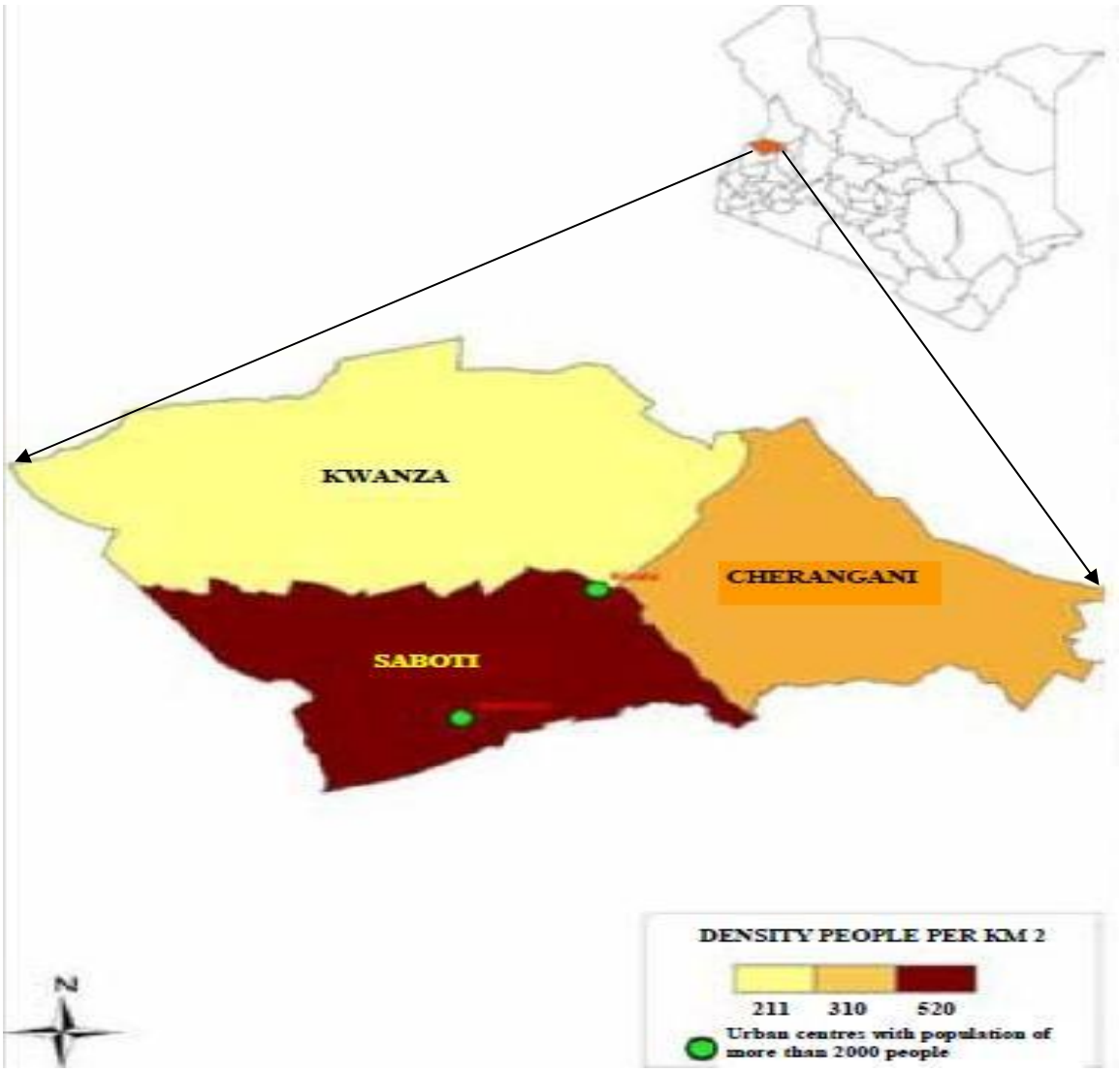
The method is simple to use and weighing scales are available at most health centres in low income countries (WHO 1995). However, it should be noted that the index reflects both weight for height and height for age. Thus, it fails to distinguish between tall and thin children from those who are short but with adequate weight. Children with a low weight for age may be genetically short, or their low weight for age may result from stunting or nutritional growth failure. This condition is characterised by low weight for age but weight appropriate to their short stature.

Consequently, the prevalence of under-nutrition in small children may be over-estimated if only weight for age is used. On the other hand, in populations where prevalence of stunting is high but wasting is low (e.g. Kenya where stunting, 35.3%, wasting levels, 6.7%), the use of weight-for-age to estimate prevalence of under nutrition leads to a gross under-estimation of the problem (WHO, 1995).

CHAPTER THREE: STUDY SETTING AND METHODOLOGY

3.1 Study Setting and Population

The study was conducted in Trans Nzoia County located in the Kenyan highlands west of the Rift Valley. It has a population of 195,173, with 39,119 households (KNBS, 2009). The area exhibits a bimodal rainfall pattern with the long rains occurring between the months of March and May and the short rains occurring between the months of October and December. A study map of the area is given in Figure 8.



Source: Ochieng, 2012

Figure 8: Map of the study area

The study population consisted of preschool children aged between 6 and 59 months from resource poor households in Kitale town and Chepsiror location. As aforementioned in the introduction, this group was chosen because they are the most vulnerable to nutritional stress and are usually the benchmark for most interventions in food and nutrition security. The respondents were the primary care givers.

3.2 Research methodology

3.2.1 Study Design

An observational longitudinal study design was employed in the research. Selected subjects in the urban and rural households were followed over study period from pre-harvest season after the March-April-May long rains to the post-harvest season after the October-November-December short rains. Their nutritional status was measured as shown in figure 9 below.

Figure 9: An observational longitudinal design of the proposed study

3.3 Sampling

3.3.1 Sample size determination

The following formula was applied in the determination of sample size (Magnani, 2007).

$$n = D\left[(Z_1 + Z_2)^2 * (P_1(1 - P_1) + P_2(1 - P_2)) / (P_2 - P_1)^2\right]$$

Where**:-**

n = required minimum sample size per survey round

D = design effect (assumed to be a *default* value of 2)

P_1 = estimated level of an indicator measured as a proportion at the time of the first survey or for the control area (underweight prevalence level 24 %, KNBS and ICF Macro, 2010)

P_2 = the *expected* level of the indicator either at some future date or for the project area such that the quantity (P_2 - P_1) is the size of the magnitude of change it is desired to be able to detect (expected change of 20 % from baseline to end of period)

Z_1 = the Z-score corresponding to the degree of confidence with which it is desired to be able to conclude that an observed change of size (P_2 - P_1) would not have occurred by chance (the level of statistical significance), 95% confidence Z_1 being1.645

Z_2 = the z-score corresponding to the degree of confidence with which it is desired to be certain of detecting a change of size (P_2 - P_1) if one actually occurred (statistical power). Statistical power of 80%, Z_2 being 0.840

Hence, applying the formula in the study will yield the following sample size.

$n = 2\ [(1.645 + 0.840)^2 * ((0.24)\ (0.76) + (0.05)\ (0.95)) / (0.05\text{-}0.24)^2]$

$n = 2\ [(6.175 * ((0.1824 + 0.0475) / 0.03610)]$

n =78.65 children

n ≈ 80 children (minimum sample size)

n ≈ 90 children (Including 10% attrition rate)

Therefore, 180 children were required per assessment i.e. 90 in rural and 90 in urban area

However, it should be noted that four households in both areas i.e. rural and urban area were lost.

Thus, the study followed up on the remaining 86 children, a sample size still within the sample size range considering that an attrition rate of 10% was used in sample size determination.

3.3.2 Sampling Procedure

A sampling schema as given in Figure 10 was employed in arriving at the rural households and urban households in the County.

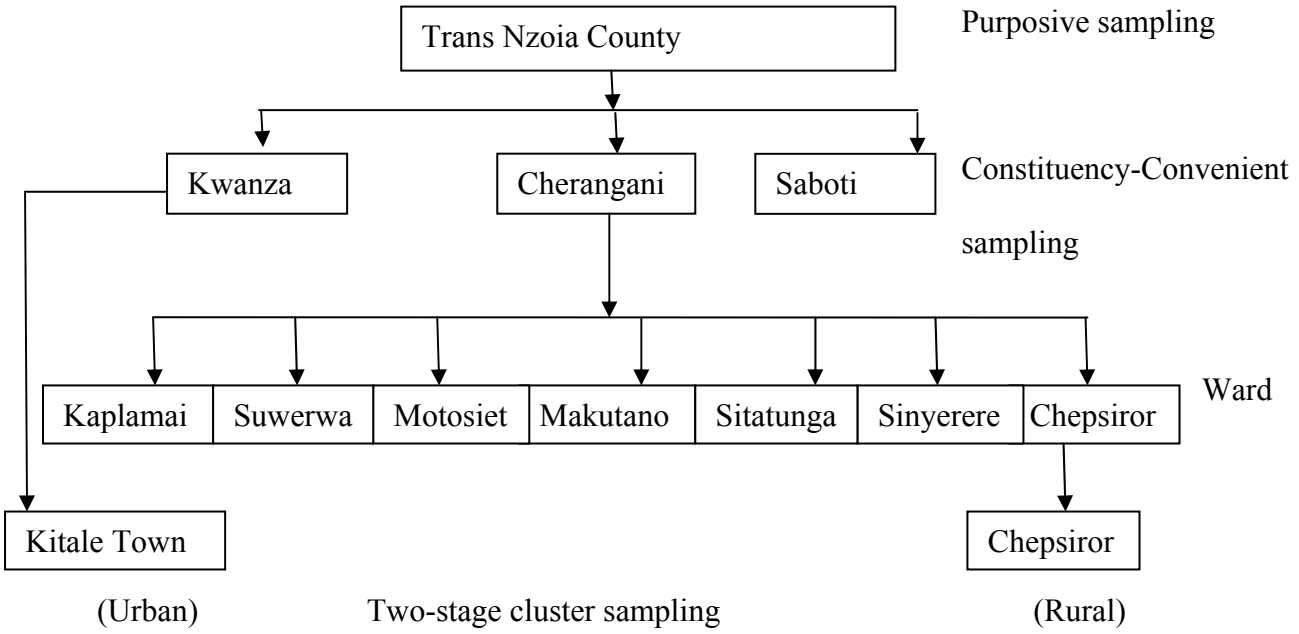


Figure 10: Sampling procedure schema for rural and urban households

Trans Nzoia County was purposively sampled as it is a high agricultural production region. Cherangany constituency was conveniently chosen as this was where the principle researcher could easily find the resources to conduct the research study. Chepsiror Sub location was chosen by simple random sampling. Numbers were assigned to each sub location in schema from 1 to 7.

The numbers assigned to each sub-location were not revealed to the principle researcher. The Principle researcher then randomly chose number 4 which had been assigned to Chepsiror sub location.

Purposive sampling was used in selecting four villages known which included households which fit the inclusion criteria i.e. subsistence farming households living in mud-walled houses. These were Lokiriama, Bondeni, Lokotos and Kapsirwo. The sample size for each village was determined proportionate to the household populations in each village as shown in table 4. Thereafter, households in each village were randomly selected by employing the random walk technique.

Table 4: Proportionate sample size determination for the rural area

Cluster/Village	Population (households)	Proportionate Population	Sample Size
Lokiriama	110	(110/290) ≈0.4	0.4*90=36
Bondeni	70	(70/290) ≈0.2	0.2*90=18
Lokotos	50	(50/290) ≈0.2	0.2*90=18
Kapsirwo	60	(60/290) ≈0.2	0.2*90=18
Total	290	1	90

Kitale town was chosen purposively as it is the headquarters of Trans Nzoia County and the major urban area in the county. Within the town, resource poor households were drawn from Kipsongok Informal Settlement. Due to the close proximity of households within the settlement, the centre of the settlement was determined and the random walk technique was used directly to select households until the sample size required i.e. 90 was attained.

3.4 Research Tools and Instruments

Structured questionnaire

A questionnaire was employed to obtain information on the household demographic profile and socio-economic characteristics (see Appendix 1). Data on household food stock and percentage of total household expenditure on food was obtained as well.

Data on factors varying between rural and urban residences known to affect the nutrition status of the study children were also obtained. These included morbidity experience, access to health facility, health seeking behaviour of primary care givers, water and sanitation, immunisation and infant and young child feeding practices and 24 hour dietary diversity score for the children.

Anthropometric equipment

The following anthropometric equipment was required for the study:-

I. Salter scale: was used to measure weights of children 6-23 months
II. Bathroom scale: was used to measure the weights 24-59 months
III. Stadiometer: was used to measure the heights of children (lengths for children 6-23 months)

3.5 Data Acquisition Procedures

The administration of the structured questionnaire was done through interviewing which was the main method of data acquisition. Secondary data on rainfall patterns and agricultural production in the county was obtained through desk studies of records in the Ministry of Agriculture. These methods are summarised in the table 5.

Table 5: Data acquisition procedures

Specific objective	Variables	Data acquisition method	Activity	Instrument	Indicator
To determine the demographic and socio-economic characteristics of study households	Age, gender, household size and distribution, education level, household income,	Interview	Develop , pre-test, revise and administer questionnaire	Questionnaire	
To investigate the influence of season on nutritional status of study children	Season weight height age	Measurement (MOA) Measurement	Take anthropometric measurements	Health card Salter Scale Height Board Bathroom Scale	Z score=±2SD-normal Z score>±2SD-malnourished
To assess the dietary diversity of study children during pre-and post-harvest	Residence weight height age	Measurements (KNBS) Measurement	Take anthropometric measurements	Health card Salter Scale Height Board Bathroom Scale	Z score=±2SD-normal Z score>±2SD-malnourished
To examine if season and residence interact to influence nutritional status and dietary of study children	Seasonality and Residence weight height age	Records (MOA & KNBS) Measurements	Take anthropometric measurements	Health card Salter Scale Height Board Bathroom Scale	Z score=±2SD-normal Z score>±2SD-malnourished .

The following procedures as obtained from Gibson, 2005, were followed in obtaining the anthropometric measurements of the preschool children.

Recumbent length measurement procedure (children < 2 years)

1. Place the subject, face upward, with the head at the fixed end of the board and the body parallel to its long axis.
2. Apply gentle traction to bring the crown of the child's head into contact with the fixed headboard and simultaneously position the head so that it is in the Frankfurt plane (examiner 1)
3. Hold the subject's feet, without shoes, toes pointing upwards, while keeping subject's knees straight and bring the movable foot board to rest against the heels(examiner 2)
4. Record the length to the nearest millimetre]
5. Repeat measurement
6. Obtain average if second measurement differs from the first by 0.1cm

Height measurement procedure (children ≥2 years)

1. Ask the subject to stand straight with the head in the Frankfurt plane, feet together, knees straight, and heels, buttocks, and shoulder blades in contact with the vertical surface of the stadiometer.
2. Make sure that the subject's arms are hanging loosely at the sides with palms facing the thighs.
3. Ask the subject to take a deep breath and stand tall to aid the straightening of the spine. Shoulders should be relaxed
4. Lower the movable headboard until it touches the crown of the head.
5. Take the height measurement ensuring that examiner's eyes are level with the headboard

6. Repeat measurement
7. Obtain average if second measurement differs from the first by 0.1cm

Weight measurement procedure (children < 2 years)

1. Zero the Salter scale and calibrate with a standard weight
2. Hang the Salter scale on a firm support ensuring that the examiner's eyes are at eye level with the scale
3. Remove excess clothing of the subject.
4. Slip the child into the weighing sling with the assistance of the mother/caretaker
5. Ensure the child is hanging freely
6. Record the weight as soon as the indictor on the scale has stabilised
7. Repeat measurement
8. Obtain average if second measurement differs from the first by 0..1 kg

Weight measurement procedure (children ≥2 years)

1. Place the bathroom scale on a hard flat surface.
2. Zero the scale and calibrate with a standard weight
3. Remove excess clothing of the subject.
4. Ask the subject to stand unassisted in the centre of the platform, and to look straight ahead.
5. Record the body weight to the nearest 0.1kg
6. Repeat measurement
7. Obtain average if second measurement differs from the first by 0.1kg

The raw measurements of weight, height and age were used to obtain Z-scores. These were used to determine the nutritional status of the preschoolers.

Dietary Diversity

Fourteen food groups were used in scoring the children's dietary diversity (FAO, 2011). These food groups were aggregated from the food groups used in calculating the household dietary diversity score which is given in the questionnaire (see appendix 1). The list of the aggregated food groups are listed in table 6.

Table 6: Aggregation of food groups from the questionnaire to create individual dietary diversity scores

Question number(s)	Food group
1,2	Starchy staples[1]
4	Dark green leafy vegetables
3,6 and red palm oil if applicable	Other vitamin A rich fruits and vegetables[2]
5,7	Other fruits and vegetables [3]
8	Organ meat
9,11	Meat and fish [4]
10	Eggs
12	Legumes, nuts and seeds
13	Milk and milk products
14	Oils and fats

1 The starchy staples food group is a combination of Cereals and White roots and tubers.
2 The other vitamin A rich fruit and vegetable group is a combination of vitamin A rich vegetables and tubers and vitamin A rich fruit.
3 The other fruit and vegetable group is a combination of other fruit and other vegetables.
4 The meat group is a combination of meat and fish.

Source: FAO, 2011

Estimation of age

This was obtained by making use of clinic cards or recall by the primary care givers.

3.6 Ethical and Human Rights Considerations

Administration in the study area was informed about the study and permission sought to conduct it. Each selected primary care giver was informed of the study objectives and data collection procedures before seeking for consent to participate in the study.

Consent from the respondent was sought before commencement of data collection. The respondent was free not to respond to questions that made them uncomfortable and to pull out of the study if they were not willing to continue participating.

Research assistants held themselves accountable to upholding confidentiality and privacy rights of the respondents. The principle researcher saw to it that research assistants who deviated from this requirement were dealt with accordingly.

Finally, preschool children found to be malnourished and/or ill were referred to the nearest health facility for treatment.

3.7 Recruitment and Training of Field Assistants

The principle researcher recruited six locals with at least secondary school education level from the study area as research assistants. However, college students especially in the field of nutrition were given priority hence out of the six locals recruited; three were college students with scientific background. Availability throughout the study period, good standing with the community and gender balance was considered in their recruitment.

The research assistants were informed of study objectives, general conduct and research ethics required of them. They were also trained on rapport creation, questionnaire administration, anthropometric measurements of body size using height and weight raw measurements and how to conduct a 24 hour dietary diversity score. This was done according to the curriculum in appendix 2.

3.8 Data Quality Control/Validation

The common errors of anthropometric measurements and ways of minimising them as stipulated by Gibson, 2005 were employed and are indicated in Table 7.

Table 7: Common errors in anthropometric measurements of body size and solutions

Measurement	Common error	Solution
Length	Incorrect method for age	Use only when subject is<2 years
	Footwear or head gear not removed	Remove where possible/make allowance
	Head not in correct plane	Correct position of child before measuring
	Child not straight along board/and or feet not parallel with movable board	Have child's parent present: settle struggling child
	Board not firmly against heels	Correct pressure be applied
Height	Incorrect method for age	Use only when subject is ≥2 years
	Footwear of head gear not removed	Remove where possible/make allowance
	Head not in correct plane, subject not straight, knees bent, or feet not flat on floor	Correct technique with practise and regular retraining.
	Board not firmly against head	Provide adequate assistance. Calm non-cooperative children
		Move head board to compress hair
Weight	Scale not calibrated to zero	Re-calibrate after every subject
	Subject wearing heavy clothing	Remove where possible/make allowance
	Subject fidgety or anxious	Wait until subject is calm or remove cause of anxiety e.g. scale is too high
24 hr recall	Under or over-estimation of portion sizes by the respondent	Use food models (preferably graduated) and volumes to estimate portion sizes and ingredient quantities

Training of the research assistants was done uniformly in both the study areas mentioned.

The principle investigator ensured that there was a common understanding of the questionnaire before commencing of actual data collection.

Error due to bias mainly takes the form of selection. This arises when respondents are selected in such a way that gives distorted data. This was minimised by ensuring that respondents were randomly chosen into the study by adhering to the sampling procedure strictly.

Confounding factors such as gender, age and illness may have an effect on the nutritional status of the children. The effect of these factors was minimised by employing stratified analysis e.g. analysing the nutritional status of boys and girls in the two locations separately, analysing the nutritional status of children < 24 months and ≥ 24 months separately and children with illness and without illness in the past 14 days separately.

Identification of errors of sex and date was prioritized because they contaminate derived variables. Prioritization was essential since the study was under time pressures and resources for data cleaning were limited.

3.9 Data Management and Analysis

3.9.1 Data management

Development of data entry templates

Data entry templates were developed using Statistical Package for Social Scientists (SPSS) Versions 16, 2007.

Data cleaning

Data cleaning was conducted through a three-stage process, involving repeated cycles of screening, diagnosing, and editing of suspected data abnormalities as recommended by Van den Broeck et al, 2005.

I. Data Screening

Lack or excess of data; outliers, including inconsistencies and strange patterns in paired samples were detected using descriptive/explorative statistical methods such as graphical exploration of distributions: box plots, histograms, and scatter plots. This was achieved by employing SPSS VERSION 16, 2007 and ENA-Delta statistical software.

II. Data Diagnosis

The true nature of the worrisome data points, patterns, and statistics was clarified at this stage. Data points were ascertained to be either erroneous, true extreme, true normal (i.e., the prior expectation was incorrect), or idiopathic (i.e., no explanation found, but still suspect).

III. Data Editing

Erroneous data was corrected by entering the correct data if error had occurred due to wrong entry from questionnaire. However, if error was a true outlier, then such data was not included in data analysis. Care was taken to strictly comply with the sampling protocol allowing for attrition in order not to compromise the research study.

3.9.2 Data analysis

As shown in table 8, the main methods employed in meeting the specific objectives were correlation, paired t-test, independent t-test and 2-way ANOVA.

Correlation was employed in determining positive or negative association between households' demographic and/or socio-economic factors and the nutrition status of the study children.

The paired t-test was used to determine whether there was a significant difference in the nutrition status of the study children before and after the harvest season

. In determining whether there was a significant difference in the nutrition status between urban and rural preschoolers, the independent t-test was employed.

Lastly, the 2-way ANOVA was used to show whether there was an interaction between season and place of residence and whether this interaction (if any) had any influence on the nutrition status of the study children.

Statistical Package for Social Scientist (SPSS VERSION 16, 2007) was used in the analysis of the aforementioned data.

Table 8: Data analysis matrix

Overall objective: To assess the relationship of nutritional status of preschool children from resource-poor households with season and place of residence			
Specific objective	**Variable**	**Data type**	**Basic statistic**
To determine the household demographic and socio-economic characteristics	Age, gender, household size and distribution, education level, household income,	Categorical Continuous	Chi-Square Correlation R=±1 [High correlation] R=1 [Equal correlation] R=0 [No correlation]
To investigate the influence of season on nutritional status of study children	Season weight height age	Categorical Continuous	Chi-Square Paired sample t-test [comparison to be made between calculated t value and tabulated t value]
To assess the influence of residence on nutritional status of study children	Residence weight height age	categorical Continuous	Chi-Square Independent sample t-test [comparison to be made between calculated t value and tabulated t value]
To investigate the influence of interaction between season and residence on nutritional status of study children	Seasonality and Residence weight height age	Categorical Continuous	2 way ANOVA [comparison to be made between calculated F-value and tabulated F-value]

Raw measurements of weight and height were transformed into anthropometric indices by employing the use of Z-scores to determine the nutritional status of the preschool children. This was done using the ENA-Delta software. Cases of stunting, wasting and underweight were identified as shown in table 9

Table 9: Z scores indicators of nutritional status of preschoolers

Nutrition Status	**<-3SD**	**>-3SD - < -2SD**	**Global (<-2SD)**
Weight for age (underweight)	Severe	Moderate	moderate + severe
Height for age (Stunting)	Severe	Moderate	moderate + severe
Weight for height (wasting)	severe	Moderate	moderate + severe

Source: Adapted from Gibson, 2005

Z-score (or SD-score) = (observed value - median value of the reference population) /standard deviation value of reference population

Dietary Diversity Score

Dietary diversity scores were calculated by summing the number of food groups consumed by the child in the previous 24 hours. They were then classified as low, medium or high according to the total number of food groups consumed. This categorisation is given below.

Lowest dietary diversity (≤ 3 food groups)

Medium dietary diversity (4 and 5 food groups)

High dietary diversity (≥ 6 food groups)

CHAPTER FOUR: RESULTS

4.1 Demographic and socio-economic characteristics of household heads and female primary care givers

The various demographic and socio-economic characteristics of the study households investigated are shown in Table 10

Table 10: Demography and socio-economic characteristics of household heads and primary care givers

Variable	**Urban households (%) n=86**		**Rural households (%)n=86**	
Marital status of primary care givers				
Never Married	12.8		26.7	
Married	83.3		65.1	
Cohabiting	0		1.2	
Divorced/Separated	3.8		0	
Education level	**Household heads**	**Primary care givers**	**Household heads**	**primary care givers**
None	7.0	4.7	5.8	7
Not completed primary	36.0	29.1	19.8	19.8
Completed Primary	24.4	30.5	31.4	26.7
In Primary	8.1	2.3	0	1.2
Not Completed Secondary	16.3	2	7.0	25.6
Completed Secondary	7.0	31.4	33.7	11.6
In Secondary	0	0	0	0
College/Diploma	1.2	0	2.3	8.1
Occupation of household heads				
Salaried employee	9.5		8.1	
Business	18.9		17.4	
Farming	1.4		53.5	
Casual labourer	37.8		15.1	
Unemployed	29.7		4.7	
Student	2.7		1.2	

There was a significant difference in the marital status between primary care givers in urban and rural households (P=0.019). For instance, 83.3 % of urban primary care givers were married as compared to 65.1%. Furthermore, the proportion of unmarried rural care givers was slightly higher than that for urban care givers (26.7 % over 12.8 %).

The education level of household heads and the primary care givers also differed significantly between urban and rural households (P=0.033 and P=0.013 respectively). Rural household heads were found to be more schooled as 33.7% of them had completed secondary education compared to 7% of urban household heads. The same scenario was found among primary care givers where 64% of them had completed their primary education compared to 80.2% of their rural counterparts.

In regards to occupation, it was noted that 53.5% of the rural households practised farming (sold additional produce obtained from subsistence farming) while only 1.4% of the urban households were engaged in farming. Moreover, more urban household heads were unemployed (29.7%) as compared to only 4.7% of rural household heads. However, a greater proportion of the urban household heads engaged in casual labouring (37.8%) as compared to rural household heads (15.1%).

There was no significant difference in the household size between urban and rural households. The former had an average of 5 members per household while the latter had an average of 3 members per household.

4.2 Nutrition Status in Pre-harvest and Post-Harvest Season

The wasting rates of the study children in the pre-and post-harvest season are shown in Figure 11.

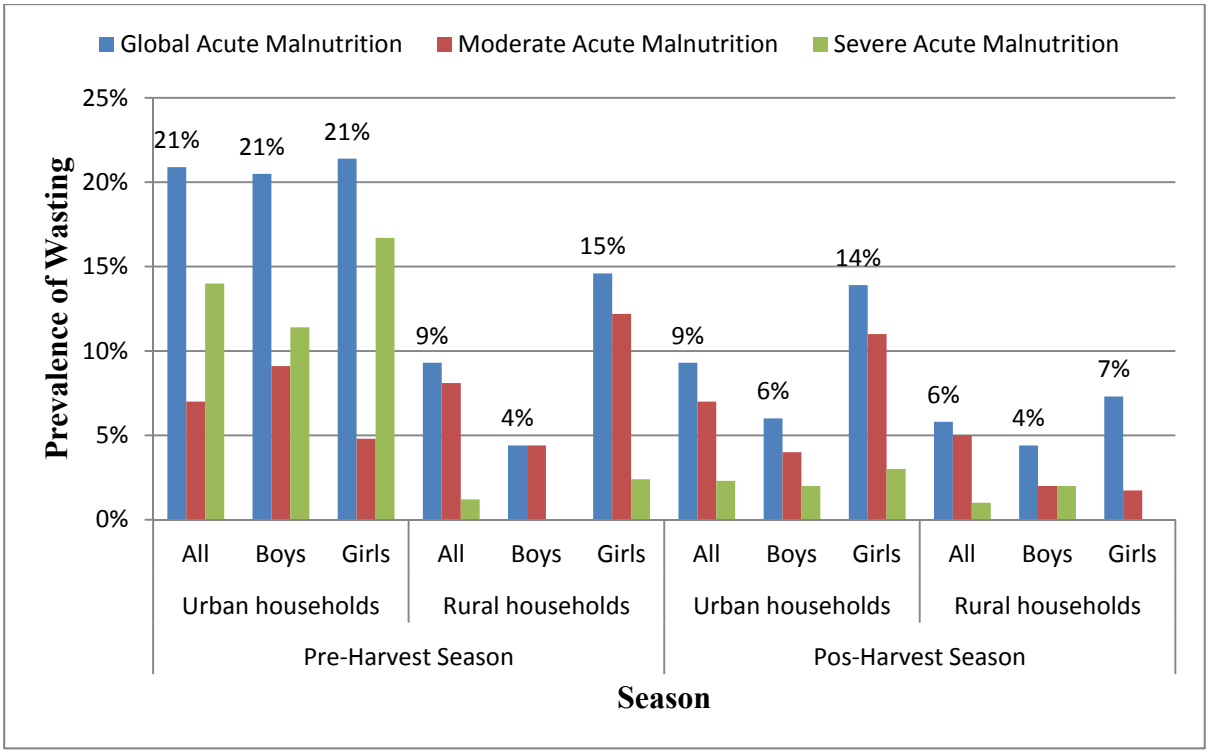


Figure 11: Comparison of wasting between urban and rural preschoolers in the pre-harvest period and post-harvest season

There was a significant difference in the wasting prevalence rates between rural and urban preschoolers (P=0.038) within the pre-harvest period. Urban Preschoolers had higher wasting rates i.e. 21 % as compared to their rural counterparts with prevalence of wasting being only 9 %. Girls in the rural households exhibited higher wasting rates i.e. 15% compared to the boys with prevalence of only 4 %. In the post-harvest period, wasting rates between urban and rural preschoolers also differed significantly (P=0.008).

There was a significant reduction (P=0.042 and P=0.036 respectively) in wasting rates among both rural and urban preschoolers before and after harvest; rural preschoolers exhibited a 3 % reduction while urban pre-schoolers exhibited a 12 % reduction. It is worthy to note that the reduction among rural pre-schoolers is attributed wholly to an 8 % reduction in the wasting rates of the girls as that of boys remained the same as it was in the pre-harvest season i.e. at 4 %.

The underweight prevalence rates of the study children in the pre- and post-harvest season are shown in Figure 12.

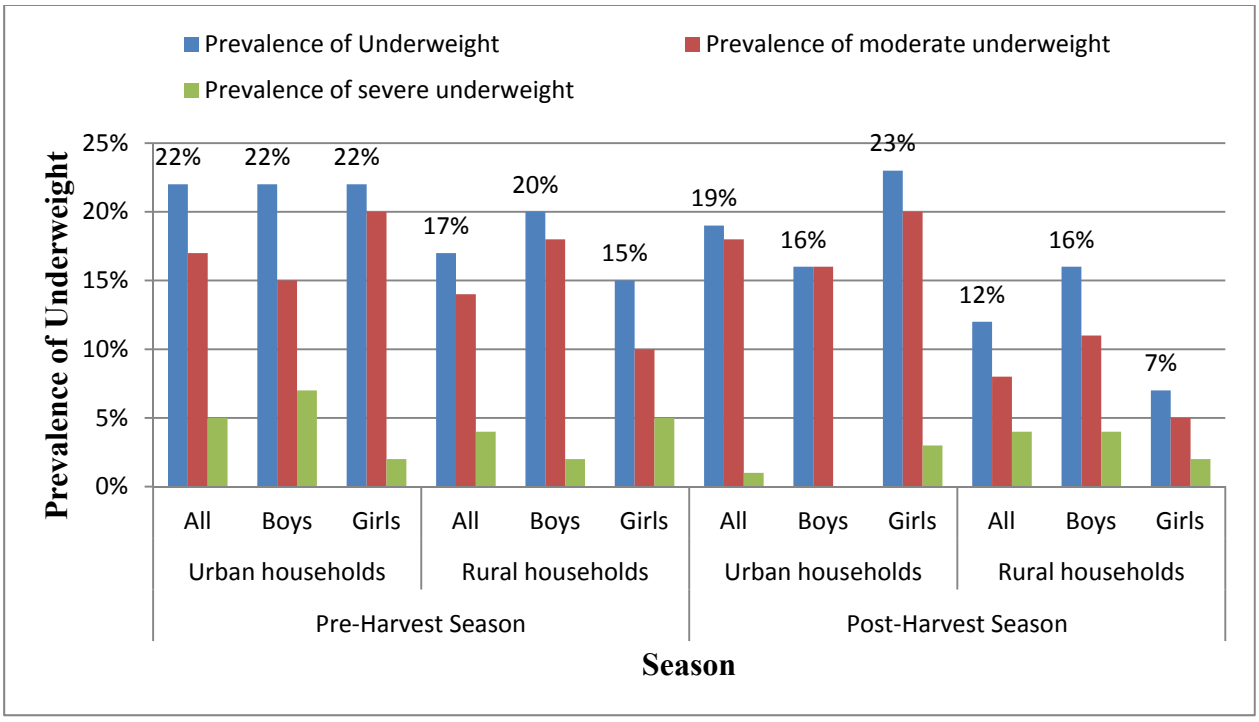


Figure 12: Comparison of underweight rates between urban and rural preschoolers in the pre-harvest and post-harvest period

Within the pre-harvest season, there was no statistically significant difference in the underweight prevalence rates between rural and urban preschoolers (P=0.638). However, urban preschoolers exhibited slightly higher rates i.e. 22% as compared to their rural counterparts, 17%.

There was no significant difference in the underweight rates of both rural or urban preschoolers between pre-harvest and post harvest season (P=0.089). However, a reduction was noted among both the urban and rural preschoolers (3% and 5% respectively) albeit this reduction was not statistically significant.

The prevalence of stunting is as shown in Figure 13

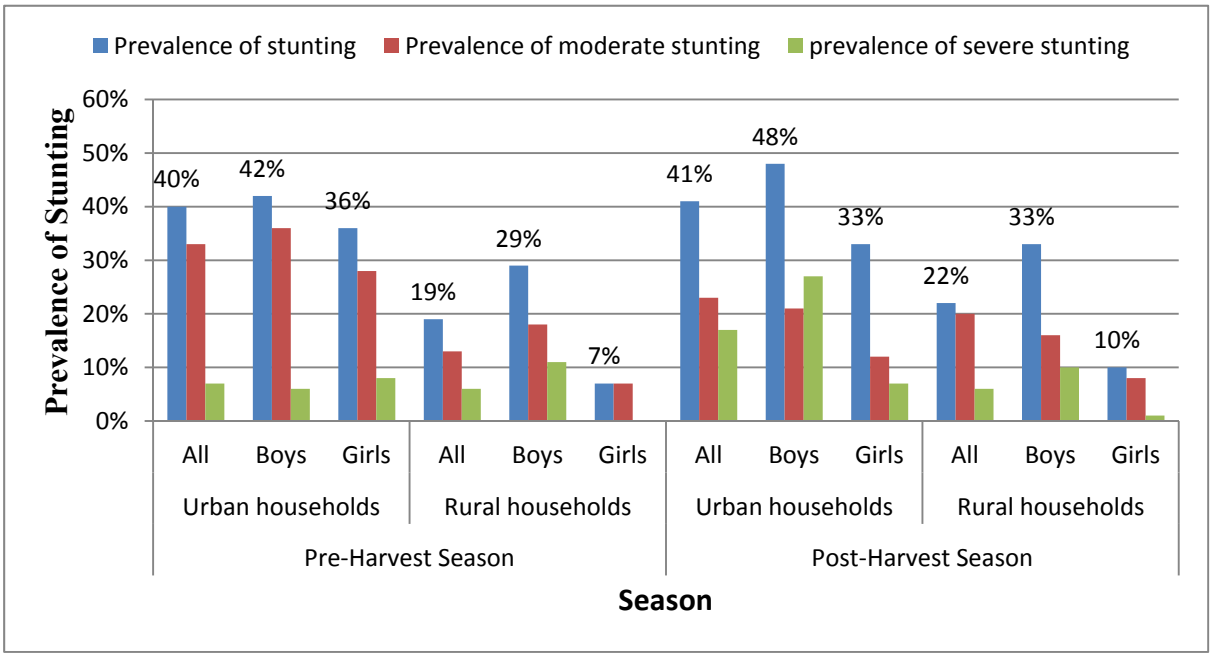


Figure 13: Comparison of stunting between urban and rural preschoolers in the pre-harvest and post-harvest season

A statistically significant difference on the stunting rates was noted (P=0.047) within the pre-harvest season with the urban children exhibiting higher stunting rates as compared to their rural counterparts (40% over 19%). However, there was no significant difference in the stunting rates of either rural or urban preschoolers between pre-harvest and post-harvest season (P=0.640). Nonetheless the significant difference noted between urban and rural preschoolers within the pre-harvest period was also noted in the post-harvest period (P=0.049).

4.3 Dietary Diversity in Pre-harvest and Post-Harvest Season

A comparison of the individual dietary diversity scores between urban and rural preschoolers in pre-harvest and post-harvest season are given in Figure 14 and 15 respectively.

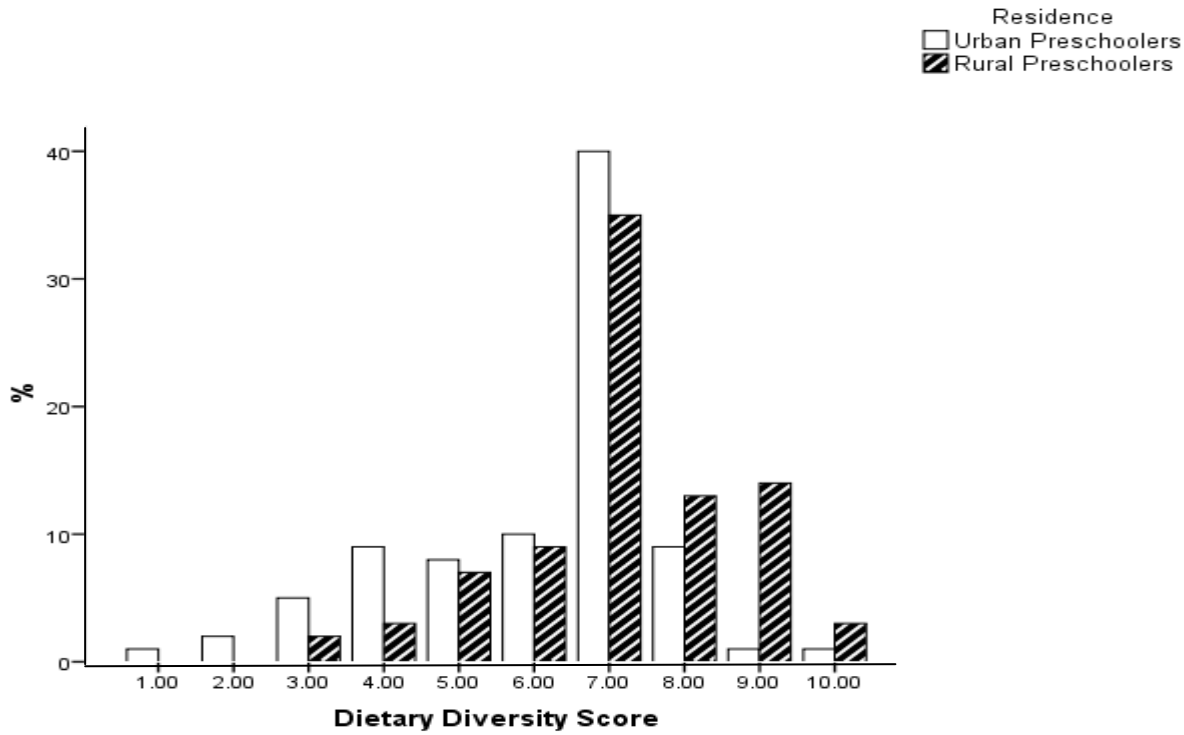


Figure 14: Individual dietary diversity score of preschoolers in the pre-harvest period

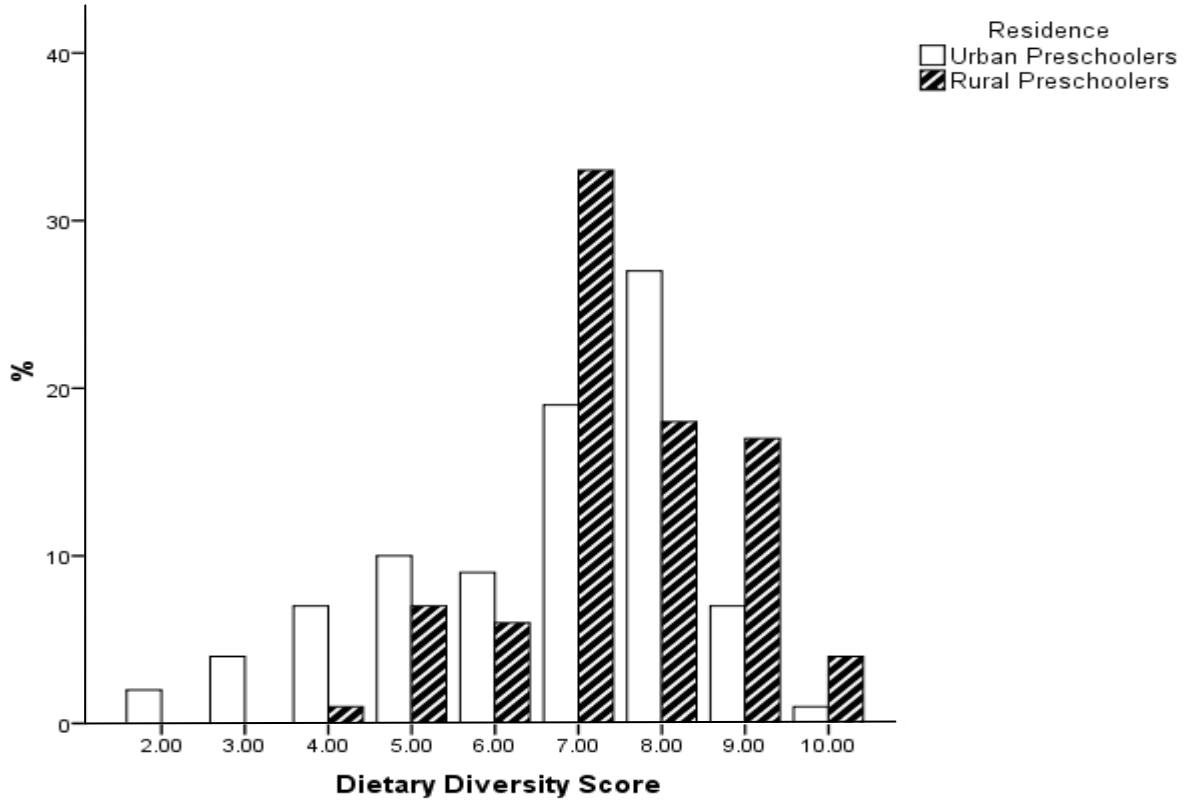


Figure 15: Individual dietary diversity score of preschoolers in the post-harvest period

In the pre-harvest season, the mean dietary diversity score for urban preschoolers was higher than for rural preschoolers (7.1 vs. 6.1 respectively). However, in the post-harvest season, urban preschoolers had a lower mean dietary diversity score of 6.6 while rural preschoolers had a score of 7.5.

The mean dietary diversity scores of the urban and rural preschoolers were significantly different within both pre-harvest and post-harvest season (P=0.007 and P=0.001). However, these scores were not significantly different between the two seasons for both the urban and rural preschoolers (P=0.09).

Considering that the pre-schoolers' dietary diversity was tested out of ten food groups, it is evident that the dietary diversity of rural preschoolers during the pre-harvest season was on the higher end of medium diversity while their urban counterparts were in the lower end of a high dietary diversity. In the post-harvest season, both preschoolers show high dietary diversity.

The food groups consumed by more than 50% of either urban pre-schoolers or rural pre-schoolers are listed in the table 11.

Table 11: Food groups consumed by ≥ 50% of urban and rural preschoolers

	Urban Pre-Schoolers	**Rural Pre-Schoolers**
starchy staples,	✓	✓
dark green leafy vegetables	✓	✓
other non-rich vitamin A fruits and vegetables	✓	✓
legumes, nuts and seeds	✓	✓
milk and milk products	✓	✓
Oils and fats	✓	✓
eggs	X	✓
Vitamin A rich fruits and vegetables	X	✓

4.4 Season and Residence Interactions and its Influence on Nutritional status and Dietary Diversity

There was an interaction between season and residence as revealed by evidence of intersection in the estimated marginal means of weight-for-height Z score for both urban and rural preschoolers. This is as shown in the Figure 16.

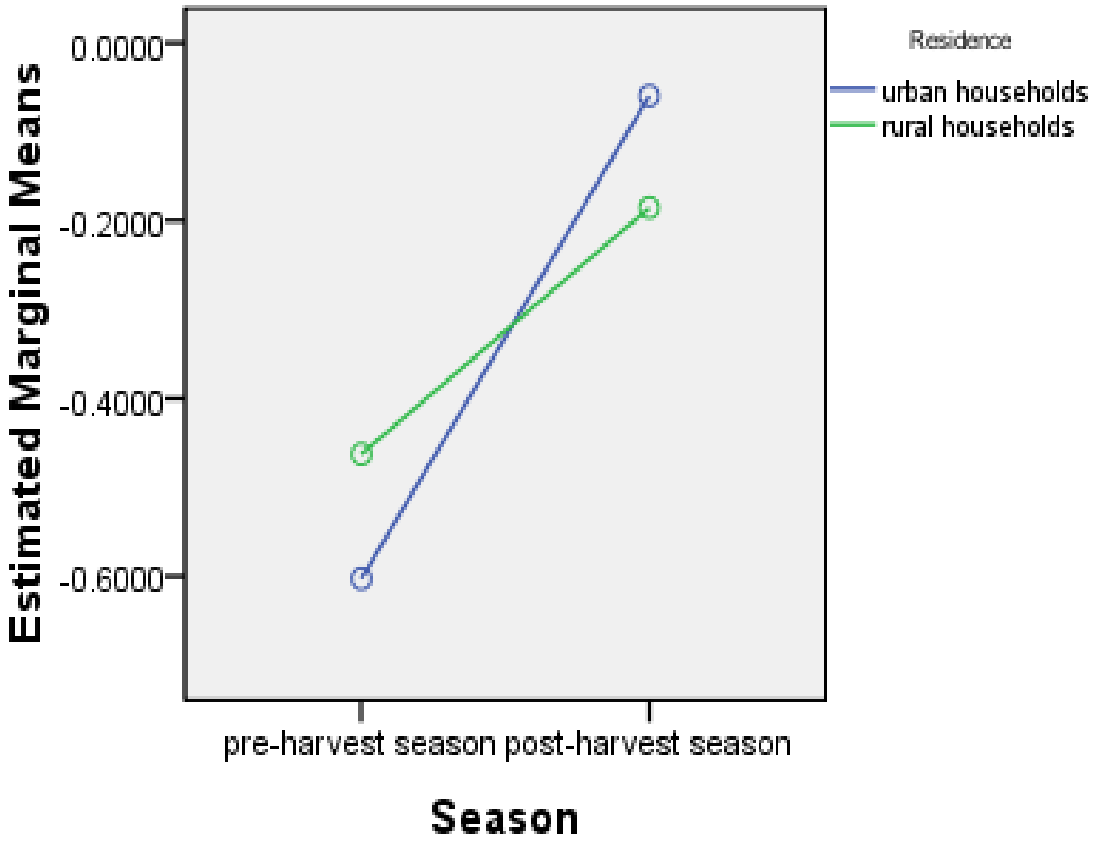


Figure 16: Estimated marginal means of wasting across season and residence

However, this interaction was not statistically significant (P=0.343). Nonetheless, when residence and season were factored singly against weight-for-height, season was shown to have a statistically significant positive effect on weight-for-height (P=0.004) as evidenced in appendix 3.

There was no interactive effect of season and residence on the dietary diversity score of the preschoolers as evidenced by the parallel estimated marginal means of the scores as shown in Figure 17.

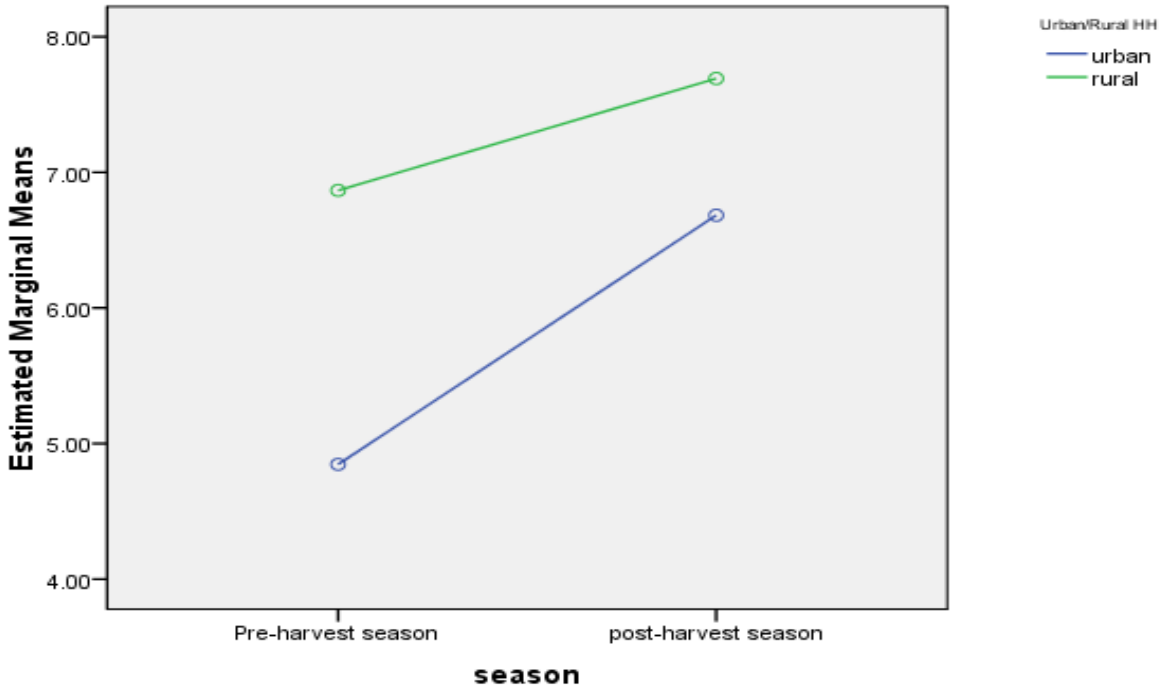


Figure 17: Estimated marginal means of individual dietary diversity scores of preschoolers

4.5 Associated Factors with Nutrition Status and Dietary Diversity

4.5.1 Demographic, Socio-economic Characteristics of household heads and primary care givers

The marital status, education level of the primary care givers and occupation of the household heads was tested for association with nutrition status of the children. The results are summarised in Table 12. Furthermore, household size was also correlated with the children's nutrition status whereby a statistically significant correlation with nutrition status (P=-0.038) was only seen among urban preschoolers.

Table 12: Distribution of selected demographic and socio-economic characteristics with wasting index the preschoolers

Variable	Urban households (n=86)		Rural households (n=86)	
	χ^2-value	P-value	χ^2-value	P-value
Marital status of primary care giver	1.51	0.496	1.75	0.450
Education Level of the primary care giver	5.085	0.0298	5.078	0.0196
Occupation of the household head	3.409	0.0359	4..22	0.031

It was found that only education level of the primary care givers and occupation of the household heads had statistically significant associations with the wasting indices of the preschoolers.

4.5.2 Water, sanitation and hygiene

Findings on water, sanitation and hygiene profiles of study households are summarised in Table 14.

Table 13: Water, sanitation and hygiene profile of study households

Factor	Urban Households (n=86)	Rural Households (n=86)
% Households that treated water	7	22
% Morbidity Experience among study children	42	22
% Households that used a community toilet	37	5
Average number of households per community toilet	15	10

As seen only 7% of urban households treated their water as compared to 22 % of rural households. It is worth noting that the main sources of water for the urban households were community borehole (81%) and river (19%) while for rural households they were river (72%) and protected wells (28%). Furthermore, urban preschoolers reported higher morbidity experiences (42%) than the rural preschoolers (22%). It was also revealed that sanitation was compromised in the urban area where 37% of the households used a communal toilet shared by an average of 15 households as opposed to rural households whereby only 5 % used a communal toilet shared by an average of 10 households.

4.5.3 Households experiencing food shortage

A higher proportion (46%) of urban households experienced food shortage in the previous month as compared to their rural counterparts (28%). The major reasons cited for this shortage among urban households was low purchasing power (37%) and increased food prices (9%). Rural households attributed the food shortage to a combination of poor harvest (9%), low purchasing power (7%) and increased food prices (12%). These variations among the two residences are shown in the Figure 18.

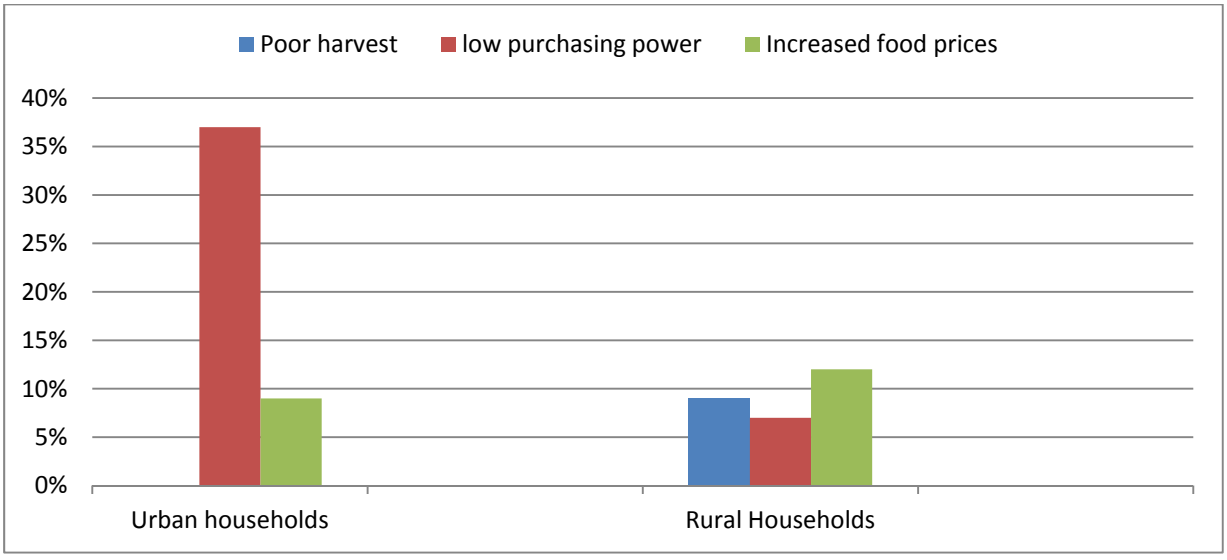


Figure 18: Self -reported causes of food shortage across urban and rural households

4.5.3 Household expenditure on food and non-food items

Urban households were noted to spend a significantly higher proportion of their income on food (58%) than rural households (31%).

A closer look at the household expenditure on particular food items showed that both populations spent a considerable amount of their monthly income on maize, wheat, milk and milk products, rice, vegetables and energy i.e. firewood and charcoal (see Figure 19) in pre and post-harvest seasons.

Expenditure on maize by both urban and rural households exceeded Ksh 1200 per month in the pre-harvest season. This reduced slightly in the post-harvest season albeit the reduction was very minimal. Furthermore, an increase in expenditure on milk and milk products in the post-harvest season was observed in both urban and rural households.

However, stark differences were noted in the expenditures on firewood/charcoal, roots and tubers. In these items, urban households spent higher amounts than rural households.
For instance, in the pre-harvest season rural households spent ≈ Ksh700 on firewood/charcoal per month as compared to their urban counterparts this spent ≈ Ksh300.

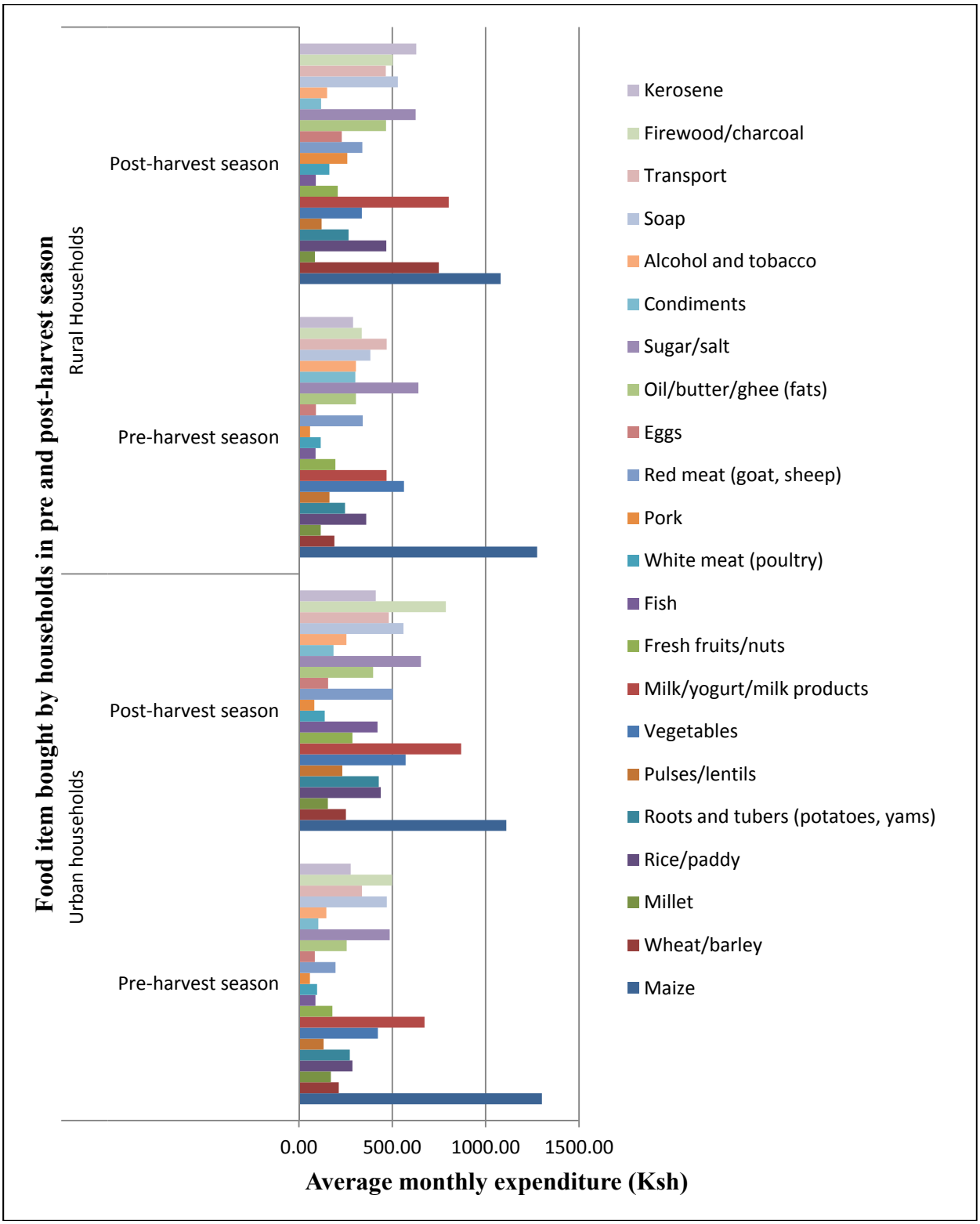


Figure 19: Households expenditure on food items

CHAPTER FIVE: DISCUSSION

5.1 Demographic and socio-economic characteristics of household heads and female primary care givers and Nutrition Status of Preschoolers

The demographic and socio-economic characteristic found to have the strongest association with nutrition status of the preschoolers was education level of the female primary care givers.

5.1.1 Education level of female primary care givers

There is sufficient evidence that the level of education of the primary care giver influences the nutrition status of the concerned children. For instance, the previous Kenya Demographic and Health Survey children of 2008 revealed that children whose mothers have completed secondary education are more likely to consume foods rich in vitamin A as compared to children whose mothers have not completed secondary education (KNBS and ICF Macro, 2010).

Furthermore, it also found that children of mothers with at least some secondary education have the lowest stunting levels (26 percent), while children whose mothers have no education or only incomplete primary education have the highest levels of stunting (39-40 percent). The proportion of underweight children was also negatively correlated with the level of education of the mother. Children, whose mothers have no education have the highest levels of underweight (28 percent), while children whose mothers have some secondary education have the lowest (8 percent).

The above scenario is depicted in Trans Nzoia County whereby the children whose mothers have higher levels of education are less likely to be malnourished as compared to their counterparts whose mothers are less educated. This scenario may best be explained by the

fact that a higher level of education among primary care givers results in better nutrition knowledge, feeding and care practises. Whereas the Kenya and Demographic Health Survey found that rural children are more likely to be underweight (17 percent) than urban children (10 percent) this study found the reverse to be true.

This could be explained by the fact that rural caregivers were found to be more schooled than their urban counterparts. Furthermore, it can also be explained by the higher morbidity experience among urban preschoolers as compared to their rural counterparts. In a study conducted by Abuya *et al*, 2012, it was proved that poor health and nutrition is more evident among urban poor children as opposed to rural poor children. This was chiefly attributed to the erosion of health benefits accrued to urban residents due to increased population in urban areas. The investigators also found that maternal education is a strong predictor of child stunting, There was minimal attenuation from other factors at child level: birth weight and gender, maternal level: marital status, parity, pregnancy intentions, health seeking behaviour and household level: socio-economic status.

5.2 Nutrition Status

A notable finding of this study is the higher levels of malnourishment among boys over girls. While it was expected that perhaps girls would have lower nutrition status due to say intra-household food distribution favouring the boys, this was not the case. This could be explained by other external factors such as health seeking behaviour of care givers or even higher energy expenditure among the boys than their intake.

In another study conducted in Philippines, it was found that a child's gender had a positive effect on the calorific adequacy ratio but a negative effect on height for age (Senauer, & Garcia, 1991). This meant that while boys received a larger percentage of their recommended

daily allowance for calories, they were more stunted than girls. This difference was noted to be perhaps a reflection of the impact of other inputs on their long-run health production functions which differs from that of girls.

5.3 Dietary Diversity and nutrition status in Pre-harvest and Post-Harvest Season

Dietary diversity score and nutrition status are positively correlated as evidenced in the results whereby urban preschoolers exhibited a lower dietary diversity score and a lower nutrition status. This was the opposite in rural preschoolers whereby they scored higher and consequently, had higher nutrition status. Variety in food choice is one of the six cardinal principles of diet planning. This is because different foods contain different arrays of nutrients and give one the advantage of added bonus in fruits and vegetables which contain different types of phyto-chemicals (Ministry of Medical Services, 2010).

This is crucial in boosting the immunity of the preschooler and perhaps it is the reason why the urban pre-schoolers with a lower dietary diversity score have higher morbidity experiences than their rural counterparts who have higher scores but lower morbidity experience.

It has been proven that severity of malnutrition is strongly correlated with the extent and severity of illness especially upper respiratory infections, gastrointestinal infections and measles (Ministry of Medical Services, 2010).

A global acute malnutrition rate of 21% as noted among urban preschoolers is a point of concern. This is because it is above 15%, the rate considered to constitute an emergency situation and is considered critical.

5.4 Season, Residence and Nutrition Status

While it was expected that season should have a significant influence on the general nutrition status (wasting, underweight and stunting) of the preschoolers, this was found to be only true for wasting. This is explained by the fact that wasting is an indication of acute malnutrition. On the other hand, underweight and stunting indicate malnutrition over a considerable period of time. However, the type of rainfall experienced in Trans Nzoia County was also crucial as to whether it affects nutrition status significantly or not. It has been shown that the nutrition status of preschoolers is not significantly affected by season in high agricultural production areas that exhibit bimodal rainfall patterns as compared to areas that experience unimodal rainfall patterns (Schofield, 1974). Trans Nzoia County has two rainy seasons and hence the reason why this did not a have a significant effect on underweight and stunting rates of the preschoolers as the period between each season (four months) was too short for any significant change in height and age and subsequently stunting and underweight rates.

The interaction between season and residence and its subsequent influence on the nutrition status of the preschoolers, albeit statistically insignificant, warrants further investigation. This interaction might be exhibited in food price changes, morbidity experience, food choices as dictated by food availability and access, household income or even size. Such investigation might require qualitative techniques supported by extensive experimental quantitative modelling.

5.5 Associated Factors with Nutrition Status

5.5.1 Household size

It has been shown that household size is closely associated with nutritional status. For example, in Bushenyi District, Western Uganda, it was shown that households with sizes

greater than five had more stunted children than households with less than five members (Kikafunda and Bambona, 2005).

However, in this study, only among urban households did household size correlate with nutrition status of the preschoolers. This casts doubt on blanket population control programmes based on association between malnutrition and household size.

Some studies show that conditions such as poverty, and subsequently malnutrition are escalated by a myriad of factors such as gender relations and prevailing economic conditions (Merrick 2001). It is thus crucial that resources directed towards population control be based on area-specific evidences of a link between household sizes and increased risk of malnutrition. However, in the case of Trans Nzoia County, this link is non-existent in the population that was studied. Nonetheless, perhaps the lack of strong association between household size and nutrition status could be attributed to limited variation in household size.

5.5.2 Household Food Security

Households' resilience to external shocks such as drastic spikes in food prices and lowered purchasing power is largely influenced by their diversity in sources of income. Households with various sources of income are better equipped to withstand such changes in the short term. Urban households are most responsive to this principle as they purchase almost 100% of their food. However, rural households' resilience is best measured in response to changes in climatic patterns which largely affects harvest, and subsequently, food prices and purchasing power (Rigg, 2006). All in all, the nutritional status of preschool children, whether urban or rural, is affected by the household's resilience to the aforementioned external shocks.

5.5.3 Household Expenditure on Food and Non-Food Items

The proportion of household expenditure on food over non-food items reveals the approximate level of family income and which foods are consumed by the resource-poor populations. Perisse et al 1969, showed that nutrient intake patterns changed by income class; roughly 75 % of total calories in the low income groups came from starchy staples, a proportion that dropped to 30% at high income groups.

This finding is corroborated by Bennett's law which states that the starchy staple ratio of a household declines as the household's income increases. It is also worthy to recall Engel's law which states that the proportion of a household's budget dedicated to food declines as the household's income increases (Perisse et al 1969). These universal truths are important for Trans Nzoia as it has been shown that urban households spend a significant 58% of their household income on food as compared to 31% by their rural counterparts. Scrutiny of the expenditure of the urban and rural resource-poor populations reveals that a considerable amount is spent on starchy staples such as maize, wheat and rice. It is thus evident that even in the rural area where households produce maize for own consumption; the yields are not enough to meet their dietary requirements and thus additional maize stock have to be purchased. This information is crucial in designing targeted interventions that will raise the food intake of both populations in an efficient and effective manner.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

There is a significant difference in the demographic and socio-economic characteristics of rural and urban study households. This difference is mainly noted in household size, education level of primary care givers and sources of income.

The only household demographic and socio-economic characteristics which have a significant association with the nutrition status and dietary diversity of both rural and urban study children are education level of the primary care givers (female) and occupation of the household heads (male). Household size has a significant association with nutrition status only among urban preschoolers.

The only significantly different index of nutrition status in preschoolers, from resource poor households in high agricultural production zones, between pre-harvest and post–harvest, is wasting. In addition to wasting, stunting indices of the children are also significantly different within either pre-harvest or post-harvest season. Season has no significant influence on the dietary diversity of the children. Education level of the female primary care giver has strong association with the nutrition status of the child; children whose mothers have attained higher levels of education are likely to be less malnourished as those whose mothers have lower levels of education.

Season and place of residence do not interact to jointly influence the nutrition status or dietary diversity of the children.

Lastly, the malnutrition rates in urban and rural households in Trans Nzoia County are high enough to warrant food and nutrition security interventions.

6.2 Recommendations

Supplementary feeding generalised for all urban preschoolers should be given and therapeutic feeding for severely malnourished children in both rural and urban areas instituted in the pre-harvest season.

Programmes aimed at improving access of the girl-child to education to be initiated in both rural and urban areas. It is advisable that both genders be involved.

Nutrition education is to be conducted in both urban and rural areas. It is advisable that the Positive Deviance/Hearth be employed among urban households because there is a close proximity between households and it is more sustainable than employing mediums of mass communication.

Interventions such as setting up fair price shops, lowering the price of kerosene which increases the purchasing power of urban households should be designed and implemented in the urban area. Income transfer programs such as the Urban Food Subsidy program piloted in Mvita and Likoni should be extended to the urban poor of Trans Nzoia.

In the rural area, interventions largely aimed at protecting households from the vagaries of poor harvest should be implemented. Such interventions can take the forms of agric-insurance, proper and timely agricultural extension services, timely provision of farm inputs such as seed and fertiliser or even setting up of community cereal banks.

In relation to morbidity experience, it is pivotal that sanitation among urban households be improved expediently.

Water for domestic use should be treated preferably at the source and possibly later at the household level. More communal toilets should be constructed to ease the congestion; a maximum of five households per toilet down from fifteen would be desirable.

In seeking to implement the above recommendations, it is advisable that community based organisations, non-governmental organisations and the County government work hand in

hand to ensure that the nutrition status of the preschoolers in both urban and rural areas is improved and maintained at normal status. Hence, regular interaction between such entities through public engagements, conferences, and partnership programs should be encouraged.

Lastly, it is pivotal that research into the nutrition status of vulnerable populations such as preschoolers should take into account factors such as household incomes, demography among other factors. For instance, the Kenya Demographic Health Surveys could be more appropriate if the nutrition status of preschoolers is stratified according to household income, education of the primary care givers or even occupation of the household heads.

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APPENDICES

Appendix 1: Questionnaire

Influence of seasonality and residence on the nutritional status of preschool children in a high agricultural production region: a study of urban and rural households in Trans Nzoia County, Kenya

Hello. My name is..... I am a student at the University of Nairobi doing human nutrition. In order to get information about the influence of seasonality and residence on the nutritional status of preschool children in _____I am conducting research in this area and your household has been selected by chance from all households in this area.

The information you provide was useful in assessing influence of seasonality and residence on the nutritional status of preschool children in this community. Findings of this research was submitted to your community leaders who may use it for planning interventions aimed at improving the nutritional status of preschool children in the community.

All information you give was confidential. The information was used to prepare papers and reports but will not include any specific name. There was no way to identify that you are the one who gave the information.

We encourage you to participate in this study and your cooperation was highly appreciated.

If it is okay with you, may I proceed to ask you some questions related to food security and health of children in your household?

Respondent agreed to be interviewed _____ 1= Yes 2 = No

Signature of interviewer _____ Date_____

GENERAL INFORMATION

Questionnaire no: _____Cluster no_____

Team Number: _____ _ Constituency/District: _____

Location: _____ Sub-location: _____

Village: _____

SECTION 1: HOUSEHOLD DEMOGRAPHIC PROFILE

No.	Name	Age	Sex	Marital Status	Rshp to HH Head	Education Level	Occupation	Contribution. to HH Income
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Codes

Sex	Marital Status	Relationship to HH	Education Level	occupation	Contribution to HH income
1= Male	1=never married	1=household head	0= None	1= Salaried employee	1=nothing
2=Female	2=married	2=spouse	1= Not completed primary	2= Business	2=money
	3=cohabiting	3=son/daughter	2= Completed Primary	3= Farming	3=labour
	4=divorced/separated	4=Grandson/daughter	3= In Primary	4= Casual Labourer	4= Childcare
	5=widowed	5=employee	4= Not completed Secondary	5=Unemployed	
	99= Not applicable	6=relatives	5=Completed Secondary	6= Other (Specify)	
		7=parent	6= In Secondary	7=Student	
		8= visitor	7=College/Diploma Degree	99=Not applicable	
			99=Not applicable		

SECTION 2: FOOD SECURITY

2.1 Food Consumption Score

Yesterday, how many meals did…….eat in this house? **Adults……..…Children (<59 months)……..**			
Food Item	**No. of days eaten over last 7 days**	**Food source (main and secondary)**	**Food Source Codes**
Maize		[ ], [ ]	1 = Own production (crops, animals) 2 = Hunting, fishing 3 = Gathering 4 = Borrowed 5 = Purchased with wages 6 = Exchanged labour for food 7 = Exchanged items for food 8 = Gift (food) from relatives 9 = Food aid (NGOs, etc.) 10 = Other (Specify) :.....
Rice		[ ], [ ]	
Millets		[ ], [ ]	
Wheat/Barley		[ ], [ ]	
other cereal products		[ ], [ ]	
Roots and tubers		[ ], [ ]	
(potatoes, yam)		[ ], [ ]	
Pulses/lentils		[ ], [ ]	
Fish		[ ], [ ]	
White meat (poultry)		[ ], [ ]	
Pork		[ ], [ ]	
Red meat (goat, sheep)		[ ], [ ]	
Red meat (Beef)		[ ], [ ]	
Eggs		[ ], [ ]	
Milk/curd/other		[ ], [ ]	
dairy products		[ ], [ ]	
Vegetables		[ ], [ ]	
Fresh fruits		[ ], [ ]	
Oil/fats/ghee/butter		[ ], [ ]	
Sugar/sweets		[ ], [ ]	
Salt/spices/condiments		[ ], [ ]	

2.2 Variation in food sources across between seasons

In the last calendar year (2012) what was the contribution of (source) to your annual food consumption? How does this differ throughout the year? (Use proportional piling, or divide the pie method, to estimate the relative contribution of each source to total food consumption)					
Food source	Annual (%)	Jan.–Feb	March-May	June–Sept	Oct.–Dec.
Own production					
Hunting, fishing, gathering					
Purchases					
Gifts/borrowing					
Food aid					
Total contribution	100	100	100	100	100

2.3. Are there periods when your household experiences food shortage?

1=Yes 2= No **(If No, skip to section 3)**

2.3.1. Which period (s) of the year does this happen?

1. Jan-Feb
2. March-May
3. June-Sep
4. Oct-December

Rank	1	2	3	4

1=All periods, 2=3 periods 3= 2periods 4=1 period

2.3.2. Give the main reasons for food shortage?

1=Poor harvest 3= Livestock Diseases 5=Increased food prices

2=Low purchasing power 4=other (specify).....

2.4. Have you experienced food shortages in the last one month?

1= Yes

2 = No (if No, skip to **Section 3**)

2.4.1. Did you use any of the following coping strategies in the past one week?

Coping strategy	**1=Yes** **0=No**
a. Shift to less preferred (low quality, less expensive) foods?	
b. Limit the portion/quantity consumed in a meal?	
c. Take fewer numbers of meals in a day?	
d. Borrow food on credit from the shop/market?	
e. Borrow food on credit from another household?	
f. Consume preserved seeds or meat?	
g. Restrict consumption of adults in order for small children to eat?	
h. Gather wild food or hunt?	
i. Rely on food donations from relatives?	
j. Rely on food donations from the clan/community?	
k. Seek or rely on food aid from humanitarian agencies?	
l. Send household members to eat elsewhere?	
m. Beg for food?	
n. Skip entire days without eating?	
o. Consume spoilt or left-over foods	

2.5 Household Expenditure (Food versus Non-Food Items)			
In the past **MONTH**, how much money have you spent on each of the following items or services? (Write 0 if no expenditure.)		**a.** Estimated expenditure in cash	**b.** Estimated expenditure in credit (if applicable)
1	Maize		
2	Wheat/barley		
3	Millet		
4	Rice/paddy		
5	Roots and tubers (potatoes, yams)		
6	Pulses/lentils		
7	Vegetables		
8	Milk/yogurt/milk products		
9	Fresh fruits/nuts		
10	Fish		
11	White meat (poultry)		
12	Pork		
13	Red meat (goat, sheep)		
14	Eggs		
15	Oil/butter/ghee (fats)		
16	Sugar/salt		
17	Condiments		
18	Alcohol and tobacco		
19	Soap		
20	Transport		
21	Firewood/charcoal		
22	Kerosene		
In the past **6 MONTHS** (semester), how much money (in cash) have you spent on each of the following items or services? *Write 0 if no expenditure.*		**a.** Estimated expenditure in cash	**b.** Estimated expenditure in credit (if applicable)
24	Equipment, tools, seeds		
25	Hiring labour		
26	Medical expenses, health care		
27	Education, school fees		
28	Clothing, shoes		
29	Veterinary expenses		
30	Celebrations, social events, funerals, weddings		
31	Fines/taxes		
32	Debts		
33	Construction, house repair		

SECTION 3: WATER

3.0. A. What is your main source of water for household use during the dry season?

1. =River
2. = Dam/ Public water pan

1. =Piped
2. =Well (Protected)
3. =Well (Not protected)
4. =Borehole
5. =Tanker
6. =Rain water
7. =Others (specify)_____

3.1. How long does it take to and back from the water source?

Minutes/Kilometers_____
Within premises_____

3.2. What is your main source of water for household use during wet season?

1. River
2. Dam/ Public pan
3. Piped
4. Well (Protected)
5. Well (Not protected)
6. Borehole
7. Tanker
8. Rain water
9. Others (specify)_____

3.3. How long does it take to and back from the water source?

Minutes_____/ Kilometres _____

3.4. What means do you use to fetch water?

1. Bicycle
2. Human carts
3. Donkey carts
4. Walk
5. Others (specify)
6. 99 Not applicable

3.5. How frequently is water available from your current source?

1. Always available

2. Several hours per day
3. Once or twice a week
4. Infrequently

3.6. How much water does your house use per day?_____.

3.7. Do you buy this water?

1. Yes
2. No (If NO skip 3.8)

3.7.1. If yes in 3.7, How much do you pay for a 20lt jerrican of water? Ksh._____

3.7.2. If yes in 3.7, if other containers specify Container _____Amount_____

3.8. Who fetches the water? _____

3.9. How do you store water for future use?

1. Jerricans
2. Pots
3. Drums
4. Tanks
5. Others (specify)_____

3.10. Do you treat your household water?

1=yes
2=no (if no go to 13)

3.11. How do you treat your water?

1. Chemical e.g. Chlorine, water guard
2. Filtration/Sieving
3. Boiling
4. Decanting
5. Sanding
6. Charcoal
7. Others (specify)_____

SECTION 4.0: HYGIENE AND SANITATION

4.1. Does your household have access to a toilet facility? (Observe)

1= yes

2= no (**If no skip to section 5**)

4.2. If yes 4.1, what kind of toilet facility does your household have?

1. Flush toilet
2. Pit latrine
3. No facility/Bush/Open field
4. Others (Specify)_____

4.3. Do you share this toilet facility with other household or neighbours?

1. Yes (If no skip to 4.5)
2. No

4.4. How many other households use this toilet facility? _____

4.5. Where do you dispose the child/children's faecal matter?

1. Latrine or toilet
2. Drain into the river
3. Throw into compost pit
4. Left in the open
5. Others (specify)_____

SECTION 5: MORBIDITY

5.1. For the past two weeks has the child been ill?

1. Yes
2. No **(if no skip to 5.2)**

5.1.1. **If yes in 5.1**, what was the child suffering from?

Disease	1=Yes 2=No
Diarrhoea/watery stool/bloody stool	
Cough/ difficulty in breathing	
Fever/Shivering/ Malaria	
Cold/flu	
Persistent vomiting	
Pus from ears	
Persistent abdominal pain	
Any other disease/ailment	

5.1.2. What measures did you take?

0= No measure 2=Health centre 4=over the counter medication

1= Traditional Herbal remedy 3=Home remedy 5=others (Specify)

5.2. Do you have access to a health facility?

1= Yes 2= No

5.3. How far is the nearest health facility? _____Kilometre

SECTION 6: 24 HOUR DIETARY DIVERSITY SCORE - FOR CHILDREN 6-59 MONTHS

QNo.	FOOD GROUP	EXAMPLE	1 = YES 0=NO
1	Cereals	Maize, wheat, rice, millet, sorghum and any other grains or foods made from these (e.g. bread, spaghetti, noodles, porridge, ugali, githeri	
2	Roots and tubers	Irish potatoes, yams, cassava, or other foods made from these (e.g. chips/French fries,	
3	Vitamin A rich vegetables and tubers	Pumpkin, carrots, squash, orange-fleshed sweet potato, other locally available vitamin A vegetables e.g. red sweet pepper,	
4	Dark green-leafy vegetables	Dark green-leafy vegetables including wild forms and locally available vitamin A rich leaves such as amaranth, cassava leaves, kales, spinach e.t.c	
5	Other vegetables	Other vegetables e.g. tomato, onion, egg plant, green bananas and any other locally available vegetable	
6	Vitamin A rich fruits	Ripe mango, apricots, ripe pawpaw, ripe banana, avocado, 100% fruit juice and any other locally available vitamin A rich fruits	
7	Other fruits	Including wild fruits, 100% fruit juice made from this.	
8	Organ meat	Liver, kidney, heart and other organ meats and blood-based foods.	
9	Flesh meats	Beef, pork, lamb, goat, rabbit, game, chicken, duck, other birds and insects.	
10	Eggs	From chicken, duck, guinea fowl or any other eggs.	
11	Fish and sea food	Fresh or dried fish	
12	Legumes, nuts and seeds	Dried beans, dried peas, lentils, nuts, green grams, or food made from these e.g. peanut butter	
13	Milk and milk products	Milk, cheese, mala, yogurt.	
14	Oils and fats	Oils, fats, margarine or butter added to foods or used for cooking	
15	Sweets	Sugar, honey, sweetened soda, sugar cane sweetened juice drinks, sugary foods such as chocolate, candies, cookies and cakes,	
16	Spices, condiments and beverages.	Spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, fermented beverages.	
Total Dietary Diversity Score			

SECTION 7: DIETARY INTAKE-24 hour dietary recall

Please describe the foods and drinks taken during the last 24 hours from morning to night time whether at home or outside the home.

(Researcher to list all foods mentioned, where composite meals are mentioned probe for the ingredients, when respondent is through probe for any meal that might not have been mentioned.)

Match the meal according to time given by the respondent.

Time	Dish	Ingredients	Amount	Total volume of food prepared	Unit in grams	Amount served to the child	Amount left over	Amount consumed

SECTION 8.0: IYCF QUESTIONNAIRE

8.1. Who is the primary care giver of the children? (Relationship to the child, 6-59 months) 1=mother 2=grandmother 3=older sibling 4=house help
8.2. Age of the primary care giver_____ (Years)
8.3. Level of education of care giver____

0= None 1= Not completed primary 2= Completed Primary 3= In Primary 4= Not completed Secondary 5=Completed Secondary
6= In Secondary 7=College/Diploma Degree

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Child No.	**Get the children's below 2 yrs first name** (If more than one child, record them **sequentially by age)**	**Child's Date of Birth** **(Use Clinic Cards and Calendar of EVENTS** (D/M/Y)	**Enter the Age** of child in **months** **(Use Clinic Cards and Calendar of EVENTS**	**Child Sex** 1= **M** 2= **F**	Has this child ever been breastfed? 1= Yes 2 =No *If no go to question 9*	How long after birth did you first put the child to the breast 1 = Within one hour 2 = In first day (within 24 hours) 3 = After first day (>24 hours)	Did you feed your child with fluid or liquid that came from breasts in the first 3 days after birth **(Colostrum)** 1 = Yes 2= No	Is this child still breastfeeding now? 1 = Yes 2= No	Exclusive breast feeding: Other than breast milk, what other foods fluids did you give the child before the age of 6 months 1 =None other than breast milk 2=Powder/animal milk/yogurt 3 = Cereals based diet 4 = Plain water 5 = Fruit Juice 6 = Sugar water 7 = Vegetables	At what age did you start giving these foods/fluids? (months)	Yesterday (During the day and at night). How many times did you feed [Name] solid and semisolid Foods? No. of times child was given food to make it full
1.											
2.											

	ANTHROPOMETRY			
Q1	**Q24**	**Q25**	**Q26**	**Q 27**
Child Serial No	Weight In KGs (Nearest 0.1kg) Write down the decimal and do not round up	Height In cm (Nearest 0.1cm) Write down the decimal and do not round up	Oedema 1=present 2=absent	MUAC In cm (Nearest 0.1cm) Write down the decimal and do not round up
1				
2				

Appendix 2: Independent and paired t-tests used in testing hypotheses 2 and 3.

Independent Samples Test

Assumptions=Equal variances assumed

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
WAZ	.190	.664	-4.7106713E-1	170	.638	-.0773140	.1641251	-.4012997	.2466718
HAZ	1.713	.192	-1.7226595E0	170	.047	-.3294070	.1912200	-.7068785	.0480645
WHZ	2.967	.087	5.1699136E-1	170	.606	.0994802	.1924215	-.2803629	.4793234

Independent Samples Test of Wasting Indices between Urban and Rural Preschoolers

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
WHZ	Equal variances assumed	4.302	.040	-.416	170	.038	-.0799919	.1924749	-.4599406	.2999568
post-harvest weight for height	Equal variances assumed	.096	.757	-.419	170	.606	-.08587	.20515	-.49084	.31910

Paired Samples Test of wasting indices before and after harvest of urban preschoolers

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	WHZ - post-harvest weight for height	.3997442	1.8758092	.2022737	-.0024301	.8019185	1.976	85	.036

Paired Samples Test of wasting indices before and after harvest of rural preschoolers

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 2	WHZ - post-harvest weight for height	.393864	2.0665433	.222841	-.0492038	.8369317	1.767	85	.042

Appendix 3: 2-wayANOVA of season*residence effect on wasting

Dependent Variable: Weight-for-height Z score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	15.830[a]	3	5.277	3.157	.025	.027
Intercept	36.704	1	36.704	21.957	.000	.061
Season	14.367	1	14.367	8.594	.004	.025
Residence	.004	1	.004	.003	.960	.000
Season * Residence	1.509	1	1.509	.903	.343	.003
Error	565.013	338	1.672			
Total	617.903	342				
Corrected Total	580.843	341				

Appendix 4: Training curriculum for research assistants

Day	Time	Content	Method
1	9:oo am-10:00am	Introduction: study objectives, general conduct and research ethics	Lecture
	10:30 am-12:00 pm	Rapport Creation	Role Play
2	9:oo am-10:00am	Questionnaire Administration	Lecture
	10:30 am-12:00 pm	Questionnaire Administration	Role Play
3	9:oo am-10:00am	Anthropometric measurements	Lecture
	10:30 am-12:00 pm	Anthropometric measurements	Role Play
4	9:oo am-10:00am	24 hr dietary recall	Lecture
	10:30 am-12:00 pm	24 hr dietary recall	Role Play