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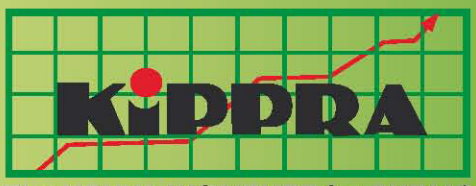

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Dietary Diversity and Child Malnutrition in Kenya

Teresia Mbogori

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THE KENYA INSTITUTE FOR PUBLIC POLICY
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Dietary Diversity and Child Malnutrition in Kenya

Teresia Mbogori

Productive Sector Division
Kenya Institute for Public Policy
Research and Analysis

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Abstract

Malnutrition in children below the age of five years is critical due to the developmental requirements of that age. Dietary intake and diseases are the immediate causes of malnutrition, which are influenced by food security of a household, the child caring practices, and the environment within which the child lives. In Kenya, the determinants of child malnutrition have been studied extensively, and various factors such as maternal education, socio-economic status and inadequate access to food have been analyzed. However, work on dietary intake by children, especially using dietary diversity scores, has not been exhaustively studied. This study aimed at analyzing dietary diversity in Kenya and its impact on child malnutrition.

The main objectives of the study are to determine the level of dietary diversity in children aged 6-59 months in Kenya, and to analyze the impact of dietary diversity on child malnutrition. Data from the Kenya Demographic Health Survey (KDHS) 2008/09 was used, from which the nutritional status and dietary diversity variables were derived. Forty two (42) per cent of the children had low dietary diversity, while 41 per cent and 17 per cent had medium and high dietary diversity, respectively. Logistic regression analysis showed that intake of a highly diversified diet reduced the probability of a child being malnourished by 9 per cent. In addition to dietary diversity, caring capacity of the child and the environment the child was exposed to were shown to influence the nutritional outcome of the child. This study concludes that dietary diversity is very important in the fight against child malnutrition, and should be included in the Food and Nutritional Security Policy as one of the measures to be used in reducing child malnutrition in Kenya.

Abbreviations and Acronyms

KDHS	Kenya Demographic Health Survey
WFA	Weight for Age Z score
HFA	Height for Age Z score
WFH	Weight for Height Z score
BMI	Body Mass Index
MUAC	Mid Upper Arm Circumference
DDS	Dietary Diversity Score
FAO	Food and Agriculture Organization
GoK	Government of Kenya
UNICEF	United Nations Children's Fund
WHO	World Health Organization
FNSP	Food and Nutrition Security Policy
HFIAS	Household Food Access Scale
HDDS	Household Dietary Diversity Score
HFSSM	Household Food Security Survey Measure
CSI	Coping Strategy Index

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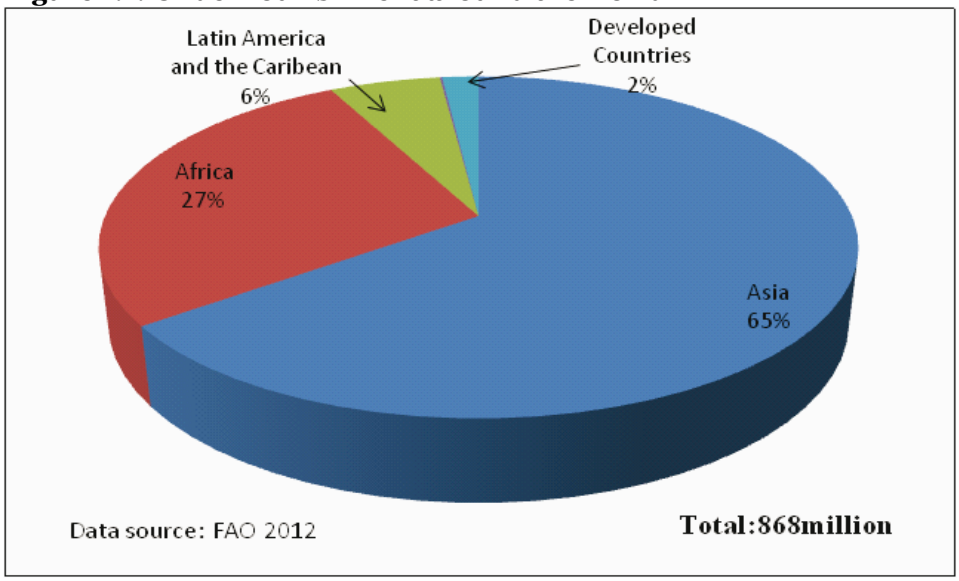
1. Introduction

1.1 Background

Malnutrition occurs when there is an imbalance between the body's need for certain nutrients and their intake. Malnutrition could occur as either under-nutrition, whereby there is inadequate intake of nutrients required by the body, or over-nutrition, where there is excessive supply. However, the terms malnutrition and under-nutrition have previously been used synonymously, especially in the developing countries (Gulati, 2010). The Food and Agriculture Organization (FAO) estimates that 868 million people were undernourished in 2012, with majority coming from developing countries (Figure 1.1). In Kenya, it is estimated that about 10 million people suffer from food insecurity and poor nutrition (Government of Kenya, 2011). Of the 10 million people, 6 million are in transitory food insecurity, whereas 4 million are constantly food insecure.

Food insecurity could occur either as chronic or acute, leading to different forms of under-nutrition, namely stunting and wasting. Stunting occurs as a result of prolonged deprivation of adequate food, and is reflected in a child being too short for their age. Wasting, on the other hand, mainly occurs when there has been an acute food shortage that may be occasioned by seasonal calamities such as drought or floods. This is reflected in a child being too thin for their height. A combination of both stunting and wasting leads to underweight, whereby the child is too light for their age.

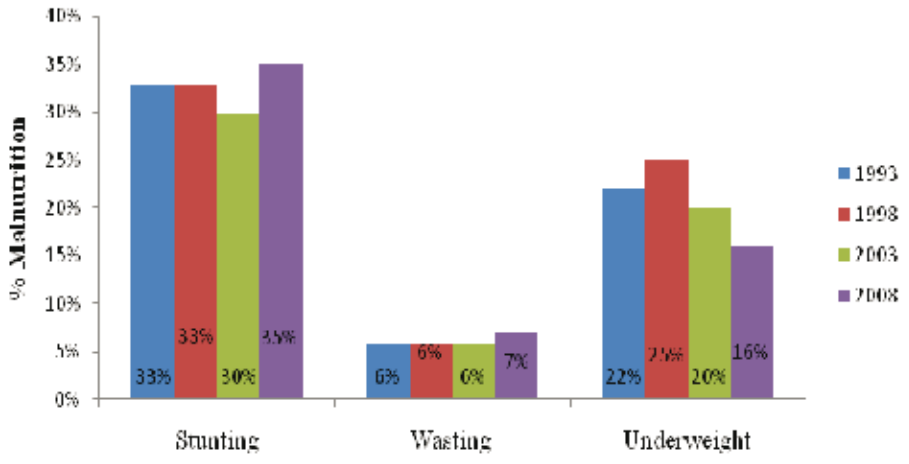
Figure 1.1: Undernourishment around the world



Malnutrition has serious implications on an individual, household and the society. Under-nourished pregnant women are at greater risk of dying during childbirth or delivering low birth weight babies who do not survive infancy (Barker, 2001). If the infants survive infancy and food insecurity persists, they end up with nutritional disorders during childhood. These are disorders such as low cognitive ability, which results to poor education achievement by the child. This child, as an adult, will have low labour productivity, which perpetuates the cycle of poverty and may lead to other social crimes (Walker *et al.*, 2007). Therefore, the global community and national governments must put in place measures to reduce malnutrition both at international, national and household levels.

A joint report by UNICEF (2012) on child malnutrition estimated that globally, 25.7 per cent, 16.1 per cent and 8.0 per cent of children under the age of five years were stunted, underweight and wasted, respectively. This was a 11 per cent, 6 per cent and 0.9 per cent reduction in stunting, underweight and wasting, respectively, for the last 15 years. For Africa, it was estimated that 35.6 per cent, 17.8 per cent and 8.5 per cent of the children were stunted, underweight and wasted, respectively. There slight reduction in the levels of under-nutrition. However, in Kenya, results of the Demographic Health Survey of 2008 showed that 35 per cent of children below 5 years were stunted, 16 per cent underweight and 7 per cent wasted (KNBS, 2008). This indicated that there was a slight increase in the levels of stunting and wasting, and a slight decrease in underweight in the last 15 years as shown in Figure 1.2. In addition to the levels contrasting the world trends, they are also contrary to the Millennium Development Goals that expected malnutrition to be halved by 2015 so as to reduce the negative effects related to child malnutrition.

Figure 1.2: Childhood malnutrition in Kenya (1993-2008)



Data source: KDHS various reports

To address high levels of malnutrition in Kenya, the government developed and adopted a Food and Nutrition Security Policy (FNSP) in 2011. This policy adopts a framework of improving food and nutrition security in Kenya through four dimensions: availability, accessibility, stability and utilization of food (Government of Kenya, 2011). There are several flagship projects in various ministries that have been established to increase availability, accessibility and stability of food. These are projects such as cash transfers to the vulnerable people, irrigation projects, fish farming, and introduction of school feeding programmes, among others. However, there are other important approaches such as ensuring dietary diversity, despite their known importance in improving nutritional status of children having not been adequately factored in the policy document.

Dietary diversity is the number of foods consumed across and within food groups over a reference period, usually 24 hours, 3 days or 7 days. Increasing the variety of foods and food groups in the diet ensures that there is adequate intake of essential nutrients, hence good health. For children 6-59 months, lack of dietary diversity is particularly critical because they require energy and nutrient-dense foods for both physical and mental growth and development, so as to live a healthy life. In developed countries, evidence has shown that dietary diversity is strongly associated with nutrient adequacy (Bernstein *et al.*, 2002; Foote *et al.*, 2004). However, evidence from developing countries is scarce due to consumption of monotonous diets that mainly rely on few plant based staples and sometimes few or no animal products, with occasional fruits and vegetables (Arimond and Rauel, 2004). Therefore, many developing countries, including Kenya, have a limited record of the level of dietary diversity and its role in ensuring health and nutrition among their population.

1.2 Problem Statement

The Constitution of Kenya (Article 43) recognizes that it is the right of every Kenyan to be free from hunger and to have adequate food of acceptable quality. In this regard, Kenya adopted a Food and Nutrition Security Policy in 2011 that sought to improve food and nutrition security by ensuring food availability, accessibility, stability and utilization. Unlike the programmes to improve food availability, stability and accessibility, those out to improve food utilization, such as consumption of nutritious foods through dietary diversity, have not had adequate attention. This is probably because of lack of adequate research that links dietary diversity to malnutrition in Kenya, unlike other determinants of malnutrition such as maternal education, household food security, environmental sanitation and accessibility, and utilization of health facilities that have had adequate studies done. Therefore, this study seeks to analyze the contribution of

dietary diversity to malnutrition in children in Kenya, and its association with the other determinants of malnutrition. The results are expected to strengthen the existing policy recommendations in the Food and Nutrition Security Policy, and suggest new policy recommendations that will help in reducing childhood malnutrition in Kenya.

1.3 Research Questions

(a) What is the level of dietary diversity in Kenyan children?

(b) How is dietary diversity related to child malnutrition in Kenya?

1.4 Objectives

The broad objective of the study is to determine the level of dietary diversity in Kenyan children, and analyze its effect on the nutritional status of children aged 6-59 months, with the aim of proposing policy recommendations for reducing child malnutrition in Kenya. The specific objectives are to:

(i) Determine the level of dietary diversity in children aged 6-59 months in Kenya

(ii) Analyze the contribution of dietary diversity to child malnutrition in Kenya

1.5 Significance of the Study

For Kenya to achieve the Vision 2030 of a newly industrializing, middle-income country with a high quality of life for all its citizens, malnutrition needs to be prioritized. Malnutrition is preventable and easily managed, especially when intervened in childhood. It is more desirable if governments and other stakeholders dealing with food and nutrition security take a more proactive rather than reactive measure in dealing with malnutrition. Encouraging dietary diversity is one proactive measure that may be used to sensitize people to consume adequate energy and nutrients, hence promote good nutrition. The results from this study will give possible interventions that can be used by government and stakeholders to tackle malnutrition from childhood to prevent the negative implications of malnutrition in adulthood. Also, the results will form a baseline for future studies on the same area.

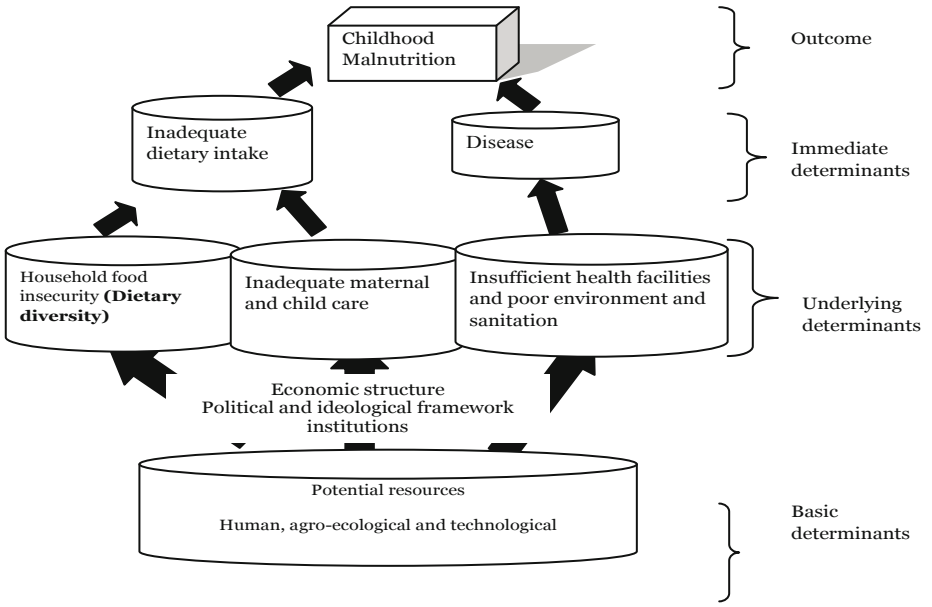
2. Literature Review

2.1 Determinants of Childhood Malnutrition

Multiple and interrelated factors are involved in the development of malnutrition in children. The United Nations Children's Fund (UNICEF) developed a conceptual framework on the causes of childhood malnutrition in 1990 and revised it in 1998. This is a comprehensive framework that incorporates both socio-economic and biological causes of malnutrition at both macro and micro levels (UNICEF, 1990 and 1998). It recognizes three levels of the causes of malnutrition and classifies them as basic, underlying or immediate Figure 2.1.

Basic causes of malnutrition in a society relate to the resource availability, their allocation and the way these resources are controlled. These basic determinants include the potential resources available to a community, which are limited by the natural resources such as arable land and rainfall, quality of human resources and availability and accessibility to technology in a society. In Kenya, there is a big disparity in availability, allocation and use of resources, which translates to poverty and impacts on the child's nutritional status (KNBS, 2007). Utilization of these resources and how they are translated to resources for the underlying determinants of malnutrition are influenced by the political, economic, social and cultural factors (Smith and Hadaad, 2000).

Figure 2.1: Conceptual framework on the determinants of child malnutrition



Adapted and modified from UNICEF, 1990 and 1998

Underlying causes of malnutrition manifest themselves at the household or family level. They are clustered into three categories: food insecurity, poor care practices for women and children, and poor sanitation and health facilities. These three elements individually do not result to optimal health and nutrition, but are required to be present together (Bellamy, 1998). Food security is said to exist when all people at all times have physical, social and economical access to sufficient, safe and nutritious food to meet their nutritional needs and food preferences in order to have an active healthy life (FAO, 2012). A household is considered to be food insecure if it lacks the ability to acquire the food needed by all its members. This may be defined in two ways, either in a transitory or in a permanent basis. Transitory food insecurity describes when there is food shortage in a periodic manner, for instance due to seasonality of food production, whereas permanent food insecurity is when there is long term inaccessibility to sufficient food (Pinstrup-Andersen, 2009). Household food insecurity is measured using several methods: Household Food Access Scale (HFIAS), Household Dietary Diversity Score (HDDS), Household Energy Adequacy per Adult Equivalent (EnergyAdq), Household Food Security Survey Measure (HFSSM) and the coping strategy index (CSI) (Coates *et al.*, 2006; Cordeiro *et al.*, 2012).

Along with household food security, good nutrition is achieved when there is adequate care for the mother and child. Care practices for the mother include attending prenatal clinics, intake of iron and folic acid supplements, and intake of sufficient nutritious foods during both pregnancy and lactation. Care of the child is manifested in breastfeeding and introduction of complementary foods. Children are sometimes malnourished even when there is adequate food in the household, due to poor weaning practices between 4-18 months (Bellamy, 1998). This is a period when most women introduce other foods and sometimes withdraw breastfeeding. Poor care practices are sometimes influenced by the mother's knowledge, and therefore the education level of the mother becomes a very important input when discussing the care practices of the child and mother (Engel *et al.*, 1997).

Lastly, on the underlying determinants of malnutrition, sanitation and access to health facilities are very critical. According to Bellamy (1998), access to both preventive and curative medical care that is affordable and is of good quality plays a very important role in one's health and nutrition. Inaccessibility to clean water, poor handling of food, and poor sanitary conditions such as poor waste disposal are associated with occurrence and spread of infectious diseases such as diarrhea, especially in young children (Bellamy, 1998)). Such diseases, coupled with a long distance from a good quality health facility and inadequate dietary intake, leads to child malnutrition as the immediate determinants.

The immediate determinants of malnutrition are expressed at the child level, whereby dietary intake of macro and micronutrients and presence of diseases are considered factors that influence an individual's nutrition status. These factors are interdependent and create a vicious cycle. A sick child has poor appetite, experiences decrease in the level of absorption of nutrients, and increase in energy demand by the body. In turn, a child with inadequate dietary intake is more susceptible to disease and infections (UNICEF, 1998).

2.2 Dietary Diversity

Dietary diversity is a useful indicator of food security that measures food accessibility both at household and individual level (intra-household food security). High dietary diversity has been previously associated with positive outcomes such as high energy intake, improved child anthropometric measurements, improved hemoglobin levels and reduced mortality from cardiovascular diseases (Hoddinit and Yohannes, 2000). Many dietary guidelines also recommend inclusion of a variety of foods in the diet, which is associated with adequate intake of all the essential nutrients (Ruel, 2003).

Factors such as access to land and the income of a household are seen to determine how diverse the diet of a household will be. They determine the ability of the household to obtain food either by own production or through purchase (Khgapola and Boshoff, 2002). A study on the impact of home gardens on access to food, dietary diversity and nutrient intake of pre-school children in an informal settlement in Eatonside, Vaal Region, South Africa, found improved food access, dietary diversity and micronutrient intake by the children (Selepe, 2010). In Vihiga District, Western Kenya, household income was found as one the factors that were significantly associated with dietary diversity of the household. Other factors found in that study to greatly influence dietary diversity were ethnicity, savings behaviour of the household, and nutritional awareness (Nyangweso *et al.*, 2007).

2.3 Dietary Diversity and Childhood Malnutrition

A study carried out in Tanzania on the effect of dietary diversity on the nutritional status of adolescents (10-19 years) found that dietary diversity was a significant predictor of malnutrition in the adolescents, after controlling for age, puberty and gender. An increase in consumption of one food group at the household level decreased the odds of an adolescent being malnourished (BMI kg/m^2 < 5th percentile) by 14 per cent ($P< 0.05$) (Cordeiro *et al.*, 2012). Hatloy *et al.* (2000) examined the association between dietary diversity and nutritional status

of children 6-59 months in Mali. Results indicated that in the urban settings, children who consumed foods from 6-7 food groups were 1.3 times more likely to be stunted, while those who consumed 5 and less food groups were 2.4 times more likely to be stunted (<-2 HAZ) compared to those who consumed more than 8 food groups (Hatloy *et al.*, 2000). On the contrary, no association was found between high dietary diversity and malnutrition in the rural areas. However, this study did not investigate further what may have led to this outcome.

Association between dietary diversity and child nutrition status in children 6-23 months using 11 demographic health surveys was done by Arimond and Ruel (2004). This study was aimed at assessing whether lack of dietary diversity is a determinant of childhood malnutrition, even after other factors associated with dietary diversity, such as socio-economic status of the household, are controlled. Among the 11 countries surveyed, 9 showed bivariate associations between dietary diversity and Height for Age Z-scores. This association was, however, lost in 3 countries after multivariate analysis that controlled for child, maternal and household factors. Despite this, the study still concluded that dietary diversity is independently associated with child nutritional status as a main effect or in association with other socio-economic factors.

In Western Kenya, a study assessed food diversity verses breastfeeding choice in determining anthropometric status in children 12-36 months. The results indicated that consumption of a more varied diet (more than 5 food groups) was strongly and consistently related to the children weight for age, height for age and weight for height measurements. An increase in one food item consumed showed an increase in weight for age Z-scores by 19 per cent, height for age Z-scores by 17 per cent and weight for height Z-scores by 12 per cent (Onyango et al., 1998). An earlier study done in Machakos, Kenya, by Corbert *et al.* (1992) also indicated that children who consumed a more varied diet had significantly higher height for age measures. These studies have shown that dietary diversity is related to malnutrition in different parts of the country, but they have used data only specific for certain regions. Studies that have used nationwide data have mainly investigated other factors that cause child malnutrition, such as socio-economic status, maternal characteristics and health related issues (Kabubo-Mariara *et al.*, 2009). There is no study to date that has utilized national data in Kenya to study the contribution of dietary diversity to child malnutrition.

2.4 Overview of Literature

Dietary diversity is an important element in ensuring food and nutrition security of a child. Dietary diversity influences a child's nutritional status directly through

adequate calorie and nutrient intake, or indirectly through adequate intake of micronutrients that enhance the immunity of a child, hence reduction of disease incidences. Dietary diversity affects a child's nutritional status individually or in association with other determinants of child malnutrition such as inadequate nutritional knowledge, poor health and sanitation and poor caring capacity of the children. Reviewed studies from other countries show that children with diverse diets are more likely to have better nutritional outcomes than those with poor diets. Despite malnutrition rates being very high in Kenya, the role of dietary diversity on malnutrition has not been fully exploited.

3. Methodology

3.1 Study Design

Cross-sectional data from the Kenya Demographic and Health Survey 2008/2009 was used in this study. The sampling frame was drawn from a master sampling household frame, NASSEP IV. This frame was developed in 2002 from enumeration areas generated from the 1999 census. The study covered 10,000 households from 400 clusters drawn from the whole country (KNBS, 2008).

3.2 Sampling Procedure

This study used data from all the children aged 6-59 months available in the data set. The sample population was 4,896 children from the 10,000 households covered. Of these children, 4,770 had their anthropometric measurements sampled and from these, 3,870 children who had dietary intake data were used for the final analysis.

3.3 Data

Dependent variable (Child malnutrition)

Four approaches are used to determine the nutritional status of a child: dietary records, biochemical assessments, clinical assessment and anthropometrics (measurements of the size, weight and proportions of the human body - Truswell, 2007). Anthropometrics is the method that has been internationally adapted to measure the nutritional status, especially for a population due to objectivity and relatively low technology (Duggan, 2010). The most frequently used anthropometric indices are: weight for height (WFH, wasting), weight for age (WFA, underweight) and height for age (HFA, stunting). Others include: mid upper arm circumference (MUAC), head circumference for age and BMI for age mainly used as screening tools for admission in specific programmes (Duggan, 2010).

Height for age measures prolonged food deprivation, especially in areas of chronic food insecurity, whereas WFH measures acute food deprivation, especially in times of natural disasters and calamities. WFA is a composite measure that takes into account both the long term and acute food shortage (Waterlow *et al.*, 1977). The choice of the index to use mainly depends on the purpose of the survey and the accuracy of the data available. For instance, in many nutritional surveys, getting accurate data on age is not possible, and therefore the WFH becomes the only possible indicator. In other cases, height measurements for children are not

recorded and, therefore, HFA or WFH measurements may not be used (Gorstein et al., 1994). In order to use HFA, WFH or HFW as indicators of childhood malnutrition, they are converted into either Z-scores or percentile rankings. A Z-score is a measure of the deviation of the value for an individual from the median value of the reference population, divided by the standard deviation for the reference population.

Z-score = (Mesured value-Median value of reference population)/(Standard deviation of reference population)

Generally, children with Z scores above -2 are considered to be adequately nourished, between -2 and -3 moderately malnourished, and below -3 as severely malnourished (Wang and Chen, 2012). On the other hand, percentile rankings, which refer to the position of an individual child on a given reference population, are used (Wang and Chen, 2012).

Percentile = (Mesured value)/(Median value of reference population)

Use of percentile rankings has been criticized since it does not take into account the fact that standard deviation varies with age and sex in the reference population. A single percentage of the median can not in itself judge malnutrition (Glick and Sahn, 1998). Therefore, many studies use Z-scores to indicate nutritional status of the population as opposed to use of percentiles. For this study, child malnutrition was determined using Z scores. Through use of the World Health Organization (WHO) 2005 Anthro programme, height-for-age, weight for height weight-for-age Z-scores were generated. The Z-scores obtained were used to determine whether the child was wasted, stunted or underweight. Malnutrition for this study was represented by stunting, which is a measure of prolonged food deprivation.

Independent variables

Selection for other determinants of malnutrition was guided mainly by the conceptual framework for the causes of malnutrition (UNICEF, 1990) and the available data in the KDHS data set. The UNICEF conceptual framework incorporates both biological and socio-economic causes of malnutrition at several levels, that is basic underlying and immediate. However, the variables present in the KDHS data set fit better with the underlying causal level of the framework. Therefore, this study models the determinants of child malnutrition at the underlying causal level. The variables at this level explain the food security of a household, the caring capacity directed to the child by other household members, and the health and sanitation present in the environment where the child lives.

Food security

There are several proxies used to measure the food security of a household, including total caloric intake of the individuals in the household, micronutrient intake and dietary diversity. Caloric and micronutrient intake require data on individual foods consumed and their quantities, which is not captured in the KDHS data set. Therefore, for this study, dietary diversity of the children was used as a proxy for food security in the household. Dietary diversity scores (DDS) were generated from the foods consumed, according to the 24-hour dietary recall responses. Foods were classified into six groups as follows: a) Grains/roots/ tubers; b) Milk and milk products; c) Vitamin A–fruits/ vegetables; d) Other fruits and vegetables; e) Meat/poultry/fish/eggs; and f) Legumes. Each food group consumed represented one DDS, and total DDS was determined by the total food groups consumed by the child. Terciles of DDS were created whereby 0-2 DDS was classified as poor dietary diversity, 3-4 DDS as moderate dietary diversity, and 5-6 DDS as high dietary diversity.

Caring capacity of the mothers and children

Caring capacity of the household is measured by the extent to which the child and the mother receive support from the household and the community. Adequate breastfeeding measured by the duration the child was breastfed, and infant feeding practices indicated by the number of times the child is fed in a day, are considered good care practices for the child and are expected to show a positive relationship with the nutrition status of the child. For the mother, number of times antenatal clinics were attended is used as a good indicator of proper care because the more the times the higher the chances of the mother receiving all the immunizations and supplements, which lead to better nutritional and health outcomes of her baby.

There are other factors that are associated with caring behaviour in a household, such as age of the child whereby older children are more likely to be malnourished than younger ones and the nutritional status of the child at birth indicated by the birth weight. Low birth weight children may either be stunted or overweight, depending on the environment they are exposed to after birth. If there is continued food insecurity, the children may be malnourished but if there is food sufficiency, the child will grow normally and may even end up being overweight. The education level of the mother in this study is determined by whether there is no schooling at all, primary education, secondary education or tertiary education. The more educated the mother is, the better the nutritional status of the child. Also, the nutritional status of the mother is likely to influence that of the child. A mother who has a compromised nutritional status reflected in having a low Body Mass Index (BMI) has a higher likelihood of having a malnourished child than a mother with a normal BMI.

Sanitation and access to health

Access to clean water and toilet facilities in the household are associated with better sanitation for the household, hence good nutritional outcomes for the children. For this study, water is classified as either safe for use, which comprises of tap water and water from protected sources such as boreholes, and unsafe water, which comprises water from unprotected sources such as rivers and uncovered wells. As for toilet facilities, those with flush toilets and pit latrines that are covered are considered to have adequate facilities, while those with uncovered latrines, no facility at all or use of bush, are considered to have inadequate toilet facilities. Access to health is measured as whether the child has been immunized or not, and whether the child has had vitamin A supplementation or not. Children who have had vitamin A supplementation and are immunized are expected to have better nutrition status than their counterparts. Other factors that are expected to influence the health and environment the child lives in are the region of residence, and whether it is urban or rural setting.

3.4 Analytical Framework

The determinants of child malnutrition are modeled using the standard household utility maximization model by specifying the production function for the child's nutritional status (Behrman and Deolalikar, 1988; Strauss and Thomas, 1995). This model assumes that a household maximizes a joint utility function that comprises of nutrition of each household member, food and non-food purchases, food from own production and leisure or labour supplied to the market. This is expressed in equation 3.1.

$$Uh=f(N, F, C, L; Xh, \xi) \quad (1)$$

Where N is the nutritional status of individuals in the households, F is food consumption, C is non-food consumption, L is leisure and X_h is exogenous household specific characteristics.

Child nutrition is generated by a biological production function with a number of inputs such as food intake, general care of children, and environmental characteristics. Households, therefore, maximize child nutrition given the budget and information constraints they face. Guided by literature (Strauss and Thomas, 1995; Thomas *et al.*, 1996), the reduced form of nutrition function can be estimated using equation 2.

$$N_c = f(K^h_c, CBc, E_h, \xi) \quad (2)$$

Where *K* is the food intake of the child in the household from the food available to the household, *CB* is the caring behaviour directed towards the child *c*, and *E* is the environment of the household and ξ is the unobservable characteristics.

3.5 Model Specification

Child malnutrition in this study will be estimated as a binary variable as whether the child is stunted or not. Due to the binary nature of the outcome, binomial logit model will be used because it assumes a non-linear distribution of data and normal distribution of the error term, unlike OLS.

Therefore, equation 2 in a linear form is expressed as:

$$N_c = +\beta K+\beta CB+\beta E+v_i \quad (3)$$

Where N represents the probability of the child being stunted, *K*, *CB* and *E* represent variables related to the child's food intake, caring behaviour and environment, respectively, β is the corresponding coefficient to be estimated, and v_i the error terms. For estimation, the maximum likelihood model was used. Table 3.1 describes the explanatory variables and their expected outcomes.

Table 3.1: Variable description

Variable	Proxy	Description	Expected sign
Food intake	Dietary diversity scores (DDS)	Categories of either low, moderate or high dietary diversity	_
Child care behaviours	Months of breastfeeding	Number of months the child was breastfed	_
	Antenatal clinics	Number of times the mother attended antenatal clinics	_
	Complementary feeding behaviours	Number of times the child was fed in the previous day	_
	Maternal education	Categories of education and level of the mother	_
	Wealth index	The wealth index of the household in 3 categories of rich, poor or middle	_
	Maternal Nutritional status	Maternal BMI	_
	Household head	Dummy variable for male=0 female =1	+/-
	Birth weight of the child	Continuous variable of individual child weight	_
Environment (sanitation and health)	Water source	Source of water for household use. Dummy variable for safe and unsafe sources	_
	Toilet facilities	The type of facilities available. Categories of flush toilet, pit latrine or no facility	+
	Region	Dummy variables for every region (8 provinces)	+/-
	Rural/urban	Dummy variable where urban=0 and rural=1	+/-

4. Results and Discussion

This study sought to investigate the association between dietary diversity and malnutrition in children aged from 6–59 months in Kenya, using data from KDHS. A total of 3,870 children were used for the study. The average age of the children was 31.6 months and that of the respondents 28.5 years. Of these respondents, 76.8 per cent were from rural areas, whereas 23.2 per cent were from urban households. In terms of education attainment, majority of the respondents (56.6%) had only primary education, with only 5.3 per cent having tertiary education and 21.4 per cent no education at all. Most households had an average of 2 children below 5 years. Of these, only 2.6 per cent were from multiple births. According to the wealth index calculations, 47 per cent of the respondents were from poor households. In terms of nutritional status, 38 per cent were stunted, 8 per cent wasted and 18 per cent underweight. These malnutrition levels were slightly higher than those reported in the KDHS report. This is mainly attributed to the difference in sample population because our study excluded children below 6 months who are less likely to be malnourished than their older counterparts. Comprehensive results for the general characteristics of the sample appear in Appendix 1.

4.1 Level of Dietary Diversity in Kenya

The first objective of this study was to determine the level of dietary diversity in Kenyan children. Dietary diversity was described as the sum of all food groups consumed in the previous 24 hours preceding the survey. The foods were grouped into 6 main food groups, namely: cereals and tubers; milk and milk products; meats and eggs; vitamin A rich fruits and vegetables; other fruits and vegetables; and legumes. In relation to the 6 food groups analyzed, cereals and tubers were consumed by 81.6 per cent of the children. Fruits and vegetables, which were not rich in vitamin A, as well as milk and milk products were second highest with consumption by about 56 per cent of the children. The least consumed were legumes and meats, which were consumed by 27.2 per cent and 28.0 per cent of the children, respectively, and vitamin A rich fruits and vegetables, which were consumed by 37 per cent of the children.

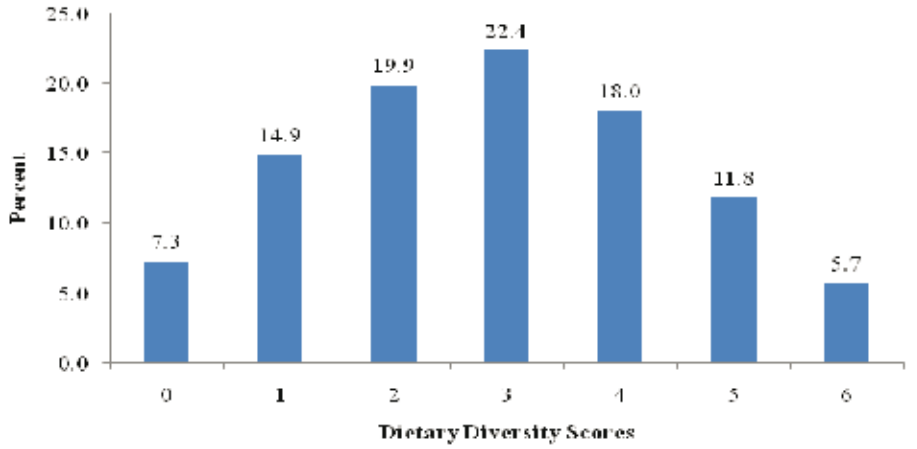
As expected, consumption of cereals and tubers was highest with 81.6 per cent followed by fruits and vegetables, which are not rich in vitamin A, and milk and milk products. Previous studies have also shown that consumption of cereals and tubers is high (99%) (Bwibo *et al.*, 2003). However, in the current study, almost 20 per cent of the children did not consume the staple food. This could indicate that, actually, a large number of the children were not having adequate food. There was

also notably low consumption of meats and their alternatives. This is quite serious because these are the body building foods without which malnutrition problems such as kwashiorkor thrive. Earlier studies had indicated that there was a serious need to increase consumption of animal protein foods by the Kenyan children (Bwibo *et al.*, 2003)

As shown in Figure 4.1, majority of the children (22.4%) consumed 3 different types of foods with as much as 7.3 per cent of the children consuming no food at all. Only 5.7 per cent of the children were able to consume all the six food groups. In terms of low medium and high dietary diversity, 42 per cent, 41 per cent and 17 per cent were classified as low, medium and high, respectively. The food guide pyramid developed by USDA (United States Department for Agriculture) classified food groups into five, mainly: cereals, meats and alternatives, fruits and vegetables, milk and milk products, and fats and oils. However, for this study, meat and its alternatives were separated for Kenya due to the low consumption of animal based protein in Kenya, and fruits and vegetables were reclassified to capture those that provide vitamin A, which is a notable deficient nutrient in the Kenya population. As noted by Hatloy *et al.* (2000), there is no consensus on the number of food groups to be included in the dietary diversity scores, as many studies classify foods according to the aim of the study. Notably missing from this study was data on consumption of fats and oils, which is a main food group required for analysis of dietary data. This was due to its omission in the primary data collection.

Further analysis showed that different regions in Kenya had different levels of dietary diversity. Nairobi and Central regions had the highest levels of dietary diversity (37% and 35%, respectively) of children with low dietary diversity

Figure 4.1: Dietary diversity in Kenya



compared to Coast and North Eastern (11% and 7%, respectively). In terms of rural urban dimension, those in urban areas consumed a more diverse diet than their rural counterparts. In terms of education of the mother, mothers who had higher levels of education had 44 per cent of their children consuming a highly diversified diet compared to 6.2 per cent of children from the mothers who had no education at all. The wealth status of the household was also associated with consumption of a more diverse diet, with those classified as rich having a highly diversified diet. Detailed results are as shown in Table 4.1. Due to data limitation, analytical work on the determinants of dietary diversity was not carried out in this study. This is because land size, land ownership, crops grown and household income are major determinants of dietary diversity, whose data is not captured in the KDHS dataset.

Table 4.1: Factors associated with dietary diversity in Kenya

Dietary Diversity		**Low DD (0-2 food groups)**	**Medium DD (3-4 food groups)**	**High DD (5-6 food groups)**
Region	Nairobi	17.8	44.8	37.3
	Central	16.8	48.2	35
	Coast	49.5	39.1	11.2
	Eastern	41.7	38.7	19.5
	Nyanza	42.8	42.6	14.6
	Rift Valley	41.9	41.9	16.1
	Western	39.4	43.2	17.5
	North Eastern	62.7	25.5	7.4
Residence	Urban	29	44	26
	Rural	45.8	39.4	14.9
Maternal Education	No education	66.8	27	6.2
	Primary	39	43.9	16.8
	Secondary	24.4	47.6	28
	Higher	19.9	35.9	44.2
Wealth Index	Poor	52.8	36.1	11.1
	Middle	37.3	45.5	17.2
	Rich	28.2	44.7	27.7
Child Age	6-23 months	38.9	43.2	17.9
	24-60 months	44.5	38.2	17.2
Maternal Occupation	Farmer	38.5	42.2	19.6
	Non farmer	42.5	40.1	17.3
Malnutrition	Stunting	45.6	40.3	14.1
	Wasting	52.6	35.6	11.9
	Underweight	51.2	38.6	10.2

4.2 Dietary Diversity and Child Malnutrition

Logistic regression analysis reporting coefficients and marginal effects were computed. Goodness of fit test was performed, which indicated that the model fitted well at $P<0.05$. Multi-collinearlity test was performed and all the variables in the model did not show high correlations; therefore none was dropped from the analysis. Dietary diversity, antenatal care and maternal nutrition from literature had been indicated to be potentially endogenous. However, the instruments suggested in literature and by intuition were not available in the data set used, and therefore this formed one limitation of the study. The results of the regression analysis are presented in Table 4.2.

Dietary diversity was analyzed at three levels: low, medium and high. Low dietary diversity was considered to be consumption of 0-2 food groups, medium 3-4 and high 5-6 food groups. High dietary diversity was significantly associated with reduced probability of stunting. Intake of a highly diversified diet reduced the probability of stunting by 9 per cent. These results conformed with those of a study in Mali, whereby children in the urban areas who consumed less than 5 food groups in a 10 scale dietary diversity score had more than double chances of being stunted (Hatloy *et al.*, 2000). These results were also similar to studies that had been done on Kenyan toddlers, whereby a higher dietary diversity score of 5 and above was associated with improved growth for children who were not breastfed, as compared to those who were still breastfed (Onyango *et al.*, 1998). However, a study in DRC found contrary results, whereby dietary diversity was not found to be a determining factor on malnutrition in children (Ekesa *et al.*, 2011). These results indicate that in some countries or regions, dietary diversity may not influence the levels of malnutrition, unlike other factors such as education, health and economic status.

Child care practices are expected to influence the nutritional outcome of the child. Children who are breastfed for a longer time, fed several times in a day, whose mothers attended antenatal clinics and have a good nutritional status, are less likely to be stunted. In this study, increase in complementary feeding times increased the probability of the child being stunted. This was contrary to our expectation of a negative relationship, which may be attributed to mothers trying to feed children who have compromised nutritional status more times than those who have good nutritional status. Also, children complementary feeding may be happening as a substitute for breastfeeding, which in itself would compromise the nutritional status of the child. However, this study did not interrogate this relationship any further. The quality of these feeds was also not evaluated, which would give the actual nutrient quality and quantity that the child was getting.

Child age and male gender were shown to increase the probability of stunting. Increase in 1 month of age increased the probability of stunting by 10 per cent. This has been shown previously in a study on the nutritional status of under-five children living in an informal urban settlement in Nairobi, Kenya, where children from 36-47 months were more likely to be stunted that those in the 6-11 age bracket (Olack *et al.*, 2011). Also, in an Indian study on the effect of maternal factors on nutritional status of 1–5 year-old children in urban slum population, similar results were found, whereby the age bracket of 36-47 months was found to be worst affected by stunting. In both studies, this is attributed to poor complementary feeding practices, where there is poor introduction of foods that are of the right quality and quantity. However, quantitative analysis for this claim was not pursued in this study. Similarly, a female child was shown to have 8 per cent decreased chances of being stunted than their female counterparts. The relationship between gender and malnutrition is mainly attributed to the type of foods and the times they are introduced to the children. Other studies attribute it to the fact that female children adapt to environmental stresses better than male, hence are able to cope with poor diets better (Olack *et al.*, 2011).

For the environmental determinants of child malnutrition, having no toilet facility increased the probability of stunting by as much as 10 per cent compared to use of flush toilets. Lack of proper toilet facilities is an indication of poor sanitary conditions, which may be associated with increased disease incidences. As shown in the conceptual framework of malnutrition (UNICEF, 1990), diseases and dietary intake are the immediate determinants of child malnutrition. Another environmental indicator that was significantly associated with child malnutrition was the region of residence. The probability of stunting was greatly minimized in children who lived in Nyanza and Western regions, and marginally in Rift Valley, Eastern and Coast regions. Children in Central and North Eastern regions of Kenya did not show any significant difference from those who lived in Nairobi. Though detailed analysis to find out why this pattern was present was beyond the scope of this study, maybe it can be explained by the uneven distribution of resources in Kenya as stipulated in the Commission for Revenue Allocation report of 2011 (KNBS, 2011). This gives an insight that in Kenya, not all areas require similar interventions in the fight against malnutrition. Further studies (and especially in terms of counties) would be required to interrogate why such a difference occurred.

Table 4.3: Dietary diversity and child malnutrition

Stunting	Marginal effects	Coefficients	Standard error	P>Z
Central	-0.1022849	-0.46061	0.296171	0.1200
Coast	-0.1016299	-0.45325*	0.260781	0.0820
Eastern	-0.1165566	-0.52728*	0.285234	0.0650
Nyanza	-0.1280152	-0.57696**	0.273854	0.0350
Rift Valley	-0.1078272	-0.48109*	0.272268	0.0770
Western	-0.2041574	-0.98322***	0.286561	0.0010
Northeastern	-0.0540793	-0.23697	0.343028	0.4900
Rural household	-0.0410922	-0.17483	0.165302	0.2900
Primary education	0.087064	0.37498	0.178787	0.0360
Secondary education	0.0455038	0.19115	0.21711	0.3790
Higher education	-0.0302528	-0.13068	0.315056	0.6780
Number of children under 5 years	0.0268587	0.114273**	0.05929	0.0540
Maternal age	0.003113	0.013245***	0.007728	0.0870
Maternal BMI	-0.0001041	-0.00044***	0.000126	0.0000
Female	-0.0856587	-0.36592***	0.096805	0.0000
Age of child	0.1006954	0.428418***	0.072424	0.0000
Months of breastfeeding	-0.0000689	-0.00029	0.004394	0.9470
Times attended antenatal clinic	0.0076859	0.032642	0.110351	0.7670
Birth weight of the child	0.0000117	4.99e-05***	1.64e-05	0.0020
Complementary feeding	0.0147664	0.062825**	0.030994	0.0430
Rich wealth index	-0.0761896	-0.32733**	0.160015	0.0410
Medium dietary diversity	-0.0155953	-0.06639	0.119615	0.5790
High dietary diversity	-0.0930802	-0.40951***	0.153284	0.0080
Unprotected water source	0.0135414	0.05746	0.137271	0.6760
Pit latrine	0.0874491	0.379335	0.234666	0.1060
No toilet facility	0.106585	0.443181	0.267934	0.0980
_Cons		-0.3652	0.538325	0.4980

5. Conclusion and Policy Recommendations

5.1 Conclusion

Child malnutrition is still high in Kenya, despite efforts by governmental and non-governmental organizations to reduce it. There are several determinants of malnutrition that have been studied and analyzed to provide policy recommendations to help minimize the high levels. Dietary diversity, despite its known association with childhood malnutrition, has not been adequately analyzed in Kenya. This study sought to fill the existing gap on the association of dietary diversity and malnutrition in children, and provide policy recommendations that may assist in reducing the high levels of malnutrition in Kenya. The results showed that, indeed, a more diverse diet reduced chronic malnutrition. In addition, poor child care practices, poor environmental sanitation, and region of residence significantly influence children malnutrition in Kenya. Increasing dietary diversity among children below 5 years and at the same time improving sanitary conditions and ensuring that the mothers and children are well taken care of in the household would reduce the levels of chronic malnutrition in Kenya.

5.2 Policy Recommendations

Encouraging dietary diversity in the households should be emphasized in the current food and nutrition security policy framework. This should be done at the county levels because dietary diversity in Kenya differs with regions. The steps that should be followed to achieve dietary diversity in the country are as follows:

Establish dietary patterns for different regions

With the new county governments, dietary patterns and foods available to a particular county should be established. This should be done by the District Nutrition Officers, the Home Economics Officers and Agricultural Extension Officers. After establishing the foods available, the communities should then be taught how to diversify their diets using the foods available. Establishing foods available may lead to discovery of some foods that have been abandoned in favour of the western diets. For instance, foods such as cassava that are drought resistant have been abandoned in some communities, with the younger generation opting for modernized foods such as rice (it is considered modern because it was not grown and eaten by local communities; and it is not easily grown like cassava, which is a traditional food). These people may be taught how to cook such foods in modern ways and make them acceptable for such people.

'Nutritionalize' agriculture

Agriculture should not only be commercialized in Kenya, but also done with considerations of the nutritional benefits of the crops grown. For farming households, agricultural diversity should be encouraged, whereby a household is advised on growing different types of foods, and having kitchen gardens (small farms that households grow vegetables and fruits for their consumption, and rear small animals that can provide proteins of high biological value). This would be especially beneficial for counties that grow cash crops such as sugarcane and tea, and neglect growing of food crops. Agricultural extension officers would be in a position to educate the households on how best to utilize their farms in order to attain maximum economic potential, as well as nutrition potential. This concept should also be taken up by the government as they open up areas for irrigation, such that they do not plant only maize, but also diverse crops.

Education on dietary diversity

Majority of Kenyan mothers, according to the Kenya Demographic and Health Survey of 2008, attain only primary education, with a large number having no education at all. More educated mothers have less chances of having chronically malnourished children, may be because of possibility of higher income that may enable them buy nutritious foods for their children, or access to knowledge of the right food to feed the children. Therefore, mothers need to be educated on good nutritional practices through other channels, in addition to formal education. Chief's barazas is one channel whereby pregnant mothers and those with young children can be taught on best child feeding practices using locally available foods. This may be done in antenatal and post-natal clinics, and may be done more individually to children found to be malnourished.

5.3 Areas for Further Research

National surveys should include comprehensive data on food intake by all age groups to enable researchers and policy analysts draw sound recommendations. For instance, in the data used in this study, consumption of fats and oils was not included in primary data collection, hence the consumption pattern of that food group was not analyzed. Fats and oils are a major energy giving food that provides a base within which fat soluble vitamins are transported in the body.

Also, nutrient adequacy of the foods consumed should be analyzed, as well as ietary diversity to establish the actual relationships. This was not done in this study due to lack of key data on some key variables. These are variables such as household food production and household income.

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Appendix

Appendix 1: Descriptive characteristics of the sample

Characteristic	Description	Amount
Dietary diversity	Mean dietary diversity score	2.9
Region	Nairobi	6.53%
	Central	8.37%
	Coast	14.84 %
	Eastern	12.81 %
	Nyanza	17.12 %
	Rift Valley	17.84 %
	Western	13.33 %
	North Eastern	9.15 %
Gender	Male	51 %
	Female	49 %
Child age	Mean age	31.6 months
Maternal education	None	21.37
	Primary	56.65
	Secondary	16.71
	Tertiary	5.28
Maternal BMI	Average maternal BMI	22.48
Maternal height	Average maternal Height	159 cm
Type of residence	Rural	76.8%
	urban	23.2%
Wealth index	Poorest	29.68
	Poorer	18.02
	Middle	16.54
	Richer	16.33
	Richest	19.43
Vitamin A status	Ever had vitamin A supplementation	64%
	Never had vitamin A supplementation	36 %
Vaccination	Ever vaccinated	85. %
	Never vaccinated	14.2 %
Toilet facility	Flush toilet	9.43 %
	Pit latrine	64 %
	No facility	27%
Source of water	Piped water	26.2%
	Wells and boreholes	26.17%
	Rivers and springs	41.6%
Diarrhea incidences	Had diarrhea two weeks before the survey	17.7%
	No diarrhea	82%
Nutrition status	Stunted	38%
	Wasted	8%
	Underweight	18%

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