

## **FACTORS ASSOCIATED WITH INCREASE IN UNDERNUTRITION AMONG CHILDREN AGED 6-59 MONTHS IN KAMORIONGO VILLAGE, NANDI COUNTY, KENYA**

**Mutua, N.M, Onyango, D.A.O, Wakoli, A. B., & Mueni, H. N.**  
University of Eastern Africa Baraton, KENYA

### **ABSTRACT**

Malnutrition is an imbalance in a person's intake of nutrients and other dietary elements needed for healthy living. It can manifest itself as undernutrition or overnutrition. Undernutrition encompasses stunting, wasting, and deficiencies of essential vitamins and minerals. The general objective of this study was to determine the factors associated with increase in undernutrition among children aged 6-59 months in Kamoriongo village, Nandi County. The specific objectives were to determine the extent of stunting, underweight and wasting and identify the possible causes of undernutrition among these children. The study was a cross-sectional descriptive study and the data was collected using a semi-structured questionnaire, anthropometric measurements and food frequency questionnaire and direct observation was done to validate the results given by respondents. One hundred and one children between 6-59 months in Kamoriongo Village, Nandi County, Kenya, were purposefully selected to participate in the study and their anthropometric measurements taken after permission from their parents had been granted. Data entry was done using Statistical Package for Social Sciences (SPSS) and analysis of anthropometric nutritional data was done Emergency Nutrition Assessment (ENA) Software to determine the Z- score values. Chi-square was used to determine relationships between the variables. According to the study, the prevalence of wasting showed a high rate of 57.1%, moderate wasting 17.1% and severe wasting of 25.7%, the prevalence of stunting was 39.0%, moderate stunting of 17.1% and severe stunting of 22.0%. The prevalence of underweight was 53.7%, moderate underweight of 17.1% and severe underweight of 30.0% and the factors that contributed to the increase in undernutrition were; length a mother exclusively breastfed their children and the period of introduction to other foods, and poverty.

**Keywords:** Undernutrition, Stunting, Wasting, Underweight, Kamoriongo.

### **INTRODUCTION**

#### **Background Information**

Protein-energy Malnutrition (PEM) affects a large proportion of children aged 6-59 months in the developing world (Friedman, 2005). World Health Organization (2008) report estimates that about half of the world's population, suffers from poor nutrition. Under nutrition causes about 5.6 million of 10 million child deaths per year, with severe malnutrition contributing to about 1.5 million of these deaths worldwide (Hekens et al., 2008). WHO has estimated that 32.5% of all pre-school children under 5 years of age are malnourished.

The prevalence of undernutrition varies greatly from region to the other: Two Global sub-regions of Eastern and Western Africa show significant increases in prevalence unlike South Asia which shows a slow drop in malnutrition by half from the year 2000. Out of 99 settings in Africa and Asia for which data from both 2008 and 2009 were available, 48% showed an increase in the prevalence of global acute malnutrition (GAM) and 42% show a decrease. Kenya and Sudan, in particular, were countries where the nutritional situation worsened considerably (CE DAT SCENE, 2010). In sub-Saharan Africa, the prevalence stands at 55.2%. Globally, Kenya was ranked 47 out of 144 countries for PEM based on Height for Age (Stunting) by the year 2009 with the prevalence standing at 30% stunting, while in Western Rift Kenya it is at 30% stunting, 20% underweight and 5% wasting.

According to the United Nations Children's Emergency Fund (UNICEF, 2009), socio-economic status, gender and culture contributes mostly to under nutritional cases in African countries and mostly Sub-Saharan areas. The statistics showed that 30-40% of under nutrition cases were affecting the poor. Evidence has shown that unemployment and low wages are presenting factors that lead to families eating cheaper food, which is less nutritious leading to weight loss and malnutrition.

According to a study carried out in 2008 by health professionals at the Moi University, College of Health Sciences in the community on the 'Nutritional status of children aged 6 to 59 months in Community Based Education and Service centres (COBES) in Western Kenya', Meteitei in Nandi County showed the highest malnutrition prevalence of 53% stunting value, underweight of 27.6% and wasting at 15%, which poses a major public health concern. The study indicated that the reason could not be immediately evident but one of the possibilities could be dependence on tea as a major cash crop at the expense of food crops.

It was also notable that stunting levels at Mosoriot were slightly higher (9.5%). The reasons for this were not yet clear. This indicated that the nature of malnutrition in Nandi County points to both chronic and long-term malnutrition. The current national figure for malnutrition according to the study stands at 30% as well as in Western Rift Kenya, whereas prevalence in other centres was within the normal range. The study recommended improved nutritional practices in this area however; the nutritional status of a child is mostly affected by child's dietary intake, food security, and adequate care for mothers and proper health environment (Ndiku, 2010).

Although poverty is the major cause of the problem in Kenya as well as other developing parts of the world, other factors such as; demography, lifestyle, socioeconomic as well as genetics, breastfeeding, immunization, birth weight and other childhood illnesses such as measles, diarrhea, malaria and many others directly affect the nutritional status of people especially the children aged 6-59 months, who are the most vulnerable group, and could cause malnutrition. With the above statistics on under nutrition state in Kenya, this study was aimed at assessing the major factor associated with the increase in under nutrition among the children aged 6-59 months in Kamoriongo Village, Nandi County.

## **Statement of the Problem**

According to the assessment of malnutrition prevalence over years in Nandi county by Masibo (2008-2009) results showed an upward trend such that, in 2000 stunting levels was at 38%, in 2002 44% and in 2006, 51%. In 2008, stunting levels in Meteitei, Nandi County was at 53%. Also, a study by Ngare and Muttunga, (2010) indicated that the problem since the first survey in 1977 shows an upward trend. Assumptions have therefore been made on the causative factor of under nutrition in the country to be mainly poverty; however, no study has been carried out especially in Nandi County to establish the exact cause of the increase in under nutrition levels. Therefore, this study attempted to find out the factors that are associated with the increase in undernutrition in Kamoriongo Village, Nandi County.

## **Objectives of the Study**

### **General objective**

To determine the factors associated with increase in undernutrition among children aged 6-59 months in Kamoriongo village, Nandi County.

### **Specific objectives**

1. To determine the extent of stunting among the children aged 6-59 months in Kamoriongo Village, Nandi County.
2. To determine the extent of wasting among the children aged 6-59 months in Kamoriongo Village, Nandi County.
3. To determine the extent of underweight among the children aged 6-59 months in Kamoriongo Village, Nandi County.
4. To identify the possible causes of undernutrition among the children aged 6-59 months in Kamoriongo Village, Nandi County.

## **Research Questions**

1. What is the extent of stunting among the children aged 6-59 months in Kamoriongo Village, Nandi County?
2. What is the extent of wasting among the children aged 6-59 months in Kamoriongo Village, Nandi County?
3. What is the extent of underweight among the children aged 6-59 months in Kamoriongo Village, Nandi County?
4. What are the possible factors of undernutrition among the children aged 6-59 months in Kamoriongo Village, Nandi County?

## **Justification**

Studies by Masibo (2008-2009), Ngare and Muttunga, (2010 ) have been done on the prevalence of undernutrition among children aged 6-59months throughout the globe and results have shown an upward trend in the levels of under nutrition over years since 1977 in Nandi County indicating deterioration over years. In the assessment of undernutrition among children aged 6-59 months

per county in Kenya by the Moi University Students (2012), Nandi County was found to have the highest percentage in the Western Rift of 53%. These results therefore show that undernutrition is still a serious public health problem in Kenya and requires urgent attention.

### **Significance of the Study to Nutrition**

On completion of this research project findings will help understand the main causes of increase in undernutrition among the children aged 6-59months in Kamoriongo village and thus help the health officers in the formulation of appropriate policies aimed at addressing factors associated with undernutrition among children aged 6-59months and their effects. It is therefore hoped that relevant interventions will then be designed with the view of reducing the incidence of undernutrition in children aged 6-59months in Nandi County. It will also give references to other future studies that will be carried out in other areas nationally, regionally and even globally and may form basis for other researches to be done.

### **LITERATURE REVIEW**

Malnutrition is an imbalance - a deficiency or an excess - in a person's intake of nutrients and other dietary elements needed for healthy living. Malnutrition can manifest itself as hunger (or under nutrition), deficiency in vitamins or minerals, or overfeeding. Protein Energy Malnutrition (PEM) affects a large proportion of children under the age of 5 years in the developing world. The prevalence of PEM varies greatly from region to the other. World Health Organization has estimated that 32.5% of all pre-school children are malnourished (WHO, 2009). The World Health Organization (2008) estimates that fully half of the human family suffers from malnutrition of one kind or another. One out of five people in the developing world suffers from the worst of the variants of malnutrition – hunger (Under nutrition).

Undernutrition encompasses stunting, wasting, and deficiencies of essential vitamins and minerals (collectively referred to as micronutrients). Stunting or growth retardation or chronic protein-energy malnutrition (PEM) is deficiency for calories and protein available to the body tissues and it is inadequate intake of food over a long period of time, or persistent and recurrent ill-health. This height-for-age index (stunting) is less sensitive to temporary food shortages and thus seems to be considered as the most reliable indicator. Because studies have shown that wasting is volatile over seasons and periods of sickness and underweight shows seasonal weight recovery and being overweight for some children can also affect weight-for-age index (World Bank; 2009).

Wasting or acute protein-energy malnutrition captures the failure to receive adequate nutrition during the period immediately before the survey, resulting from recent episodes of illness and diarrhea in particular or from acute food shortage. Underweight status is a composite of the two preceding ones, and can be due to either chronic, acute malnutrition or PEM (World Bank; 2009).

Under nutrition therefore is not merely a result of too little food; rather, it is a consequence of myriad factors, including poverty, repeated illnesses, inadequate access to health services, insufficient macro and micronutrient intake, unsafe water, and lack of access to improved

sanitation (PSI, Population Services International, 2013) When a person is not getting enough food or not getting the right sort of food, undernutrition is just around the corner. Even if people get enough to eat, they will become malnourished if the food they eat does not provide the proper amounts of micronutrients - vitamins and minerals - to meet daily nutritional requirements.

A well-nourished child is one with access to adequate food supply, care and health. Such a child will have weight and height measurements that compare very well with the standard normal distribution of heights (H) and weights (W) of healthy children of the same age and sex (Onis, Monteiro, Akre and Clugston (2003). Thus, the best way to evaluate the nutritional status and overall health of a child is to compare the child's growth indices with the set cut-off points in the standard normal distribution of well-nourished children that are associated with adequate growth (Mahgoub, 2006).

Factors that contribute to undernutrition among children are many and varied: These include the child's birth-weight, breastfeeding patterns and duration type and frequency of food intake, especially protein-energy rich foods, family headship, parental education, maternal nutritional knowledge, residence location (urban or rural), age, and gender. The primary determinants of malnutrition, as conceptualized by several authors relate to unsatisfactory food intake, severe and repeated infections, or a combination of the two (Mahgoub, 2006).

The UNICEF Conceptual framework of child survival shows the interactions of these conditions with the nutritional status and overall health of the child - and by extension - of the populations in which the child is raised. (UNICEF, 1990)

The framework indicates that malnutrition occurs when dietary intake is inadequate and health is unsatisfactory, being the two immediate causes of malnutrition. In developing countries, infectious diseases, such as diarrhoeal diseases (DD) and acute respiratory infections (ARI) are responsible for most nutrition-related health problems. Readily available food, appropriate health systems and a "healthy" environment are ineffective unless these resources are used effectively. As a result, the absence of proper care in households and communities is the third necessary element of the underlying causes of malnutrition. Finally, the conceptual framework recognizes that human and environmental resources, economic systems and political and ideological factors are basic causes that contribute to malnutrition (Mahgoub, 2006).

Malnutrition at an early age leads to reduced physical and mental development during childhood. Stunting, for example, affects more than 147 million pre-schoolers in developing countries, according to SCN's World Nutrition Situation 5th report (2004). Iodine deficiency, the same report shows, is the world's greatest single cause of mental retardation and brain damage. Undernutrition affects school performance and studies have shown it often leads to a lower income as an adult. It also causes women to give birth to low birth-weight babies.

Eliminating malnutrition therefore involves sustaining the quality and quantity of food a person eats, as well as adequate health care and a healthy environment. World Food Program helps fight malnutrition by treating it, giving malnourished people the food and nutrients they need, but also by preventing it. Individual nutritional status depends on the interaction between food that is eaten, the overall state of health and the physical environment. Malnutrition is both a medical

and a social disorder, often rooted in poverty. Combined with poverty, malnutrition contributes to a downward spiral that is fuelled by an increased burden of disease, stunted development and reduced ability to work.

How these factors contribute to undernutrition:

**Poverty-** poor socioeconomic position is associated with chronic malnutrition since it inhibits purchase of nutritious foods such as milk, meat, poultry, and fruits. As much as food shortages may be a contributing factor to malnutrition in countries with lack of technology, the Food and Agriculture Organization (2008) has estimated that eighty percent of malnourished children living in the developing world live in countries that produce food surpluses. Children living in rural areas and children from poorer households in Kenya are more likely to be malnourished (KDHS 1998- 2008)

**Poor water and sanitation-** Civil conflicts and wars, by damaging water infrastructure and contaminating supplies, contribute to increased malnutrition. Water supply, sanitation and hygiene, given their direct impact on infectious disease, especially diarrhea, are important for preventing malnutrition. Both malnutrition and inadequate water supply and sanitation are linked to poverty. The impact of repeated or persistent diarrhea on nutrition-related poverty and the effect of malnutrition on susceptibility to infectious diarrhea are reinforcing elements of the same vicious circle, especially amongst children in developing countries (WHO, 2000).

**Maternal Nutritional Knowledge-**A mother is the principal provider of the primary care that her child needs during the first six years of its life. The type of care she provides depends to a large extent on her knowledge and understanding of some aspects of basic nutrition and health care. It is understandable that her educational status has been reported to influence her child-care practices (Parul et al, 2005)

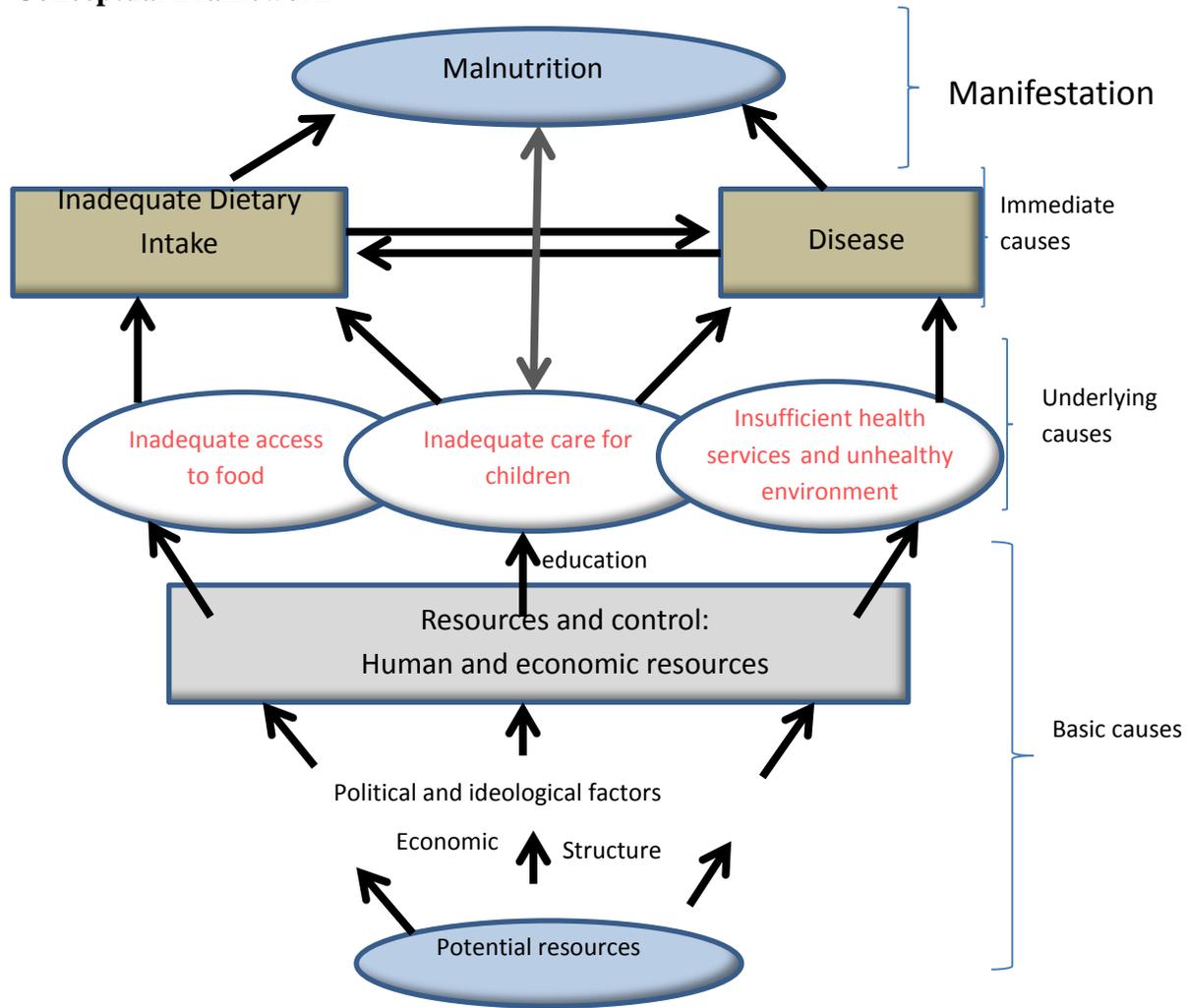
**Diseases and infections-** Malnutrition can be a consequence of health issues such as gastroenteritis or chronic illness, especially the HIV/AIDS pandemic. Diarrhea and other infections can cause malnutrition through decreased nutrient absorption, decreased intake of food, increased metabolic requirements, and direct nutrient loss. Parasite infections can also lead to malnutrition (Mandell ed, 2010).

**Dietary practices-** A lack of adequate breastfeeding leads to malnutrition in infants and children, associated with the deaths of an estimated one million children annually. Deriving too much of one's diet from a single source, such as eating almost exclusively corn or rice, can cause malnutrition. This may either be from a lack of education about proper nutrition, or from only having access to a single food source (Burchi, Fanzo, Frison, 2011).

**Immunization-** Children who are malnourished are nine times more likely to die from infectious diseases such as pneumonia, diarrhea, malaria and measles. A child coping with such diseases will find it difficult to retain essential nutrients, thus putting that child at risk of falling into a dangerous state of malnutrition (UNICEF, 2009)

The effects of malnutrition on human performance, health and survival have been the subject of extensive research for several decades and studies show that malnutrition affects physical growth, morbidity, mortality, cognitive development, reproduction, and physical work capacity (United Nations Children Fund and the World Health Organization, 2013).

**Conceptual Framework**



Adopted from United Nations Children’s Fund (UNICEF 1990)

**METHODOLOGY**

**Study Design:** A descriptive cross sectional study was used to examine the relationship between the variables in this study. The variables being undernutrition (dependent variable) and factors associated with increase in prevalence (independent variable). Descriptive study is a type of research conducted to describe and explore phenomena occurring in real life. It is used to obtain information concerning the current status of the phenomena and to describe "what exists" with respect to variables or conditions in a situation (kombrabail, 2012). Cross sectional study examines subjects at one point in time (Nieswiadomy, 2010). Cross-sectional studies involve

data collected at a defined time. They are often used to assess the prevalence of acute or chronic conditions, or to answer questions about the causes of disease or the results of intervention. They may also be described as censuses. (Bland M., 2001). In this study, these factors were examined and undernutrition among children aged 6-59months was assessed.

**Study Site:** The study was conducted in Kamoriongo Village, Chemundu sub-location, Kapsabet division in Nandi North District, Nandi County, Kenya. The nearest market center is Baraton Market and the nearby town is Kapsabet which is 45 KM southwest of Eldoret along Eldoret-Kisumu road. Kamoriongo Village is 7 KM from this town. The climate in the area is cold and wet with temperatures ranging from 24-26 degrees and a geocode of latitude 0.23333/ longitude 35.0decimal degrees. The main economic activity in this area is tea farming.

**Study Population:** This study was conducted among the children aged 6-59months in Kamoriongo Village. The population of children aged 6-59months in Kamoriongo Village was 123 as per the Kamoriongo village elder's record.

**Sample Size:** A representative sample size was determined using the table for determining sample size from a given population by Krejcie, Robert V., Morgan, Daryle W. (1970) which was developed at a confidence level of 95.0% and a degree of accuracy of 0.05(5%)

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Where;

N represents the total population

S represents the sample

Therefore, with a population of 123 children obtained from records of the Chief, Kamoriongo Village, the sample used was 92 plus 10% attrition rate of 92 which was 9. The sample in total was 101 children.

**Sampling Design:** Purposive sampling was used to obtain the 101 children since only households with children between 6-59months of age were visited.

**Sources of Data:** Both primary and secondary data were used. The primary data was obtained from the mothers and guardians of the children whereas the secondary data was obtained from records in the child's MCH cards in checking for immunizations and diseases

### **Tools for Data Collection**

**Questionnaire:** Semi-structured questionnaires were used as the main research instruments to collect data from the respondents such as demographic data of the child, to ensure that the respondent meet the criteria of the study, child's birth-weight, breastfeeding patterns and duration type and frequency of food intake, especially protein-energy rich foods, diseases, family headship, parental education, maternal nutritional knowledge, staple foods in the area.

### **Anthropometric measurements**

The anthropometric measurements for the children were determined according to standard WHO procedures. The anthropometric parameters considered included Age (in months), Weight (Kgs), Height (cms) and the mid-upper arm circumference (cms).

**Food Frequency Questionnaire:** A Food Frequency Questionnaire (FFQ) was used to find out how often each items of both foods and beverages indicated in the checklist were consumed by the child for over a specified periods of time.

**Direct Observation:** This was done by researcher to validate the results given by the respondents.

**Data Analysis:** According to Kothari, 2004, analysis refers to the computation of certain measures along with searching for patterns of relationship that exist among data-groups. The questionnaires were therefore examined for completeness and coded then the data classified and tabulated using SPSS (Statistical package for social Sciences) version 19.

Data was analyzed using proportions, and descriptive analysis was used to describe the data. Chi-square, which is a non-parametric inferential technique, is appropriate for comparing sets of data that are in the form of frequencies or percentages (nominal data) (Nieswiadomy,2010), it was therefore used to determine the if there is a relationship between increase in malnutrition prevalence (dependent variable) and various factors assessed (independent variable).

Analysis of anthropometric nutritional data was done using Emergency Nutrition Assessment (ENA) software to determine the Z- score values from anthropometric data. The z-scores ( $< -2SD$ ) values were determined from the age, height and weight measurements giving the height for age (HAZ), weight for age (WAZ) and weight for height (WHZ) values using reference data from WHO classified as stunted, underweight or wasted if HAZ, WAZ or WHZ was  $< -2HAZ$ ,  $< -2WAZ$  or  $< -2WHZ$  or severe if the values are  $< -3Z.s$ . Interpretation was done using in visual representation of bar graphs.

**Limitation:** The scope of this study was limited to Nandi North County and specifically Kamoriongo Village and only among children aged 6-59 months of age.

Challenges experienced during data collection were;

- i. Language barrier between the researcher and the respondents.
- ii. Illiteracy of the respondents.

**Delimitations:** An interpreter was identified to help in the communication. The researcher helped the respondents in filling of the questionnaires.

**Ethical Considerations:** Ethical considerations included:

Approval from the Internal Research Ethics Committee (IREC) of the University of Eastern Africa, Baraton was obtained before conducting this study.

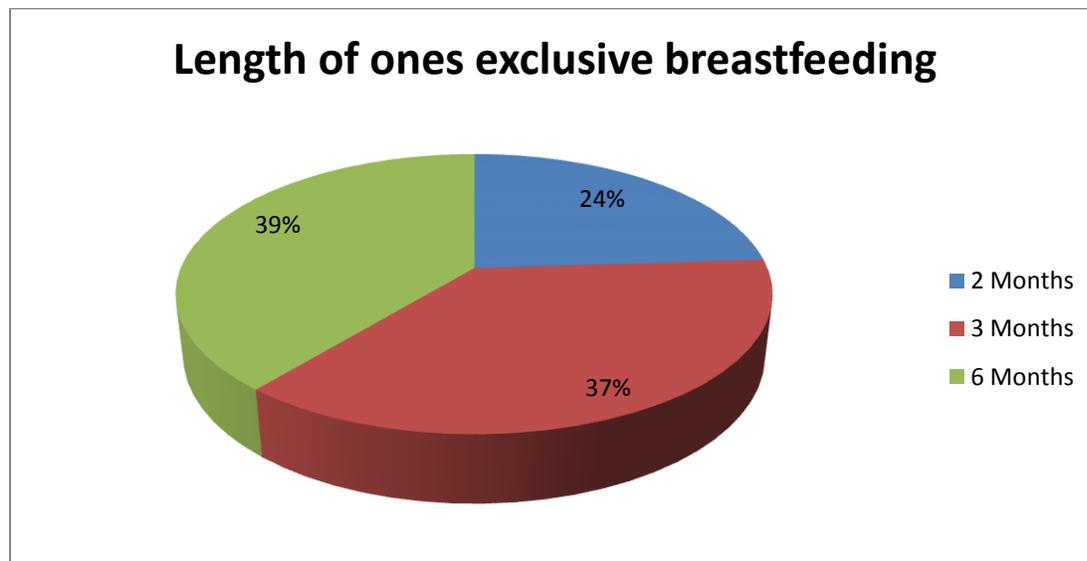
Permission to conduct the study was sought from the Chief of Kamoriongo Village.

Autonomy was ensured by explaining the aims and objectives of the study to the respondents beforehand, and they were informed that their participation was voluntary. Confidentiality was ensured through the participants' anonymity and since a statement was included on the questionnaire, requesting respondents not to include identifiers.

Verbal consent was sought from the parents and guardians of the children prior to taking anthropometric measurements.

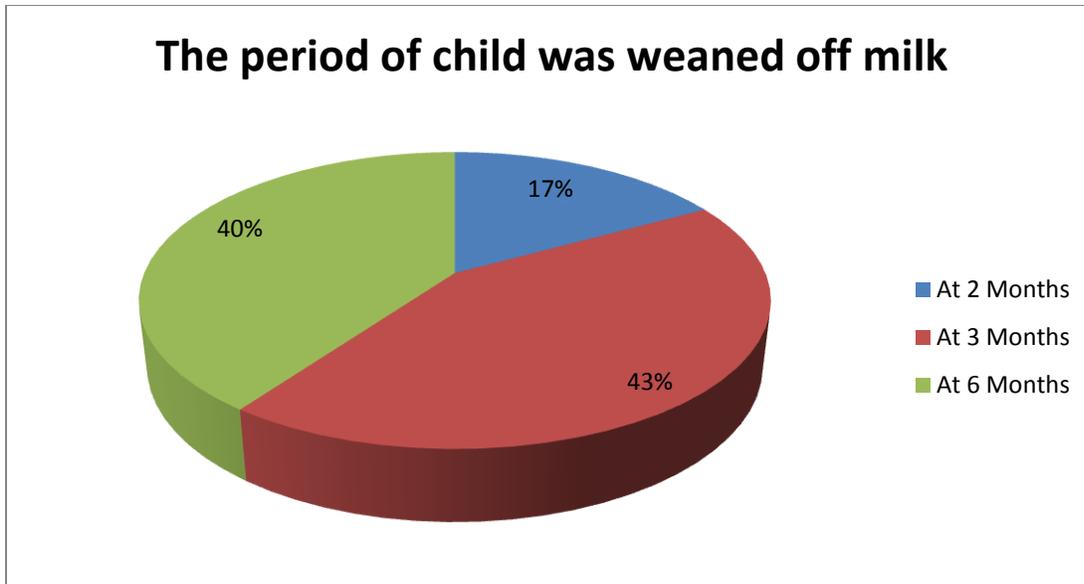
## RESULTS

From the findings of this study, the following results were obtained which have been presented in graphs and pie charts below:



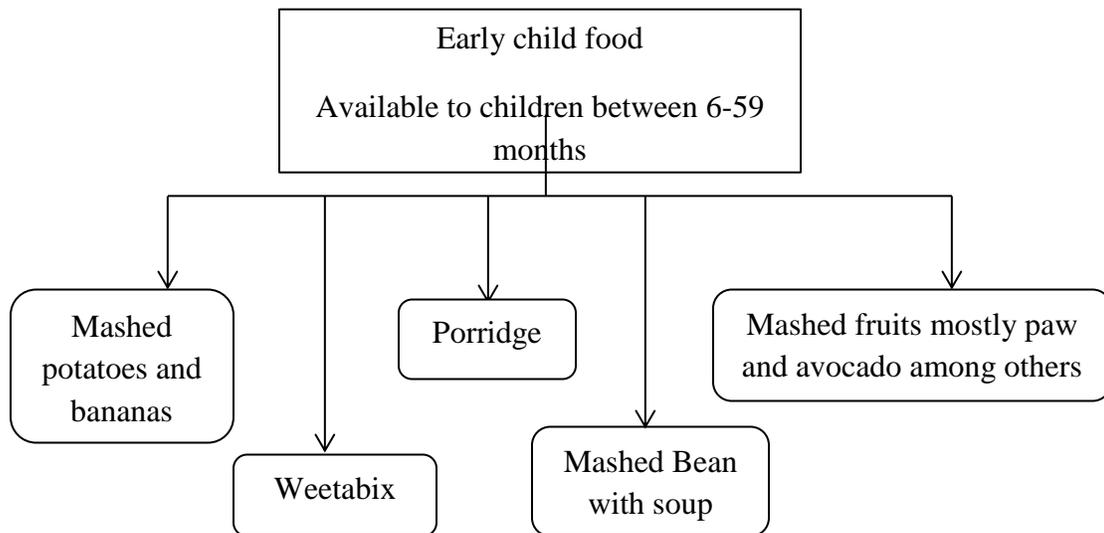
**Figure 1: Length of one's exclusive breastfeeding**

From figure 1 above, it was found out that 39% exclusively breastfed their children for 6 months, 37% did it for 3 months while 24% performed for 2 months.



**Figure 2: Period when the child started on complementary feeding**

From the feedback 43% introduced their babies to other foods at the their months or rather did it after 3 months, 40% after 6 months and 17% after 2 months.



**Figure 3: Foods that were started on complementary feeding**

In the figure above it indicates that the following foods were introduced to the child alongside breastfeeding by their mothers, mashed potatoes and bananas, weetabix, porridge, mashed beans with soup and finally Mashed Paw-Paw and avocado among other fruits.

**Common Diseases**

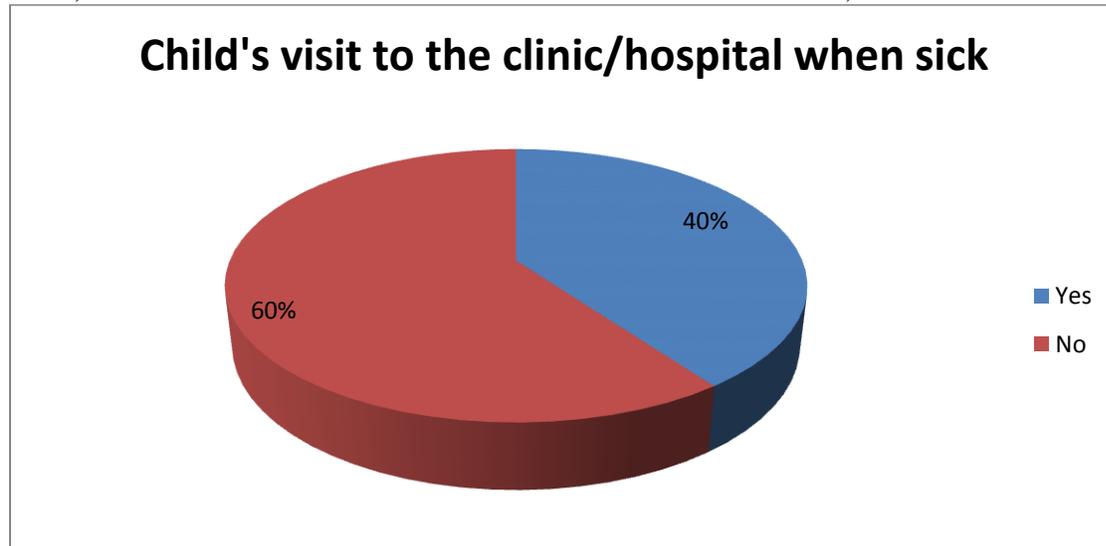
	Yes	No	Number of times	
			< 3times	> 3 times
<b>Malaria</b>	<b>38 (38%)</b>	<b>62 (62%)</b>	<b>29 (87.9%)</b>	<b>4 (12.1%)</b>
<b>Diarrhoea</b>	<b>45 (45%)</b>	<b>55 (55%)</b>	<b>39 86.7%)</b>	<b>6 (13.3%)</b>
<b>Typhoid</b>	<b>22 (22%)</b>	<b>78 (78%)</b>	<b>14 (77.8%)</b>	<b>4 (22.2%)</b>

**Table 1 Common Diseases in the last 6 months**

It was found out that only 38% of the babies had ever suffered from Malaria while 62% had never. From the babies who had suffered from Malaria 88% had suffered less than 3 times while 12% more than 3 times.

It was found out that 45% of the children had ever suffered from diarrhoea while 55% had never. It was found out that 87% of those who had suffered from diarrhoea less than 3 times, while 13% more than 3 times.

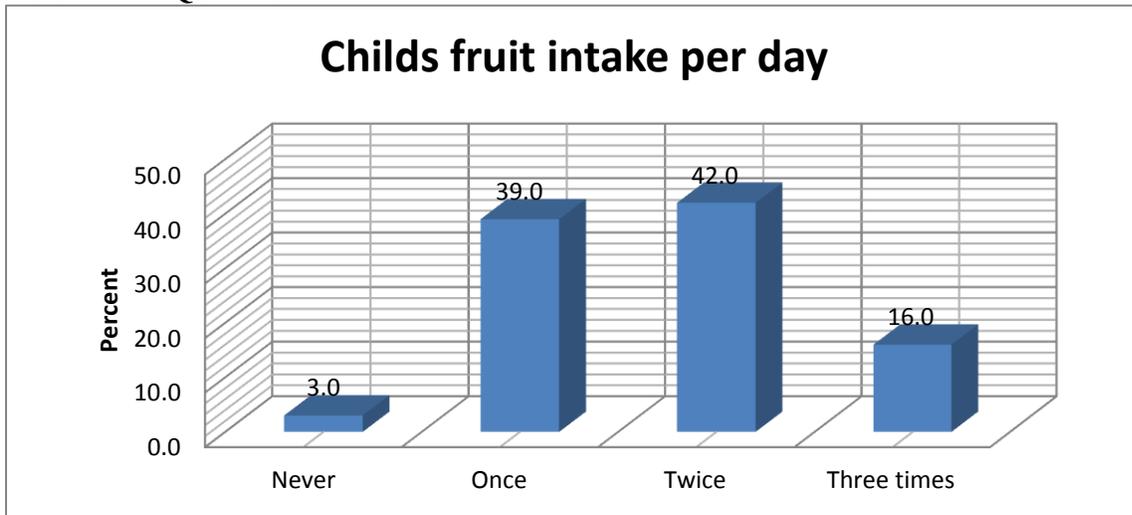
From the respondents of children who suffered from typhoid only 22% had ever suffered while 78% had never. From the children who had suffered from typhoid as indicated in the previous chart, 78% had suffered less than 3 times while 22% had suffered, more than 3 times.



**Figure 4: Number of child’s visit to clinic/hospital when sick**

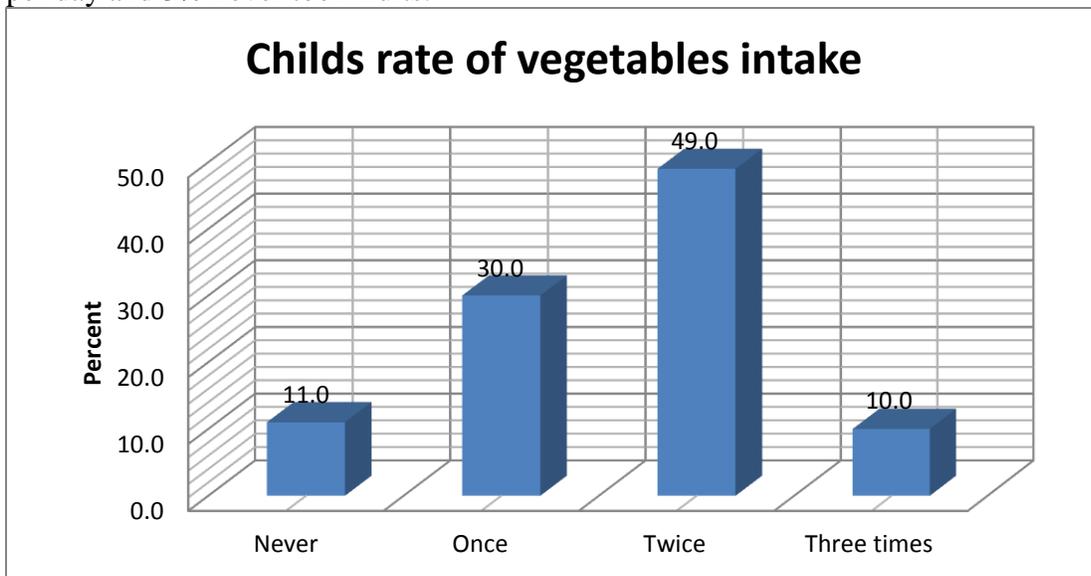
It was found out that the 40% did visit clinic/hospital when the child was sick while 60% never did so.

**FOOD FREQUENCY**



**Figure 5: Childs fruit intake per day**

From the respondents 42% of the children took fruits twice a day, 39% once a day, 16% thrice per day and 3% never took fruits.



**Figure 6: Childs intake rate of vegetables**

From the respondents 49% of the children took vegetables twice a day, 30% once a day, 10% thrice per day and 11% never took vegetables.

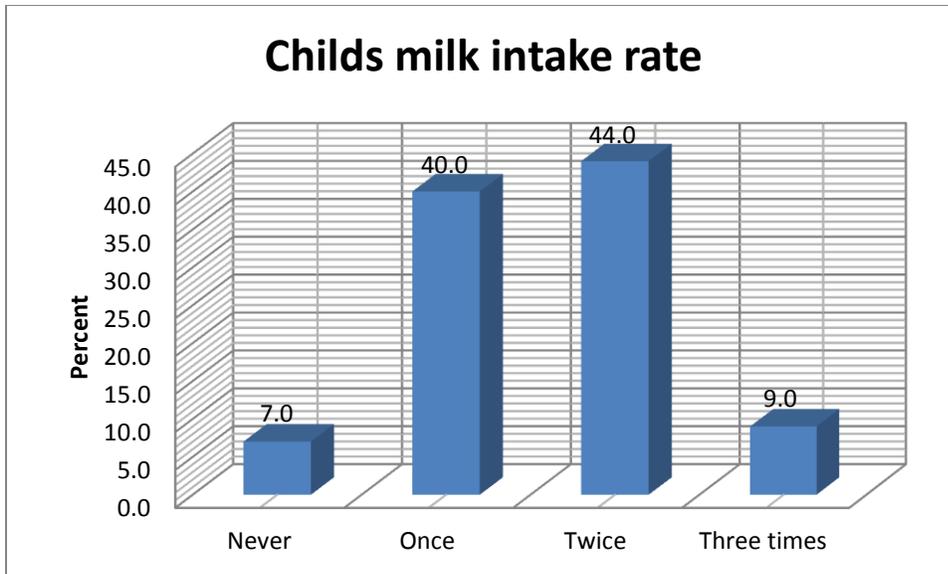


Figure 7: Childs intake rate of milk

From the respondents 44% of the children took milk twice a day, 40% once a day, 9% thrice per day and 7% never took milk.

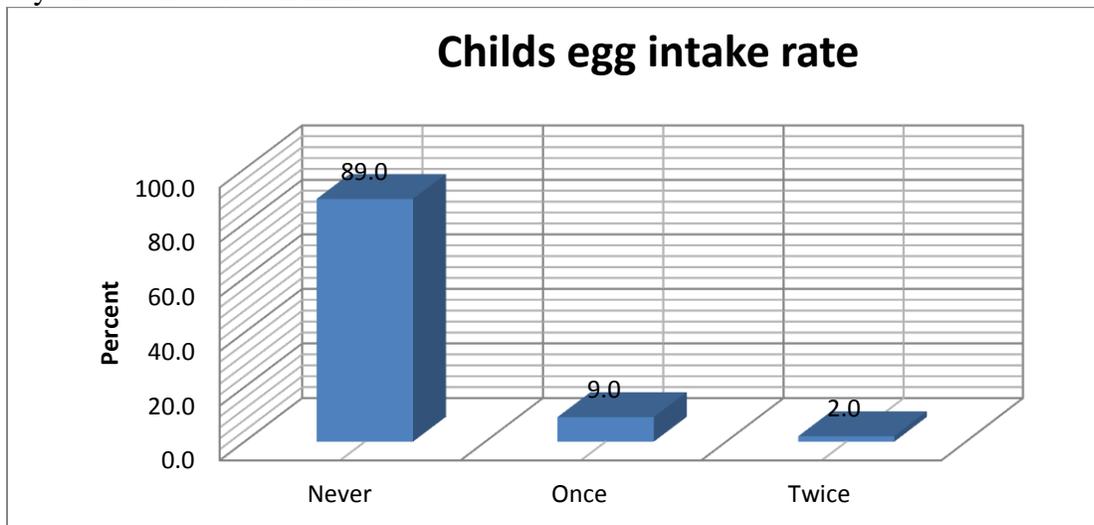


Figure 8: Childs intake rate of eggs

From the respondents 89% of the children never took eggs a week, 9% once a week and 2% took thrice per week.

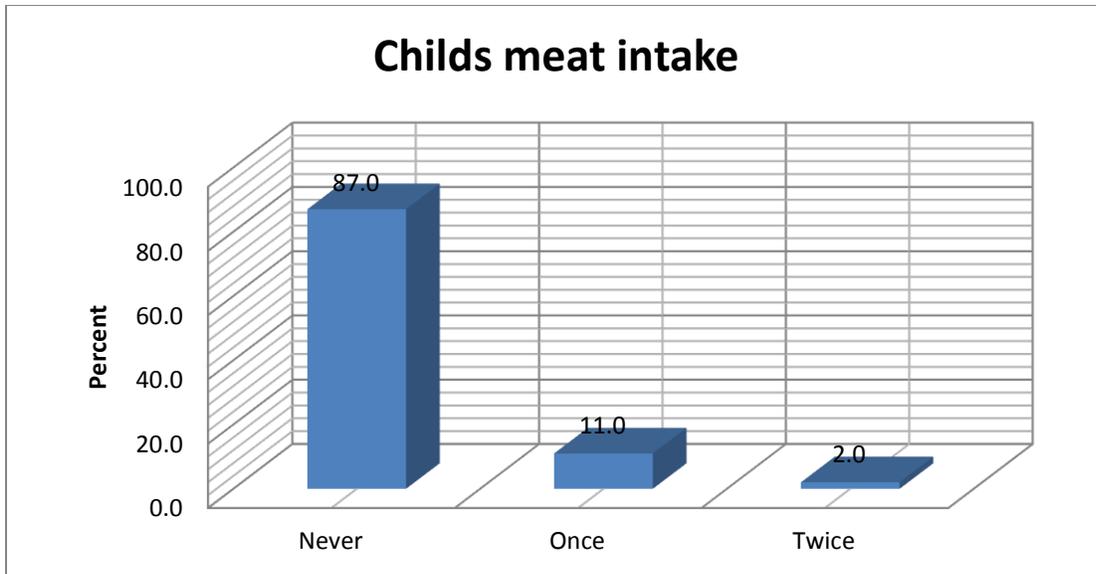


Figure 9: Childs intake rate of meat

From the respondents 89% of the children never took meat a week, 9% once a week and 2% took thrice in a week.

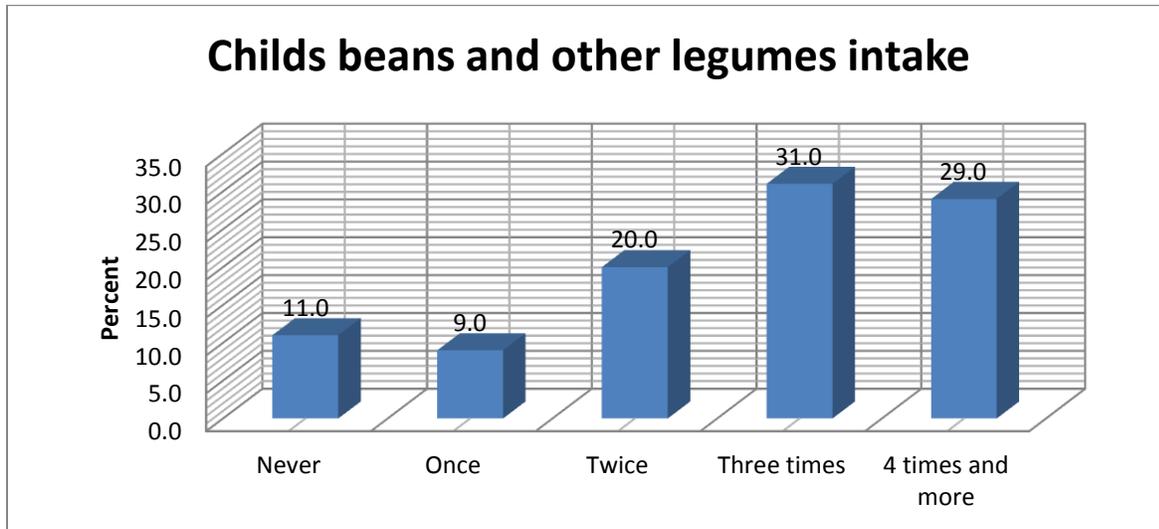
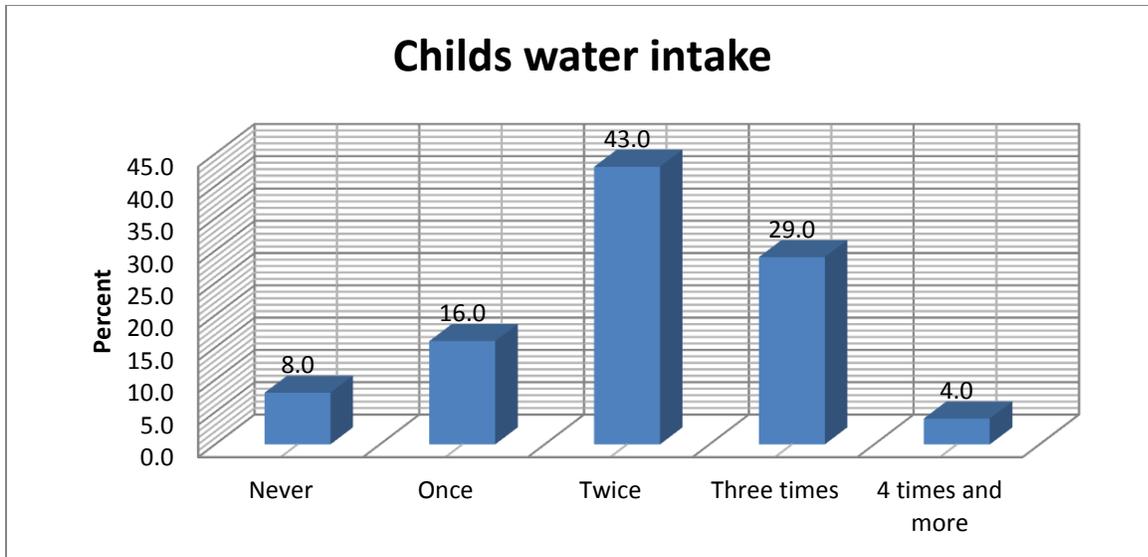


Figure 10: Childs intake rate of beans and other legumes

From the respondents 31% of the children took beans and other legumes 4 times a week, 29% thrice a week, 20% twice per week, 9% once a week while 11% never took any.



**Figure 11: Childs water intake**

From the respondents 43% of the children took water twice in a day, 29% thrice a day, 16% once per day 4% took it 4 times a day while 8% never take water.

**MODEL NUTRITION ASSESSMENT REPORT**

Following is the anthropometric result as per Emergency Nutrition Assessment ENA

**Anthropometric results: children (based on NCHS reference 1977)**

Definitions of acute malnutrition should be given (for example, global acute malnutrition is defined as <-2 z scores weight-for-height and/or oedema, severe acute malnutrition is defined as <-3z scores weight-for-height and/or oedema)

*Table 2: Distribution of age and sex of sample*

	Boys		Girls		Total		Ratio
	no.	%	no.	%	no.	%	Boy:girl
<b>6-17 months</b>	6	50.0	5	50.0	11	11.4	1.0
<b>18-29 months</b>	21	58.3	13	41.7	34	34.3	1.4
<b>30-41 months</b>	8	50.0	7	50.0	17	17.1	1.0
<b>42-53 months</b>	10	42.9	11	57.1	20	20.0	0.8
<b>54-59 months</b>	8	50.0	7	50.0	17	17.1	1.0
<b>Total</b>	18	51.4	17	48.6	100	100.0	1.1

This table shows the distribution of age and gender in the order of 6-17 months having 6 boys and 5 girls, 18-29 months having 21 boys and 13 girls, 30-41 months having 8 boys and 7 girls, 42-53 months having 10 boys and 11 girls, 54-59 months having 8 boys and 7 girls and their corresponding percentage with ratio.

Table 3: Prevalence of acute malnutrition based on weight-for-height z-scores (and/or oedema) and by sex

	All n = 100	Boys n = 52	Girls n = 48
<b>Prevalence of global malnutrition (&lt;-2 z-score and/or oedema)</b>	(17) 41.5 % (26.4 - 56.5 95% C.I.)	(9) 40.9 % (20.4 - 61.5 95% C.I.)	(8) 42.1 % (19.9 - 64.3 95% C.I.)
<b>Prevalence of moderate malnutrition (&lt;-2 z-score and &gt;=-3 z-score, no oedema)</b>	(7) 17.1 % (5.6 - 28.6 95% C.I.)	(3) 13.6 % (-0.7 - 28.0 95% C.I.)	(4) 21.1 % (2.7 - 39.4 95% C.I.)
<b>Prevalence of severe malnutrition (&lt;-3 z-score and/or oedema)</b>	(10) 24.4 % (11.2 - 37.5 95% C.I.)	(6) 27.3 % (8.7 - 45.9 95% C.I.)	(4) 21.1 % (2.7 - 39.4 95% C.I.)

The prevalence of oedema is 0.0 % thus there was no oedema.

The prevalence of undernutrition varies greatly from region to the other: Two Global sub-regions of Eastern and Western Africa show significant increases in prevalence unlike South Asia which shows a slow drop in malnutrition by half from the year 2000. Out of 99 settings in Africa and Asia for which data from both 2008 and 2009 were available, 48% showed an increase in the prevalence of global acute malnutrition (GAM) and 42% show a decrease. Kenya and Sudan, in particular, were countries where the nutritional situation worsened considerably (CE DAT SCENE, 2010). In sub-Saharan Africa, the prevalence stands at 55.2%. Globally, Kenya was ranked 47 out of 144 countries for PEM based on Height for Age (Stunting) by the year 2009 with the prevalence standing at 30% stunting, while in Western Rift Kenya it is at 30% stunting, 20% underweight and 5% wasting.

Table 4: Prevalence of acute malnutrition by age based on weight-for-height z-scores and/or oedema

Age (months)	Total no.	Severe wasting (<-3 z-score)		Moderate wasting (>= -3 and <-2 z-score)		Normal (>= -2 z score)		Oedema	
		No.	%	No.	%	No.	%	No.	%
6-17	4	0	0.0	1	25.0	3	75.0	0	0.0
18-29	12	4	33.3	0	0.0	8	66.7	0	0.0
30-41	6	1	16.7	3	50.0	2	33.3	0	0.0

<b>42-53</b>	7	3	42.9	0	0.0	4	57.1	0	0.0
<b>54-59</b>	6	1	16.7	2	33.3	3	50.0	0	0.0
<b>Total</b>	35	9	25.7	6	17.1	20	57.1	0	0.0

The prevalence of severe wasting (weight for height) showed a high rate in the 42-53 months with 42.9%, 18-29 months followed at 33.3%, while both 30-41 months and 54-59 months had 16.7%. Months of 6-17 had no severe wasting. For moderate wasting the months affected were 6-17 months with 25%, 30-41 months with 50% and 54-59 months had 33.3%. For normal wasting 6-17 months and 75%, 18-29 months had 66.7%, 30-41 months had 33.3%, 42-53 months had 57.1%, while 54-57 months had 50%.

Table 5: Distribution of acute malnutrition and oedema based on weight-for-height z-scores

	<-3 z-score	>=-3 z-score
<b>Oedema present</b>	Marasmic kwashiorkor No. 0 (0.0 %)	Kwashiorkor No. 0 (0.0 %)
<b>Oedema absent</b>	Marasmic No. 24 (24.4 %)	Normal No. 76 (75.6 %)

There was a high evidence of no oedema among the children but however there was marasmic evidence with high evidence of 24% and a normal nutrition status of 76%.

Table 6: Prevalence of acute malnutrition based on the percentage of the median and/or oedema

	n = 100
<b>Prevalence of global acute malnutrition (&lt;80% and/or oedema)</b>	(36) 36.6 % (21.8 - 51.3 95% C.I.)
<b>Prevalence of moderate acute malnutrition (&lt;80% and &gt;= 70%, no oedema)</b>	(13) 14.6 % (3.8 - 25.5 95% C.I.)
<b>Prevalence of severe acute malnutrition (&lt;70% and/or oedema)</b>	(22) 22.0 % (9.3 - 34.6 95% C.I.)

Just as was observed from the previous table 3 t=with no oedema this table further demonstrate the distribution of oedema and as indicated there no oedema found in each category as highlighted. This table above indicates the median of percentage for acute malnutrition.

### Main survey results for HAZ: (Height for Age Z-Scores also referred to as stunting)

#### Prevalence of stunting

(<-2 z-score)

All (100): (39) 39.0% (24.1-54.0 C.I.)

Boys (52): (27) 45.5% (24.6-66.3 C.I.)

Girls (48): (12) 31.6% (10.7-52.5 C.I.)

From the results it was found out the 39 (39%) were of normal stunting with 27 of the 39 children being boys and 12 being girls.

### **Prevalence of moderate stunting**

(<-2 z-score and >=-3 z-score)

All (100): (17) 17.1% (5.6-28.6 C.I.)

Boys (52): (9) 18.2% (2.1-34.3 C.I.)

Girls (48): (8) 15.8% (-0.6-32.2 C.I.)

From the prevalence of moderate stunting it was found out that 17, (17.1%) of the children had moderate stunting with 9 boys and 8 girls as observed above.

### **Prevalence of severe stunting**

(<-3 z-score)

All (100): (22) 22.0% (9.3-34.6 C.I.)

Boys (58): (16) 27.3% (8.7-45.9 C.I.)

Girls (48): (8) 15.8% (-0.6-32.2 C.I.)

From the prevalence of severe stunting it was found out that 22, (22.0)% of the children had severe stunting with 16 boys and 8 girls as observed above.

The rest who were not accounted for (22) was found to be below the threshold of 6-59 months.

Main survey results for WAZ: (weight for Age Z scores results for underweight)

### **Prevalence of underweight**

(<-2 z-score)

All (100): (53) 53.7% (38.4-68.9 C.I.)

Boys (52): (30) 59.1% (38.5-79.6 C.I.)

Girls (48): (23) 47.4% (24.9-69.8 C.I.)

It was found that the prevalence of normal underweight with 53 children while boys were 30 and girls 23.

### **Prevalence of moderate underweight**

(<-2 z-score and >=-3 z-score)

All (100): (17) 17.1% (5.6-28.6 C.I.)

Boys (58): (9) 13.6% (-0.7-28.0 C.I.)

Girls (48): (8) 21.1% (2.7-39.4 C.I.)

It was found that the prevalence of moderate underweight with 17 children while boys were 9 and girls 8.

### **Prevalence of severe underweight**

(<-3 z-score)

All (100): (30) 30% (21.8-51.3 C.I.)

Boys (52): (20) 45.5% (24.6-66.3 C.I.)

Girls (48): (10) 26.3% (6.5-46.1 C.I.)

It was found that the prevalence of severe underweight with 30 children while boys were 20 and girls 10.

Prevalence of oedema : 0.0% (n=0)

mean ± SD of WAZ : -1.03±3.58

Design effect of WAZ < -2 :  
z-scores not available : 0  
z-scores out of range : 0

(C.I. => 95% Confidence Interval assuming cluster sampling)  
There was no evidence of oedema with none of the children having oedema.

**INFERENCEAL STATISTICS**

Table 7: Mother’s Level of Education \* Undernutrition  
**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.612 <sup>a</sup>	4	.047
Likelihood Ratio	12.717	4	.013
Linear-by-Linear Association	8.612	1	.003
N of Valid Cases	100		

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .48.  
As seen in the table above, the Asymp. Significance value of the Pearson Chi-Square is .047 which is less than the alpha value of .05 which shows that there is a relationship between one’s level of education and the increase in undernutrition based on the level of confidence of .05

Table 8: Preferred length for exclusive breastfeeding \* Undernutrition  
**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	180.893 <sup>a</sup>	6	.000
Likelihood Ratio	188.907	6	.000
Linear-by-Linear Association	72.647	1	.000
N of Valid Cases	100		

a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is .48.  
As seen in the table above, the Asymp. Significance value of the Pearson Chi-Square is .000 which is less than the alpha value of .05 which shows that there is a relationship between the preferred length of exclusive breastfeeding and the increase in undernutrition based on the level of confidence of .05.

Table 9: Introduction of complementary feeding \* Undernutrition  
**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	159.564 <sup>a</sup>	6	.000
Likelihood Ratio	176.964	6	.000
Linear-by-Linear Association	85.751	1	.000
N of Valid Cases	100		

a. 4 cells (33.3%) have expected count less than 5. The minimum expected count is .48.

As seen in the table above, the Asymp. Significance value of the Pearson Chi-Square is .000 which is less than the alpha value of .05 which shows that there is a relationship between the introduction of other foods alongside breastfeeding and the increase in undernutrition based on the level of confidence of .05

Table 10: Suffered from Malaria \* Undernutrition  
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.842 <sup>a</sup>	2	.033
Likelihood Ratio	6.823	2	.033
Linear-by-Linear Association	4.765	1	.029
N of Valid Cases	100		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.12.

As seen in the table above, the Asymp. Significance value of the Pearson Chi-Square is .003 which is less than the alpha value of .05 which shows that there is a relationship between the child suffering from Malaria and increase in undernutrition based on the level of confidence of .05

Table 11: Suffered from Diarrhea \* Undernutrition  
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.421 <sup>a</sup>	2	.015
Likelihood Ratio	8.652	2	.013
Linear-by-Linear Association	.202	1	.653
N of Valid Cases	100		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.80.

As seen in the table above, the Asymp. Significance value of the Pearson Chi-Square is .015 which is less than the alpha value of .05 which shows that there is a relationship between the child suffering from diarrhea and the increase in undernutrition based on the level of confidence of .05

Table 12: Suffered from Typhoid \* Undernutrition  
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.086 <sup>a</sup>	2	.048
Likelihood Ratio	6.143	2	.046
Linear-by-Linear Association	1.034	1	.309
N of Valid Cases	100		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.28.

As seen in the table above, the Asymp. Significance value of the Pearson Chi-Square is .048 which is less than the alpha value of .05 which shows that there is a relationship between the

child suffering from typhoid and the increase in undernutrition based on the level of confidence of .05

Table 13: Childs fruit intake per day \* Undernutrition  
**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.435 <sup>a</sup>	6	.037
Likelihood Ratio	14.458	6	.025
Linear-by-Linear Association	9.674	1	.002
N of Valid Cases	100		

a. 4 cells (33.3%) have expected count less than 5. The minimum expected count is .72.

As seen in the table above, the Asymp. Significance value of the Pearson Chi-Square is .037 which is less than the alpha value of .05 which shows that there is a relationship between the child’s fruit intake per day and the increase in undernutrition based on the level of confidence of .05

Table 14: Childs rate of vegetables intake \* Undernutrition  
**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	25.051 <sup>a</sup>	6	.000
Likelihood Ratio	26.384	6	.000
Linear-by-Linear Association	10.523	1	.001
N of Valid Cases	100		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is 2.40.

As seen in the table above, the Asymp. Significance value of the Pearson Chi-Square is .000 which is less than the alpha value of .05 which shows that there is a relationship between the child’s rate of vegetable intake and increase in undernutrition based on the level of confidence of .05.

Table 15: Childs milk intake rate \* Undernutrition  
**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.512 <sup>a</sup>	6	.001
Likelihood Ratio	25.547	6	.000
Linear-by-Linear Association	7.583	1	.006
N of Valid Cases	100		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is 1.68.

As seen in the table above, the Asymp. significance value of the Pearson Chi-Square is .001 which is less than the alpha value of .05 which shows that there is a relationship between the child's milk intake rate in a day and increase in undernutrition based on the level of confidence of .05

Table 16: Childs egg intake rate \* Undernutrition

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.332 <sup>a</sup>	4	.001
Likelihood Ratio	22.902	4	.000
Linear-by-Linear Association	12.997	1	.000
N of Valid Cases	100		

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .48.

As seen in the table above, the Asymp. significance value of the Pearson Chi-Square is .001 which is less than the alpha value of .05 which shows that there is a relationship between the child's egg intake rate in a week and the increase in undernutrition based on the level of confidence of .05

Table 17: Childs meat intake \* Undernutrition

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.372 <sup>a</sup>	4	.000
Likelihood Ratio	27.629	4	.000
Linear-by-Linear Association	15.816	1	.000
N of Valid Cases	100		

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .48.

As seen in the table above, the Asymp. Significance value of the Pearson Chi-Square is .000 which is less than the alpha value of .05 which shows that there is a relationship between the child's meat intake rate in a week and the increase in undernutrition based on the level of confidence of .05

Table 18: Childs beans and other legumes intake \* Undernutrition

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.704 <sup>a</sup>	8	.090
Likelihood Ratio	14.813	8	.063
Linear-by-Linear Association	2.415	1	.120
N of Valid Cases	100		

a. 7 cells (46.7%) have expected count less than 5. The minimum expected count is 2.16.

As seen in the table above, the Asymp. Significance value of the Pearson Chi-Square is .090 which is more than the alpha value of .05 which shows that there is no relationship between the child's beans and other legumes intake and the increase of undernutrition based on the level of confidence of .05

Table 19: Childs water intake \* Undernutrition  
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.713 <sup>a</sup>	8	.001
Likelihood Ratio	28.075	8	.000
Linear-by-Linear Association	.581	1	.446
N of Valid Cases	100		

a. 7 cells (46.7%) have expected count less than 5. The minimum expected count is .96.

As seen in the table above, the Asymp. Significance value of the Pearson Chi-Square is .000 which is less than the alpha value of .05 which shows that there is a relationship between the child's water intake and the increase in undernutrition based on the level of confidence of .05

Of the entire chi square test performed there was an almost strong association with the dependent variable of undernutrition. This is how it relates with the independent variables. Pearson correlation of Level of Education and increase in undernutrition was found to be .047 and a linear by linear association of .003, Pearson correlation of preferred length for exclusive breastfeeding and increase in undernutrition was found to be .000 and a linear by linear association of .000, Pearson correlation of Introduction of other foods alongside breastfeeding and increase in undernutrition was found to be .000 and a linear by linear association of .000, Pearson correlation of Suffered from Malaria and increase in undernutrition was found to be .033 and a linear by linear association of .029, Pearson correlation of Suffered from diarrhea and increase in undernutrition was found to be .015 and a linear by linear association of .653, Pearson correlation of Suffered from Typhoid and Increase in Undernutrition was found to be .048 and a linear by linear association of .309, Pearson correlation of Childs fruit intake per day and Increase in Undernutrition was found to be .037 and a linear by linear association of .002, Pearson correlation of Childs rate of vegetables intake and Increase in Undernutrition was found to be .000 and a linear by linear association of .001, Pearson correlation of Childs milk intake rate and Length of one's exclusive breastfeeding was found to be .001 and a linear by linear association of .006, Pearson correlation of Childs egg intake rate and Increase in Undernutrition was found to be .001 and a linear by linear association of .000, Pearson correlation of Childs meat intake and Increase in Undernutrition was found to be .000 and a linear by linear association of .000, Pearson correlation of Childs beans and other legumes and Increase in Undernutrition was found to be .090 and a linear by linear association of .120, Pearson correlation of Childs water intake and Increase in Undernutrition was found to be .001 and a linear by linear association of .440.

## DISCUSSION

Most mothers in Kamoriongo Village, Nandi County are farmers, 47% and housewives, 43% with only 7% as business persons and 3% students. The monthly income of most of them, 83% is Kshs. 5000 or less, only 9% had an income of Kshs. 5,000 to Kshs. 10,000 while 8% had an income of Kshs. 10,000 to Kshs. 15,000. This indicates some level of poverty in the village. This is in line with United Nations Children's Emergency Fund (UNICEF, 2009), which states that "Socio-economic status, gender and culture contributes mostly to under nutritional cases in African countries and mostly Sub-Saharan areas." Also according to UNICEF, (2009) 30-40% of under nutrition cases affects the poor. It states that "... unemployment and low wages are presenting factors that lead to families eating cheaper food, which is less nutritious leading to weight loss and malnutrition". This could therefore be a reason for the increasing undernutrition rate in Kamoriongo Village, Nandi County, Kenya.

A mother is the principal provider of the primary care that her child needs during the first six years of its life. The type of care she provides depends to a large extent on her knowledge and understanding of some aspects of basic nutrition and health care. It is understandable that her educational status has been reported to influence her child-care practices (Parul et al, 2005). This explains why only 37% of the mothers said other meals should be introduced after 6 months of exclusively breastfeeding, 44% said after 3 months, 17% said it should be introduced after 2 months while 2% said it should be introduced after 1 year. These results indicate a lack of maternal knowledge which shows a significant relationship to the increase in undernutrition in Kamoriongo village, Nandi County. These results also agree with Burchi, Fanzo and Frison's study (2011) that said "A lack of adequate breastfeeding leads to malnutrition in infants and children..."

In assessing the child's dietary history using food frequency questionnaires to find out how often each item of both foods and beverages indicated in the checklist were consumed by the child for over a specified period of time, it was found out that only 10% thrice per day, 49% of the children took vegetables twice a day, 30% once a day, and 11% never took vegetables, 44% of the children took milk twice a day, 40% once a day, 9% thrice per day and 7% never took milk, 89% of the children never took eggs and meat in a week, 9% once a week and 2% took thrice per week, 31% of the children took beans and other legumes 4 times a week, 29% thrice a week, 20% twice per week, 9% once a week while 11% never took any and finally, 43% of the children took water twice in a day, 29% thrice a day, 16% once per day 4% took it 4 times a day while 8% never take water. These results showed that only the beans and other legumes were frequently consumed by most children but the others were left out which came out as a major cause of undernutrition in Kamoriongo Village, Nandi County. These findings agree with Burchi, Fanzo, Frison's (2011) study which stated that "Deriving too much of one's diet from a single source, such as eating almost exclusively corn or rice, can cause malnutrition. This may either be from a lack of education about proper nutrition, or from only having access to a single food source).

The rate of children suffering from various diseases was: Malaria 38%, Typhoid 22%, Diarrhoea 45% and they also showed a relationship with the increase in undernutrition on the Chi-square

test. This agrees with a Mahgoub (2006) that, “In developing countries, infectious diseases, such as diarrhoeal diseases (DD) and acute respiratory infections (ARI) are responsible for most nutrition-related health problems.” The UNICEF conceptual framework developed in 1990 also recognizes diseases as an immediate cause of undernutrition among children. Mandell ed, (2010) also mentioned that diarrhea and other infections can cause malnutrition through decreased nutrient absorption, decreased intake of food, increased metabolic requirements, and direct nutrient loss. Parasite infections can also lead to malnutrition.

This study therefore concurs with the Population Services International (2013) that under nutrition is not merely a result of too little food; rather, it is a consequence of myriad factors, including poverty, repeated illnesses, inadequate access to health services, insufficient macro and micronutrient intake, unsafe water, and lack of access to improved sanitation.

## **CONCLUSIONS**

In conclusion, the prevalence of under nutrition in Kamoriongo Village Nandi County is as follows: The prevalence of wasting (weight for height) showed a high rate of 57.1%, moderate wasting 17.1% and severe wasting of 25.7%.

The prevalence of stunting is 39.0%, moderate stunting of 17.1% and severe stunting of 22.0%. The prevalence of underweight is 53.7%, moderate underweight of 17.1% and severe underweight of 30.0%.

The factors that are attributed to contribute to under nutrition among children are; the length a mother exclusively breastfed their children and the introduction to other foods which is directly influenced by their lack of maternal nutritional knowledge. Also the child’s intake of fruits, vegetables, milk, eggs, meat, and water which was affected by the poverty rate.

## **RECOMMENDATION**

Recommendations drawn from this study are that;

The ministry of health for the Nandi county to conduct a community awareness to the mothers and organizing Barazas that will educate or create awareness of exclusive breastfeeding and importance of giving the children balanced diet.

Nutritional training or health awareness seminars for community members in Nandi County. Women should be encouraged to check on the constant nutrition status of their children by visiting a health facility to get a medical check.

## **Areas for Further Studies**

Another similar study may be conducted in a different area in Nandi County to find out if the attributed factors are similar. A longitudinal study may be conducted in Nandi County on a wider range to establish the exact causes of the increase in undernutrition level.

## ACKNOWLEDGEMENTS

We wish to acknowledge the support of the University of Eastern Africa Baraton which provided a conducive environment for the research to be carried out as well as the necessary assessment tools that were used in this research. Many thanks also the community members of Kamoriongo village who participated in the research.

## REFERENCES

- Burchi F, Fanzo J, Frison E (February 2011). The role of food and nutrition system approaches in tackling hidden hunger. *Int J Environ Res Public Health* 8 (2): 358–73.
- de Onis M, Monteiro C, Akre J and G Clugston, (2003). *The worldwide magnitude of protein-energy malnutrition: an overview from the WHO Global Database on Child Growth*.
- Dolin, Gerald et al. (2010). *Mandell, Douglas, and Bennett's principles and practice of infectious diseases (7th ed.)*. Philadelphia, PA: Churchill
- FAO. *The state of food insecurity in the world 2000 (FAO, Rome)*. Available from <http://www.fao.org/docrep/x8200e/x8200200.htm>
- Friedman J.F. et al. (2005). *Risk factors for Protein-Energy Malnutrition among young children in an area of intense perennial malaria transmission in Western Kenya: Results of cross sectional survey*.
- Gardner, Gary; Halweil, Brian (2006). *Escaping Hunger, Escaping Excess*. Available from <http://www.worldwatch.org/node/488>.
- Masibo PK, Makoka D, (Jun 14, 2012). *Trends and determinants of undernutrition among young Kenyan children: Kenya Demographic and Health Survey; 1993, 1998, 2003 and 2008-2009*.
- WHO, (2000). *Turning the tide of malnutrition: responding to the challenge of the 21st century*. (WHO/NHD/00.7). [http://www.who.int/nut/documents/nhd\\_brochure.pdf?ua=1](http://www.who.int/nut/documents/nhd_brochure.pdf?ua=1)
- World Bank: *World Development Indicators 2009*. Washington DC: the World Bank; 2009.
- UNICEF: *The state of the World's children*. Oxford University Press, Oxford, 1998.
- UNICEF: *Young Child Survival and Development, Ysenburg, 2009. Livingstone/Elsevier. pp. Chp 93*.
- United Nations Sub-Committee on Nutrition, 5th Report on the World Nutrition Situation: *Nutrition for Improved Outcomes*. (March 2004).