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Determinants of Malnutrition among Children Aged 6-59 Months in Trans-Mara East Sub-County, Narok County, Kenya

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Abstract

Malnutrition is associated with a lot of morbidity and more than one-third deaths in children under 5 years globally. A majority of those who suffer from the brunt of malnutrition are in developing countries. Of note Kenya is one of the countries with the greatest burden of malnutrition associated with rapid nutrition, economic and social transitions. However, there is a paucity of data on malnutrition and the factors related to it in children in rural settings. This study therefore examined the prevalence and predictors of malnutrition among children aged 6-59 months in Trans-Mara East sub-county in Narok county. The study employed a descriptive cross-sectional design and data was collected using a semi-structured questionnaire. Analysis was done using multivariate logistic regression. Of the 350 children enrolled in this study, 31%, 22% and 8% of the children were stunted, underweight and wasted, respectively. Besides, 9% and 4% of the children suffered from overweight and obesity respectively. The key determinants for stunting were number of children in the household (adjusted Odds Ratio (aOR): 1.86; 95%CI: 1.01-3.43), mother being a house wife (aOR: 3.63; 95%CI: 1.08-12.24), and being poor (aOR: 3.33; 95%CI: 1.44-7.68). For obesity, the predictors were child age with 12-23 months (Crude Odds Ratio: 2; 95%CI: 0.175-22.8); 24-35 months (odds ratio of 2.22; 95%CI: 0.22-22.3), child gender with males more likely to be obese relative to females (OR: 3.27; 95%CI: 0.856-12.5). This study indicates that there is double burden of malnutrition in rural settings characterized by high prevalence of under nutrition and low prevalence of over nutrition. The results of this study will be useful for the Ministry of Health and other developmental partners targeting child nutrition in formulating context-specific interventions that are optimized according to the level of food insecurity within different settings.

Keywords: Child malnutrition; Double burden malnutrition; Rural settings; Predictors

Introduction

Malnutrition or malnourishment is a condition associated with either consuming a diet without enough (under nutrition) or too much nutrients (over nutrition) resulting in different types of health problems [1]. However, in less developed countries, food malnutrition is often used specifically to refer to under nutrition [2]. Under nutrition can be due to lack of protein or deficiency in other dietary nutrients [3]. Moreover, the protein energy malnutrition can manifest as either marasmus, which is lack of proteins and other dietary nutrients whereas kwashiorkor, is just protein deficiency [4]. Several studies have indicated that under nutrition during pregnancy or before the first two years of life impacts negatively on both physical and mental development of children [5]. The main driver of malnutrition in developing countries is poverty leading to food insecurity while in developed countries it is the abundance of food leading to malnutrition associated with obesity [6]. However, recent studies indicate that even in developing countries there is double burden of malnutrition where children are presenting with both under nutrition and over nutrition [7]. The burden of obesity has begun to shift to the poor, and the dual burden can be observed within low income communities [8].

Globally, over 10 million children under the age of 5 years die every year from preventable and treatable illnesses despite effective health interventions with malnutrition contributing to a half of these deaths [9-11]. Child malnutrition is still one of the most serious health problems with countries in sub-Saharan Africa and South Asia. It is estimated that nearly 3.1 million children die annually either directly or indirectly as a result of malnutrition [9]. Data indicate that the burden of malnutrition is much higher in South Asia and Africa relative to other parts of the world [12]. This has led nearly 165 million children to be affected by chronic restriction of potential growth [10]. Of note, chronic malnutrition has been a persistent problem for young children in Sub-Saharan Africa and the number of undernourished (low weight for age) people of all ages in sub-Saharan Africa increased from about 90 million in 1970 to 225 million in 2008, and is projected to add another 100 million by 2015 [13]. Although the proportion of children with stunted growth has declined from 35% in 2000 to 30% in 2008 to 2009 [14], Kenya is one of 34 countries with the highest burden of child malnutrition in the world [9]. Of interest is that stunting is more pronounced in children from 0-59 months [2]. However, there is a paucity of data on the prevalence of malnutrition in Trans-Mara East sub-county, an area with food insecurity [15]. Therefore, this study determined the prevalence of malnutrition in Trans-Mara East sub-county among children aged 6-59 months.

It has been demonstrated that malnourished children have lowered resistance to infection; therefore, they are more likely to die from common childhood ailments such as diarrhoea l diseases and respiratory infections [2]. In addition, malnourished children that survive are likely to suffer from frequent illness, which adversely affects their nutritional status and locks them into a vicious cycle of recurring sickness, faltering growth and diminished learning ability [2,4]. In developing countries, malnutrition is a major health problem [16]. Frequent and chronic attacks of malnutrition in early childhood have a

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potential negative impact on the physical and mental growth of children [17]. Besides these impacts, there is a possibility that malnutrition may expose children to chronic diseases, which further exacerbates the high rate of child morbidity and mortality [18]. Moreover, malnutrition is associated with stunting (low height-for-age) which can cause chronic restriction of a child's potential growth [19]. Specifically, it refers to children from the ages of 0-59 months who are below 2 standard deviations from the median height-for-age determined by the World Health Organization (WHO) Child Growth Standards. Along with wasting (low weight-for-height) and underweight (low weight-for-age), stunting is an indicator of under nutrition [4,20,21]. In addition, malnutrition can result in severe acute malnutrition (SAM) defined by WHO and UNICEF by a weight-for-height index (WHZ) less than -3 z-score or a mid-upper arm circumference (MUAC) less than 115 mm, or presence of edema in children age 1-5 years [6]. Therefore, this study carried out anthropometric measurements to determine the most common type of malnutrition among children aged 6-59 months in Trans-Mara East sub-county.

Studies have further shown that several factors are context specific and are associated with malnutrition [2,9]. Significantly, the causal factors for stunting in children less than 5 years old, varies with age and are ecologically linked with each other [2,9]. This includes environmental factors in households such as household food security and healthy household environment that are important in long term in preventing stunting in children [2,9,22]. In addition, the other household environment related to child nutrition includes the knowledge and perception of caregivers, care givers age and food insecurity [23], child health and food selection [24], and household socio-economic status [25], infestations with ecto-parasites [2]. Studies have also shown that gender of the child is a determinant of malnutrition with females being more likely to suffer from malnutrition relative to males [2]. On the hand infestation with jiggers and ringworms and endo-parasites like tapeworms are also predictors of malnutrition [26]. These intra-household environmental factors contribute to the neglect of children's needs, especially their nutritional status from birth to preschool [24]. Furthermore, the intra-household environment is affected by environmental, cultural, and historical factors in the communities' where the mothers' live [2].

The prevalence of childhood obesity has increased considerably in recent years [1]. Recent systematic review evidence revealed a transition towards increasing proportions of overweight over time among school-aged children (5 to 17 years) in sub-Sahara Africa [27]. Overweight is problematic in children due to the resulting increased risk of obesity in adulthood, physical and psychosocial morbidity, and premature mortality in adulthood. Childhood overweight is also associated with impaired social and economic productivity in adulthood [28]. Consequently, the concern for a growing prevalence of non-communicable diseases in SSA is worrying [14]. Therefore, this study was designed to determine the influence of household environmental factors on the nutritional status of children aged 6-59 months in a community with a high-level of food insecurity in Trans-Mara East sub-county.

Problem Statement

Malnutrition is associated with a lot of morbidity and mortality especially in children under 5 years old. Studies have shown that rural communities bear the brunt of malnutrition. More importantly, although the proportion of children with stunted growth has declined from 35% in 2000 to 30% in 2008 to 2009, Kenya is still one of 34 countries with the highest burden of child malnutrition in the world and the levels of under nutrition has persisted for decades in Kenya. Moreover, the levels of wasting and stunting have remained majorly unaltered for about 20 years at between 6% and 7% for wasting and 30% and 35% for stunting, however, a recent survey has shown that there has been a great improvement with stunting currently at 26%, underweight at 11% and wasting at 4%. Of note studies indicated that malnutrition is a very common phenomenon in rural communities and those living in peri-urban or urban poor settings because of poverty and food insecurity, but not all children suffer from malnutrition even in food insecure situations, suggesting that other unique context specific factors may be critical in driving malnutrition. Hence there is a need to study these context-specific issues that influences malnutrition in children. Therefore, this study was designed to evaluate the determinants of malnutrition in Trans-Mara East sub-county. Of note, this sub-county was formerly mainly populated by Maasai community but there has been immigration to this region by other tribes. This has led into shift of Maasai lifestyle from pastoralism to agro-pastoralism. Moreover, high rates of population growth and in-migration and immigration has impacted on pastoral lands and food security. Hence there is need to understand how these factors have impacted on malnutrition in this region.

Objectives

Broad objective: To determine determinants of malnutrition among children aged 6-59 months in Trans-Mara East sub-county.

Specific objective:

1. To determine the prevalence of malnutrition among children aged 6-59 months in Trans-Mara East sub-county
2. To determine maternal and child characteristics associated with malnutrition among children aged 6-59 months in Trans-Mara East sub-county
3. To determine the predictors of malnutrition among children aged 6-59 months in Trans-Mara East sub-county

Justification

Frequent and chronic attacks of malnutrition in early childhood have a potential negative impact on the physical and mental growth of children [17]. It affects children in many ways, predisposing them to different infectious diseases, psychosocial mal-development, and cognitive deficiencies. Besides these impacts, there is a possibility that malnutrition may expose children to chronic diseases which further exacerbates the high rate of child morbidity and mortality [18]. Also, even though the government and other health stakeholders have introduced a number of nutritional intervention programs to address the problem of malnutrition in various counties, not all of them are based on scientifically proven association. In Narok county a survey carried out on the nutritional baseline indicators, did not explore factors associated with malnutrition [29]. A rapid assessment of the development situation in 2004, ranked the area (Kirindon, the now Trans-Mara East sub-county) as the poorest division, with 40 percent (20,000) of the total poor (51,200) in the district. The assessment identified development issues that included poor education standards, poor health status, inadequate clean water supply, high rates of HIV and AIDS, poor infrastructure, inadequate food security, and insecurity due to ethnic and clan conflicts [15]. These factors potentially changed due to social and economic disparities. Although risk factors for malnutrition have been identified, individual factors potentially change in specific areas over time and a current characterization of risk factors

provides the basis for preventive intervention programs. The present study sought to establish the determinants of malnutrition.

Methodology

Research design

This study was a cross-sectional descriptive survey using a semi-structured questionnaire and measurements of weight and height to determine the nutritional status of children aged 6-59 months and also examine the determinants of malnutrition among these children.

Study variables

Dependent variable: Malnutrition indicated by stunting, wasting underweight overweight and obesity.

Independent variables: Determinants assessed as independent variables.

Socio-economic and demographic variables: Head of household**,** marital status, ethnicity, religion, family size, income, education, occupation, ownership of livestock and size of farm land.

Child characteristics: Age, sex, birth order, place of delivery, gestational age, type of birth, breastfeeding status and sickness status (fever and diarrhea).

Child caring practices: Feeding mode, health care seeking and immunization.

Maternal characteristics: Age, number of children ever born, ANC visits, extra food during pregnancy/lactation, health status during pregnancy, use of extra food during pregnancy or lactation and decision-making on use of money.

Environmental health condition: Water source, sanitation means, mode of water treatment and main source of cooking fuel.

Study area

The study was carried out in Trans-Mara East sub-county in Narok county. The sub-county has a population of 110,000 by 2009 census in Kenya, with a growth rate of 3% annually, and a total number of 20,759 households [14]. The total number of children under five is 18,590 (16.9% of population) in which 16,731 falls between 6-59 months (90% of under-fives).

It covers an area of 320.5 km^2 with population density of 332 and longitude 35.054536 and latitude -0.960695. Recent data indicated that 4.4% of children under the age of 5 years suffer from severe acute malnutrition (Narok county, 2013). Majority of the cases came from Trans-Mara East sub-county.

Study population

Target population: All households which had children aged 6-59 months in Trans-Mara East sub-county.

Inclusion criteria: This study included households with children aged 6 to 59 months. In addition, primary caregivers' that is the person responsible for the day-to-day care and wellbeing of an infant/child between the age of 6 and 59-months, including biological mothers, grandparents, aunts, and others in cases where the biological parents were deceased or unavailable. The study was only done in households where the household heads gave informed consent.

Exclusion criteria: This study excluded households with children below 6 months or above 59 months of age**,** or whose caretakers did not consent. Moreover, children who were visitors to the households in the area of study were excluded. The study also excluded the following children from the analysis: those whose caregivers were unable to answer the questions due to hearing disability; those who were severely sick; and those whose birth date were not appropriate or not known.

Sample size determination

Since the aim of this study was to determine the prevalence of malnutrition in Trans-Mara-East sub-county. The sample size calculation was therefore based on data from previous study that indicated that the national prevalence estimate for stunting which is 35% [7,30]. Fisher's formula was used to calculate the sample size at 95% significance level as follows [31],

$$n=Z^2Pq/d^2$$

where n is the desired sample size (if the targeted population is greater than 10,000); Z is the critical value associated with level of significance usually 1.96 corresponding to 95%; P is proportion of target population estimated to have a particular characteristic. P, the national prevalence estimate for stunting was given as 35% [7,14,31]; d is the margin of error i.e., 5%=0.05.

$$q=1-p.$$

$$n=1.96^2 \times p\ (1-p) \div d^2=\text{sample size required}$$

$$n=1.96^2 \times 0.35\ (1-0.35) \div 0.050^2=(3.8416 \times 0.2275)=(0.873964) \div (0.0025)=350 \text{ children}$$

The sampling technique: Multi stage cluster sampling technique was used because it involved a wide geographical area (sub-county) and came up with six clusters based on the existing administrative units called locations. Probability proportionate to size (PPS) sampling was used to compute the cluster sample. This was then followed by simple random sampling to select children from the households. From the 197 existing villages, 17 were selected by simple random sampling.

Sampling procedure: Clusters were formed based on the 6 existing locations. In each cluster, the sample was computed through probability proportional to size (PPS) taking the number of households in that particular cluster (location) as the enumerator over the total number of households in the entire Sub-county, multiplied by 350 (The determined sample size) (Figure 1). Using the total number of villages in the cluster as the numerator and the overall number of villages in the sub-county as denominator multiplied by the calculated cluster sample computed by PPS, the required number of villages to be visited out of the sampling frame of 197 villages was obtained. In each cluster, based on the obtained sample, According to Mugenda [31], a sample size of between 10% and 30% is a good representation of the target population and hence the 30% was adequate for sampling.

After establishment of the required number of villages within the clusters, simple random sampling technique was applied to select the villages that were visited. Eventually, households with eligible children were randomly selected based on the determined sample size per cluster. Enumerators administered the questionnaire after obtaining consent from the caregiver and thereafter took the anthropometrical measurements.

$$\text{Cluster Sample}=(A/Z \times 350)$$

where A is the cluster total number of households and Z is total number of households in the entire sub-county.

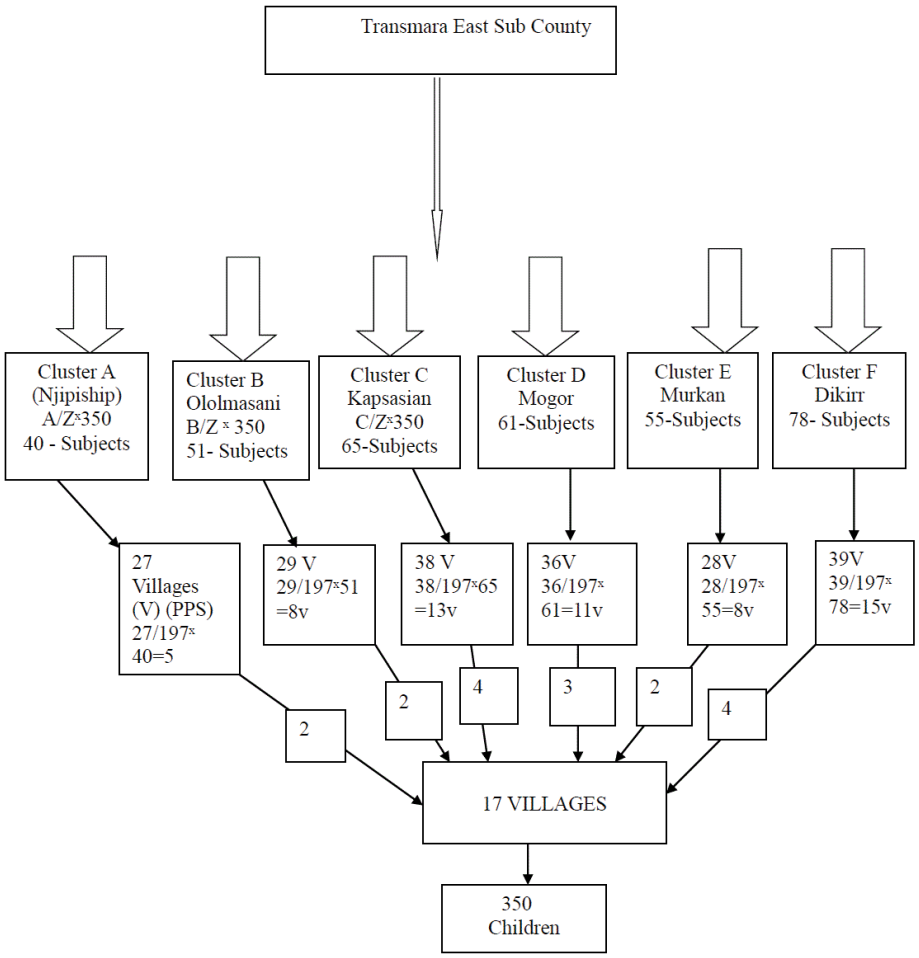

Figure 1: Schematic presentation of sampling procedure.

Formula used to calculate sample size of each selected cluster (location):

$$ni=(n \times Ni)/N$$

where ni is sample size of each selected cluster; n is total sample size; Ni is total number of household in each cluster; N is total number of household in all clusters.

The clusters were households with eligible children were randomly selected based on the calculated/determined sample size per cluster. Enumerators administered the questionnaire after obtaining consent from the caregiver and thereafter took the anthropometrical measurements.

Data collection tools/instruments

Data collection procedures: The questionnaire was pre-tested and refined on the basis of the feedback obtained from the pre-test. Data were collected using semi-structured questionnaire and anthropometric measurement. Twelve data collectors who were able to communicate in the local language were recruited. Training was provided for data collectors and two supervisors for one day. Interview was conducted with mothers/care takers of the children to fill the questionnaire. In households with more than one child of age between 6-59 months, one child was selected randomly by lottery method.

The correct age of a child was confirmed using his/her maternal and child health (MCH) handbook or by the response from the caregiver where the MCH handbook was not available.

Anthropometric data: The anthropometric data were collected using the procedure stipulated by the WHO [20]. Before taking anthropometric data for children, their age should first be determined in order to ensure that, was within the target population. A local event such as circumcision time of an age group was used to establish the birth period if the child's card was not available [32].

Height/length measurement: Body length of children age up to 23 months was measured without shoes and the height was read to the nearest 0.1 cm by using a horizontal wooden length board with the infant in recumbent position. However, height of children 24 months and above was measured using a vertical wooden height board by placing the child on the measuring board, and child standing upright in the middle of board. The child's head, shoulders, buttocks, knees and heels touching the board.

Weight measurement: Weight was measured by electronic digital

weight scale with minimum/lightly/clothing and no shoes. Calibration was done before weighing every child by setting it to zero. In case of children age below two years, the mother was first weighed alone then she was weighed with the baby and the baby's weight was calculated by subtracting the mothers' weight from the combined mother/baby weight. Edema was checked and noted on data sheet because children with edema were severely malnourished. In order to determine the presence of bilateral edema, normal thumb pressure was applied to the two feet for three seconds whether a shallow print or pint remains on both feet when the thumb is lifted.

In determining children's nutritional status, World Health Organization (WHO) child growth standards of 2006 [20] was used to calculate Z-scores for the anthropometric indicators. Children were considered wasted, stunted or underweight when their WHZ/WLZ, HAZ/LAZ and WAZ score was less than -2 SD respectively. A Z score of +2 SD (i.e. 2 SD above the median) and +3 SD or more was considered overweight and obesity respectively.

Household food security level measurements: The household food security level was measured using the household food insecurity access scale (HFIAS) with scores ranging from 0 to 27 by household level [33]. The HFIAS scores obtained from households were categorized into 4 levels of food insecurity, namely, "food secure," "mildly food insecure," "moderately food insecure," and "severely food insecure," based on the HFIAS guideline [34]. The household socioeconomic status (SES) was parameterized by the principle component analysis (PCA) method using house properties confirmed by the questionnaire: property owned, source of drinking water, sanitation method used and hand washing facilities. The score in the first PCA component was used as an asset index of SES status for each household [35]. According to the PCA-based asset index, households will be divided into 4 groups, the first quartile SES group was considered the poorest and the fourth quartile SES group was the richest in the study area.

Data analysis

Malnutrition status was determined by univariate logistic regression analyses. Multiple logistic regression analysis was also conducted to control confounding factors by backward stepwise selection with 0.2 of significant level of removal from the model. STATA version 13 software was used for the analysis.

In order to obtain comparable estimates of malnutrition indices across other surveys, data were analyzed using the proposed procedures and cut-offs by the World Health Organization. Using the WHO method, overweight was defined as weight-for-height z-score>1 (corresponding approximately to the 84th percentile) and obesity as weight-for-height z-score>2 (corresponding to approximately 98th percentile).

Ethical considerations

Ethical clearance was obtained from Board of Post-Graduate Studies (BPS) of Jaramogi Oginga Odinga University of Science and Technology and Research Ethic Committee University of Eastern Africa, Baraton, Eldoret. It was also granted by ministry of Health office, Trans-Mara East sub-county administrative unit. Verbal consent from parents/care taker of the study subjects was obtained and the objective of the study was explained to them. Privacy and confidentiality of collected information was ensured at all level.

Results

Demographic and socio-economic characteristics of households

From the total planned study subjects, complete response was obtained for 350 (100%) (Table 1). As indicated in Table 1, 277 (79.1%) households (HH) were headed by males and a majority of the respondents were married 290 (82.9%). In the study area, most of the respondents interviewed were of the Kipsigis ethnic group 349 (98.3%) and 99.4% were Christians. In addition, 335 (95.7%) had more than four family members in their respective household sand slightly more than two-thirds of the households had 2-3 children under five years of

Characteristics		Frequency	Percent
Head of HHs	Male	277	79.1
	Female	73	20.9
Marital status	Married	290	82.9
	Divorced	6	1.7
	Others	54	15.4
Ethnicity	Kipsigis	349	99.7
	Luhya	1	0.3
Religion	Christianity	348	99.4
	Others	2	0.6
Family size	1-3 members	15	4.3
	>4 members	335	95.7
HHs with under 5 years' children	1	106	30.3
	2-3	244	69.7
	Can't read and write	112	32
	Can read and write	238	68
Paternal education	Primary education	236	67.4
	Secondary education	29	8.3
	Higher education	1	0.3
	No education	80	22.9
	Can't read and write	105	30
	Can read and write	245	70
Maternal Education	Primary education	215	61.4
	Secondary education	22	6.3
	Higher education	8	2.3
	Housewife only	252	72
Occupation of caregiver	Farmer	58	16.5
	Merchant/Trade	31	8.9
	Others	9	2.6
Occupation of child's Father	Farmer	242	69.1
	Gov't employee	15	4.3
	Merchant/Trade	56	16
	Others	2	0.6
	No job	35	10
Monthly income (in KShs)	Less than KSh 3000	80	22.9
	3000-9000	226	64.6
	>9000	44	12.5
Decision making on use of money	Mainly husband	81	23.1
	Mainly woman	127	36.3
	Only husband	20	5.7
	Both jointly	122	34.9
Ownership of livestock	Yes	264	75.4
	No	86	24.6
Livestock per household	1-5	214	61.1
	6-10	30	8.6
	>10	20	5.7
Ownership of land	Yes	320	91.4
	No	30	8.6
Land by hectare per HH	Below 1 hectare	118	43.7
	Above1 hectare	202	57.7

Table 1: Demographic and socio-economic characteristics of households in Trans-Mara East sub-county.

age 244 (69.7%). Concerning educational status, 112 (32%) of mothers and 105 (30%) of fathers cannot read and write, 215 (61.4%) and 236 (67.4%) of fathers and mothers respectively had attained primary education compared to 8 (2.3%) of fathers and 1 (2.3%) of mothers who had attained a higher level of education. Close to three-quarters of the mothers 252 (72.0%) were housewives and 58 (16.5%) were farmers compared to 242 (69.1%) of fathers who are farmers. Regarding livestock, 264 (75.4%) of HHs had livestock, where 214 (61.1%) had 1-5 livestock and 20 (5.7%) had more than 10 livestock. On the other hand, 320 (91.4%) of the households possessed farm land, and out of them 202 (57.7%) had more than 1 Hectare. Majority of the HHs, 226 (64.6%) had a monthly income of Kenya shillings 3,000-9,000.

Prevalence of malnutrition among children aged 6-59 months

The study also assessed the levels of malnutrition (Table 2). It was found that slightly more than a quarter of the participants were healthy 89 (25%). For the remaining children, 108 (31%), 78 (22%), 32 (9%), 29 (8%) and 14 (4%) of children were stunted, underweight, overweight, wasted or obese respectively (Figure 2).

The study further assessed the malnutrition status by gender of which females had higher malnutrition status in underweight, stunted and obese at 44 (56.41%), 65 (60.19%) and 11 (78.57%) respectively. The males had higher levels of malnutrition at wasted 18 (62.07%) and overweight at 17 (53.12%). Slightly more than half of the females 46 (51.69%) were healthy. The study also looked at the children's age and their malnutrition status. It was found that 20 (36.36%) and 18 (32.73%) of underweight children, 38 (46.34%) and 22 (26.83%) of stunted children, and, 23 (37.10%) and 18 (29.03%) of healthy children were aged between 36-47 months and 24-35 months respectively. In addition, 4 (19.05%) and 6 (28.57%) of overweight children, and 8 (30.77%) and 6 (23.08%) of wasted children were aged between 6-11 months and 12-23 months respectively.

Prevalence of malnutrition types by socio-demographic characteristics

This study also assessed the prevalence of the various types of malnutrition by the socio-demographic characteristics (Table 3). Of children aged 6-11 months, 7 (20.59%) were underweight, 6 (17.65%) were stunted and 8 (23.53%) were wasted. Of those aged 36-47 months; 20 (20.00%) were underweight, 38 (38.00%) were stunted and 24 (24.00%) were healthy. Under gender, 44 (22.92%) were underweight and 65 (33.85%) were stunted in males compared to 34 (21.52%) and 43 (27.2%) in females. In socio-economic status, 15 (19.48%) were underweight and 22 (28.57%) were underweight in the poorest category, 20 (31.75%) were underweight and 26 (41.27%) were stunted in the very poor category. There was no statistical significant association found on age with p=0.211, gender p=0.088, mothers age p=0.41, household head p=0.702, marital status at p=0.086. However, socio economic status had a statistical significant association to malnutrition p=0.02.

Prevalence of malnutrition types by health and dietary status

Of those who had diarrhea in the past two weeks, 19 (17.76%), 35 (32.71%) 13 (12.15%) were underweight, stunting and wasting respectively though there was no statistically significant difference to those who had no diarrhea (p=0.181). Of those who had fever, 25 (20.83%), 39 (32.50%) and 14 (11.67%) were underweight, stunting

Variable	Underweight	Stunted	Wasted	Overweight	Obese	Normal
Gender						
Male	44 (56.41%)	65 (60.19%)	11 (37.93%)	15 (46.88%)	11 (78.57%)	46 (51.69%)
Female	34 (43.59%)	43 (39.81%)	18 (62.07%)	17 (53.12%)	3 (21.43%)	43 (48.31%)
Age (m)						
6-11 months	7 (12.73%)	6 (7.32%)	8 (30.77%)	4 (19.05%)	1 (7.69%)	8 (12.9%)
12-23 months	10 (18.18%)	16 (19.51%)	6 (23.08%)	6 (28.57%)	3 (23.08%)	13 (20.97%)
24-35 months	18 (32.73%)	22 (26.83%)	5 (19.23%)	5 (23.81%)	5 (38.46%)	18 (29.03%)
36-47 months	20 (36.36%)	38 (46.34%)	7 (26.92%)	6 (28.57%)	4 (30.77%)	23 (37.1%)

Table 2: Malnutrition status by gender of children.

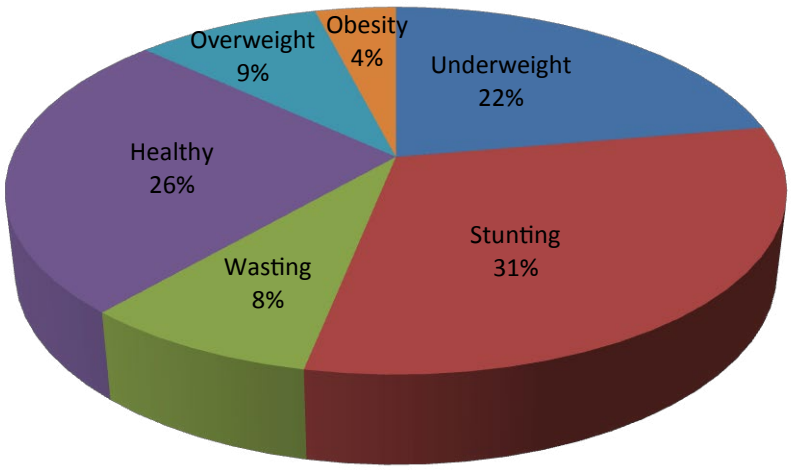

Figure 2: Prevalence of malnutrition among children aged 6-59 months.

Variables	Underweight	Stunted	Wasted	Healthy	Overweight	Obesity	p value
Child age (m)							**0.211**
6-11	7 (20.59)	6 (17.65)	8 (23.53)	8 (23.53)	4 (11.76)	1 (2.94)	
12-23	10 (18.87)	16 (30.19)	6 (11.32)	12 (22.64)	6 (11.32)	3 (5.66)	
24-35	18 (24.66)	22 (30.14)	5 (6.85)	18 (24.66)	5 (6.85)	5 (6.85)	
36-47	20 (20.00)	38 (38.00)	7 (7.00)	24 (24.00)	7 (7.00)	4 (4.00)	
48-59	23 (25.56)	26 (28.89)	3 (3.33)	27 (30.00)	10 (11.11)	1 (1.11)	
Child gender							**0.088**
Boy	44 (22.92)	65 (33.85)	11 (5.73)	47 (24.48)	14 (7.29)	11 (5.73)	
Girl	34 (21.52)	43 (27.22)	18 (11.39)	42 (26.58)	18 (11.39)	3 (1.90)	
Mothers age (y)							**0.41**
15-19	6 (26.09)	6 (26.09)	4 (17.39)	5 (21.74)	2 (8.70)	0 (0.00)	
20-29	29 (17.26)	49 (29.17)	15 (8.93)	49 (29.17)	18 (10.71)	8(4.76)	
30-39	29 (25.22)	42 (36.52)	5 (4.35)	25 (21.74)	9 (7.83)	5 (4.35)	
40-49	14 (31.82)	11 (25.00)	5 (11.36)	10 (22.73)	3 (6.82)	1 (2.27)	
Household head							
Father	60 (21.66)	89 (32.13)	22 (7.94)	73 (26.35)	23 (8.30)	10 (3.61)	
Mother	18 (24.66)	19 (26.03)	7 (9.59)	16 (21.92)	9 (12.33)	4 (5.48)	
Marital status							**0.702**
Married	65 (22.41)	89 (30.69)	24 (8.28)	77 (26.55)	25 (8.62)	10 (3.45)	
Single	4 (16.67)	6 (25.00)	2 (8.33)	8 (33.33)	2 (8.33)	2 (8.33)	
Divorced/Widowed/Separated	9 (25.00)	13 (36.11)	3 (8.33)	4 (11.11)	5 (13.89)	2 (5.56)	
Number of children in household							**0.086**
1	23 (21.70)	25 (23.58)	5 (4.72)	37 (34.91)	11 (10.38)	5 (4.72)	
2	38 (20.77)	66 (36.07)	15 (8.20)	41 (22.40)	15 (8.20)	8 (4.37)	
3	17 (27.87)	17 (27.87)	9 (14.75)	11 (18.03)	6 (9.84)	1 (1.64)	
Decision maker on income							**0.562**
Mother	31 (24.41)	38 (29.92)	15 (11.81)	26 (20.47)	9 (7.09)	8 (6.30)	
Mainly father	17 (20.99)	29 (35.80)	7 (8.64)	19 (23.46)	8 (9.88)	1 (1.23)	
Father only	4 (20.00)	6 (30.00)	1 (5.00)	7 (35.00)	1 (5.00)	1 (5.00)	
Both	26 (21.31)	35 (28.69)	6 (4.92)	37 (30.33)	14 (11.48)	4 (3.28)	
Socio-economic status							**0.02**
Poorest	15 (19.48)	22 (28.57)	7 (9.09)	24 (31.17)	6 (7.79)	3 (3.90)	
Very poor	20 (31.75)	26 (41.27)	6 (9.52)	5 (7.94)	4 (6.35)	2 (3.17)	
Poor	16 (22.86)	25 (35.71)	5 (7.14)	11 (15.71)	9 (12.86)	4 (5.71)	
Less poor	19 (25.00)	15 (19.74)	9 (11.84)	24 (31.58)	7 (9.21)	2 (2.63)	
Least poor	8 (12.50)	20 (31.25)	2 (3.13)	25 (39.06)	6 (9.38)	3 (4.69)	

Table 3: Prevalence of malnutrition status by socio-demographic characteristics.

and wasting respectively though there was no statistically significant difference to those who had no fever (p=0.485). Edema presence had a significant association with malnutrition status (p=0.002) (Table 4).

Care givers demographic and behavioral characteristics

The study had 168 (48.0%) of the care givers aged between 20-29 years, 115 (32.9%) aged between 30-39 years and 44 (12.5%) aged between 40-49 years. Close to two-thirds of the mothers had given their first birth aged 12-19 years 224 (64.0%) followed by 20-27 years at 124 (35.4%). In addition, 105 (30.0%) of caregivers, had 1-2 previously born children. Majority of the caregivers, 236 (67.4%) had visited the ANC more than 4 times at a health facility, 158 (45.1%) of the caregivers do use family planning method of which 118 (74.7%) of them use Depo-Provera while 35 (22.2%) use other family planning methods (Table 5).

Behavioral and clinical characteristics of children

The children interviewed in the study comprised of 192 (54.9%) males who are slightly more than half of the sample. Moreover, close to three-quarters of the children were above 24 months of age, that is 73 (20.9%), 100 (28.6%) and 90 (25.7%) were aged between 24-35 months, 36-47 months and 48-59 months respectively. Majority of the children were delivered at home 245 (70.0%) and 326 (9.1%) of the children had gestational age at 9 months. In addition, 335 (95.7%) were single births. Furthermore, 268 (76.6%) of children were not being breast fed of which 208 (77.6%) caregivers cited that child was above breast feeding age as the reason and 25 (9.3%) cited maternal pregnancy. On clinical characteristics, 107 (30.6%) of the children experienced diarrhea in the past 2 weeks prior to the study, of which 52 (48.6%) of them had more than 5 episodes and 25 (23.4%) had two episodes of diarrhea. Lastly 120 (34.3%) of the children were reported to have experienced an episode of fever in the past two weeks (Table 6).

Feeding practices of children

The study also looked at the children's feeding practices whereby 264 (75.4%) of the children were breast fed immediately after birth, 237 (67.7%) of children had water with sugar as pre-lactation food, 120 (34.3%) and 117 (33.4%) of children started complementary feeds at 4-5 and 1-2 months respectively. In addition, 211 (60.3%) had their complementary feeds in fluid forms, 154 (44.0%) and 151 (43.1%) were fed three or more than three times daily respectively. The methods of feeding comprised mostly of cups 218 (62.3%) and bottles 82 (23.4%). Furthermore, 160 (45.7%) had exclusive breast feeding for a period of

Variables	Underweight	Stunting	Wasting	Normal	Overweight	Obesity	p value
Diarrhea past 2 weeks							**0.181**
Yes	19 (17.76)	35 (32.71)	13 (12.15)	25 (23.36)	8 (7.48)	7 (6.54)	
No	59 (24.28)	73 (30.04)	16 (6.58)	64 (26.34)	24 (9.88)	7 (2.88)	
Fever past 2 weeks							**0.485**
Yes	25 (20.83)	39 (32.50)	14 (11.67)	27 (22.50)	9 (7.50)	6 (5.00)	
No	53 (23.04)	69 (30.00)	15 (6.52)	62 (26.96)	23 (10.00)	8 (3.48)	
Edema presence							**0.002**
Yes	0 (0.00)	6 (54.55)	3 (27.27)	0 (0.00)	0 (0.00)	2 (18.18)	
No	78 (23.01)	102 (30.09)	26 (7.67)	89 (26.25)	32 (9.44)	12 (3.54)	
Dietary Intake							
Daily feeding frequency							**0.4567**
<3 times	10 (22.22)	17 (37.78)	1 (2.22)	15 (33.33)	2 (4.44)	0 (0.00)	
3 times	36 (23.38)	42 (27.27)	14 (9.09)	41 (26.62)	14 (9.09)	7 (4.55)	
>3 times	32 (21.19)	49 (32.45)	14 (9.27)	33 (21.85)	16 (10.60)	7 (4.64)	
Exclusive breast feeding (m)							**0.055**
1-3	35 (21.88)	52 (32.50)	13 (8.13)	40 (25.00)	14 (8.75)	6 (3.75)	
4-5	14 (20.90)	20 (29.85)	5 (7.46)	22 (32.84)	5 (7.46)	1 (1.49)	
6	13 (16.67)	22 (28.21)	4 (5.13)	26 (33.33)	8 (10.26)	5 (6.41)	
7-12	16 (35.56)	14 (31.11)	7 (15.56)	1 (2.22)	5 (11.11)	2 (4.44)	

Table 4: Prevalence of malnutrition by health and dietary status.

Characteristics	Frequency	Percent
Age of mother (years)		
15-19	23	6.6
20-29	168	48
30-39	115	32.9
40-49	44	12.5
Age at first birth (years)		
12-19	224	64
20-27	124	35.4
36-43	2	0.6
Total child born before		
No	56	16
1-2	105	30
3-4	98	28
5-6	68	19
7 and above	23	7
How many times did you visit health facility for ANC		
Once	29	8.3
Twice	73	20.9
At least 4 times	236	67.4
No visit made	12	3.4
Family planning used		
Yes	158	45.1
No	192	54.9
Types of family planning used		
Pills	5	3.2
Depo-provera	118	74.7
Others	35	22.2

Table 5: Caregivers demographic and behavioral characteristics.

1-3 months compared to 78 (22.3%) who had exclusive breast feeding for 6 months. Lastly, 293 (83.7%) children were given vitamin A (Table 7).

Feeding patterns by wealth index

The research also looked at feeding patterns and its association with the wealth index. Close to half, 124 (46.9%) of the least poor began breast feeding initiation immediately, 57 (75.0%) of the very poor began 1 hour to 2 hours. On giving other drinks than breast milk, 3 (60%) of the least poor were given honey and 110 (46.4%) sugar. In addition, 58 (71.6%) and 2 (66.7%) in the very poor category were given water and fruit juice respectively. On assessing the age of complementary feeding 43 (46.7%) of the least poor started at 6 months, 67 (57.2%) and 38 (31.6%) of the very poor began at 1-2 and 4-5 months respectively. On the form of complementary feeding 104 (42.9%) of the least poor were given liquid/semi-solid food compared to 76 (54.6%) of the very poor. There was statistical significant difference in breast feeding initiation, complementary feeding and age, frequency of feeding, feeding method, length of exclusive breast feeding and use of vitamin a ($p<0.0001$) (Table 8).

Environmental characteristics of households

The study also assessed the environmental health characteristics of the households. The main sources of drinking water used by households was river 187 (53.4%) followed by shallow well 67 (19.1%), water tap 45 (12.9%) and borehole 41 (11.7%). Within the study sample, almost 73 (20.9%) of households had to cover a distance greater than 30 minutes to fetch water from these sources. In regard to water consumption per household per day, 40 (11.4%) HHs used less than 40 liters and 287 (82%) used 40-80 litter per day. Concerning treatment of drinking water in households, majority of HHs 207 (59.1%) instituted no form of water treatment to make it safe for drinking. About sanitary facilities, majority of households 310 (88.6%) had latrine. In hand washing facilities, only 164 (46.9%) households washed hands using both soap and water, whereas 80 (22.9%) used water only, as 106 (30.3%) don't wash at all. Regarding waste disposal system, largely 178 (50.9%) dispose in common pit, whereas open field disposal accounted for 30.9% (108). The most widely used source of cooking fuel at household was firewood, accounting for 346 (98.9%) (Table 9).

Determinants of malnutrition among children aged 6-59 months

Correlates of malnutrition types by socio-demographic characteristics of the household and children: Wasting was statistically significant for children who were aged between 48-59 months as they were 0.11 less likely to be wasted to those aged between 6-11 months

Variables	Frequency	Percent
Child sex		
Male	192	54.9
Female	158	45.1
Child age (in months)		
6-11	34	9.7
12-23	53	15.1
24-35	73	20.9
36-47	100	28.6
48-59	90	25.7
Place of delivery		
Home	245	70
Health facility	105	30
Gestational Age at birth		
Less than 9 months	4	1.2
At 9 months	326	93.1
Greater than 9 months	20	5.7
Types of birth		
Single	335	95.7
Twin	15	4.3
Still breastfeed child		
Yes	82	23.4
No	268	76.6
Reason for not feed breast (n=268)		
Maternal health problems	8	3
Refusal of child	20	7.5
Maternal pregnancy	25	9.3
Workload	7	2.6
Child 's above breastfeeding age	208	77.6
Diarrhea		
Yes	107	30.6
No	243	69.4
Frequency of diarrhea		
1 episode	13	12.1
2 episode	25	23.4
3-4 episode	17	15.9
≥ 5 episode	52	48.6
Fever		
Yes	120	34.3
No	230	65.7

Table 6: Behavioral and clinical characteristics of children.

Characteristics	Frequency	Percent
Initiation of breastfeeding of child		
Immediately	264	75.4
After 1 hour to 24 hours	76	21.7
After a day	10	2.9
Pre-lactation food/fluids kind		
Honey	5	1.4
Water with sugar	237	67.7
Plain water	81	23.1
Fruit juice	3	0.9
Butter	5	1.4
None	19	5.4
Age complementary feeding started (in months)		
1-3	117	33.4
4-5	120	34.3
6	92	26.3
7-12	21	6
Form complementary in addition to BF		
In fluid form	211	60.3
Semi solid form	139	39.7
Frequency of feeding/day		
<3 times	45	12.9
3 times	154	44
>3 times	151	43.1
Method of feeding		
Bottle	82	23.4
Cup	218	62.3
Spoon	32	9.1
Hand	18	5.2
Length of EBF child (in months)		
1-3	160	45.7
4-5	67	19.1
6	78	22.3
7-12	45	12.9
Immunization		
Yes	316	90.3
No	34	9.7
Vitamin A supplementation		
Yes	293	83.7
No	57	16.5

Table 7: Children feeding practices.

(OR: 0.11; 95%CI: 0.02-0.52). Having 2 or 3 number of children in a household was statistically associated with being unhealthy compared to having one (OR: 0.54; 95%CI: 0.32-0.91) and (OR: 0.41; 95%CI: 0.19-0.88) respectively. Statistical significance was also reflected in stunting for those who had 2 children (OR: 2.4; 95%CI: 1.26-4.51), and 3 children in wasting (OR: 6.06; 95%CI: 1.68-21.86). On mothers who had no education, their children were 5.5 times more likely to suffer from stunting than those who had secondary education (OR: 5.47; 95%CI: 1.49-20.10) and this was statistically significant. Mothers who were decision makers in the family were 3.6 times more likely to have children in their households suffering from wasting compared to household where both parents were decision makers (OR: 3.56; 95%CI: 1.22-10.39). On socio-economic status, those who were very poor were more likely to have children who are underweight (OR: 6.4; 95%CI: 1.98-20.69) and stunting (OR: 5.67; 95%CI: 1.85-17.36) compared to the poorest. Furthermore, the very poor and poor were less likely to have unhealthy children compare to the poorest (OR: 0.19; 95%CI: 0.07-0.54) and (OR: 0.41; 95%CI: 0.18-0.92) respectively. Children who were exclusively breast fed for 7-12 months were more likely to experience underweight, stunting and wasting (OR: 32.0; 95%CI: 3.81-268.5), (OR: 16.55; 95%CI: 2.01-136.0) and (OR: 45.50; 95%CI: 4.36-474.6) respectively (Table 10).

Correlates and determinants of stunting in comparison to other health status in children: For univariate logistic regression, all the variables that were considered as factors that might influence stunted growth were included as shown in Table 11. They include: child's age and gender, parents age marital status, occupation and education status, head of household, number of children in the household and the socio-economic status and the child health condition and dietary intake. Variables that had a $p<0.25$ were put in the final model. The results from the stepwise multiple regression model of stunted children on household areas also shown in Table 11. The following factors remained and were incorporated into the regression model: child age, number of children in household, mothers' education status, mother's occupation, father's occupation and socioeconomic status (SES). Among children aged between 36-47 months they were 3.1 times more likely to have

	Wealth index n (%)			
Variable	**Very poor**	**Poor**	**Least poor**	**p value**
Breast feeding initiation				**<0.0001**
Immediately	79 (29.92)	61 (23.11)	124 (46.97)	
1 hour to 2 hours	57 (75.00)	9 (11.84)	10 (13.16)	
After a day	4 (40.00)	0 (0.00)	6 (60.00)	
Other drinks other than breast milk				**<0.0001**
Honey	2 (40.00)	0 (0.00)	3 (60.00)	
Sugar	73 (30.80)	54 (22.78)	110 (46.41)	
Water	58 (71.60)	11 (13.58)	12 (14.81)	
Fruit juice	2 (66.67)	1 (33.33)	0 (0.00)	
Butter	0 (0.00)	0 (0.00)	5 (100.00)	
None	5 (26.32)	4 (21.05)	10 (52.63)	
Age of complementary feeding (m)				**<0.0001**
1-2	67 (57.26)	10 (8.55)	40 (34.19)	
4-5	38 (31.67)	31 (25.83)	51 (42.50)	
6	26 (28.26)	23 (25.00)	43 (46.74)	
7-12	9 (42.86)	6 (28.57)	6 (28.57)	
Form of complementary				**<0.0001**
Liquid/Fluid	64 (30.33)	43 (20.38)	104 (42.29)	
Semi solid	76 (54.68)	27 (19.42)	36 (25.90)	
Frequency of feeding (daily)				**<0.0001**
<3	22 (48.89)	2 (4.44)	21 (46.67)	
3	78 (50.65)	24 (15.58)	52 (33.77)	
>3	40 (26.49)	44 (29.14)		
Feeding method				**<0.0001**
Bottle	17 (20.73)	14 (17.07)	51 (62.20)	
Cup	98 (44.95)	48 (22.02)	72 (33.03)	
Spoon	16 (50.00)	2 (6.25)	14 (43.75)	
Hand	9 (50.00)	6 (33.33)	3 (16.67)	
Length of exclusive breast feeding				**<0.001**
1-3	91 (56.88)	22 (13.75)	47 (29.38)	
4-5	15 (22.39)	13 (19.40)	39 (58.21)	
6	18 (23.08)	20 (25.64)	40 (51.28)	
7-12	16 (35.56)	15 (33.33)	14 (31.11)	
Immunization				**0.052**
Yes	122 (38.61)	61 (19.30)	133 (42.09)	
No	18 (52.94)	9 (26.47)	7 (20.59)	
Vitamin A				**<0.0001**
Yes	91 (31.06)	66 (22.53)	136 (46.42)	
No	49 (85.96)	4 (7.02)	4 (7.02)	

Table 8: Feeding patterns by wealth index.

stunted growth to those aged between 6-11 months (OR: 3.11; 95%CI: 1.07-9.02; p: 0.037). Moreover, household with 2 children were 1.8 times more likely to have stunted growth compared to households with one child (OR: 1.86; 95%CI: 1.01-3.43; p: 0.045). In addition, mothers who were housewives were 3.6 times more likely to have children with stunted growth compared to mothers who were merchants (OR: 3.63; 95%CI: 1.08-12.24; p: 0.037). Finally, those who were very poor (OR: 3.33; 95%CI: 1.44-7.69; p: 0.005) and poor (OR: 3.52; 95%CI: 1.41-8.82; p: 0.007) were 3.3 and 3.5 times more likely to have stunted children.

Correlates and determinants of overweight in comparison to other health status in children: The study also did a multivariable logistic regression on those who were overweight. It was found that children whose household heads were fathers were less likely to be overweight (aOR: 0.750; 95%CI: 0.139-4.052; p: 0.738). Children whose parents were married (aOR: 3.485; 95%CI: 0.345-35.746; p: 0.293) and divorced/widowed or separated (aOR: 4.29; 95%CI: 0.350-52.690; p: 0.255) had higher chance of being overweight compared to single/never married parents. Furthermore, those who were very poor and poor had a higher likelihood of being overweight i.e., (aOR: 3.405; 95%CI: 0.549-25.120; p: 0.188) and (aOR: 3.548; 95%CI: 0.781-16.126; p: 0.101) respectively. Children who were breastfed for over 6 months also has a higher chance of being overweight compared to those breastfed for 6 months (aOR: 14.402; 95%CI: 1.158-179.056; p: 0.0308). Lastly, children who were fed more than three times in a day were more likely to be overweight compared to those fed only 3 times (aOR: 1.252; 95%CI: 0.431-3.638; p: 0.680) (Table 12).

Correlates and determinants of obesity in comparison to other health status in children: Children who were males were more likely to obese compared to the females (aOR: 2.994; 95%CI: 0.641-13.983; p: 0.163). Households whose decision maker was only the father had a higher likelihood of having obese children (aOR: 4.969; 95%CI: 0.283-87.358; p: 0.273) compared to those who both parents were decision makers. Children who were breastfed for over 6 months also has a higher chance of being overweight compared to those breastfed for

Characteristics	Frequency	Percent
Source of drinking water		
River	187	53.4
Water tap	45	12.9
Rain water	10	2.9
Shallow well	67	19.1
Borehole	41	11.7
Water used in HH per day by liters		
<40	40	11.4
40-80	287	82
>80	23	6.6
Time to obtain drinking water (round trip)		
<15 minutes	152	43.4
15-30 minutes	125	35.7
>30 minutes	73	20.9
HHs water treatment before drinking		
Boiling	58	16.6
Filtering	78	22.3
Use of chlorine tabs/guard	7	2
No Form of treatment	207	59.1
Place of fecal disposal		
Open field	11	3.1
Sanitary latrine	310	88.6
In bush	29	8.3
Materials used to wash hands after visiting a toilet		
Using water only	80	22.9
Using soap and water	164	46.9
Don't wash at all	106	30.3
Method of disposal of HHs waste		
Open field disposal	108	30.9
In a pit	62	17.7
Common pit	178	50.9
Composing	2	0.8
Burning	50	14.3
Cooking fuel		
Animal dung	1	0.3
Charcoal	3	0.8
Firewood	346	98.9

Table 9: Environmental characteristics of households.

6 months (aOR: 2.198; 95%CI: 0.105-46.159; p: 0.612). Furthermore, those fed by bottle or cup were less likely to be overweight (aOR: 0.091,95%CI=0.007-1.382; p: 0.074) and (aOR: 0.450; 95%CI: 0.0413-4.888; p: 0.512) respectively (Table 13).

Discussion

This study found very high levels of under nutrition particularly stunting and underweight among children aged 6-59 months living the rural set up studied. This is not surprising as previous studies had reported similar finding in poor urban settings in Nairobi indicating that household socioeconomic factors play a critical role in predisposing children to under nutrition [7,36]. Consistent with previous findings that stunting is higher in urban centers relative to rural setting in many countries [25], this study reported lower levels of stunted children relative two previous studies in Kibra slums in Nairobi [7,36]. Indeed, previous studies have reported a higher prevalence of child under nutrition and mortality in urban slums compared to rural areas [7,37]. Moreover, under nutrition is a common phenomenon in East Africa with data indicating the level of stunting stands at 50% [30]. However, the level of underweight and wasted children was relative higher in the current study setting relative to the previous studies and even the national averages that stands at 26%, 11% and 4% for stunting, underweight and wasting respectively [38]. These data indication is that there are differences in maternal nutrition in urban and rural setting that may be predisposing children to different forms of under nutrition. Indeed, several studies have reported that there is a relationship between household food insecurity and under nutrition in children [39-41]. While under nutrition was the major problem in the study area, this study also reported that 9% of the children were overweight and 4% were obese which is below the national prevalence of obesity that stands at 5% [7,38,42], indicating that even rural set ups in low resource countries have also started to suffer from the double burden of malnutrition. Although this study did not look at maternal anthropometric measurement, studies have indicated that maternal obesity during pregnancy may result in an obese child [43], hence studies on child nutrition status should also focus on maternal nutritional status. Of note is that despite a paucity of data on the level of obesity in developing countries recent data indicate that it has increased from rise from 4% in 1990 to 7% currently [7,44], but Kenya is not off the track in

	Crude Odds Ratios (95%CI)					
	Healthy	Underweight	Stunting	Wasting	Overweight	Obese
Variables	**n=350**	**n=167**	**n=197**	**n=118**	**n=121**	**n=103**
Child age						
6-11 months	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
12-23 months	0.951 (0.343,2.640)	0.952 (0.255,3.553)	1.778 (0.486,6.500)	0.5 (0.125,1.999)	1 (0.212,4.709)	2 (0.175,22.80)
24-35 months	1.064 (0.409,2.763)	1.143 (0.342,3.819)	1.63 (0.477,5.565)	0.278 (0.0689,1.119)	0.556 (0.117,2.634)	2.222 (0.222,22.23)
36-47 months	1.026 (0.411,2.564)	0.952 (0.294,3.085)	2.111 (0.652,6.839)	0.292 (0.0801,1.062)	0.583 (0.135,2.527)	1.333 (0.129,13.74)
48-59 months	1.393 (0.560,3.466)	0.974 (0.306,3.096)	1.284 (0.392,4.210)	0.111** (0.0237,0.520)	0.741 (0.182,3.011)	0.296 (0.0166,5.288)
Child gender						
Male	0.895 (0.553,1.450)	1.156 (0.628,2.131)	1.351 (0.766,2.382)	0.546 (0.232,1.288)	0.695 (0.308,1.567)	3.277 (0.856,12.55)
Female	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Mothers age (y)						
15-19	0.944 (0.280,3.186)	0.857 (0.204,3.610)	1.091 (0.252,4.714)	1.6 (0.293,8.735)	1.333 (0.165,10.74)	1 (1,1)
20-29	1.4 (0.642,3.053)	0.423 (0.166,1.074)	0.909 (0.354,2.335)	0.612 (0.181,2.073)	1.224 (0.302,4.959)	1.633 (0.183,14.55)
30-39	0.944 (0.411,2.172)	0.829 (0.313,2.190)	1.527 (0.568,4.107)	0.4 (0.0947,1.689)	1.2 (0.268,5.369)	2 (0.207,19.34)
40-49	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Household head						
Father	1.275 (0.689,2.359)	0.731 (0.343,1.555)	1.027 (0.493,2.138)	0.689 (0.251,1.888)	0.56 (0.218,1.436)	0.548 (0.152,1.970)
Mother	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*

Marital status						
Married	0.723 (0.298,1.757)	1.688 (0.486,5.862)	1.541 (0.512,4.637)	1.247 (0.248,6.274)	1.299 (0.259,6.522)	0.519 (0.0965,2.798)
Single	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Divorced/Widowed/Separated	0.250* (0.0653,0.957)	4.5 (0.837,24.18)	4.333 (0.928,20.24)	3 (0.348,25.87)	5 (0.655,38.15)	2 (0.201,19.91)
Religion						
Christian	0.338 (0.0209,5.468)	1 (1,1)	1.216 (0.0750,19.72)	1 (1,1)	1 (1,1)	1 (1,1)
Muslim/Others	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Number of children in household						
1	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
2	0.538* (0.317,0.914)	1.491 (0.754,2.950)	2.382** (1.256,4.517)	2.707 (0.896,8.177)	1.231 (0.502,3.015)	1.444 (0.434,4.806)
3	0.410* (0.191,0.882)	2.486 (0.991,6.237)	2.287 (0.918,5.697)	6.055** (1.677,21.86)	1.835 (0.552,6.098)	0.673 (0.0709,6.383)
Mothers education						
None	0.475 (0.185,1.218)	0.688 (0.214,2.204)	5.469* (1.488,20.10)	1.094 (0.254,4.713)	3.125 (0.317,30.79)	2.906 (0.882,9.579)
Primary	0.677 (0.299,1.535)	0.903 (0.350,2.331)	2.702 (0.806,9.059)	0.726 (0.203,2.592)	4.032 (0.490,33.17)	1 (1,1)
Secondary	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Post-secondary	0.475 (0.0466,4.839)	1 (0.0546,18.30)	5 (0.348,71.90)	1 (1,1)	10 (0.317,315.3)	1 (1,1)
Fathers education						
None	0.379 (0.0836,1.717)	1.1 (0.199,6.088)	6.3 (0.616,64.43)	0.6 (0.111,3.255)	1.35 (0.123,14.82)	2.325 (0.720,7.509)
Primary	0.675 (0.157,2.912)	0.79 (0.153,4.089)	2.806 (0.284,27.75)	0.366 (0.0745,1.793)	1.016 (0.100,10.31)	1 (1,1)
Secondary	0.444 (0.0730,2.708)	1 (0.120,8.306)	5.25 (0.400,68.95)	1 (1,1)	0.75 (0.0321,17.51)	1 (1,1)
Post-secondary	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Mothers occupation						
Housewife only	0.938 (0.399,2.204)	1.032 (0.352,3.030)	2.168 (0.676,6.946)	0.295* (0.0930,0.935)	1.677 (0.333,8.440)	0.516 (0.0928,2.869)
Farmer	0.831 (0.301,2.289)	1.319 (0.375,4.636)	2.215 (0.588,8.340)	0.527 (0.130,2.143)	0.615 (0.0718,5.276)	1.231 (0.182,8.330)
Merchant	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Teacher	2.875 (0.346,23.92)	1 (1,1)	0.8 (0.0566,11.30)	1 (1,1)	2 (0.115,34.82)	1 (1,1)
Other work	11.50* (1.114,118.7)	1 (1,1)	1 (1,1)	1 (1,1)	1 (0.0683,14.64)	1 (1,1)
Fathers occupation						
Farmer	1.239 (0.536,2.867)	0.503 (0.191,1.324)	1.682 (0.556,5.091)	0.697 (0.167,2.915)	0.646 (0.177,2.364)	0.492 (0.0886,2.735)
Gov't employee	1.688 (0.445,6.395)	0.667 (0.145,3.075)	0.8 (0.135,4.745)	1 (1,1)	0.4 (0.0342,4.681)	0.8 (0.0566,11.30)
Trader	0.825 (0.295,2.307)	0.727 (0.216,2.444)	2.061 (0.560,7.577)	2.182 (0.444,10.73)	0.909 (0.184,4.500)	0.727 (0.0838,6.314)
Not applicable	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Other work	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Decision maker on income						
Mother	0.591 (0.332,1.055)	1.697 (0.823,3.498)	1.545 (0.783,3.050)	3.558* (1.219,10.39)	0.915 (0.345,2.428)	2.846 (0.775,10.45)
Mainly father	0.704 (0.370,1.339)	1.273 (0.558,2.904)	1.614 (0.770,3.383)	2.272 (0.669,7.716)	1.113 (0.397,3.116)	0.487 (0.0508,4.666)
Only father	1.237 (0.457,3.351)	0.813 (0.216,3.065)	0.906 (0.277,2.962)	0.881 (0.0914,8.492)	0.378 (0.0425,3.352)	1.321 (0.128,13.66)
Both	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Socio-economic status						
Poorest	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Very poor	0.190** (0.0678,0.535)	6.400** (1.980,20.69)	5.673** (1.854,17.36)	4.114 (0.960,17.63)	3.2 (0.652,15.70)	3.2 (0.419,24.42)
Poor	0.412* (0.184,0.920)	2.327 (0.854,6.343)	2.479 (0.993,6.191)	1.558 (0.403,6.020)	3.273 (0.932,11.49)	2.909 (0.554,15.27)
Less poor	1.019 (0.515,2.018)	1.267 (0.524,3.061)	0.682 (0.287,1.622)	1.286 (0.412,4.013)	1.167 (0.342,3.985)	0.667 (0.102,4.354)
Least poor	1.416 (0.706,2.840)	0.512 (0.184,1.427)	0.873 (0.383,1.991)	0.274 (0.0517,1.455)	0.96 (0.272,3.393)	0.96 (0.176,5.231)
Child Health Condition						
Diarrhea past 2 weeks						
Yes	0.853 (0.501,1.450)	0.824 (0.412,1.649)	1.227 (0.665,2.266)	2.08 (0.875,4.943)	0.853 (0.339,2.150)	2.56 (0.815,8.045)
No	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Fever past 2 weeks						
Yes	0.787 (0.469,1.321)	1.083 (0.562,2.087)	1.298 (0.713,2.362)	2.143 (0.910,5.050)	0.899 (0.368,2.195)	1.722 (0.545,5.444)
No	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Edema presence						

Yes	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
No	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Dietary Intake						
Daily feeding frequency						
<3 times	1.378 (0.674,2.818)	0.759 (0.304,1.899)	1.106 (0.489,2.504)	0.195 (0.0236,1.616)	0.39 (0.0792,1.925)	1 (1,1)
3 times	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
>3 times	0.771 (0.456,1.304)	1.104 (0.570,2.139)	1.449 (0.783,2.685)	1.242 (0.520,2.969)	1.42 (0.606,3.326)	1.242 (0.396,3.899)
Feeding mode						
Bottle	1.644 (0.935,2.892)	0.543 (0.257,1.147)	0.721 (0.371,1.401)	0.401 (0.137,1.180)	0.923 (0.377,2.263)	0.154 (0.0189,1.250)
Cup	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
Spoon	2.125 (0.970,4.655)	0.627 (0.236,1.668)	0.625 (0.249,1.567)	0.174 (0.0213,1.420)	1 (1,1)	0.333 (0.0394,2.821)
Hand	0.708 (0.197,2.548)	1.255 (0.267,5.900)	2.25 (0.578,8.759)	1 (1,1)	1.6 (0.248,10.32)	1 (1,1)
Exclusive breast feeding (m)						
1-3	0.667 (0.369,1.204)	1.75 (0.782,3.917)	1.536 (0.762,3.099)	2.112 (0.621,7.188)	1.138 (0.419,3.090)	0.78 (0.216,2.821)
4-5	0.978 (0.488,1.957)	1.273 (0.495,3.273)	1.074 (0.468,2.464)	1.477 (0.353,6.186)	0.739 (0.211,2.587)	0.236 (0.0256,2.178)
6	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*	*ref.*
7-12	0.0455** (0.00593,0.349)	32.00** (3.814,268.5)	16.55** (2.013,136.0)	45.50** (4.362,474.6)	16.25* (1.648,160.2)	10.4 (0.785,137.8)
Exponentiated coefficients; 95% confidence intervals in brackets. *p<0.05, **p<0.01, ***p<0.001. *ref* is the reference population						

Table 10: Correlates of malnutrition versus socio-demographic characteristics of the household and children.

Variables	Crude OR (95%CI)	p value	Adjusted OR (95%CI)	p value
Child age (m)		**0.2325**		
6-11	*ref.*			
12-23	2.02 (0.70-5.82)	0.194	2.15 (0.68-6.76)	0.192
24-35	2.01 (0.73-5.55)	0.176	2.11 (0.69-6.41)	0.189
36-47	2.86 (1.08-7.54)	0.034	3.11 (1.07-9.02)	0.037
48-59	1.90 (0.70-5.12)	0.207	1.92 (0.65-5.68)	0.238
Child gender		**0.1797**		
Boy	1.37 (0.86-2.17)		1.22 (0.73-2.05)	0.445
Girl	*ref.*			
Mothers age (y)		**0.4083**		
15-19	1.05 (0.33-3.36)	0.923		
20-29	1.24 (0.58-2.64)	0.585		
30-39	1.73 (0.79-3.77)	0.171		
40-49	*ref.*			
Household head		**0.3095**		
Father	1.35 (0.75-2.40)			
Mother	*ref.*			
Marital status		**0.6512**		
Married	1.33 (0.51-3.46)	0.561		
Single	*ref.*			
Divorced/Widowed/Separated	1.70 (0.54-5.34)	0.367		
Religion		**0.5722**		
Christian	*ref.*			
Muslim/Others	2.25 (0.14-36.34)			
Number of children in household		**0.0712**		
1	*ref.*			
2	1.83 (1.06-3.14)	0.029	1.86 (1.01-3.43)	0.045
3	1.25 (0.61-2.56)	0.539	1.14 (0.49-2.64)	0.755
Mothers education		**0.0101**		
None	4.86 (1.55-15.26)	0.007	3.36 (0.94-11.98)	0.092
Primary	2.48 (0.83-7.34)	0.104	2.41 (0.75-7.73)	0.138
Secondary	*ref.*			
Post-Secondary	4.17 (0.52-33.26)	0.178	-	
Fathers education		**0.0902**		
None	4.45 (0.53-37.51)	0.169		
Primary	2.59 (0.31-21.47)	0.379		

Secondary	4.08 (0.41-40.46)	0.229		
Post-secondary	*ref.*			
Mothers occupation		**0.2305**		
Housewife	2.60 (0.96-7.01)	0.059	3.63 (1.08-12.24)	0.037
Farmer	2.34 (0.77*7.08)	0.132	3.00 (0.82-10.94)	0.095
Merchant	*ref.*			
Teacher	1.73 (0.15-20.23)	0.661	2.92 (0.08-106.67)	0.559
Other	-		-	
Fathers occupation		**0.141**		
Farmer	2.48 (0.99-6.21)	0.053	2.40 (0.85-6.82)	0.1
Employee	1.21 (0.26-5.64)	0.81	2.01 (0.31-13.03)	0.465
Trader	2.11 (0.74-6.01)	0.163	2.70 (0.78-9.38)	0.117
Other	-			
Not applicable/None	*ref.*			
Decision maker on income		**0.745**		
Mother	1.06 (0.61-1.83)	0.831		
Mainly father	1.38 (0.76-2.53)	0.286		
Father only	1.07(0.38-3.00)	0.56		
Both	*ref.*			
Socio-economic status		**0.069**		
Poorest	*ref.*			
Very poor	1.76 (0.87-3.55)	0.117	3.33 (1.44-7.69)	0.005
Poor	1.39 (0.69-2.78)	0.354	3.52 (1.41-8.82)	0.007
Less poor	0.61 (0.29-1.30)	0.204	1.72 (0.66-4.52)	0.27
Least poor	1.13 (0.55-2.34)	0.729	2.52 (0.99-6.43)	0.053
Child Health Condition				
Diarrhea past 2 weeks		**0.615**		
Yes	1.13 (0.70-1.84)			
No	*ref.*			
Fever past 2 weeks		**0.635**		
Yes	1.12 (0.70-1.81)			
No	*ref.*			
Edema presence				
Yes	2.79 (0.83-9.34)			
No	*ref.*			
Dietary Intake				
Daily feeding frequency		**0.348**		
<3 times	1.62 (0.80-3.26)	0.177		
3 times	*ref.*			
>3 times	1.28 (0.78-2.09)	0.324		
Feeding mode		**0.376**		
Bottle	1.05 (0.611.84)	0.849		
Cup	*ref.*			
Spoon	1.09 (0.49-2.44)	0.827		
Hand	2.41 (0.91-6.34)	0.076		
Exclusive breast feeding (m)		**0.9199**		
1-3	1.23 (0.68-2.22)	0.502		
4-5	1.08 (0.53-2.22)	0.828		
6	*ref.*			
7-12	1.15 (0.52-2.56)	0.733		

Table 11: Odds Ratios (OR) for child stunting among the whole child group using univariate and multiple logistic regression.

meeting World Health Assembly on child obesity [7,45]. However, the increase in obesity levels can be associated with food transition or shifts in dietary patterns from traditional food systems to western type food systems that include cereal based high-energy diets [46]. The transition from rural to an urban lifestyle is associated with increased levels of overweight and obesity which has been linked to dramatic changes in lifestyle. In many developed countries, higher calorie intakes and lower calorie expenditure have already resulted in a rapid increase in the prevalence of overweight, obesity and related non-communicable diseases [47]. Many developing countries including Kenya are in the process of undergoing similar transition with increase in prevalence, often in addition to an on-going problem of under nutrition [48]. In deed data shows that mothers who are highly educated tend to have obese children mainly due to over nutrition with food rich in sugars and saturated fats due to their high income [49].

Previous studies have shown that malnutrition especially under-nutrition is associated with several factors including gender of the child,

Variable	aOR (95%CI)	p value
Household head		
Father	0.750 (0.139-4.052)	0.738
Mother	*ref.*	
Marital status		
Married	3.485 (0.340-35.746)	0.293
Single	*ref.*	
Divorced/Widowed/Separated	4.29 (0.350-52.690)	0.255
Socio-economic status		
Poorest	*ref.*	
Very poor	3.405 (0.549-25.120)	0.188
Poor	3.548 (0.781-16.126)	0.101
Less poor	1.385 (0.309-6.203)	0.67
Least poor	1.368 (0.306-6.127)	0.682
Exclusive breast feeding (m)		
1-3	1.222 (0.398-3.751)	0.726
4-5	0.835 (0.212(3.296)	0.797
6	*ref.*	
7-12	14.4015 (1.158-179.056)	**0.038**
Daily feeding frequency		
< 3 times	0.489 (0.094-2.551)	0.396
3 times	*ref.*	
> 3 times	1.252 (0.431-3.638)	0.68

Table 12: Odds Ratios (OR) for child overweight among the whole child group using univariate and multiple logistic regression.

Obesity		
Variable	**aOR (95%CI)**	**p value**
Child gender		
Male	2.994 (0.641-13.983)	0.163
Female	*ref.*	
Decision maker on income		
Mother	2.978 (0.589-15.066)	0.187
Mainly father	0.276 (0.023-3.382)	0.314
Only father	4.969 (0.283-87.358)	0.273
Both	*ref.*	
Diarrhea past 2 weeks		
Yes	3.022 (0.652-14.013)	0.158
No	*ref.*	
Exclusive breast feeding (m)		
1-3	0.346 (0.0598-2.006)	0.237
4-5	0.095 (0.007-1.382)	0.085
6	*ref.*	0.612
7-12	2.198 (0.105-46.159)	
Feeding mode		
Bottle	0.091 (0.007-1.257)	0.074
cup	*ref.*	
Spoon	0.450 (0.0413-4.888)	0.512
Hand	-	

Table 13: Odds Ratios (OR) for child obesity among the whole child group using univariate and multiple logistic regression.

age of the child, mothers' education status and socioeconomic status of the family [2,7]. Consistent with these studies the present study also found that children aged between 36-47 months are 3.1 times more likely to have stunted growth relative to those aged 6-11 months. This can be due to the fact that as the children grow, the caregiver or mother stops giving breast milk and complementary food and shifts to improper feeding practices like providing tea or porridge with milk which are low in nutritive value [50]. Of note is that porridge causes negative nutrient-nutrient interactions and malabsorption in children due to immaturity of infant's gut and is also rich in phytates and tannins that binds to available nutrients leading to reduction of their bioavailability [51,52] ultimately leading to stunting among children within this age group. Children then become chronically undernourished at this age. In this scenario, education focused on caregivers' feeding habits of complementary food for 2 to 3-year-old children can help prevent childhood stunting [50]. Further studies might be necessary to determine the right types of interventions for each community with the problems of childhood stunting and food insecurity. These data indicate that both chronic and acute child malnutrition, develop during the weaning period and rise sharply thereafter.

Education is one of the most important resources that enable women to provide appropriate care for their children. Education of women is believed to have an impact on health and specifically nutritional status of children since it provides the mother with the necessary skills for child care, increase awareness and improve uptake and health care seeking behavior of the caregivers in the community. Additionally, it also changes traditional beliefs about diseases causation, and use of contraceptives for birth spacing [53]. This study found that children from mothers with no education were 5.5 timely more likely to be stunted relative to those children whose mothers had secondary education. These findings are consistent with earlier findings that indicated that maternal education is a critical determinant of under-nutrition among children [53]. Together these data indicate that educated mothers are better aware on the nutritional requirements of their children and they usually provide improved health care as a result of their awareness. In addition, the results of this study show that the number of children within households is an important determinant of under-nutrition. These findings are consistent with previous findings that showed that increased number of children negatively influenced nutritional status of children [2].

This study also found that children who were exclusively breast fed for 7-12 months in this study were more likely to experience underweight, stunting and wasting. These data indicate that delay in initiation to weaning has a negative effect on the nutritional status of the children. Indeed, previous studies have shown that protein energy malnutrition (PEM) usually manifests at 6-24 months are associated with delayed introduction of solid foods [54]. Moreover, conversely, late introduction of adequate complementary foods as recommended, places children at risk for stunting or underweight [55]. Thus, late introduction of complementary feeding has a set back to the children nutritional status. However, a recent study in Nairobi Kenya showed that there is no association between exclusive breast feeding within six-month breast feeding and children nutritional status but this in an urban setting where there is low prevalence of exclusive breast feeding [7]. These studies indicate that there is need for comparative studies between urban and rural settings in Kenya to understand the effects of exclusive breast-feeding on nutritional status of children. Of note, studies have shown childcare practices that are important to the wellbeing of the child [42,56].

Significantly this study also found that immunization of children has a protective effect on children nutritional status. This is consistent with studies that found that immunization status is significantly associated with the nutritional status of children [57]. It is noteworthy to note that in the current study although 67.4% of the mothers had made four ante-natal care (ANC) visits during pregnancy to a health facility though there were still high prevalence of under-nutrition among children from the study area indicating that apart from health facility related factors other factors may be critical predictors of under-

nutrition. Consistent with this view this study found that, children from families who do not treat their drinking water by boiling, filtering and using chlorine were more likely affected by wasting relative to those from family that treat water. In fact, a previous study in western Kenya showed that, more children who drank water that was not consistently treated in households were wasted [58]. Of note is that 59.1% of the families did not treat their drinking water. However, this problem is not limited to the study area alone since a previous study indicated that rural households do not use an appropriate treatment method to ensure that water is safe for drinking relative urban households [17]. This may lead to high prevalence of diarrhea and waterborne diseases at households' level might increase the prevalence of malnutrition directly or indirectly.

Several studies have found association between being obesity and several factors including the child gender, children's' age and maternal occupation [7,49,59]. Consistent with these studies this study also found that obesity is associated with child age with those between 12-23 months and 24-35 months being more likely to be obese. In addition, this study found that being male, mothers age, maternal marital status, father education, mothers being decision maker and exclusive breast-feeding for 7-12 months. Data have shown that in limited or poor resource settings that are high chances of children being exposed to high-energy dense foods leading to obesity. Furthermore, high level of poverty and food insecurity in a given setting can either lead to mothers accessing lower quality of food having wasted children while those accessing lower quality of food limited in dietary diversity, fruit and vegetable and energy dense food predisposes children to obesity [7,56]. Hence the double burden of malnutrition in poor rural setting should also include the types of food children are exposed to so that it can inform guidelines of weaning children.

Conclusion

The empirical result of this study confirms a coexistence of child double burden malnutrition in the rural setting. In this study, 31%, 22% and 8% of the children were stunted, underweight and wasted, respectively. Analysis also revealed that 9% and 4% of the children suffered from overweight and obesity respectively. The predictors for stunting were number of children in the household, mother being a house wife and being poor. For obesity, the predictors were child age with 12-23 months and 24-35 months, child gender with males more likely to be obese relative to females. The study has demonstrated that poor livelihoods and low socio-economic status, high levels of food insecurity and consumption of high energy dense foods, poor access to water and environ-mental sanitation and health care services, and poor child feeding practices in this settings are key determinants of malnutrition. More importantly, addressing poverty is likely to lead to improvements in the nutritional status of the children. In light of these results it is imperative that policymakers pay utmost attention to the constraints that beset child nutrition.

Recommendations for action

New and innovative strategies will be required to counter the growing double burden of malnutrition (DBM). Collaboration across sectors, complemented by an effective coordination mechanism, should join the efforts of those within and outside the nutrition community to address the DBM. Improving county-level capacity to coordinate nutrition actions is critical.

1. To reduce the existing high rate of malnutrition in the area, the study suggests targeting of community units with health education programs and provision of clean water, including health promotion to create demand and advocate for behavior change.
2. Assist partner agencies to ensure the availability of medical treatment to all existing supplementary feeding programs.
3. Advocate for community lead total sanitation (CLTS) to address sanitation problem in Trans-Mara East sub-county.
4. Improve nutritional surveillance and response through capacity building of the Ministry of Health and partners on nutrition.
5. Conduct further nutrition surveys to establish if the factors are consistent over time or if there have been any changes, considering the rapidly changing economic and socio-demographic characteristics of the population, influenced by technological advances and rural-urban migration, among other factors to inform health and nutritional interventions across the sub-county.
6. Plan for outreach services (immunization) to ensure that children and expectants mothers to access health care services. Integrate deworming with other services during the outreach and also organize for periodic deworming program. The periodic deworming programs should be included in public health strategies because malnutrition makes children more susceptible to parasitic infections and diminishes the immune response to infections. Some parasitic infections influence nutritional status through a subtle reduction in digestion and absorption of nutrients, chronic inflammation and loss of nutrients.

Recommendations for future research

This study did not look at maternal anthropometrical measurement, however studies have indicated that maternal obesity during pregnancy may result in an obese child, hence a study on child nutritional status alongside with maternal nutritional status need to be done. A further study is also imperative to determine the right types of interventions for each community with the problems of childhood malnutrition and food insecurity. A comparative study between urban and rural settings in Kenya or Narok county is needed to understand the determinants on nutritional status of children in the two different settings.

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