Dietary Micronutrient Intake amongst Mothers in Kangai and Mutithi locations of Mwea West Sub County, Kenya

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Abstract

The purpose of this study was to determine the Dietary Micronutrient Intake amongst Mothers in Kangai and Mutithi locations of Mwea West Sub County, Kenya. The study design was cross sectional survey while data collecting instruments included a structured questionnaire and a meal preparation observation guide. Data were collected on the dietary intake of Vitamin A, iron, and zinc through the four weeks food frequency recall technique, and through observation of Meal preparation in the households. A sample of 399 mothers participated in the structure questionnaire while a sub sample of 63 mothers participated in the meals preparation. The data were processed by the use of the SPSS software. Food Consumption Score tool were used to compute acceptable, borderline and poor categories of dietary intake of micronutrients while National Nutrient Data base for Standard Reference, Release 26 Software v.1.4, to compute nutrient content in foods. The t-tests were used to test hypotheses. It was established that food consumption behaviors and the dietary intake of micronutrients were significantly different in the two locations ($p < 0.05$). The mothers did not meet the Recommended Dietary Allowances (RDA) for Vitamin A, iron and zinc, while Food Consumption Score (FCS) tool categorized 33% of the mothers in Kangai and 51% in Mutithi under poor dietary micronutrient intake. The study concluded that mothers in the two studied locations experienced micronutrient deficiency. Further research is recommended using serum biochemical analysis of Vitamin A, iron and zinc in order to get the actual status of these micronutrients in the community.

Key Words: Malnutrition, Micronutrient Status, Food Security Status, dietary intake, Poverty

1. Introduction

According Food and Agriculture Organization (FAO, 2009), micronutrients play leading roles in production of enzymes, hormones and other substances, helping to regulate growth, activity development and functioning of human immune and reproductive systems . However, according to (Bamji, 2011) lack of dietary intake of vitamins and minerals (micronutrients), results in micronutrient deficiency diseases. Over 2 million people worldwide suffer from micronutrient malnutrition called hidden hunger (FAO, 2002). These people's diets supply inadequate vitamins and mineral salts such vitamin A, iron and zinc among others. Deficiencies of these nutrients result when habitual diets lack diversity and do not include sufficient fruits, vegetables, dairy products, meat and fish, that are best sources of micronutrients (FAO 2002).

Globally, some of the three micro nutrient deficiencies of great public health significance are those of vitamin A, iron and zinc. They have been found to be very common and of great concern for women (FAO, 2009: Skalicky, 2006).These micronutrient deficiencies can be eliminated by modifying diets to include a greater diversity of nutrient rich foods (FAO, 2009). Micronutrient deficiencies reduce work capacity. Research findings suggest that iron deficiency anemia reduces the productivity of a manual laborer by up to 17%. As a result, hungry and malnourished adult earn lower wages. This is because they are unable to work as many hours or years as well-nourished people. They also fall sick more often and have a shorter lifespan. Micronutrient deficiency results from many basic factors including poor utilization of the micronutrients by an individual as a result of, among others, unsafe water source, poor sanitation and long distances to health facilities (Bamji, 2011).

1.1 Micronutrient Intake and Household Food Security Status

Micronutrient deficiency is a global public health problem especially among women. Women of reproductive age are among the most vulnerable to micronutrient deficiencies due to physiologically higher micronutrient requirements during the reproductive life (FAO, 2002). The impact of poor maternal micronutrient status is transmitted inter generationally from mother to child, resulting in less optimal fetal growth and development (Kennedy et al., 2012). People who are food insecure eat diets with less variety , consume lower amounts of fruits and vegetables , and are more likely to have micronutrient deficiencies as well as suffering from malnutrition (Bamji, 2011). There has been an effort in promoting and implementing food based strategies to achieve sustainable improvements in micronutrient intake. These strategies focus on improving availability, access, and consumption (utilization) of vitamin A and mineral rich foods. Benefits of such food strategies include not only improved intakes of specific nutrients but also improved overall diet and health status (FAO, 2009).

1.2 Consequences of Inadequate Intake of Micronutrients

According to Bamji, (2011), inadequate intake of micronutrients (micronutrient deficiencies) has very adverse effects. He says that apart from human suffering due to morbidity and mortality, micronutrient deficiencies have a high economic cost. He argues that productivity losses due to poor nutrition are estimated to be more than 10% of life time earnings for an individual, and 2-3 % of gross domestic product to the nation (GDP). He also adds that the cost of treating malnutrition is 27 times more than the investment required for its prevention through dietary intake.

Vitamin A and mineral deficiencies (iron and zinc) have a significant impact on human welfare and on the economic development of communities and nations. These deficiencies can lead to serious health problems, including reduced resistance to infectious diseases, blindness, lethargy, reduced learning capacity, mental retardation and sometimes death. The deficiencies in total result in loss of human capital and work productivity especially for women (FAO, 2009). The earliest manifestation of vitamin A deficiency (VAD) is night blindness and Bitot's spots on the white of the eye. Severe vitamin A deficiency leads to keratomalacia (ulceration of the cornea) and total blindness (Bamji, 2011). Close to 20 million women in developing countries is Vitamin A deficient. One third of this number is clinically blind (FAO, 2003). The cause of VAD is poor diet. (Bamji, 2011).

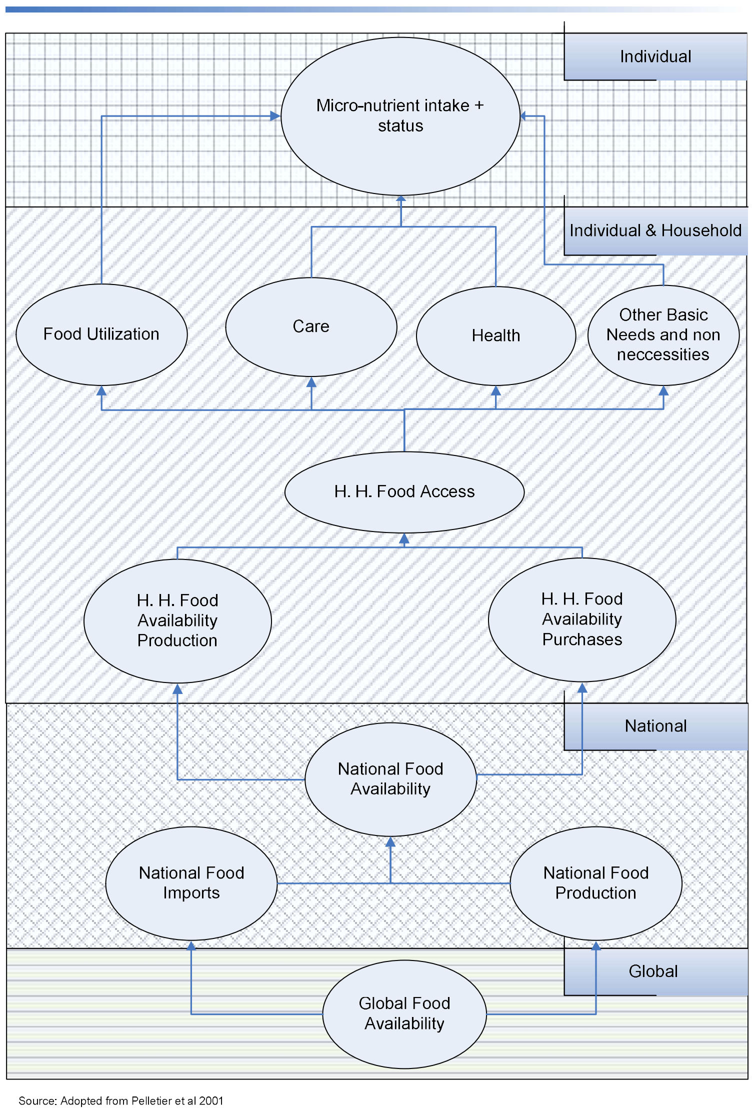
Iron deficiency anemia, the most common nutritional disorder in the world, lowers resistance to disease infection and weakens physical stamina. It is a consequence of poverty and a significant cause of maternal mortality. It also increases the risk of hemorrhage and infection during childbirth (Bamji, 2011). Nearly 2 billion people are estimated to be anemic and millions are iron deficient, the vast majority of them women. A range of factors cause iron deficient anemia, including inadequate diet, blood loss associated with menstruation and parasite infections such as hookworm (Bamji, 2011). Other factors that contribute IDA are the presence of inhibitors of iron absorption as well as repeated pregnancies. Iron deficiency anemia can be reduced by poverty reduction, improving access to diversified diet, improving health services and sanitation and improving care and feeding practices for vulnerable groups (Kennedy et al., 2012).

Beck et al., (2014) say that the diets people eat have enough iron if enough food to give enough energy is eaten, and that women may be at risk of having iron deficiency anemia. This is because they have lower energy needs; hence they consume less food than other groups. A factor just as important as the total iron content of the diet is the bioavailability of the iron ingested, that is, its absorbability. How much iron is effectively absorbed by the body varies considerably depending on a number of factors including presence of ascorbic acid (present in fruits, green leafy vegetables, and fermented cereal products) and, animal proteins (meat, poultry, fish). It should be noted that most foods of plant source contain iron. However, a percentage of this iron is not absorbed due to the presence of phytates (present in cereal grain, legumes, nuts , seeds) and polyphenols including tannins (present in coffee, tea, cocoa, herbal infusions) , in the same food (Beck et al., (2014) .

Iron deficiency develops gradually and usually begins with a negative iron balance when iron intake does not meet the daily need for dietary iron .This negative balance initially depletes the storage form of iron. While the blood hemoglobin level, a marker of iron status, remains normal, iron deficiency anemia is an advanced stage of iron depletion. It occurs when storage sites of iron are deficient and blood levels of iron cannot meet daily needs. Blood hemoglobin levels are below normal with iron deficiency anemia (Institute of Medicine, 2001). Iron deficiency can be controlled through de worming (Berger and Dillion, 2002) and through utilization of fortifying foods and giving iron supplement (Berger and Dillion, 2002).

Zinc promotes normal growth and development and is an element in enzymes that work with red blood cells, which move carbon dioxide from tissues to lungs. It also helps maintain an effective immune system. Zinc deficiency in malnourished children contributes to growth failure and susceptibility to infections, and is also thought to be associated with complications of childbirth. This deficiency usually occurs where malnutrition is prevalent and is now recognized as a public health problem in many countries (Sardi, 2013). Trials in Bangladesh, India and Indonesia have shown reductions of about one third in the duration and severity of diarrhea in children receiving zinc supplements and a median 12 per cent decline in the incidence of pneumonia (Sardi, 2013). Zinc deficiency, is increasingly recognized as widespread among women in developing countries, and is associated with long labor which increases the risk of maternal and infant deaths. A number of studies have found that zinc supplementation reduces complications of pregnancy (UNICEF, 1998; Sardi, 2013).

1.3 Relationship between household food security and micronutrient intake



Source: Adapted from Pelletier et al 2001
Figure 1 Levels of food security

Food insecurity is associated with micronutrient deficiencies. Globally, food security concerns overall availability of food where countries with surplus food export to those with deficits. The national level is concerned with availability of food in the market. When a country produces less food the solution is importation. In developing countries, where majority of people rely on own grown food, imported food are likely to be too expensive. The household level is concerned with the availability and access to food by the households from own production and from market purchases. People in the urban area may rely mostly on purchasing all the foods. However, those people that have land and live on the land in the rural areas rely on own grown foods. Never the less, they also have to access some foods from the market since it is not possible to grow everything. At individual level, food security status and micronutrient intake concern food consumption and utilization. The micronutrient intake and status is determined by a number of factors such as bioavailability of the nutrients consumed, how often meals are taken, health status of the individual and other competing needs of the household which may make consumption second priority.

2. Problem Statement

Women are more vulnerable to individual and household food insecurity (Sharkey et al., 2011). The gendered nature of food related hardships may be related to women being more likely than men living in poverty. They do low paying casual jobs, are responsible for unpaid domestic work such as caring for children and other family members, washing clothes and cleaning the house. Rural women are particularly vulnerable to household food insecurity and its consequences. They have unique characteristics including less education, less chances of employment opportunities while being more likely to be mothers and caring for children (Sharkey et al., 2011). In addition, it is well known fact that women are actively involved in the household food production. However, few studies have been done to highlight their micro nutrient intake status. Except for national household surveys, no other study on household micronutrient intake status has been conducted specific to this rural Sub County. The purpose of the study was therefore to determine mothers' dietary intake of vitamin A, iron and zinc (using food based approaches only), during the dry and wet seasons in Kangai and Mutithi locations of Mwea West Sub County.

3. Hypothesis

H_0: There is no significant difference in mothers' dietary intake of vitamin A, iron and zinc (micronutrients) between dry and wet seasons, in Kangai and Mutithi locations of Mwea west Sub County.

4. Methodology

4.1 Research Design, Target Population and Sampling

The survey design was cross sectional in nature and facilitated collection of self-reporting data using the four weeks food frequency recall technique. The target population in this study included mothers in the households and there were 12,909 households (GOK, 2009). The sampling frame was all mothers with at least one child aged 2 to 5 years. The size of the sample was calculated using the formula proposed by Fisher et al., (1991) with the inputs of 95 % confidence level, 5 % of margin of error, non-response rate of 5 % and the poverty prevalence rate of 46%, (GoK, 2005). Accordingly, sample size of 401 was computed.

According to Esturk, (2014), food frequency questionnaires are not sufficient base from which to draw inferences on likely micronutrient status. The study therefore applied the meal observation technique which looked at the composition of food items consumed by the respondents for breakfast, lunch and supper (AWSC, 2014). The technique was applied to sub sample of 63 mothers, selected randomly, 27 from Kangai and 36 from Mutithi. Gibson (2007), in her paper "Determining the risk factors of zinc deficiency", recommended the use of a minimum sub sample of 30- 40 respondents. Probability proportionate to size of population sampling technique was then adopted as suggested by Turner (2003).

Table 01 Number of respondents by location

Location	*Total number of household*	*Number of respondents*	*Sub sample*
Kangai	5,302	165	27
Mutithi	7,607	236	36
Total	12,909	401	63

4.2 Data and Data Methods

Two data sets on food frequency recall were collected, during a dry season and a wet season. The mothers were asked to state how often commonly found foods in the region were eaten in the past four weeks. The two sets of data were compared statistically and inferences made.

The Meal preparation data were collected from the 63 respondents who were visited and observed at home during meal preparation. The meals observed were breakfast, lunch and supper. The mothers were asked about the name of the dish, the ingredients used and the quantities, the number of people to eat the meal and whether the food was eaten once or twice. The method of cooking was observed or explained if any food was pre-cooked. The purpose of this technique was to get quantity of food consumed by household members per adult equivalent (members of the household were assumed to consume equal quantities) .The quantity cooked was therefore divided by the number of people in the household. This method has been used by WFP, (2009). The ingredients used were analyzed for nutrient content using the *National Nutrient Data base for Standard Reference, Release 26 Software v.1.4* (2013).

5. Findings

5.1 Food consumption scores

This study looked at the dietary intake patterns of the most commonly used food products in the community. These included fats and oils, animal products, fruits, vegetables and grains and legumes, with aim of identifying consumption patterns of micronutrient rich foods by season and location. Using the criteria recommended by the (WFP, 2008; Appendix), all the respondents were categorized as acceptable, borderline or poor as shown in Figure 2.

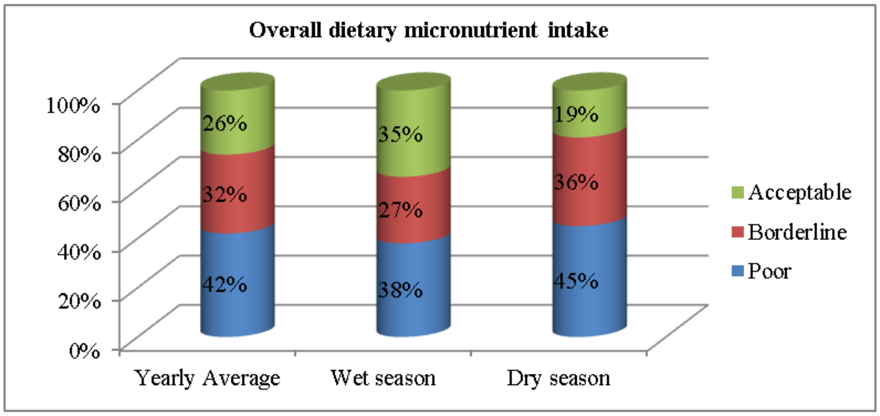


Figure 2 Overall dietary micronutrient intake of mothers by season

The findings were that during the dry season, majority of the mothers (45%) were categorized as poor in consumption of micronutrient rich foods, with only 19% being in the acceptable category. There was a slight improvement during the wet season with the acceptable category rising from 19% to 35% while the poor category decreased from 45% to 38%. Considering the yearly average, the findings were that 74% were categorized as having poor and borderline consumption of micronutrient rich food while only 26% were in the acceptable category.

The dietary intake patterns of the most commonly used food products in the Kangai and Mutithi locations by season were as shown in Figures 3 and 4.

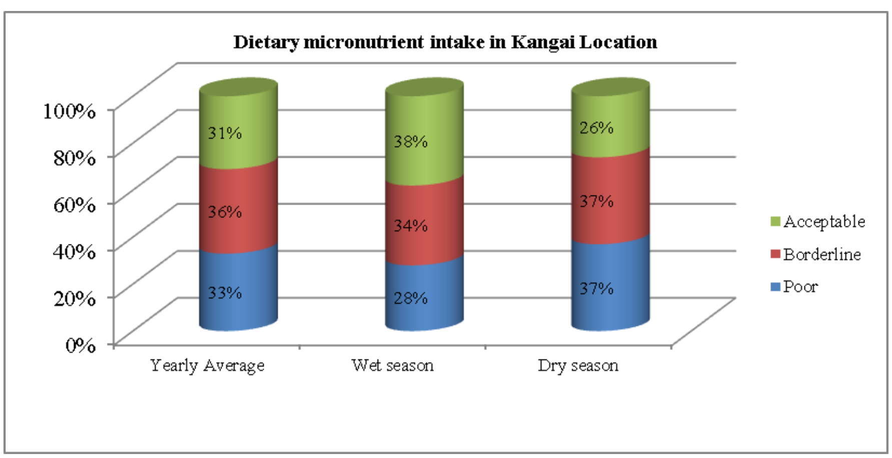


Figure 3 Dietary micronutrient intake of mothers in Kangai by season

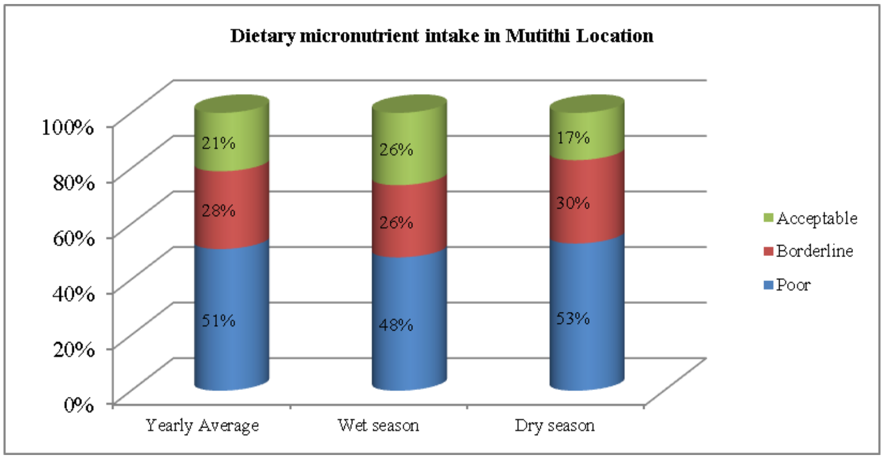


Figure 4 Dietary micronutrient intake of mothers in Mutithi by season

The findings for Kangai were that during the dry season, 74% of the mothers were categorized as poor and borderline while 26% were in the acceptable category in dietary intake of micronutrient rich food. During the wet season, 62% of the mothers were in the poor and borderline category, a 12% improvement. Considering the yearly average, the findings were that 69% were in the poor and acceptable categories while 31%, were categorized as having acceptable intake.

The findings for Mutithi were that during the dry season, 83% of the mothers were categorized as poor and borderline while 17% were in the acceptable category in dietary intake of micronutrient rich foods. During the wet season, there was a slight improvement as the poor and borderline categories had improved by 9% to 74% while the acceptable category was also better than during the dry season at 26%. Considering the yearly average, the findings were that 79% were categorized as having poor and borderline while 21% were in the acceptable category. A t-test was run to check showed that the dietary intake patterns varied significantly between the seasons in both locations ($p < 0.05$). The null hypothesis was therefore rejected.

5.2 Findings of Observation of Meal Preparation

According to the mean consumption of the main ingredients used to make the main meals (rice, bean, maize , maize four,) , the findings were that Kangai mothers consumed a mean of 30g , 20g , 20g and 11g ,respectively while the Mutithi mothers consumed 16g, 13g, 1og and 5g of the same ingredients. The Mutithi mothers consumed less than the Kangai's.

The findings were that meals cooked and consumed by the mothers for a period of two weeks, gave the respondents nutrients as indicated in Table 2. The nutrient yields of the meals actually consumed were compared to the recommended dietary allowances (RDA). It was noted that the respondents had a deficit of all the nutrients studied. However, the Mutithi respondents had a higher deficit than the Kangai ones. It should be noted that the respondents in this study consumed animal product rarely, for example meat, which was more readily available and was consumed by 57% and 75% of Kangai and Mutithi respondents respectively once a week to once a month. The actual meals, observed as prepared also indicated that fruits were never included in the meal plans, animal products were rare and vegetables appeared occasionally. The analysis of the food materials cooked and consumed yielded inadequate nutrients (lower than recommended dietary allowances, RDA). Therefore it was concluded that micronutrients, which are supplied by animal products, as well as fruits and vegetables such as Vitamin A, Iron and zinc, may be missing from the respondents' diets.

The t- tests of food consumption frequency of micronutrient rich foods showed that the consumption of fats, oils and animal products, which are rich in Vitamin A, iron and zinc, was significantly different in the two locations. This was further confirmed by meal preparation observation which showed that poorer meals were prepared by Mutithi mothers than the Kangai ones. Therefore, the null hypothesis was rejected. The conclusions of the findings were that both Kangai and Mutithi respondents did not consume micronutrient rich foods frequently and that the Mutithi mothers generally consumed less than the Kangai mothers.

Table 1 Mean quantity of food materials (ingredients) consumed by the mothers by location

Meal	Food item	Kangai N= 27 Mean consumption per person per meal (in grams)	Mutithi N= 36 Mean consumption per person per meal (in grams)
Breakfast	Millet/sorghum four(g) (porridge)	18 ± 2.36	3 ± 0.12
	Sugar(g)	15 ± 1.12	4 ± 0.57
	Milk(ml)	112 ± 3.40	44 ± 12.5
	Eggs(g)		4 ± 6.0
Lunch	Rice(g)	30 ± 5.10	16 ± 4.36
	Beans(g)	20 ± 3.40	10 ± 0.52
	Wheat flour(g)	7 ± 1.01	3 ± 0.01
	Maize flour (ugali)(g)		11 ± 2.41
	Potatoes(g)	7 ± 1.01	5 ± 1.38
	Cabbage(g)		5 ± 0.23
	Tomatoes(g)	13 ± 1.56	12 ± 0.90
	Bananas(g)		5 ± 0.52
	Maize (githeri)(g)		10 ± 3.99
	Milk (with ugali)(g)		23 ± 3.25
	Kales(g)		5 ± 1.38
Supper	Rice (g)	23 ± 8.77	30 ± 5.10
	Beans(g)	15 ± 5.78	13 ± 3.69
	Maize (githeri)(g)	20 ± 3.40	13 ± 3.69
	Maize four (ugali)(g)	11 ± 7.22	5 ± 4.17
	Bananas (g)	2 ± 0.81	5 ± 8.33
	Potatoes(g)	3 ± 1.39	6 ± 1.67
	Kale (g)	5 ± 0.94	5 ± 4.17
	Cabbage(g)	21 ± 4.36	
	Tomatoes (g)	12 ± 2.18	8 ± 6.77
	Carrots(g)		1 ± 0.01

Table 2 Nutrient content of meals prepared and consumed

Nutrient	Unit measure	RDA	Kangai N=27 Mean intake	Kangai N=27 variance	Mutithi N=36 Mean Intake	Mutithi N=36 variance
Energy	Kcal	2250	1905.2	-344.8	1773	-477
Protein	G	60	53.4	-6.6	39.2	-20.8
Carbohydrate	G	338	319.8	-17.7	286.3	-51.2
Iron Fe	Mg	18	14.1	-3.9	8.5	-9.5
Zinc zn	Mg	9.4	7.6	-1.8	5.3	-4.1
Vitamin B12	Mg	15	0.3	-14.7	0.5	-14.5
Vitamin A (RE)	RE(IU)	500	122.8	-377.2	540.9	40.9

6. Conclusion

The study found that both Kangai and Mutithi respondents consumed less than the recommended dietary allowances (RDA) of all nutrients especially micronutrients included in the study (Vitamin A, iron and zinc). They were also found to have poor and borderline consumption of micronutrient rich food which could lead to serious health problems. The communities could be exposed to reduced resistance to infectious diseases, blindness, lethargy, reduced learning capacity, mental retardation and anemia as a result of micronutrient (Vitamin A, Iron and Zinc) deficiency. In order to improve on consumption of micronutrient rich foods, the study recommends that mothers be encouraged and organized into self-help groups and to utilize the mothers funding available from the government for the purpose of setting up kitchen gardens and raising poultry for household consumption. For instance chicken are easy to keep and provide eggs which have high value proteins as well Vitamins and mineral salts. The study was mainly qualitative in nature using proxy indicators of household food security status and micronutrient intake. Further research is recommended using serum biochemical analysis of Vitamin A, iron and zinc in order to get the actual status of these micronutrients in the community.

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8. Appendix: Calculation of the Food Consumption Score (FCS) and Food Consumption Groups (FCGs)

The Food Groups and the standard weights used followed the guidelines of the United Nations World Food Program (WFP, 2008).

	Food items	Food groups	weight
1	Maize, rice, sorghum, millet, chapattis and other cereals Cassava, potatoes, sweet potatoes, matoke , yams , arrowroots and other tubers	Main staples	2
2	Beans, peas, groundnuts, cashew nuts and others	pulses	3
3	Vegetables (carrots, pumpkins and DGLV)	vegetables	1
4	Fruits (mangoes, bananas, oranges, passion)	fruit	1
5	Beef, goat, poultry, eggs, and fish	Meat and fish	4
6	Milk, cheese, yogurt and other dairy	milk	4
7	Sugar and sugar products	sugar	0.5
8	Oils, fats, butter	0il	0.5
9	Spices, tea, coffee, salt, fish power , small amount of milk for tea	condiments	0

Source: (WFP, 2008; 2011)

After food items were grouped, and consumption frequency recorded, the respondents were categorized as poor, borderline or acceptable according to the following cut off points

Food consumption score profiles

Food consumption scores (FCS)	Profiles
0-21	Poor
21.5-35	Borderline
>35	Acceptable

Source: (WFP, 2008)