Journal of Food, Nutrition and Agriculture, 2019: 2(1) 20–26
http://dx.doi.org/10.21839/jfna.2019.v2i1.278
ISSN 2616-6550/

Research Article

Association between feeding patterns and nutritional status of the under five children (6-59 months) in Mtwara Rural District, Tanzania

D. Nicodemas, L.W.T. Fweja*, S.H. Magoha
Department of Food and Nutrition, The Open University of Tanzania, P.O. Box 23409, Dar es salaam, Tanzania

(Received: 03-02-2019; Revised 22-08-2019; Accepted 17-11-2019; Published Online 23-11-2019)
*Corresponding author (E-mail: lfweja@yahoo.com)

Abstract

This study was conducted to determine the association between feeding pattern and nutritional status of the under-five children in Mtwara rural district. Nutritional assessment information was collected using three survey tools: food frequency survey, 24 hours diet survey and anthropometric assessment survey. Anthropometric measures of weight and height were used to assess the nutritional status and WHO Anthro Plus was used to compute the anthropometric data to obtain Height for Age Z-score, Weight for Age Z-score and Weight for Height Z-score. The questionnaire was administered to mothers / caregivers of 329 children aged 6 -59 months. The children's feeding patterns were determined using the 24-hour dietary recall. Dietary diversity score was computed to understand the quality of the diet consumed by the children. Data were analyzed using IBM SPSS Statistics version 20.0 using descriptive statistics. Chi-square was used to determine the association between nutrition status and the independent variables including gender. The findings indicated 41% stunting rate, 18.8% underweight and 7.3% wasting implying poor nutrition. The cassava feeding frequencies varied among households and between and within the two children age groups, (6 – 10 months) and (11-59 months). Overall 87.23% of children (6-59 months) had a feeding frequency of 2 days, 3 days or 6 days in a week. The dietary diversity indicated an average IDDS of 2.5 implying poor diversity of consumed food groups which was similarly far below the target IDDS of 5 established for this study. The results however indicated no significant association ($p \geq 0.05$) between cassava consumption pattern and prevalence of stunting, wasting and underweight and also between gender and nutrition status. The high prevalence rate of malnutrition could thus be attributed to a synergistic effect of several factors.

Keywords: Cassava, u5 Children, Nutrition Status, Consumption pattern, Individual Dietary Diversity score (IDSS)

Introduction

Over 80% of the African populations live in rural areas with great dependence on agriculture for their livelihoods. Cassava which is one of the most important staple food crops grown in tropical Africa plays an important role in alleviating the continents food crisis because of its efficient production of food energy, year-round availability, tolerance to severe stress surroundings, and suitability to current farming and food systems in Africa (Hahn *et al.,* 1988) and hence ensure food security. Cassava roots have high starch content, about 60%, and therefore a cheap and excellent source of dietary carbohydrate. It is also rich in calcium, thiamine, riboflavin and niacin but contain low amounts of protein and other essential nutrients which are more obtainable in its leaves. In view of this cassava meal can only be improved by in-cooperating other foods to make its diet nutritious (Dziedzoave *et al.,* 2006). The high prevalence of malnutrition which affect growth and development of nearly half of the children population in Tanzania has attracted the attention of nutritionists and health professions and calls for interventions. According to TFNC (2014) the country's average stunting prevalence is 35% but varies between 31.9 to 40.9% in Mtwara region. Malnutrition manifestation has also been observed in other countries where cassava is a staple food. A study conducted by Nungo *et al.* (2012) in Western Kenya indicated that children were malnourished due to high cassava consumption with a frequency of up to three times in a day mainly as porridge, boiled cassava and ugali (stiff porridge) prepared from cassava flour. According to WHO (1997) stunting which is an indicator of under nutrition is regarded to be 'very high' if is greater than 40% in the population. The commonness of cassava as a staple food and the nutritional experience from areas with similar dependence on cassava calls for evaluation of the association between cassava consumption pattern and the nutrition status of the under-five children. It is documented that (Nungo *et al.,* 2012) the nutritional status of children is affected by age, gender, household characteristics, dietary intake and health status which are considered as immediate causes. The authors (Nungo *et al.,* 2012) also describe the following as underlining determinants, food security and community infrastructure including sanitation, safe water and local market conditions.

Nutritional assessment helps to identify the individuals or population groups at risk of becoming malnourished. It facilitates populations screening to identify individuals at risk of under nutrition (or over nutrition) and the degree and severity of under nutrition, i.e. mild, moderate or severe from which the nutritional status of different population groups and nations can be compared (Gibson, 2005). The findings of which would help to develop health care programs which would address community needs and measure the effectiveness of the initiated nutritional programs and intervention. The effects of malnutrition are well recognized e.g. can lead to disability, illness and death

and jeopardize future economic growth by reducing the intellectual and physical potential of the entire population. It was thus important to conduct the current study to evaluate the association between cassava recipe consumption pattern and children nutrition status.

Methodology

Study area, design and study population

Mtwara Rural District was purposively selected as a study area due to high cassava production (FAO, 2001) and high malnutrition rate which varies from 31.9 – 40.9% (TFNC, 2014). The study employed a cross-sectional design in which the data were collected only once. The study population constituted of the under five children with their mothers/caregivers responsible for preparing their food who were randomly sampled. The sample size of the study population was computed from the formula

$$n = t^2 \, x \, (1 - p) / m^2$$

as reported by Magnani, (1997) where n=required sample size, t=Confidence Interval level 95% (standard value 1.96), p=estimated malnutrition prevalence which is 31.65% (TFNC, 2014) and m=margin error at 5% (0.05) which gave a sample of 332 under five children. Out of 332 children, 329 fully participated and successfully provided useful data for the study.

Collection of Household Information

The information about households were obtained from mothers/caregivers responsible for taking care of the children (including planning and / or preparation of children meals) from six wards (Nanguruwe, Mbawala, Libobe, Mpapura, Mayanga and Mkunwa) with a total of 14 villages namely Ngorongoro, Namahyakata shuleni, Mwindi, Libobe, Mnyinja, Mpapura, Utende, Likonde, Libobe B, Kawawa, Mayanga, Nangumi, Mkunwa and Nanyati who were interviewed.

Anthropometric Measurements

The anthropometric measurements were used to assess the nutrition status of children based on stunting, underweight and wasting conditions. Age of a child (6-59 months) was a prerequisite before taking any measurement because under nutrition is manifested at an early age. Height was measured by using a height board (Stadiometer) of UNICEF manufactured in Maryiland. Children's weight was measured using Weight Scale (UNISCALE) with a brand name SECA manufactured in German, Modal 874 1021659. Children were made to minimal clothing following standard procedures for measurements to ensure accuracy.

Dietary Assessment

The 24h dietary recall was used to collect comprehensive information given by a mother/ care-giver for all foodstuff and drinks eaten by a child for the past 24h. The quantity of food reported to be eaten by children in 24 h dietary recall was approximated by using household utensils such as cups and bowls. Food Frequency Questionnaire (FFQ) was used to determine frequency of consumption of different food groups in the households in order to derive more habitual intake. The rate of consumption of a child was computed based on food portion and meal frequency for each day in a week. The adequacy of nutrient of complementary food was computed based on the quantity of food eaten per day. Computed nutrient intake was evaluated against the RDA of respective nutrient for respective age category.

In addition Dietary diversity score was computed to determine the quality of their diet as it includes the number of food groups consumed in a meal. The questionnaires were constructed in a three stage multiple pass interview (Gibson, 2005), in which the first pass involved a 24-hour dietary recall from which the description of cassava meal recipes including cooking methods was obtained too, second pass involved a food frequency questionnaire to identify frequency of different foods consumed in a week and the third part involved dietary diversity in which the number of food groups consumed were identified to measure dietary diversity of an individual.

Individual dietary diversity score (IDDS) is often used as a proxy measure of the nutritional quality of an individual's diet. The IDDS was computed using the following formula:-

$$Average\ IDDS = \frac{Sum\ IDDS}{Total\ number\ of\ Households}$$

Where *Sum IDDS* = $(S_1+S_2+S_3+S_4 \ldots \ldots \ldots S_{329})$

And S is the score for every household which reflects the number of food groups consumed by every household out of the eight food groups. Thus S is a value through eight food groups that is either "0" or "1". For each household, S value should not exceed 8.

Statistical Analysis

IBM SPSS Statistics version 20 analytical package was used for the analysis of the data. Descriptive statistical analysis was used to establish frequencies and percentages of various variables of the dietary diversity and cassava intake as well as the mean frequency of cassava and dietary intake. Chi-square was used to establish association between the variables such as cassava consumption pattern, frequency of cassava consumption, gender and nutrition status of the under five children. WHO Anthro (World Health Organization Anthro) growth standards of 2006 taking -2SD as cut-off points was used to convert raw anthropometric data (weight, height and age of the children) into anthropometric Z-score for Height for age (HAZ), Weight for age (WAZ) and Weight for Height (WHZ) that was used to classify children into levels of nutritional status (stunting, wasting and underweight).

Results and Discussion

Child Information

A total number of 329 out of 332 recruited children were eligible for the study based on the inclusion and exclusion criteria such as age group and mental health. The recruited children were of the age of 6 to 59 months. The mean age for children was 31 months, mean weight was 11.7 kilograms and mean height was 84.8 centimeters. Of the 329 children who were eligible for the study 170 children (51.7%) were female and 159 children were male (48.3%) which indicates a more or less equal representation between genders.

Nutritional Status of the under five Children

Nutritional survey is important in revealing trends in

prevalence of malnutrition. Thus a survey was conducted to examine the prevalence of malnutrition in Mtwara rural district where cassava based meals are consumed as staple food. The findings (Table 1) indicates severe stunting of 12.8% (7.3% female and 5.5% male) and the prevalence of moderate stunting at 28%, giving an overall total stunting of 41% (<-3 and <-2 z- score) among the under five children who were assessed. Underweight and wasting were 18.8% and 7.3% respectively with <-3 and <-2 z- score combined. Generally nutrition status of children in the area was poor (Table 1) and even worse than earlier reported (TFNC, 2014) which indicated malnutrition rate of 31.65% for the entire region. The difference from the current observation could be attributed to the nutritional status of children in other district that might have lowered the overall region average. The current study was done in Mtwara rural district. And according to UNICEF (2013) global data indicate that over one third of children in rural households are stunted compared to one quarter in urban households.

The findings also show no significance association ($p \geq 0.05$) between gender and nutrition status, both genders were more or less equally impacted with malnutrition. The current findings are consistent with the findings of Schoenbaum *et al.* (1995) which indicated insignificant differences between genders in terms of the prevalence of malnutrition.

Table 1. Nutrition status of the u5 children in male and female

Nutrition status	Normal (>+2 SD)		Moderate(<−2 SD)		Severe (<−3 SD)		Total %	
	Male%	Female%	Male%	Female%	Male%	Female%	Male%	Female%
Stunting	29.2	30.1	13.6	14.3	5.5	7.3	48.3	51.7
Underweight	40.4	40.7	5.5	8.8	2.1	2.4	48.0	51.9
Wasting	46.1	47.0	2.4	2.5	1.0	1.4	49.2	50.4

Table 2. Cassava consumption frequency in a week -between age categories

Frequency in a week (number of days)	Age categories				Overall total	
	Children at 6 – 10 months		Children at 11 – 59 months			
	Number (n)	Percentage (%)	Number (n)	Percentage (%)	Number (n)	Percentage (%)
0	12	3.65	8	2.43	20	6.08
1	3	0.91	15	4.56	18	5.47
2	6	1.82	121	36.78	127	38.60
3	2	0.61	66	20.1	68	20.67
6	1	0.31	91	27.66	92	27.96
7	0	0	4	1.22	4	1.22
Total number of children & percentage in each age category	24	7.29	305	92.71	329	100

According to NBS (2011), the stunting prevalence rate in the country was 42% whereas the findings of the present study indicates about 41% prevalence rate of stunting (that is, moderate plus severe stunting, Table 1). These findings imply that, despite all the efforts to alleviate malnutrition in the country, stunting is still a problem. This could possibly be due to inadequate knowledge on nutrition and feeding practices of mothers and/ or caregivers as well as poor nutrient intake during pre-conception and during pregnancy. Furthermore, prevalence of mycotoxins in food can also affect the nutritional status as reported by Magoha *et al*., (2014). There are other causes of malnutrition such as poor sanitation and unavailability of clean water which could lead to diarrhea, high prevalence of diseases such as malaria which all affect the eating habit of the children and can facilitate prevalence of malnutrition (WHO, 2010).

Poor nutrient content of cassava recipe could be another cause for the observed poor nutritional status among children. Cassava is reported to contain little zinc, iron, and β-carotene, yet is the primary staple crop of over 250 million Africans (Gegios, 2010) Mtwara residents inclusive. The continued low intake of zinc in children might increase prevalence of stunting. Caulfield and Black (2005) showed that diets rich in zinc improved growth (increase in weight and height) of stunted children in Ethiopia and attributed it to the ability of zinc to reduce morbidity due to infection and increased appetite.

Barago (2013) in his study conducted in Mtwara Rural revealed that, despite 59.9% of the respondents having excellent knowledge on food security but food insecurity still existed. It is advocated that strategies for reducing food insecurity should involve increasing availability and access to quality nutritious food by diversifying diets. However, the results of the current study have indicated poor food diversification (Table 4). Available global data show that, over one third of children in rural households are stunted compared to one quarter in urban households. Children in the poorest households are more than twice as likely to be stunted as children in the richest households (UNICEF, 2013).

Feeding Patterns and Cassava Consumption Rate

The results in Table 2 indicate variations in the feeding frequencies among households and between and within the two age groups, which are children aged between 6 – 10 months and between 11-59 months. The 6-10 months age group constituted less than 10% of the entire study sample. In this age group the majority (3.65%) never consumed cassava based meals which implies that children were either still being exclusively breastfed or were fed none cassava based complementary foods. Similarly none among the 6-10 months aged children did consume cassava based meals for the entire week. The feeding frequency of 2 days in a week was dominant for children of 6-10 months. Among children aged 11-59 months the dominant consumption frequencies in a week was also that of two days per week (36.78%), three days (20.1%) and six days (27.66%). In this age category only few of them (2.43%) did not consume cassava based

Table 3. Cassava consumption frequency in a week in each age category

Age category (months)	Number of children (n)	Consumption frequency in a week in each age category (Number of days in a week)					
		0	1	2	3	6	7
6-10 months	24	50	12.5	25	8.3	4.2	0
11-59 months	305	2.6	4.9	39.7	21.6	29.8	1.3
Total	329	52.6	17.4	64.7	29.9	34	1.3

Table 4. Individual Dietary Diversity for children

Food Groups	% of individuals consuming / not consuming a particular food group			
	Yes	(%)	No	(%)
White potatoes, white yam, white cassava, or other foods made from roots	246	74.8	83	25.2
Pumpkin, carrot, squash, or sweet potato that are orange inside + *other locally available vitamin A rich*	19	5.8	310	94.2
Other fruits, including wild fruits and 100% fruit juice made from these	71	21.6	258	78.4
Meat, poultry, fresh or dried fish or shellfish/seafood	142	43.2	187	56.8
Dried beans, dried peas, lentils, nuts, seeds or foods made from these (e.g. hummus, peanut butter)	91	27.7	238	72.3
Milk, cheese, yogurt or other milk products	68	20.7	261	79.3
Eggs from chicken, duck, guinea fowl or any other egg	2	0.6	327	99.4
Oil, fats or butter added to food or used for cooking	169	51.4	160	48.6

meals at all. Overall the largest fraction (64.74%) of all the children (6-59 months) had a feeding frequency of cassava based meals of between 2 to 6 days in a week. The daily feeding frequency of 7days in a week was less practiced in both age groups. These variations in the consumption frequencies of cassava based meals could possibly have an implication on children nutritional status.

Table 3 separately examines the consumption pattern of cassava within each age group, that is, 6-10 months and 11-59 months respectively. For the former age group (6–10 months) half of the children did not consume cassava at all and the remaining consumed cassava at varying frequencies with a quarter of them consuming at the frequency of 2 days per week and the other remaining quarter consuming cassava based meals at a frequency of 1 day per week (12.5%) and 3 days to 6 days per week (altogether constituting 12.5%).

In the age group of 11-59 months the consumption score in percentage indicate that only 2.6% never consumed cassava but the rest were consuming cassava based meals. The dominant consumption pattern was that of 2 days per week (39.7%) followed by 6 days per week (29.8%). The results generally show that over half (52.7%) of children aged 11-59 months had a consumption frequency of cassava based meals of between 3 days to 7 days in a week.

Furthermore, it was observed that intra-household food distribution was poor, in almost all households; about 92.7% (Diana, per comm.) of children were eating from same pots with adults without offering any special treatment to children during meals. This may imply inequality in food distribution and accessibility which is likely to lead to food insecurity and hence malnutrition because food security is a key factor in good nutrition (FAO, 2008). This could further explain the high rate of malnutrition documented in the present study.

Children Dietary Diversity

The findings on children dietary diversity are presented in Table 4. The FANTA system of grouping children's diet was used in determining an individual's dietary diversity score. The number of foods consumed across and within food groups over a reference time period is widely recognized as a key dimension of dietary quality. It reflects the concept that increasing the variety of foods and food groups in the diet helps to ensure adequate intake of essential nutrients, and promotes good health (Kennedy *et al,* 2009).

The IDDS was computed based on a set of 8 food groups consumed by members of the household in view of the usefulness of these food groupings. Values for eight food groups were considered as either "0" or "1" in which case 0 indicates not consuming and 1 indicates consuming a particular food group

$$i.e.\ Sum\ IDDS = (S_1+S_2+S_3+S_4 \ldots \ldots \ldots S_{329}) = 808$$

Where by S- is the score for every single household

$$Average\ IDDS = \frac{Sum\ IDDS}{Total\ number\ of\ Households} = \frac{808}{329} = 2.5$$

It is desired that the average IDDS be compared with some meaningful target level of diversity. Unfortunately, normative data on 'ideal' or 'target' levels of diversity are usually not available but options are available for determining appropriate targets whereby an IDDS target can be established by taking the average diversity of the 33 percent of individuals with the highest diversity (upper tercile of diversity) (Swindale and Bilinsky, 2006). From this study 10 children had the highest IDDS of 5, therefore from the formula of determining the IDDS target by considering the average diversity of 33% of 10 individuals with the highest diversity you get 3.3, which is approximately 3 children.

Therefore,

$$T\ \text{arg}\ et\ \ IDDS\ = \frac{(5+5+5)}{3} = 5$$

The 5 target IDDS score shows a meaningful target level of diversity for children in Mtwara rural district which has to be attained over and above the average IDDS of 2.5 that has been attained. Thus a 2.5 average IDDS score obtained from this study implies that there is no

improvements in terms of the average food groups consumed by the children based on earlier findings (MoHCDGEC, 2015-16) which showed an average of less than 5 IDDS for many regions. An increase in the average number of different food groups consumed provides a quantifiable measure of improved household food access. In general, any increase in IDDS reflects an improvement and changes in the individual's diet. Overall there is low consumption of foods of different varieties including foods of animal origin which are rich in iron and vitamin A (Table 4). This could be among the contributing factors that lead to higher prevalence of malnutrition in Mtwara region. This can well be explained by the fact that the higher the food insecurity the lower the food diversification ever since consumers' eat what is readily available and so diet imbalance.

Association between nutrition status and feeding pattern

The cassava consumption pattern of children in the district was established to examine its association with under nutrition (stunting, underweight and wasting) (Table 5). These findings would highlight on the contributing factors to poor nutrition status observed among the under-five children in the district.

Table 5. Association between cassava consumption pattern variable and Stunting (HAZ)

HAZ	Severe n (%)	Moderate n(%)	Normal n(%)	Total n(%)	Chi-square	Df	p-value
Cassava consumption score							
Yes(consuming cassava)	38(11.6)	68(20.7)	140(42.6)	246(74.9)	1.848	2	0.432
No(not consuming cassava)	8(02.4)	23(7.0)	52(15.8)	83(25.2)			
Frequency of Cassava consumption							
Never	0(0.0)	4(1.2)	15(04.6)	19(05.8)	11.750	12	0.514
Less than 1 time per week	0(0.0)	0(0.0)	1(00.3)	1(00.3)			
1-3times per week	1(0.3)	4(1.2)	12(03.6)	17(05.2)			
4-6times per week	20(6.1)	32(9.7)	75(22.8)	127(38.6)			
1time per day	8(2.4)	24(7.3)	36(10.9)	68(20.7)			
2-3times per day	17(5.2)	25(7.6)	51(15.5)	93(28.3)			
4 or more times per day	0(0.0)	2(0.6)	2(00.6)	4(01.2)			

Chi-square test was used to test whether there is significant association ($P \geq 0.05$) between cassava consumption score and frequency and prevalence of malnutrition. The findings indicated that though the most affected children were those consuming cassava than those not consuming but the association was insignificant ($P \geq 0.05$) implying negligible effect. Similarly neither higher nor low frequencies of cassava consumption had any significant effect on the nutritional status of children.

The results generally indicate that malnutrition was neither related to cassava consumption score nor cassava consumption frequency but could rather be due to a synergistic effect of several factors including poor dietary diversity as reflected by the computed average IDDS. The computed average IDDS of 2.5 is far below the targeted IDDS of 5 in Mtwara region justifying poor dietary quality among children.

The present findings however, contradicts the results of Nungo *et al.* (2012) who conducted a research in Western Kenya and indicated that children were malnourished due to high cassava consumption at a frequency of up to three times in a day mainly as porridge, boiled cassava and ugali (stiff porridge) prepared from cassava flour which was not the case in this study. This means the higher prevalence of malnutrition in the region could be attributed to a combination of several factors as indicated earlier.

Table 6. Association between cassava consumption pattern and Wasting (WHZ)

WHZ	Severe n(%)	Moderate n(%)	Normal n(%)	Total n(%)	Chi-square	Df	p-value
Cassava consumption score							
Yes	6(1.8)	10(3.0)	230(69.9)	246(74.8)	1.747	2	0.456
No	2(0.6)	6(1.8)	76(23.1)	83(25.2)			
Frequency of Cassava consumption							
Never	1(0.3)	3(0.9)	15(4.6)	19(5.8)	11.520	12	0.353
Less than 1 time per week	0(0.0)	0(0.0)	1(0.3)	1(0.3)			
1-3times per week	0(0.0)	0(0.0)	17(5.2)	17(5.2)			
4-6times per week	2(0.6)	9(2.7)	116(35.3)	127(38.6)			

The wasting rate among the under five children was 7.3% which is reasonably low and was indicated to be independent of the cassava meal consumption pattern and frequency. This is evidenced by lack of significant association ($P \geq 0.05$) between wasting and cassava consumption score and frequency. Frozanfah *et al.* (2016) in the study conducted in Afghanistan indicated significant association between acute malnutrition (wasting) among under-five and education level of household heads, age of household heads, income, education level of mothers, history of children with diarrhea in the last two weeks of data collection, water sources and iodized salt. In view of this a similar argument could be made regarding the prevalence of malnutrition in Mtwara that, is due to synergistic effects of several factors. Though cassava based meals are inadequate by themselves in meeting the children nutritional needs but their effects can only be realized when other determining factors are out of the equation.

The results have shown no significance association between the cassava consumption score in the population (p=0.237), frequency of cassava consumption (p=0.584) with the underweight situation among children in Mtwara

Table 7. Association between cassava consumption pattern and Underweight (WAZ)

WAZ	Severe n(%)	Moderate n(%)	Normal n(%)	Total n(%)	Chi-square	Df	p-value
Cassava consumption score							
Yes	14(4.3)	35(10.6)	194(58.9)	248(75.4)	3.212	2	0.237
No	1(0.3)	12(3.6)	69(21.0)	85(25.8)			
Frequency of Cassava consumption							
Never	1(0.3)	0(0.0)	18(5.5)	19(5.8)	10.077	12	0.584
Less than 1 time per week	0(0.0)	0(0.0)	1(0.3)	1(0.3)			
1-3times per week	0(0.0)	2(0.6)	15(4.6)	17(5.2)			
4-6times per week	4(1.2)	22(6.7)	101(30.7)	127(38.6)			
1time per day	3(0.9)	12(3.6)	53(16.1)	68(20.7)			
2-3times per day	8(2.4)	14(4.3)	71(21.6)	93(28.3)			
4 or more times per day	0(0.0)	0(0.0)	4(01.2)	4(1.2)			

rural district (18.8%). The results imply that underweight among the under-five children could be attributed to a combination of several factors such as age diseases, food security, gender division of labour and other factors as reported by Shoo (2011). Moreover, Peiris and Wijesinghe (2011) indicated that though inadequate food intake is a basic cause of underweight; several other factors such as living standards, water and sanitation, birth weight, birth interval and parity, weaning practices and mother's nutritional knowledge have been identified as contributing to malnutrition among children. Therefore the observed results may have been due to a combination of several factors from among those.

Conclusions

The findings of the present study generally indicate poor nutrition status and high level of malnutrition among the under five children. Stunting was the most prevalent form of malnutrition at a rate of 41%, followed by underweight (18.8%) and wasting (7.3%). However no significance association ($p \geq 0.05$) was recorded between gender and nutrition status, both genders were more or less equally impacted with malnutrition. Cassava feeding frequencies varied among households and between and within the two age groups, (6 – 10 months) and (11-59 months). Half of the children aged 6 – 10 months did not consume cassava at all and the remaining consumed cassava at varying frequencies of 1, 2, 3 or 6 days per. In the age group of 11-59 months the dominant consumption frequencies were 2 and 6 days per week. Overall 87.23% of all the children aged 6-59 months had a feeding frequency of 2 days, 3 days or 6 days in a week. Nonetheless the results indicated no significant association between cassava consumption score and frequency and prevalence of malnultrion (stunting, wasting and underweight).

The average IDDS of 2.5 obtained in this study implies poor diversity of consumed food groups and lack of improvements in the individual's diet including low consumption of foods of animal origin. This could be among the contributing factors to higher prevalence of malnutrition in Mtwara rural district. The higher prevalence of malnutrition in the region could thus be attributed to a combination of several factors. Thus the high prevalence rate of malnutrition in Mtwara rural district may not be due to cassava consumption frequency but rather to a synergistic effect of several factors.

Acknowledgement and Declaration

The authors report no declaration of interest. The authors are responsible for the content and writing of the paper.

References

Barago, K. D. (2013). Factors affecting household food security. Mtwara Rural District-Mtwara Region. Retrivead from http://repository.out.ac.tz/515/1/ DISSERTATION_-_BARAGO.pdf

Caulfield, E.L., and Black, E. R. (2005). Comparative quantification of health risks, zinc deficiency. global and regional burden of disease attributable to selected major Vol.1 1200pp

Dziedzoave, N. T. Abass, A. B., Amoa-Aawua, W. K. A., and Sablah, M. (2006). Quality Management manual for the production of high quality cassava flour. (Adegoke, G.O. and Brimer, L., Eds). International Institute of Tropical Agriculture. Ibadan, Nigeria.

Frozanfar, K. M, Yoshida ,Y, Yamamoto, E, Reyer, A, J, Dalil, S, Rahimzad, D. A., and Hamajima, N. (2016). Acute malnutrition among under-five children in Faryab, Afghanistan: prevalence and causes. *Nagoya Journal of Medical Science*, 78, 41- 53.

Gegios, A., Amthor, R, Maziya-Dixon, B., Egesi, C, Mallowa, S., Nungo, R., Gichuki, S., Mbanaso, A., and Manary JM (2010). Children consuming cassava as a staple food are at risk for inadequate Iron, Zinc and Vitamin A intake. *Plant Foods for Human Nutrition*, 65, 64-70.

Gibson, R. S. (2005). Principles of Nutritional Assessment. Oxford University Press, Inc. Newyork.

Hahn, S. K., Reynolds. L., and Egbunike, G. N. (Eds.) (1988). Cassava as livestock feed in Africa. Proceedings of the IITA/ILCA/University of Ibadan. International Institute of Tropical Agriculture Ibaaan, Nigeria.

Kennedy, G., Fanou, N., Seghieri, C., and Brouwer, D. I. (2009). Dietary Diversity as a Measure of the Micronutrient Adequacy of Women's Diet from Bamako, Mali: Food and Nutrition Technical Assistance II Project (FANTA-2) FHI 360 1825 Connecticut Ave., NW Washington, DC 20009-5721. Retrieved from http://www.fantaproject.org

Magnani, R. (1997). Sampling guide. IMPACT Food Security and Nutrition Monitoring Project, Arlington, Va.

Magoha, H., Kimanya, M., Meulenaer, B. D., Roberfroid, D., Lachat, C., and Kolsteren, P. (2014). Association between aflatoxins M1 exposure through breast milk and growth impairement in infants from Northern Tanzania. *World Mycotoxin Journal*, 7, 277 - 284

Nungo, A. R, Okoth, W. M., and Mbugu, K. S. (2012). Nutrition status of children under five years in cassava consumning communities in Nambale Busia of Western Kenya. University of Nairobi, Kenya. *Food and Nutrition Sciences,* 3, 796-801.

Peiris, T. D. R., and Wijesinghe, D. G. N. G. (2011). Nutritional status of under 5 Year-Old Children and its Relationship with Maternal Nutrition Knowledge in Weeraketiya DS division of Sri Lanka. *Tropical Agricultural Research*, 21, 330–339.

Schoenbaum, M., Tulchinsky, T.H., and Abeid, Y. (1995). Gender differences in nutritional status and feedings patterns among infants in the Gaza Strip. *American Journal of Public Health,* 85, 965–969.

Shoo, T. A. (2011). Gender division of labour in food production and decision making power and impact on household food security and child nutrition in rural rukwa, Tanzania: Thesis submitted in partial fulfilment of Master of Philosophy degree in International Community Health to University of Oslo, Norway. Retrieved from http://urn.nb.no/URN:NBN:no-31355

Swindale, A., and Bilinsky, P. (2006). Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide Version 2. Food and Nutrition Technical Assistance III Project (FANTA) FHI 360 1825 Connecticut Avenue, NW Washington, DC.

Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC) [Tanzania Mainland], Ministry of Health (MoH) [Zanzibar], National Bureau of Statistics (NBS), Office of the Chief Government Statistician (OCGS), and ICF. 2016. Tanzania Demographic and Health Survey and Malaria Indicator Survey (TDHS-MIS) 2015-16. Dar es Salaam, Tanzania, and Rockville, Maryland, USA: MoHCDGEC, MoH, NBS, OCGS, and ICF.

Tanzania Food and Nutrition Centre –TFNC (2014). The United Republic of Tanzania Ministry of Health and Social Welfare Tanzania National Nutrition Survey 2014 Final Report Data collection: 24 September – 21 November 2014. Retrieved from https://www.unicef.org/esaro/Tanzania_National_Nutrition_Survey_2014_Final_Report_18012015.pdf

National Bureau of Statistics (NBS) [Tanzania] and ICF Macro. 2011. Tanzania Demographic and Health Survey 2010. Dar es Salaam, Tanzania: NBS and ICF Macro.

UNICEF (United Nations Children's Fund) (2013). Improving Child Nutrition: The achievable imperative for global progress. ISBN: 978-92-806-4686-3 eISBN: 978-92-806-4689-4 United Nations Publications Sales No.: E.13.XX.4. www.unicef.org/publications/index.html

WHO. (1997). *WHO Global Database on Child Growth and Malnutrition*. Programme of Nutrition. Geneva: (WHO DOCUMENT WHO/NUT/97.4)

WHO. (2006). WHO Child growth Standards. Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development. Department of Nutrition for Health and Development. https://www.who.int /childgrowth/standards/Technical_report.pdf [ISBN 92 4 154693X] (CNLM Classification: WS)

WHO. (2010). World Health Organization/UNICEF/ WFP/FAO/FSNAU, Somali Nutrition Strategy 2011-2013: Towards the Millennium Development Goals. Somalia. https://reliefweb.int/sites/reliefweb.int/files/ resources /Full_Report_1768.pdf.