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Nutrition Status of Children Under-Five Years in Cassava Consuming Communities in Nambale, Busia of Western Kenya

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ABSTRACT

A study was carried out to assess the nutritional status of under-five child population within cassava consuming community in Nambale of western Kenya. A structured questionnaire was used to collect socio economic data, 24-hour food re-call and anthropometric measurements. Data were analyzed using Statistical Package for Social Sciences. Descriptive statistics were used while Pearson's Chi Square and correlation coefficient (R) were used to test for statistical associations. A total of 320 households with 232 children participated. The findings showed nutrition status of children to be poor (<−2 SD), 26.6% were stunted, 13.9% underweight, and 10.1% were wasting. Malnutrition had reached its peak during the third year affecting boys more than girls despite a high mean score (9.2) for household dietary diversity. The findings established cassava utilization to be high (94.3%) and mainly as "porridge, boiled roots and ugali". Eight staples including cassava were used for weaning and 66.4% of the children were fed three times daily. Cassava utilization was not a determinant of child nutrition status. Age of child and education level of head of household had strong but negative influence on child nutrition status, (Pearson's R = −0.207:−0.174) indicating >50% changes in stunting could not be attributed to age of child or education level of the head of household. Farm ownership was a strong positive determinant of nutrition status, Pearson's R = 0.233. This study has established that cassava cushions hunger and there is need to improve nutrient content.

Keywords: Cassava; Children; Nutritional Status; Utilization

1. Introduction

Nutritional status of children is determined by: age, gender, household characteristics, dietary intake and health status. These are influenced by underling determinants such as food security and community infrastructure including sanitation, safe water and local market conditions. Other factors include prices of related health inputs and available household resources [1]. Malnutrition which is poor nutritional status, can lead to disability, illness and death and jeopardize future economic growth by reducing the intellectual and physical potential of the entire population [2]. Globally malnutrition is estimated to contribute to over 50% of child deaths and 40 million are affected by vitamin A deficiency [3]. It is estimated that 190 million under-five year old children in developing countries are chronically malnourished and in Africa, 38.6% are stunted with 7.2% wasted [4].

In Kenya chronic and acute malnutrition, micronutrient deficiencies and infectious diseases are prevalent, particularly among the rural populations and urban poor [5]. The Kenya government studies of 2008/2009, 2005/2006 compared to 2003 show percent increase in stunting (35:33:30), and wasting (7:6.1:6) [6]. Prevalence of severe malnutrition in Kenya at 7% is above the WHO/UNICEF 2.3% acceptable rate expected in a healthy child population for developing countries. The Kenyan under-five mortality rate (U5MR) shifted from 97/1000 in 1990 to 120/1000 in 2005 indicating vitamin A deficiency [7].

Cassava, (*Manihot esculenta*, Crantz) is very important in the diets of populations in Sub Saharan Africa and is the second staple after maize in western Kenya food systems [8]. Busia district ranked cassava first in both consumption and monetary value [9] and, high levels of malnutrition had been attributed to use of cassava, millet and sorghum [10]. Cassava contributes to calories, lacks vitamin A and has the lowest protein energy ratio (P:E), approximately 2% compared to other staple crops [11].

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Protein is required for body building and repair of tissues while vitamin A is required by the body for vision, iron metabolism, skeletal growth, bone formation, gestation, placenta development, epithelial surface stability and integrity of the immune system [7]. The objective of the study was to assess nutritional status of under-five child population in cassava consuming community for later use in planning.

2. Materials and Methods

2.1. Sampling

Busia district was purposively selected as the study area due to the high poverty levels, persistent floods [9,12], high cassava production and malnutrition. Multistage randomised sampling was used to select 1) one division from five divisions that grew cassava; 2) study sites from two locations within selected division. Fishers' equation [13] was used to calculate the least possible sample size: $n = z^2 (pq)/d^2$. Where n = minimum sample size, z = the standard normal deviate at 1.96 for a confidence level of 95%, p = rounded up proportion of malnourished children below five years in western Kenya [12], q = the proportion of children below five years who are not malnourished in western Kenya, d = the degree of accuracy desired set at 0.05.

2.2. Data Collection

A structured questionnaire was administered to responsible household representatives. Data collected included: physical information of the respondent, gender, age and physical health status of child. Anthropometric measurements (weight and height) for children below 60 months, morbidity information and 24 hour food re-call using twelve food groups [14] was used to determine dietary diversity (DD) and food sources for protein, carbohydrates and vitamin A, staples for weaning, number of times children were fed in a day and Socio economic data.

2.3. Statistical Analysis

Child nutritional status data was analyzed using the National Centre for Health Statistics (NCHS) adapted by World Health Organization (WHO) as International reference standards. Anthropometric indices were calculated using the WHO 2005, Epiinfo Anthro growth standards to convert measurement indices. WHO Z-score cut-off point of <−2 SD was used to classify, low height-for-age, low weight-for-height and low weight-for-age as moderate and <−3 SD severe under-nutrition. Both qualitative and quantitative approaches were used to analyze the data using SPSS, version 13.0 and Excel: frequencies, means, Pearson chi Square tests using cross tabulations and Pearson R using correlation coefficients significance 2/t-tests were done to establish relationships between variables. Household dietary information was analyzed using the household dietary diversity score (HDDS) [14]. The FAO categories of dietary diversity scores applied in Mozambique [15] were used. Consumption of vitamin A rich foods was calculated as percent of households consuming either: vitamin A rich vegetables and tubers or dark green leafy vegetables or vitamin A rich fruits or organ meat, or eggs or milk and milk products. Consumption of iron rich food groups was calculated as percent of households consuming meat, or fish $\frac{(\text{meat} + \text{fish})}{\text{Sample size}} \times 100$ [15].

3. Results

3.1. Household Information

A cross sectional survey conducted in 39 villages, two locations, (Bukhayo East and Nambale Township) in Busia district, western Kenya involving 320 households (female 61.6%, 38.4% male) between 18 - 68 years. A very high proportion 80.8% was within the youthful age range of 18 - 48 years unlike other studies [16] indicating age bracket 30 - 50 as youthful years. Majority 90.4% of the respondents were married and the head of household (HH) was mainly father 90%, with small percentage of mother, grandfather or grandmother and brother. Over half 52.4% of the households had between 6 and 10 members, while the lowest 2.2% had over 15 members.

3.2. Child Information

A total of 320 children were found but 88 were flagged off due to extreme age and SD leaving 232 eligible. The mean age for children was 33 months, mean weight 13.2 kilograms and mean height 88.3 centimeters with more female children than male (53.4%:46.6%) respectively and more children between 36 and 47 months.

3.3. Nutrition Status of Children

Nutrition status of children was poor, (<−2 SD and <−3 SD combined) stunting, underweight and wasting were 26.6%, 13.9%, and 10.1% respectively, stunting slightly higher among female than male at 13.5% and 13.1% respectively. Male children were more underweight and wasting than female 7.8%:6.1%, 5.1%:5.0% respectively (**Table 1**). There was a negative but significant correlation between age of child and stunting, Pearson's R = −0.207 correlation sig. at the 0.01 level (2-tailed). Locations compared, significant associations were observed

Table 1. Nutrition status of children by Gender.

Nutrition Status	Normal (>+2 SD)		Moderately Malnourished (<−2 SD)		Severely Malnourished (<−3 SD)		Total %	
	Male %	Female %	Male %	Female %	Male %	Female %	Male	Female %
Stunting N = 222	34.2	39.2	6.3	5.4	6.8	8.1	47.3	52.7
Underweight N = 229	38.9	47.2	6.5	4.8%	1.3	1.3	46.7	53.3
Wasting N = 217	42.9	47.0	2.8	1.8	2.3	3.2	48.0	52.0

for underweight among male children in Bukhayo at $p < 0.001$ and wasting among female children in Township at $p < 0.001$. Stunting in both locations was significantly associated with both female and male children at $p < 0.001$ using Pearson Chi Square Asymp Sign (2-tailed).

3.4. Child Morbidity by Nutrition Status

There were 41.8% (97/232) sick children at the study time and 90.21% had complete information for stunting, 92.15% for underweight and 89.24% for wasting. A high proportion, 72% of children who had been sick were not malnourished, stunting accounted for 28%, underweight 15% and wasting 9%. Severely stunted children who had been sick were 16% and this accounts for 45% (15/33) of all study children who were <−3 SD. There was no statistical significance ($p \geq 0.05$) between child morbidity and nutrition status as observed in other studies [17].

3.5. Household Dietary Diversity (HDDS)

A total of 2947 foods were consumed in 320 households over the 24 hour diet food recall with a mean HDDS of 9.2. Using FAO [15] dietary diversity score classification applied in Mozambique households had (96.8%:2.4%: 0.8%) high, medium and low HDDS category respectively. Households which indicated main weaning staples as bananas, sweet potatoes, Irish potatoes and cassava were all in high HDDS category while those with maize and millet were in all three categories. There was no statistical significance between nutrition status of children and HDDS category.

3.6. Main Sources of Protein, Carbohydrates and Vitamin A

Main protein sources: milk 44.9%, fish 38.5%, legumes 13.4% and poultry 3.2%. Location comparisons showed Township households had protein from all four sources, Bukahyo none had poultry. Main carbohydrate sources: maize 66.8%, cassava 20.8% and this is similar to other studies [8]. Bukhayo had higher maize and Township higher cassava consumption, 74.8% and 38.4% respectively. Fruits, vegetables and fish were sources of vitamin A with the highest proportion (92.9%) from vegetables. There was a high significant association between main source of carbohydrates, main source of vitamin A and utilization of cassava roots, ($p < 0.05$) and no association with protein.

3.7. Nutrition Status, Source of Proteins, Carbohydrates and Vitamin A

Households reporting milk and fish as main protein sources had each 40.7% stunting and more than half 55.9% (33/59) of these children were <−3 SD. Households reporting fish sources had almost half 43.8% of underweight children and of this category 15.6% (5/32) were <−3 SD. Majority, 91.7% (11/12) severely wasting children were from households reporting fish and milk as main sources of protein.

3.8. Main Staple for Weaning Children

Eight staples were used for weaning and majority (44.9%) used millet (**Figure 1**). Township had higher (81.1%) proportion using millet, no bananas, cassava, rice or sorghum compared to Bukhayo where all staples were used. Pearson Chi-Square showed high significant relationships between "main staple for weaning children" and "education level of HH" and also "occupation of HH" ($p < 0.001$). "Main staple for weaning children" was also significantly related to "utilization of cassava" ($p < 0.001$).

3.9. Frequency of Child Feeding and Food Security

The range for child feeding in a day was 1 to 6 times and majority 64.7% were fed three times followed by 19% fed four times irrespective of the age group. Majority 63.1%, giving three feeds to children per day were in the high HDDS category. Pearson's $R = 0.178$ indicated a very significant positive correlation between number of feeds children were given and HDDS category ($p \leq 0.01$). More than half (54.9%) of children fed three times a day belonged to households with 6 to10 members and Bukhayo had a higher proportion feeding three times compared

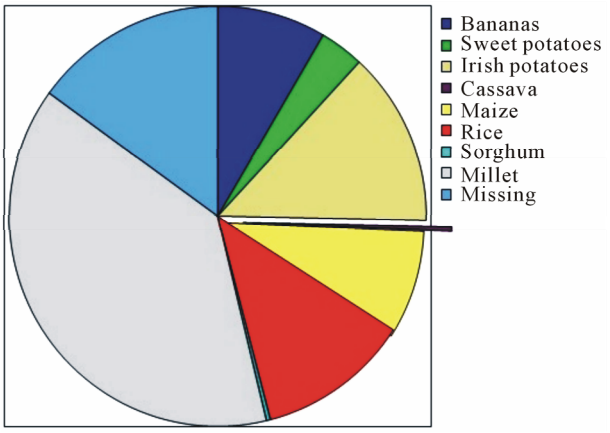

Figure 1. Main staple for weaning.

to Township (71.7% and 60.3%) respectively.

3.10. Socio-Economic Characterization

3.10.1. Education Level of Head of Household (HH)

More than half (59.1%) of the HH had some form of primary school education while 7.7% had no education, 8.9% had "secondary incomplete" and 23.6% had secondary complete and above. Combined stunting (<−2 z scores and <−3 z scores) were manifest in children irregardless of the category of education level of the HH. Households whose HH had incomplete primary level had the highest (47.5%) proportion of stunting children. There was a significant but negative (R = 174 correlation between education level of HH and nutritional status of children ($p \leq 0.05$).

3.10.2. Land Ownership and Size

Three quarters, 74.9% (n = 319), of the land was owned by HH, 24.1% ancestral and 0.3% was rented. HH with ancestral land ownership had majority 96.7% (57/59) of stunting children. Pearson's R = 0.233, showed strong positive significance between stunting and farm ownership indicating more than 50% of stunting could be linked exclusively to land ownership. Farm size ranged between <1 to >20 acres and majority (71.7%) had 1 - 5 acres while 2.7% had more than 20 acres. Pearson's R = 0.220 showed a positive significant correlation at 0.01 level (2-tailed) between farm size and education level of HH indicating more than 50% of the large land size was mainly due to education level of the HH.

3.10.3. House Roofing Material and Floor

More than half, 55.9% (n = 320), of the roofing material was corrugated iron while the rest, 44.1%, had grass thatch. Majority, 83.8% (n = 320), of the floor were smeared with earth/mud/dung, 15.6% cemented and 0.6% had ceramic tiles. High proportions of stunting and underweight 54.2% and 53.1% respectively were from "corrugated iron" households while wasting from "grass thatch" 63.6%. "Earth/mud/sand" floors had high proportions for stunting 88.1%, underweight 93.8% and wasting 86.4%. Roofing material and floor were not important determinants of the nutritional status just like in some previous studies [18].

3.10.4. Dish Rack, Toilet and Bathroom

More than half 60.2% (n = 319) of the households had a dish rack for drying utensils, 12.7% had a soak pit for draining water. Toilet facilities were, traditional pit latrines (TPL), ventilated improved pit latrine (VIP) and no facility). TPLs were owned by 78.4% (n = 320) of the respondents. More households in Township compared to Bukhayo had TPLs and no facility (80%:76.9%, 3.2%: 1.3%) respectively. Households with TPLs had majority of malnourished children, stunting 86.4% (n = 59), underweight 81.2% (n = 32) and wasting 59.1% (n = 22. The bathroom facility was mainly a live natural enclosure used by 81.3% (n = 320). Majority of stunting 95.0% (n = 59), underweight 84.3% (n = 32) and wasting 77.2% (n = 22) were all from households that used enclosed natural wall. Stunting was significantly and positively correlated with bathroom facility, R = 0.193.

3.10.5. Safe Water Provision

Majority, 72.3% (n = 320), households used unsafe water and 39.4% spent less than five minutes to fetch water. Cross-tabulation for water supply source with nutrition status showed those using "spring" water to have high proportions of stunting, underweight and wasting 28.8%, 28.0%, 40.9%. Forty percent households with sick children used water from "spring". Water source was not found to be a determinant of nutrition status.

3.10.6. Type of Cooking Fuel, Source of Firewood and Type of Cooking Stove

Majority households, 97.8% (n = 318) used firewood for cooking and the main source of firewood was bush, 79.9% (n = 319). The three stone stove was the most popular 90.7% (n = 317). There was a very high significant relationship between wasting and "how firewood is obtained" ($p \leq 0.001$). Other studies [19] have shown the availability of fuel-wood to be a crucial link between food and nutrition status.

3.10.7. Crops Grown on the Farm

There was crop diversity and 76.9% (n = 320) grew cassava among other crops. The most popular crop combination consisted of: "maize, cassava, beans, bananas, sugarcane, kales, and fruits" and least popular; "maize, beans, palm oil, groundnuts, cassava, millet and bananas"

(37.8%:2.5%) respectively. Crop combinations differed in the two locations and households with the least popular crop combination had no stunted children. There was no significant relationship between combination of crops and nutrition status. Nine varieties of cassava were grown as single variety or combination and most households grew a combination of "SS4, Migyera and Magana" while Migyera was most preferred for cooking (54.0%:52.9%) respectively. Magana was most preferred for processing while MM 96/5280 and Migyera were least processed traditionally.

3.10.8. Cassava Utilization, Legumes Grown and Used by Households

Cassava was utilized in three combinations, "for porridge, boiled roots, ugali" 94.3%, (n = 283), "porridge, boiled whole meal and roasted" 4.6%, 1.0% used "leaves as vegetables". This does not compare with myriad products mentioned elsewhere in other parts of Kenya [20]. Stunting, underweight and wasting had no statistical significant relationship with utilization of cassava, ($p \geq 0.05$). Households grew and used, "cow peas and beans": "beans and soya beans":"beans, green grams and soya beans", 72.6%:23.9%:3.5% (n = 314). HH with cowpeas and beans had higher proportions for stunting, underweight and wasting 69.0%:56.3%:59.1% respectively though there was no statistical significance, ($p \geq 0.05$).

4. Discussion

4.1. Nutrition Status

The overall prevalence of stunting and underweight 26.6%:13.9% were found to be in the medium range (20% - 29%:10% - 19%) respectively while wasting 10.1% was in the high range or serious (10% - 14%) acute global malnutrition as classified by WHO [21,22]. When compared with studies of 2008-2009 Kenya survey, stunting had decreased but wasting is higher than national average.

4.2. Child and Environmental/Sanitation Characteristics

Results from the study show malnutrition reached its peak during the third year of life affecting boys more than girls and this is similar to previous studies [2]. There were no cases of diarrhoea compared to other studies [17,23-25]. Female children suffered more from common cold and malaria while male suffered more from skin rashes. In this study children below six months were only fed between two and four times which is under feeding children who should be exclusively breastfeeding according to WHO recommendations. There were no malnutrition cases from households using "river or stream". Child characteristics (age) and some environmental factors such as toilet and bathroom were found to be significant determinants of nutritional status similar to studies elsewhere [26].

4.3. Household Dietary Diversity and Main Food Nutrient Sources

Effects of variety in food choices on dietary quality are not obvious in this study due to high presence of malnutrition. Overall there is low consumption of animal source foods rich in iron and vitamin A rich foods (14.4%:33.5%) similar to previous studies in Kenya [27]. Households reporting maize had the highest percent stunting, underweight and wasting (71.2%:78.1%:72.7%) respectively. Those reporting cassava as second carbohydrate choice had stunting, underweight and wasting at (18.6%:9.4%:9.1%) respectively. Those consuming vegetables as main source of vitamin A had high proportions of stunting, underweight and wasting (89.8%:81.2%: 90.9%) respectively. No significant association was observed between nutrient variables and child nutritional status.

5. Conclusions

The high consumption of cereals and vegetables observed and the low consumption of both animal and vegetable proteins, indicate that children under-five years in this region are consuming inadequate diets deficient in nutrient quality and quantity.

Results from the study confirm cassava as an important carbohydrate in the diet of the community in Nambale. Another finding is that nutrition deteriorates with use of "enclosed natural bathing facility" indicating unhygienic environment conditions jeopardizing the health and nutrition status of children**.** Results also indicate nutrition decreasing in households that obtain firewood from "bush/forest" while using three stones as cooking stove.

6. Recommendations

Nutrient quality of cassava should be improved by blending with available protein and vitamin A foods or bio-fortification through breeding. "Enclosed natural bathing facility" should be addressed by public health to improve on the environment and sanitation conditions in which children are exposed. Firewood and efficient cook stove are important prerequisites for food preparation and can adversely affect nutrition status of children. The Ministries of Agriculture, Environment and Forestry should mount tree planting campaigns and use of fuel saving stoves involving all communities that use fire wood and three stones for cooking.

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