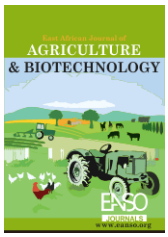

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Original Article

Nutritional Status of Under-five Children in Arumeru District, Tanzania

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ABSTRACT

Malnutrition not only hinders development but also indicates that the basic physiological needs of individuals have not been adequately met. This study was conducted to assess the nutritional status of the under-five population among the local community in the Arumeru district. The study's specific goals were to analyse under-five food usage at the household level, examine food intake frequency, and calculate the dietary diversity score among the sampled population. The study was conducted in the Arusha region, whereby a sample size of 382 households was selected from the study area. Data analysis involved the use of descriptive statistics. The findings revealed that children under the age of five in the study area experience both micro and macronutrient deficiencies, indicating a state of food nutrition insecurity. Results also showed that more than 50% of the sampled under five scored less than the WHO's recommended Household Dietary Diversity score which is 33.3%. However, 54.8% of 62 sampled under five children were underweight (<18.5). Moreover, 46% of the households (HH) had less than four meals for under five per day. The most consumed food group by the under-five was cereal, especially maize which is converted into Ugali and porridge, meat, vegetables, and milk which are most of the time shared with the adults with an average of 8,000 Kcal to 10,000 Kcal per day per head. Based on the results, the paper concludes that children under the age of five in the study area are still facing issues related to overweight and improper feeding practices. Therefore, the paper recommends extension officers (food nutritionists and development partners) to continue changing the mindset of household members through in-house training, which will capacitate the communities in preparing types of food for those under five using their own local resources and food available in their respective surroundings.

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INTRODUCTION

Nutritional status is the state of the body as influenced by diet and nutritional levels. The consumption and utilization of nutrients by the body has an impact on the health condition of individuals or demographic groups (Nyaruhucha *et al.*, 2006). However, the issue of undernourished children under the age of five persists in developing nations. In East and Southern Africa, the country has the highest rates of undernourishment, jeopardizing not only individual lives but also the economic development of the succeeding generation through missed chances, wasted resources, and lost educational possibilities. Over the past ten years, malnutrition is thought to have killed over 600,000 children under the age of five. It is estimated that 43,000 young children will have died prematurely in just 2010 as a result of malnutrition (Ismail *et al.*, 2020; Akombi *et al.*, 2017).

Malnutrition affects people, especially farmers and other labourers, often women, who are weakened by stunting, inadequate energy intake, and anaemia (Vir, 2016). Due to this, farmers are unable to exert much effort, leading to smaller harvests and reduced labour productivity. Malnutrition also lowers the likelihood of economic progress because people with delayed brain development from inadequate nutrition during childhood are less creative and able to seize new market possibilities (Siddiqui *et al.*, 2020; O'Connell and Smith, 2016). Malnutrition also wastes money that might otherwise be spent by the government. Resources are wastefully used in the health industry to treat illnesses that could be prevented with proper nutrition (Global Panel, 2016).

Tanzania invests a lot of money on primary and secondary education, but the results aren't as good as they could be because children don't get the basic food required during their vital first two years of life, which are crucial for a child's healthy brain development. (Victora *et al*., 2008; World Bank, 2007). In other words, malnutrition impairs physical and mental growth, leading to poor brain development, poor school performance, and low productivity (UNICEF, 2019). As a result, it is a severe issue since it has long-lasting negative impacts on people's health and financial well-being, diminishing human potential and productivity (Downward *et al.*, 2021).

In Tanzania, about 34% of under five children, suffer from chronic malnutrition or stunting (URT, 2019). Severe stunting affects 11.5% of children throughout the country. All in all, more than 2.7 million children in Tanzania are stunted, which will have an impact on their future prospects in terms of education, productivity, and their capacity to escape poverty (World Bank, 2018).

Based on data from the 2015–16 DHS-MIS, it was found that 34% of children under the age of five are affected by stunting, and 5% suffer from acute malnutrition, such as wasting or low weight-for-height. Conversely, 4% of children are classified as overweight. Stunting becomes more prevalent as a child grows older, with rates reaching 40% or more among children aged 18–47 months. In the age group of 24-35 months, one in six children is severely stunted. Significantly, stunting is more widespread in Tanzania Mainland (35%) compared to Zanzibar (24%) according to Sunguya et al. (2019). The regions of Rukwa (56%), Njombe (49%), and Ruvuma (44%) have the highest prevalence of stunting, whereas the Dar es Salaam region exhibits the lowest rate (15%). In contrast, Zanzibar experiences a higher incidence of wasting (7%) than Tanzania Mainland (4%), with particularly high rates in

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Kusini Pemba (9%), Kaskazini Pemba (9%), and Kusini Unguja (8%) (Faustini *et al.,* 2022. Generally, as maternal education levels increase, the rates of stunting, wasting, and being underweight tend to decrease (Khamis *et al.,* 2019; URT, 2016).

Moreover, according to Chirande *et al.* (2015) and Ministry of Health (2015) in Arusha region undernutrition was estimated to be 36%. This indicates that malnutrition among children is still high and disturbing despite the government and other agents' attempts, such as food fortification, to reduce malnutrition among the under-five population. Nonetheless, the nutritional status of children under the age of five in Arumeru district has not been adequately assessed. Hence, this study aims to investigate the nutrition status of under-five children in the mentioned district.

MATERIALS AND METHODS

The research took place in the Arusha Region, which is among the three regions impacted by malnutrition; others are Shinyanga and Simiyu. The study site was Arumeru District. This district was selected because it is among the highly affected by malnutrition of under five in the Arusha Region with the under-five being stunted (36%), with wasted growth (6.5%) and underweight (20.2%) (Mdimu *et al.,* 2020; Kejo *et al.,* 2018). The study involved households as a sampling unit whereby heads of the household were interviewed.

A sample size of 399 household respondents was expected to be used as determined by the Taro Yamane formula for a known population of 866,237 households found in the study area as follows:

$$n = \frac{N}{1+N(e)^2} = \frac{866.237}{1+866.237(0.05)^2} = 399$$

However, the study managed to collect a sample of 382 respondents. The study employed multi-stage random sampling whereby three stages were applied in the sampling process. In the first stage, the study sampled the four wards randomly from the district. In the second stage, one village was sampled from each ward and the proportionate sample of the households was picked randomly from a list of households residing in a particular village or street, which was provided by the village/street executive officer.

Methods of Data Collection

This study was undertaken using a triangulation of methods, including qualitative and quantitative methods. The data was analyzed using a blend of qualitative and quantitative methods. It is increasingly acknowledged in the development studies literature that utilizing a thoughtful combination of qualitative and quantitative approaches can effectively address challenges associated with each method individually (Birkinshaw *et al.,* 2011).

The quantitative data were collected using a structured household survey whereby a questionnaire was designed to collect information on socio-demographic and economic attributes of the sampled population, under five nutrition status in the study area, food diversity and food intake among under five children.

Methods of Data Processing and Analysis

Qualitative data were analysed with the villages involved in participatory assessments by triangulation. Data regarding the under-fives' nutritional status at the household level were analysed using Body Mass Index (BMI) and Basal Metabolic Rate (BMR). The Dietary Diversity Score (DDS) of meals was used to evaluate the under-fives' food intake, and descriptive statistics was employed to evaluate the under-fives' daily food intake.

The BMI was computed as;

$$BMI = \frac{Weight\ (Kg)}{Height\ (m^2)}$$

The DDS indicator was computed as follows:

$$HDDS\ indicator = \frac{Sum(HDDS)}{Number\ of\ food\ richesy\ hh} x100$$

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RESULTS AND DISCUSSIONS

Socio-economic status of the Respondents

Marital Status

The marital status variable was included in the study as it may have a significant contribution in the care of children under five including the case of nutrition at the household level relative to income and family stability. It was found that out of 297 respondents, 82.2% were married hence had complete families, and 0.3% were divorced. Those who were never ever married were only 9.4%.

Education Level

The education variable has a significant position in influencing the nutrition status of the under five children at the household level. A well-educated person is expected to have a wider perspective of understanding nutrition issues and has high receptivity index of adopting positive changes including the required nutrition behaviour of under five children. It was explored that the majority of respondents (57.4%) had completed primary school education and 2.4% had informal education and higher education were 4.1% (*Table 1*). This implies that only a few respondents can be able to understand thoroughly the nutrition of under five children nutrition messages.

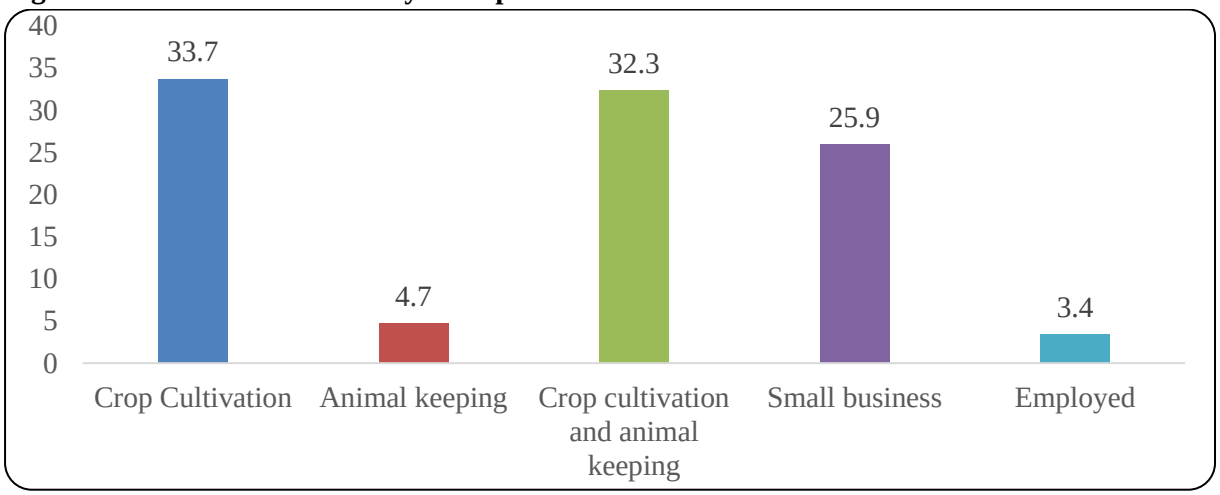
Table 1: Distribution of respondents by education level

Level of Education	Frequency	Percent
Non-formal education	7	2.4
Primary Education	170	57.4
Secondary education (form four)	91	30.7
Secondary education (Advanced level)	8	2.7
Tertiary education	8	2.7
High education	12	4.1
Total	296	100.0

Occupation

The occupation variable is very significant when one talks about the nutrition of those under five. This is so because there is a direct correspondence between the type of occupation and income level, food security as well as dietary diversity at the household level. It was observed that the majority of the respondents were peasant farmers involved in crop cultivation (*Figure 1*).

Figure 1: Main economic activity of respondents



Likewise, income plays a vital role in the agricultural production economy and related activities, allowing farmers to modernize their methods and mitigate the risks of food shortages during unexpected crop failures. The income levels of the respondents were also examined,

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revealing that a significant portion (43.3%) of the surveyed households had an income ranging from TZS 11,000 to TZS 30,000 per month per adult equivalent, with an average of TZS 17,864.35. Comparatively, the national food poverty line stood at TZS 26,085 per adult equivalent per month in 2012, as indicated by the 2017/18 Household Budget Survey (Ministry of Finance and Planning, 2019).

Another socio-economic factor examined was the primary occupation of the household head. The analysis revealed that the majority (47.9%) of household heads were engaged in mixed farming, involving both crop cultivation and livestock rearing. Crop production ranked as the second most significant occupation. This finding holds crucial implications for the decisions made by households regarding farm production. The extent of reliance on farming as the primary occupation can influence agricultural production positively or negatively, depending on the accessibility and distribution of household resources.

In situations where farm families face financial constraints due to low income from farming, they may heavily depend on family labor and use minimal technological input for their farming activities. As a result, these families are more susceptible to food insecurity, as they might encounter difficulties in accessing enough food in case of crop failure or low crop yields. This finding is in similarity with Boserup's, Sen's, and Woldemeskel's Theories.

Table 2: Heads of household's characteristics (n=297)

Characteristics	Minimum	Maximum	Mean	Std. Deviation
Age of the respondent	18.00	58.00	31.65	8.56
Household size	1.00	10.00	4.74	1.68
Number of children under five	1.00	3.00	1.22	0.43

Table 2 presents the descriptive statistics of the respondents. The average age of the respondents was approximately 31 years. The typical household size consisted of nearly five members, and on average, there was one child under the age of five in each family.

The Under-five Nutrition Status at Household Level

The Under-five Nutrition Status by Using Body Mass Index Indicator

Furthermore, the study focused on evaluating the nutrition status of children under the age of five at the household level in Arumeru District. The Body Mass Index (BMI) was utilized as a measure of under-five nutrition status in this context. To assess the nutrition status of these young children, the researchers collected direct data on individual children's nutritional status, primarily through anthropometric measurements of height and weight. This information was also supplemented with data on the children's age to gain a comprehensive understanding of their nutrition status (Govender *et al.*, 2021**)**. In the Arumeru district, the determination of under-five children's nutrition status relied on the direct relationship between an individual's nutritional status, height, and weight. To achieve this, the researchers used Body Mass Index (BMI) as a measure. However, it is important to note that BMI cannot be averaged, but the study was able to identify the minimum and maximum values for individuals in the two districts.

The normal range for individuals who are neither underweight nor overweight is typically considered to be within 18.5 – 25.0 kg/m2, according to Zierle-Ghosh and Jan (2022). This range serves as an indicator of the nutritional status of both adults and children, reflecting chronic energy deficiency, as highlighted by Dagne et al. (2021).

BMI is directly proportional to weight but inversely proportional to the square of height. Consequently, if all body dimensions double and weight scales (which is naturally coupled with the cube of height), then BMI will also double, rather than remaining the same.

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These differences result in taller individuals having reported BMI values that may appear unusually high compared to their actual body fat levels. An alternative index called the Ponderal Index (PI) takes into account the natural scaling of weight with the third power of height. However, since taller individuals often have narrower frames in proportion to their height, a more appropriate exponent for the PI might be between 2.3 and 2.7.

One common use of the BMI is to assess how much an individual's body weight deviates from what is considered normal or desirable for a person of their height. The excess or deficiency in weight may be partly attributed to body fat (adipose tissue), although other factors, such as muscularity, also significantly influence BMI.

Table 3: Distribution of selected Under five Children by groups of weight (n = 62)

Group of weights	Arumeru District (N=62)	
	Frequency	Percentage
Underweight (< 18.50)	34	54.8
Normal weight (18.50 – 24.99)	17	27.4
Overweight (≥ 25.00)	11	17.8
Total	**62**	**100.0**

As stated by Zierle-Ghosh and Jan (2022), a BMI of 18.5 or lower is considered underweight and may indicate malnutrition, an eating disorder, or other health issues. A BMI of 25 or higher is classified as overweight, while a BMI of 30 or higher is categorized as obese. These BMI ranges are mainly applicable as statistical categories when evaluating adults. It's important to note that BMI levels are gender-neutral and age-independent.

However, the applicability of BMI may vary among different populations due to differences in body proportions. Therefore, BMI may not always correlate with the same level of fatness in all individuals.

The health implications associated with increasing BMI levels remain an ongoing concern, and different groups may interpret BMI grading in relation to health risks differently.

Basal Metabolic Rate Approach to Nutrition Status

According to BMI Calories (2015), an individual's daily recommended calorie intake can be calculated based on their weight in kilograms, level of muscle mass, and activity level. Weight is a critical factor because as one's weight increases, more calories are required to maintain their body. Muscle mass also plays a significant role, as a kilogram of muscle can burn up to 50 more calories per day compared to a kilogram of fat. Moreover, the level of activity is essential to consider, as individuals with more physically demanding jobs or exercise routines burn more calories than those with sedentary lifestyles.

The formula used to calculate an individual's basal metabolic rate (BMR) is based on weight and yields an estimate of the calories required for basic bodily functions. To account for activity level, the BMR is multiplied by a specific percentage, such as 1.2 for sedentary individuals, 1.3 for moderately active individuals, and 1.4 for extremely active individuals.

The data collected during the growing season indicated a high level of activity, which corresponds to a BMR factor of 1.4. The Cunningham formula, BMR=500 + 2.2 LBM, where BMR is the Basal Metabolic Rate and LBM is the Lean Body Mass, was used for the calculations.

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Table 4: Mean BMR for the selected under-five children

Ward	Mean energy intake (BMR)(kCal)	Minimum (kCal)	Maximum (kCal)
Kikwe	1987.9	1878.8	2210.6
Akheri	1988.0	1999.7	2243.5
Nkoaranga	1899.4	1879.9	2231.5
Sing'isi	1998.8	1989.6	2319.4

Using the two cut-off thresholds of 2,100 kcal per capita per day and 2,200 kcal per adult equivalent, it was discovered that 15.8% and 28.3% had fewer daily energy consumption. (*Table 4*). This strategy, however, fell short since it relied on a pulse rate that was assumed to be a constant 66.0 revolution per minute (rpm) for everyone, including youngsters. The validity of this approach is based on the observation that dietary energy requirements vary depending on exercise level.

The Food Diversity Among Under five at The Household Level

The Dietary Diversity Score (DDS) of meals was used to analyze the variety of foods consumed by children under the age of five. This indicator counts all food consumed in the past 24 hours by all household members who live at home, including food cooked at home but consumed elsewhere (Maxwell, 2013). The study employed the USAID (2006) method to assign a score of 0 or 1 to various food items that were consumed in the study area: Cereals score an A, whereas vegetables, fruits, and roots and tubers all earn Bs. Meat, poultry, and offal were some of the others. F is for eggs, G is for fish and seafood. Milk and milk products are an H, while pulses, legumes, and nuts are an I. J = Oil and Fats. Honey and sugar both equal K, while other items equal L. The food groups included in the HDDS are intended to represent a variety of foods, from those that don't contribute to a nutritious diet but cost money to buy, such sugar, sweets, beverages, and sauces, to those that raise the nutritional value of the diet by providing necessary nutrients. These latter foods consist of grains, fruits, vegetables, fats, oils, and protein from animal sources. This indicator can be used to evaluate food security because it reveals how much a balanced diet is consumed at the household level. The USAID method uses a 12-food group diet as a proxy for assessing the nutritional value of household and personal diets. It was discovered that some food groups were not consumed throughout the study period because they were unavailable or not yet ready for eating.

ChatGPT

The study used the Dietary Diversity Score (DDS) to assess the variety of foods consumed by children under the age of five. This indicator takes into account all the food consumed in the past 24 hours by all household members living at home, including food prepared at home but eaten elsewhere (Maxwell, 2013). The scoring method employed in the study was based on the USAID (2006) approach, assigning a score of 0 or 1 to different food items consumed in the study area. For example, cereals received an A score, while vegetables, fruits, roots, and tubers were categorized as Bs. Other items such as meat, poultry, and offal were scored differently, and so on, through the various food groups.

The purpose of including specific food groups in the HDDS was to represent a range of foods, from those that do not contribute significantly to a nutritious diet but still incur expenses (e.g., sugar, sweets, beverages, and sauces), to those that enhance the nutritional value of the diet by providing essential nutrients. The latter category includes grains, fruits, vegetables, fats, oils, and animal-source proteins. The HDDS is useful for evaluating food security as it indicates the extent to which a balanced diet is being consumed at the household level.

The USAID method employs a 12-food group diet as a proxy to assess the nutritional value of household and personal diets. However, some food groups were not consumed during the study period due to their unavailability or not being ready for consumption.

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Based on the criterion of food availability, only 11.7% of the households in the study area were classified as the richest, as their DEC per capita and per adult equivalent did not lead to a reduction in the amount of food for their own consumption during the reference period of 2021/2022. This percentage is below the recommended WHO threshold of 33.3%. The data indicates that a significant proportion (88.3%) of the under-five children population in the study area suffers from micro and macronutrient deficiency, indicating food and nutrition insecurity.

Additionally, Table 5 provides the frequency and percentage distribution of food dietary diversity scores in the selected wards of Arumeru District for the year 2021/2022.

Table 5: Frequency and percentage distribution of Food Diversity Score

Score	Frequency	Percent
1.00-2.00	124	41.8
5.00-8.00	88	29.7
9.00-11.00	52	17.5
12.00-15.00	33	11.1
Total	297	100.0

It can be observed from *Table 5* that the number of households that got the recommended cut-off point for the dietary diversity score of ≥12 varieties per day was only 11.1%, also showing that a large proportion of the under five children population (88.9%) in the study area suffers from micro and macronutrients deficiency hence food nutrition insecure.

Food Intake among Under five at Household Level

Food Intake Profile

The respondents were asked to prepare special food for those under five. Findings show that 236 out of 291 respondents agreed that they are preparing special food for under five children. *Table 6* shows that 31.6% of the respondents do prepare food while 14% prepare nutritious food, which is made from nutritious flour purchased from shops. Other types of food for under five were banana porridge (5.4%), mixed porridge (5.7%), milk and maize porridge (5.6%) and others.

Table 6: The food intake for under five at the household level

Food	Frequency	Percent
Banana	8	2.7
Banana and normal porridge	6	2.0
Banana and rice	2	0.7
Banana porridge	16	5.4
Maize porridge and milk porridge	17	5.6
Mixed food	94	31.6
Mixed porridge	17	5.7
Normal porridge	24	8.1
Nutritional porridge	42	14.1
Rice	5	1.7
Total	**231**	**100.0**

Thus, from these findings, it is clear that foods which are important such as eggs, beans, soy products, fruits, vegetables, and dairy products are not prepared as special for them but for the whole family including the under five children.

Food Intake Frequency

Direct nutrition status indicators are measurements that have a stronger connection to food consumption rather than marketing channel data or health status. When direct indicators are

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either unavailable or too expensive to collect in terms of time and money, indirect indicators are typically used. Food frequency, which involves asking people how many meals they eat each day and how frequently they consume particular foods classified as substandard or superior, is one of the key direct measures of nutrient status. According to Table 7, the majority of the study area's children under the age of five eat five times each day, which is the recommended frequency.

Table 7: Meals Frequency among those under five per day

Ward	Meals Frequency among Under five Per Day						Total
	Once	Twice	Three times	Four times	Five times	Six times	
Kikwe	0	1	12	25	75	3	116
Nkoaranga	0	2	6	22	25	4	59
Akheri	2	4	22	17	28	4	77
Sing'isi	0	2	3	11	12	2	30
Total	2	9	43	75	140	13	282

CONCLUSION AND RECOMMENDATIONS

Overweight and inappropriate feeding practices still affect the under-five population in the research area. Also, the under-nutrition problem among these children becomes more severe due to the incomplete meal frequency and lack of a separate budget for children under the age of five, who then share meals with adults. This is because the per capita dietary intake as measured by dietary energy consumption per adult equivalent differs greatly. The paper advises extension officers (food nutritionists and development partners) to alter household members' mentalities through on-site training in order to empower the communities to prepare different types of food for children under the age of five using their own local resources and food available in their respective surroundings.

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