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Household and Community Factors Affecting Nutritional Status of Under-five Children (6-59 months) in Gairo District Using Composite Index of Anthropometric Failure

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Abstract

In Tanzania, where the majority of under-five children are affected, undernutrition is still a significant public health concern. The study aimed at assessing the prevalence of undernutrition and its determinants among under-five children in Gairo District using a Composite Index of Anthropometric Failure (CIAF). A household-based cross-sectional study was employed involving 300 under-five children with their mothers/caregivers in three wards in the Gairo District. Data collection on socio-demographics, dietary diversity, and healthcare factors were collected by interviewer-based semi-structured questionnaires. Anthropometric measurements using standard procedures were performed to collect anthropometric data. Odds ratios with a 95% confidence interval and p-value ≤ 0.05 were used to identify determinants of undernutrition. Prevalence of undernutrition using CIAF was 57.3%, whereby children with single failure were 105 (61%), double failures were 62 (36%) and triple failures were 5 (2.9%). Factors that were significantly associated with undernutrition were the nearest health facility (p = 0.014; OR: 0.504 (0.291-0.873)), place of delivery (p = 0.000; OR: 0.717 (0.107-0.490)), source of drinking water (p = 0.001; OR: 0.452 (0.283-0.722)), type of latrine (p = 0.000; OR: 21.338 (9.807-46.427)), household solid waste disposal method (p = 0.012; OR: 1.806 (0.682-1.964)), birth weight (p = 0.000; OR: 5.400 (2.625-11.109) and marital status (p = 0.00; OR: 0.403 (0.240-0.676)). Therefore, nutrition intervention efforts should be given to the factors reported to positively affect undernutrition.

Keywords: Undernutrition, factors, Gairo, under-five, CIAF.

Introduction

Under-five children are the most vulnerable group where undernutrition contributes to their morbidity and mortality. Undernutrition is believed to be responsible for more than half of the global burden of anthropometric failure among under-five children (Sen and Mondal 2012). The best single indicator of social development and wellbeing is under-five mortality rate than gross national product per capita (Dasgupta et al. 2015).

The prevalence of undernutrition among children in Tanzania is still high. According to the Tanzania National Nutrition Survey (TNNS) the prevalence of stunting, underweight and wasting were 31.8%, 14.6% and 3.5%, respectively (MoHCDGEC 2018). Undernutrition can be assessed in many ways based on conventional indicators such stunted versus not stunted, underweight versus not underweight and wasted versus not wasted, whereby most of the previous research on anthropometric failure were based on

conventional indicators (Gausman et al. 2021). However, in anthropometric failure a child may be categorized as stunted in conventional indicator while he/she may either have single or multiple failures (Jeong et al. 2019).

The most recent way of assessing undernutrition is through Composite Index of Anthropometric Failure (CIAF), which was initially proposed by Svedberg and later modified by Nandy (Dasgupta et al. 2015). The model considers all parameters of estimation of nutritional status of under-five children, since an underweight child can also be stunted and/or wasted (Nandy and Miranda 2008). Several researchers have reported that CIAF is a more useful than the conventional anthropometric measure for assessing prevalence of undernutrition (Nandy et al. 2005).

Although many studies are available on assessing the prevalence of undernutrition among under-five children in Tanzania, data on levels of undernutrition is missing in Gairo District. This study used CIAF to assess the nutritional status of under-five children in Gairo District. Determining the magnitude of under nutrition and its risk factors will help health administrators and policy makers to act on the factors identified for prevention and control of undernutrition in the district.

Materials and Methods

Study area

The study was conducted in Gairo District in Morogoro Region. The study involved three wards (Gairo, Kibedya and Mandege). Agricultural production is the main source of food in the district, with the major crops being maize, millet, sweet potatoes and beans. The study area was selected because there are no studies that have investigated the household and community factors affecting nutritional status of under-five children in Gairo District.

Study design

The study was a cross-sectional type and simple random technique was used to select wards. Using prevalence rate of stunting in Morogoro Region (26.4%) (MoHCDGEC et al. 2018) with the normal distribution of 95% and absolute error of 5%, a total of 300 mothers/caregivers and their children were recruited. A sample size was determined by using Cochran's formula as adopted by Bartlett et al. (2001). The formula used was:

$$n = \frac{Z^2 p (1-p)}{d^2}$$

Where, Z^2 = standard normal distribution at 95% equal to 1.96, P = estimate of stunting prevalence 26.4% (0.264), d = absolute error of 5% which is equal to 0.05,

Hence, $n = 1.96^2 \times 0.264 (1-0.264)/0.05^2$,

$n = (3.8416 \times 0.1943)/0.0025$,

$n = 298.57$,

$n = 300$.

Therefore, a total of 300 children were recruited.

Data collection and instruments

A semi-structured questionnaire and standard equipment were used to collect data. The information collected was anthropometric measurements, demographic characteristics and household and community characteristics.

Anthropometric measurements

Standard technique and equipment were used for anthropometric measurements of weight and height. Weight of a child was measured and recorded to the nearest 0.1kg (accuracy of 100 g) using a SECA weighing scale for both children who could stand themselves and those who could not. A scale was placed on flat surface and adjusted to zero. Children above 2 years were asked to step on the scale and measurements were recorded. For children below 2 years, mothers/caregivers were asked to step on the scale without the child, the scale was set to zero, the child was given to the mother/caregiver, and then weight of a child was recorded.

Recumbent length of the child under 2 years old was measured with the subject lying in a supine position on a length measuring board, which had a fixed head rest and a movable foot piece and placed on a flat surface. Care was taken to maintain the subject's head in an upward upright position,

with legs stretched to a full extent and feet at right angles with legs. After positioning the child, the foot piece was moved to touch the feet and the length was recorded to the nearest 0.1 cm. For children older than 2 years heights were measured using a stadiometer. Measurement was recorded while the subject was standing without shoes on a horizontal flat plate attached to the base of the stadiometer with their heels together. The subject was closely observed to ensure that the heels remained on the plate and that the head was in upright position during the measurement. The headpiece was then brought down on the subject's head and reading taken.

Age was obtained from the neonatal cards and recall of the mother. Anthropometric indices that were used were height-for-age Z-score (HAZ), weight-for-age Z-score (WAZ), and weight-for-height Z-score (WHZ), and these were compared to reference values recommended by the National Centre for Health Statistic (NCHS) (WHO 1995). The low indices of HAZ, WAZ and WHZ were used to categorize children in different Composite Index of Anthropometric Failures (CIAFs).

To determine the prevalence of undernutrition, CIAF was constructed using all children who had any form of anthropometric indicators on the basis of Z-scores. According to CIAF classification, children are divided into seven groups such as no failure (A), wasting only (B), wasting and underweight (C), wasting, stunting and underweight (D), stunting and underweight (E), stunting only (F) and underweight only (Y) (Nandy et al. 2005). The total prevalence of undernutrition (CIAF) was measured by summation of all groups except group A. CIAF classification is shown in Table 1.

Table 1: Classification of children with anthropometric failure

Groups	Description	Wasting	Stunting	Underweight
A	No failure	No	No	No
B	Wasting only	Yes	No	No
C	Wasting and underweight	Yes	No	Yes
D	Wasting, stunting and underweight	Yes	Yes	Yes
E	Stunting and underweight	No	Yes	Yes
F	Stunting only	No	Yes	No
Y	Underweight only	No	No	Yes

Source: Nandy et al. (2005).

Therefore, CIAF = B + C + D + E + F + Y

Dietary diversity score

The dietary diversity score was adopted from Infant and Young Child Feeding practices (USAID/AED/FANTA/UCDAVIS/IFPRI/UNICEF/WHO 2008). A dietary diversity score was calculated by summing the seven food groups categorized from the list of food items a child consumed in the past 24 hours, using a 24 hours recall method. The food groups included: (i) grains, roots and tubers (ii) legumes and nuts (iii) dairy products (milk, yogurt and cheese) (iv) flesh foods (meat, fish, poultry and liver/organ meat) (v) eggs (vi) vitamin A rich fruits and vegetables (vii) other fruits and vegetables. A value of one (1) was assigned if a child consumed one of the food groups and zero (0) was assigned if a particular food group was not consumed. Then the scores were summed up to obtain the dietary diversity score. A dietary diversity score of 4 or greater than 4 food groups was regarded as a minimum dietary diversity.

Ethical considerations

The permission to carry out this study was granted by the National Institute for Medical Research (Certificate No. NIMR/HQ/R.8a/Vol. IX/3926). An informed consent was obtained from each mother/caregiver. Participants were assured for confidentiality of the information provided.

Statistical analysis

Anthropometric data were processed using WHO Anthro Software version 3.2.2. Data were exported to the Statistical Package for the Social Sciences (SPSS) software version 20 for further analysis. Descriptive analysis (frequencies and percentages) was performed. Multiple regression analysis was performed to compare group variables on household and community factors. The analyses were set at $p \leq 0.05$ levels of significance.

Results and Discussion

Results

Anthropometric failures of under-five children

According to the CIAF classification, 172 children (57.3%) were undernourished, 105 children(61%) suffered from single anthropometric failure (groups B, F and Y), 62 children (36%) suffered from double anthropometric failures (groups C and E) and 5 children (2.9%) experienced triple anthropometric failures (group D) (Table 2).

Table 2: Anthropometric failure of under-five children according to wards

Groups	Categories of CIAF	n	%
A	No failure	128	42.7
B	Wasting only	3	1.0
C	Wasting and underweight	3	1.0
D	Wasting, stunting and underweight	5	1.6
E	Stunting and underweight	59	19.7
F	Stunting only	99	33.0
Y	Underweight only	3	1.0
	CIAF (B + C + D + E + F + Y)	172	57.3

Socio-demographic characteristics of respondents

About sixty-four percent of mothers/caregivers aged 25–34 years, 68% were married, 82% were farmers and 61% had primary education. Fifty-six percent of households had more than five family members, 59% had one under-five child. Sixty-seven percent of under-five children live with their fathers and mothers. About 67% of children aged 24–59 months and 79% of children had birth weight ≥ 2.5 (Table 3).

Table 3: Socio-demographic characteristics of respondents

Socio-demographic characteristics		**n**	**%**
Maternal/caregiver age	15–24 years	109	36.3
	25–34 years	133	44.3
	Above 35 years	58	19.3
Maternal marital status	Married	205	68.3
	Single	95	31.7
Maternal occupational	Farmer/pastoralist	246	82.0
	Employed	34	11.3
	Housewife	20	6.7
Maternal education	Primary school	183	61.0
	Secondary/Tertiary	45	15.0
	Illiterate	72	24.0
Child's sex	Male	148	49.3
	Female	152	50.7
Child's age	6–11 months	29	9.7
	12–23 months	70	23.3
	24–59 months	201	67.0
Birth weight	≥ 2.5 kg	236	78.7
	< 2.5 kg	64	9.3

Healthcare characteristics of respondents

Seventy-one percent of the respondents reported that the nearest health facility was a dispensary, and 73% used less than one hour to the nearest health facility. The most reported place of delivery was a health facility (71.3%) and 76.4% of under-five children were fully immunized. Sixty seven percent of mothers used family planning methods and all mothers reported to have attended antenatal clinic during pregnancy (Table 4).

Table 4: Healthcare characteristics of respondents

Healthcare characteristics		**n**	**%**
The nearest health facility	Hospital	78	26.0
	Dispensary	213	71.0
	Community/village health	9	3.0
Hours to health facility	Less than 1 hr	219	73.0
	Greater than 1 hr	81	27.0
Transport used	Walking	297	99.0
	Motorcycle	3	1.0
Treatment when child sick	Government health facility	259	86.3
	Pharmacy or drug store	41	13.7
Place of delivery	Health facility	214	71.3
	Home	86	28.7
Immunization status	Not immunized	1	0.3
	Fully immunized	229	76.4
	Currently in immunization	70	23.3
Used family planning?	Yes	201	67.0
	No	99	33.0
Attended antenatal clinic?	Yes	300	100.0
	No	0	0.0
Frequency of attendance	2-3 times	54	18.0
	4 and above	246	82.0
Folic acid taken	Yes	287	95.7
	No	13	4.7

Environmental characteristics and dietary diversity

The main source of food was own production (53.7%), the main source of drinking water was improved water sources (63.7%) and 54.7% used pit latrines. About 56% of the respondents reported burning as a method of solid waste disposal, 52% of children consumed three meals per day and the highest (84.3%) dietary diversity score was four or greater than four scores (Table 5).

Table 5: Environmental characteristics and dietary diversity

Environmental and dietary diversity		**N**	**%**
Main source of food	Own production	161	53.7
	Own production and purchase	139	46.3
The source of drinking water	Improved water source	191	63.7
	Un improved water source	109	36.3
Water treatment practice	Boil/add chlorine	57	19.0
	None	243	81.0
Type of latrine	Pit latrine	167	55.7
	Improved pit latrine	133	44.3
Household solid waste disposal	Collected by municipality	25	8.3
	Burying/dispose in compound	106	35.3
	Burning	169	56.4
Dietary diversity score	Greater/equal to 4	253	84.3
	Less than four	47	15.7
Number of meals	One/two	19	6.3
	Three	155	51.7
	Four and above	126	42.0

Logistic regressions analysis on socio-demographic characteristics

Maternal/caregiver age, occupation, education, child's age and child's sex were not significantly associated with undernutrition. Significant association were found for married mothers/caregivers (p = 0.00; OR: 0.403 (0.240–0.676)) and for children with birth weight ≥ 2.5 kg (p = 0.000; OR: 5.400 (2.625–11.109)) (Table 6).

Table 6: Logistic regression analysis on socio-demographic

Socio-demographic characteristics		**OR (95% CI)**	***P*-value**
Maternal/caregiver age	15–24 years	0.938 (0.448–1.962)	0.986
	25–34 years	0.955 (0.475–1.923)	0.898
	Above 35 years	1	
Maternal marital status	Married	0.403 (0.240–0.676)	0.001*
	Single	1	
Maternal occupation	Farmer/pastoralist	1.808 (0.665–4.911)	0.246
	Government employed	0.987 (0.300–3.254)	0.983
	Housewife	1	
Maternal education	Primary school	1.361 (0.765–2.423)	0.294
	Secondary/Textually	2.078 (0.918–4.703)	0.079
	Illiterate	1	
Child's sex	Male	1.163 (0.706–1.015)	0.554
	Female	1	
Child's age	6–11 months	0.989 (0.401–2.438)	0.981
	12–23 months	1.112 (0.611–2.024)	0.729
	24–59 months	1	
Birth weight	≥ 2.5 kg	5.400 (2.625–11.109)	0.000*
	< 2.5 kg	1	

Logistic regression analysis on healthcare, environmental and dietary diversity

The model revealed that children born at health facilities were significantly associated with undernutrition (p = 0.000; OR: 0.717 (0.107–0.490)). Also improved water source (p = 0.001; OR: 0.452 (0.283–0.722)), use of pit latrines (p = 0.000; OR: 21.338 (9.807–46.427)) and burying/dispose of solid waste (p = 0.012; OR: 1.806 (0.682–1.964)) were significantly associated with undernutrition. Immunization status, the use of family planning methods, water treatment practices, dietary diversity score and number of meals were not significantly related to undernutrition (Table 7).

Table 7: Logistic regression analysis on healthcare, environmental and dietary diversity

Healthcare, environmental and dietary diversity		**OR (95% CI)**	***P*-value**
The nearest health facility	Hospital	0.504 (0.291–0.873)	0.014*
	Dispensary/village center	1	
Place of delivery	Health facility	0.717 (0.107–0.490)	0.000*
	Home	1	
Immunization status	Fully immunized	1.349 (0.778–0.911)	0.392
	Currently in immunization	1	
Used family planning	Yes	0.890 (0.498–1.591)	0.695
	No	1	
The source of drinking water	Improved water sources	0.452 (0.283–0.722)	0.001*
	Un improved water sources	1	
Water treatment practices	Boil/add chlorine	0.812 (0.450–1.46)	0.490
	None	1	
Types of latrine	Pit latrine	21.338(9.807-46.427)	0.000*
	Improved pit latrine	1	
Household solid waste disposal	Collected by municipality	0.636 (0.134–3.026)	0.673
	Burying/dispose in compound	1.806 (0.682–1.964)	0.012*
	Burning	1	
Dietary diversity score	Greater/equal to 4	0.740 (0.397–1.383)	0.345
	Less than 4	1	
Number of meals	One/two	1.513 (0.573–3.991)	0.403
	Three	1.458 (0.903–2.355)	0.123
	Four and above	1	

Discussion

The prevalence of undernutrition using CIAF was found to be 57.3%, which is higher than the one that was reported by Khamis et al. (2020) (38.2%) in Tanzania and 47.8% which was reported by Savanur and Ghugre (2015) in the slums of Mumbai City. On the other hand, the rate was lower than 73.1% which was reported by Mandal and Bose (2009) in Hooghly west Bengal and 80.3% which was reported in Bankura District in west Bengal (Shit et al. 2012). These differences could either be attributed to various factors such as conditions of living, feeding practices, maternal health, socio-economic status and the rate of infections. The factors associated with undernutrition in this study were nearest health facility, place of delivery, and source of drinking water, type of latrine, household solid waste disposal method, birth weight and marital status.

Significant association was seen between marital status and undernutrition whereby children from married mother/caregivers were less likely to be undernourished. This study was in line with the findings of the study by Khamis et al. (2020). Married

mothers/caregivers are expected to be in good socio-economic status as their partners help them in income generation and childcare.

The study found no association between mothers/caregivers education level and undernutrition. The findings of this study are similar to those of Permatasari and Chadirin (2022) that found no difference between children from educated mothers and uneducated ones in terms of anthropometric failure, but different from the findings reported by Asif et al. (2018) that there was an association between maternal education and anthropometric failures as children from educated mothers had a lower risk of being undernourished because educated mothers understand health information provided via different media.

This study found no significant differences between two genders and undernutrition as well as between child's age and undernutrition. The findings were similar with those of Daral et al. (2017) but different from those of Fenta et al. (2021). As age increases, undernutrition also increases. This could be caused by the fact that child's nutritional needs are not fulfilled as age increases. This may increase the chances of undernutrition.

The current study found association between birth weight and undernutrition in which CIAF was more likely in children with average/larger birth weight. These findings are similar with the findings of Islam and Biswas (2020). This may be due to overestimation of children with ≥ 2 kg birth weight since birth weight was collected from neonatal cards and recall of the mother.

The study found an association between the source of drinking water and the type of latrine used in the household with undernutrition. The findings corroborate with the study conducted in Odisha by Ansary and Rath (2021) and Soni et al. (2022) in which latrine type and source of drinking water were associated with undernutrition. An access to safe drinking water and improved latrines are the preventive measures against exposure to pathogens and diseases at the same time undernutrition will be reduced (Clasen et al. 2014, Kochupurackal et al. 2021).

The nearest health facility and the place of delivery were shown to be significantly associated with undernutrition. These findings agree with the findings from Tanzania in which prevalence of anthropometric failure was higher among children born at home than those born at health facilities (Khamis et al. 2020). Also, Shahid et al. (2022) reported that when distance to health facility increases, undernutrition also increases. Effective transport services were identified as barriers to the health facilities. Subjects spend long time to reach health facilities (some spend more than three hours to reach the facility). This increases the number of mothers who do not visit antenatal clinic as well as the number of mothers who deliver at home.

The study found no association between dietary diversity and anthropometric failures. The reason for this result was not figured out. These results corroborate the findings of Khamis et al. (2020).

Conclusion

The findings of this study revealed that, the prevalence of undernutrition was considerably high in the study area as estimated by CIAF and was still an important problem among under-five children in Gairo District.

The factors associated with undernutrition were the nearest health facility, place of delivery, source of water, type of latrine, household solid waste disposal method, birth weight and marital status. It would be important to increase much nutrition and health related intervention efforts on improving the living environment of children by ensuring access to safe drinking water, safe and nutritious food resources and health care conditions such as equal access to reproductive and child health care services.

Declaration of Interest: No conflict of interest to declare.

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