SOKOINE UNIVERSITY OF AGRICULTURE

MSc Dissertation

Prevalence and Factors Associated with Undernutrition among Under-five Children in Gairo District, Morogoro, Tanzania

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PREVALENCE AND FACTORS ASSOCIATED WITH UNDERNUTRITION AMONG UNDER-FIVE CHILDREN IN GAIRO DISTRICT, MOROGORO, TANZANIA

***A dissertation submitted in partial fulfillment of the requirements for the degree of masters of science in Human Nutrition of Sokoine University of Agriculture, Morogoro, Tanzania*.**

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EXTENDED ABSTRACT

In Tanzania, undernutrition in children under the age of five years is a significant public health concern. Despite efforts made to combat undernutrition still Tanzania has the highest prevalence of undernutrition. Therefore, this study aimed to assess the prevalence and associated factors of undernutrition among children under-five years of age in Gairo district, Morogoro region. In three areas of the Gairo district, 300 children under the age of five years and their mothers or guardians participated in a cross-sectional household survey. A semi-structured questionnaire was used and anthropometric measurements were taken using standard procedures and techniques. The number of food groups consumed by children the day before were from 0 to 7, they were added up to create a dietary diversity score. A score of four or more food groups was then utilized as the minimum dietary diversity. The prevalence of undernutrition was assessed using the standard measures of stunting, wasting, and underweight utilizing the low indices of HAZ, WAZ, and WHZ. To determine the rate of undernutrition in the district, children were divided into distinct anthropometric failure categories using a composite index of anthropometric failure (CIAF), which was calculated using the low indices of HAZ, WAZ, and WHZ. Odds ratios with 95% confidence intervals and p-values of 0.05 or less were used to identify factors associated with undernutrition. According to this study, the prevalence of stunting was 54.3% (severe stunting 26.3% and moderate stunting 28%), underweight 23.3% (severe underweight 7% and moderate underweight 16.3%) and wasting 3.7% (severe wasting 1.3% and moderate wasting 2.4%). %). The main factors that showed positive association were; maternal occupation was associated with stunting (p = 0.002) and underweight (p = 0.026). The age of the child was linked with stunting (p = 0.030), the age of the mother during pregnancy was connected with being underweight (p = 0.046), and the area of residence was associated with stunting (p = 0.000) and underweight (p = 0.008). The CIAF showed a prevalence of undernutrition of 57.3%, with children experiencing single failure at a rate of 105 (61%), double failures at a rate of 62 (36%) and triple failures at a rate of 5 (2.9%). Factors that were significantly associated with CIAF were the nearest health facility (p = 0.014; OR: 0.504 (0.291-0.873)), location of delivery (p = 0.000; OR: 0.717 (0.107-0.490)), and water supply (p = 0.001; OR: 0.452 (0.283-0.722)) , type of latrine used (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, Governmental and non-governmental nutritional and health interventions that aim at the whole regions throughout districts are required, emphasizing enhancing the living conditions of children by ensuring that, they have equal access to food, water, and health care resources.

MUHTASARI

Nchini Tanzania, ukosefu wa lishe bora kwa watoto kati ya umri wa miaka mitano ni tatizo kubwa la afya ya umma. Licha ya juhudi zinazofanywa kupambana na utapiamlo bado Tanzania ina kiwango kikubwa cha maambukizi ya utapiamlo. Kwa hiyo, lengo la utafiti huu lilikuwa kutathmini kiwango cha maambukizi na sababu zinazohusiana na utapiamlo miongoni mwa watoto wenye umri chini ya miaka mitano katika wilaya ya Gairo, mkoani Morogoro. Katika maeneo matatu ya wilaya ya Gairo, watoto 300 walio chini ya umri wa miaka mitano na mama zao au walezi walishiriki katika utafiti wa kaya. Hojaji iliyoundwa ilitumiwa na vipimo vya anthropometric vilichukuliwa kwa kutumia taratibu na mbinu za kawaida. Idadi ya makundi ya vyakula vinavyotumiwa na watoto siku moja kabla ya utafiti yalikuwa kuanzia 0 hadi 7. Mkundi hayo yalitumika ili kuunda alama ya utofauti wa lishe. Alama ya makundi manne au zaidi ya vyakula yalitumika kama aina ndogo ya lishe. Kuenea kwa utapiamlo kulitathminiwa kwa kutumia vipimo vya kawaida vya kudumaa, ukondefu, na uzito mdogo kwa kutumia fahirisi za chini za HAZ, WAZ na WHZ. Ili kubaini kiwango cha utapiamlo katika wilaya, watoto waligawanywa katika makundi tofauti za kutofaulu kwa anthropometric kwa kutumia faharasa ya mchanganyiko wa kutofaulu kwa anthropometric (CIAF), ambayo ilikokotolewa kwa kutumia fahirisi za chini za HAZ, WAZ, na WHZ. Uwiano wa odd na vipindi vya kutegemewa vya 95% na thamani za p za 0.05 au chini ya hapo zilitumika kubainisha mambo yanayohusiana na utapiamlo. Kwa mujibu wa utafiti huu, maambukizi ya udumavu yalikuwa 54.3% (udumavu mkubwa 26.3% na udumavu wa wastani 28%), uzito wa chini 23.3% (uzito wa chini sana 7% na uzani wa wastani 16.3%) na ukondefu 3.7% (ukondefu mkubwa 1.3% na ukondefu wa wastani 2.4%). %). Sababu kuu zilizoonyesha uhusiano mzuri ni kazi ya mzazi ilihusishwa na kudumaa (p = 0.002) na uzito mdogo (p = 0.026). Umri wa mtoto ulihusishwa na kudumaa (p = 0.030), umri wa mama wakati wa ujauzito ulihusishwa na uzito mdogo (p = 0.046), na eneo la makazi lilihusishwa na kudumaa (p = 0.000) na uzito mdogo (p = 0.008). CIAF ilionyesha kukithiri kwa utapiamlo kwa asilimia 57.3, huku watoto wakifeli mara moja kwa kiwango cha 105 (61%), kufeli mara mbili kwa kiwango cha 62 (36%) na kufeli mara tatu kwa kiwango cha 5 (2.9%). Mambo ambayo yalihusishwa kwa kiasi kikubwa na CIAF yalikuwa kituo cha afya cha karibu (p = 0.014; AU: 0.504 (0.291-0.873)), eneo la kujifungua (p = 0.000; AU: 0.717 (0.107-0.490)), na usambazaji wa maji (p. = 0.001; AU: 0.452 (0.283-0.722)), aina ya choo kinachotumika (p = 0.000; AU: 21.338 (9.807-46.427)), njia ya utupaji taka ngumu nyumbani (p = 0.012; 8.6-1.9)) , uzito wa kuzaliwa (p = 0.000; AU: 5.400 (2.625-11.109)) na hali ya ndoa (p = 0.00; AU: 0.403 (0.240-0.676)). Afua za kiserikali na zisizo za kiserikali za lishe na afya zinazolenga mikoa yote katika wilaya zote zinahitajika, zikiweka mkazo katika kuimarisha hali ya maisha ya watoto kwa kuhakikisha kwamba, wanapata chakula, maji na rasilimali za afya sawa.

DECLARATION

I, TAUSI MTONGA MOHAMED, do hereby declare to the Senate of Sokoine University of Agriculture that, this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

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(Supervisor)

LIST OF PUBLISHED MANUSCRIPTS

1. Prevalence and factors associated with undernutrition among Under-five children in Gairo district (Published in Tanzania Journal of Health Research, 23(4): 1-10).

2. Household and community factors affecting nutritional status of under-five children (6-59 months) in Gairo district using composite index of anthropometric failures (Published in Tanzania Journal of Science, 49(1):76-85,2023).

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DEDICATION

To my late grandfather Said Mtonga, my grandmother Hawa Manyika, my father Mohamed Mtonga, my mother Maridhia Lugezi, my aunt Rehema Mtonga and my sister Rukia Mtonga for their love, support and patience.

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LIST OF ABBREVIATIONS

CIAF	-	Composite Index of Anthropometric Failure
DDS	-	Dietary Diversity Score
IQ	-	Intelligence Quotient
IYCF	-	Infant and Young Child Feeding
MAM	-	Moderate Acute Malnutrition
MOH	-	Ministry of Health
MOHSW	-	Ministry of Health and Social Welfare
MoHCDGEC	-	Ministry of Health, Community Development, Gender Elderly and Children
NIMR	-	National Institute of Medical Research
NMNAP	-	National Multi-sector Nutrition Action Plan
OR	-	Odds Ratio
P	-	P- value
KNBS	-	Kenya National Bureau of Statistics
SAM	-	Severe Acute Malnutrition
SPSS	-	Social Package of Statistical Software
SUA	-	Sokoine University of Agriculture
TNNS	-	Tanzania National Nutrition Survey
UBOS	-	Uganda Bureau of Statistics
UNICEF	-	United Nations Children Education Fund
URT	-	United Republic of Tanzania
WB	-	World Bank
WHO	-	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Malnutrition is a leading cause of morbidity and mortality in children under-five years. It contributes to between 3.5 and 5 million annual deaths among under-five children. According to WHO, about 60% of deaths occurring among under-five children in developing countries are contributed to malnutrition (WHO, 2022).

Malnutrition also results in several effects. Apart from its effect on physical growth, child malnutrition also affects cognitive development and the Intelligence quotient (IQ) of the child, resulting in delayed enrolment, higher absenteeism and poor performance in school. Evidence has shown that there irreversible physical and cognitive damage due to undernutrition, which is a major threat to human development (Martins *et al*., 2011).

Globally, in the year 2016, it was estimated that 22.9% of approximately 154.8 million children under the age of five years were stunted, which decreased from 32.6% in 2005. Out of these 7.7% (approximately 51.7 million) were wasted and 20 million children were underweight (UNICEF/WHO/WB, 2017). In the year 2017, it was estimated that around 150.8 million children were stunted and 50.5 million were wasted (Fanzo *et al*., 2018). Child malnutrition remains most dominant in developing countries whereby the prevalence of chronic malnutrition was about 39.9% in Africa, and the prevalence rate of underweight was 26.6% in South-East Asia (Ashis, 2017).

In Sub-Saharan Africa, the proportion of stunted children was estimated to be 30.3% in 2017, a decrease from 38.3% in 2005 (UNICEF/ WHO/ WB, 2020) and (WHO, 2017). Despite the decrease in the region in sub-Saharan Africa, the number of stunted children increased by 16% or 58.7 million from the year 2000 to 2017 (Luchuo *et al*., 2013; UNICEF/WHO/WB, 2017; Masereka *et al*., 2020). In South Africa, there is a triple burden of malnutrition among under-five children whereby stunting accounts for 80% of the world's stunted children (Modjadji & Madiba, 2019).

In East Africa, approximately 35.6% of children under the age of five years were stunted and 6.5% were wasted (Onis & Branca, 2016; WHO, 2017). According to the Uganda Demographic and Health Survey of 2016, three in ten Ugandan children under-five years of age 29% were stunted (short for their age), four percent were wasted (thin for their height), and 11 percent were underweight (low weight- for -age) (UBOS & ICF, 2018). In Kenya, according to Kenya Demographic Health Survey 2014 reports, 26% of children under-five years were stunted, 4% were wasted and 11% were underweight (KNBS, 2015).

In Tanzania, according to the Tanzania National Nutrition Survey (MoHCDGEC, 2018), about 31.8% of children under-five years were stunted, 14.6% of children under-five were underweight and 4% were wasted. In Morogoro region the prevalence of stunting, wasting and being underweight was 26.4, 12.1 and 3.8% respectively (MoHCDGEC, 2018).

Factors that may indirectly influence stunting levels among children in developing countries include socioeconomic status such as the mother's education (Abuya *et al*., 2012) occupation, household income (Sunguya *et al*., 2019) and health expenditure (Currie & Goodman, 2010; WHO, 2012). Moreover, factors such as poverty, education, occupation,

family size, age and marital status of the mother, feeding practices, workload, parity of mother, environmental sanitation, eating habit, and food security on nutritional status of under-five children can be important factors of health and nutritional outcomes in many low-income countries (Kamiya, 2011).

Tanzania is one of the Sub-Saharan African countries facing undernutrition problem. To overcome that, several nutritional interventions have been developed and implemented by the Ministry of Health (MOH) to reduce child undernutrition. These include infant and young child feeding (IYCF) protocols, sanitation, deworming, vitamin A supplementation, and health education (MOHSW, 2015). Despite these interventions, child undernutrition remains a challenge in Tanzania in general as well as in Morogoro region. Therefore there was a need to assess the prevalence and factors associated with undernutrition in Gairo district, Morogoro region to identifying the interventions that can be implemented to reduce the prevalence of undernutrition in the region.

1.2 Problem Statement

Although malnutrition is one of the key causes of the high morbidity and mortality rates among children under the age of five years in Tanzania. Adequate nutrition is a fundamental human right for everyone, especially children under the age of five years.

The UNICEF nutrition plan 2020–2030 includes UNICEF's programs for the prevention of all types of malnutrition in the first five years of life, such as undernutrition including stunting, underweight and wasting, micronutrient deficiencies, overweight and obesity (URT, 2016). These interventions make sure that young children under the age of five years receive diets, services, and practices that promote the best possible nutrition, growth, and development in infancy. The promotion of age-appropriate complementary foods and feeding practices during the first two years of life, as well as advocacy for and support of policies, strategies, and programs that aim to protect and promote the recommended breastfeeding practices for infants and young children starting at birth (UNICEF, 2020), because malnutrition has an impact on these areas.

Despite significant progress in recent years, Tanzania has a high rate of undernutrition among children under the age of five years. UNICEF, WHO, and the World Bank estimate that, there is still a long way to go before there is no more malnutrition on the planet. To meet the goals set by the World Health Assembly for 2025 and the Sustainable Development Goals for 2030, not enough progress has been made, according to the joint estimates, which were published in March 2020 and cover indicators of stunting, wasting, and overweight in children under the age of five years.

Even though numerous studies have looked at the nutritional status on a national and regional level, the factors that contribute to poor nutrition status in children under the age of five years are still largely unknown at the district level. Studies by Nyaruhucha *et al*. (2006), Khan *et al*. (2016), Galgamuwa *et al*. (2017), Babar (2020), and Ahmad *et al*. (2020) were among those that examined the nutritional status of children.

Global data show that, prevalence of stunting and wasting was 22.9% and 7.7%, respectively.

TNNS provides information on undernutrition prevalence at national and regional levels. The prevalence of undernutrition in Morogoro region in 2018 was 26.4% stunted, 12.1% underweight and 3.8% wasted (MoHCDGEC, 2018). Data on levels and patterns of undernutrition at districts levels are limited.

1.3 Justification

There is limited information on the prevalence and causes of undernutrition in Tanzania, particularly in rural regions. Establishing the scope and underlying causes of child undernutrition in districts is crucial. As a substantial number of undernourished children come from rural regions, it is important to assist in the formulation of effective intervention methods to reduce the levels of child undernutrition at the district level. The purpose of this study was to evaluate the prevalence and contributing variables of undernutrition among children under the age of five in Gairo District, Morogoro.

1.4 Study Objective

1.4.1 General objective

Assessment of the prevalence and factors associated with undernutrition among under-five children in Gairo district, Morogoro region, Tanzania.

1.4.2 Specific objectives

The specific objectives of the study were to:

i. Determine the prevalence of undernutrition among under-five children in Gairo district, Morogoro region.
ii. Identify maternal factors affecting nutritional status of under-five children in Gairo district, Morogoro region.
iii. Identify child factors affecting nutritional status of under-five children in Gairo district in Morogoro region.
iv. Identify household and community factors affecting nutritional status of under-five children at Gairo in Morogoro.

1.4.3 Research questions and hypotheses

1.4.3.1 Research Questions

i. What was the prevalence of undernutrition among under-five children in Gairo district in Morogoro region?
ii. What were the maternal factors affecting the nutritional status of under-five children in Gairo district, Morogoro region?
iii. What were the children factors affecting nutritional status of under-five children in Gairo district in Morogoro region?
iv. What were the household and community factors affecting nutritional status of under-five children in Gairo district?

1.4.3.2 Research Hypothesis

1.4.3.2.1 Null hypothesis

The nutritional condition of children under-five years in Gairo district did not associate with any undernutrition-related indicators.

1.4.3.2.2 Alternative hypothesis

In Gairo district, there was an association between the nutritional condition of children under the age of five years and risk factors for undernutrition.

1.5 Significance of the Study

The local, national, regional, and international organizations participating in or working on establishing nutrition interventions for children under the age of five years will find the study findings to be helpful.

1.6 Conceptual Framework on Factors Associated with Undernutrition of Under-five Children

A redesigned conceptual framework for malnutrition causes is shown in Fig. 1.1. The UNICEF framework from 1997 served as a model for this framework, which divided causes of malnutrition into three categories: immediate causes, underlying causes, and basic causes. However, the framework used in Gairo district was split into two groups: dependent and independent variables. The dependent variable was undernutrition, which included stunting, wasting, and being underweight, and the independent variables were maternal, child, household, and community factors affecting the nutritional status of children under the age of five. To reduce undernutrition in the district, it is important to be aware of the causes of it, including the maternal, child, household, and community factors that affect the nutritional status of children under the age of five years in Gairo district.

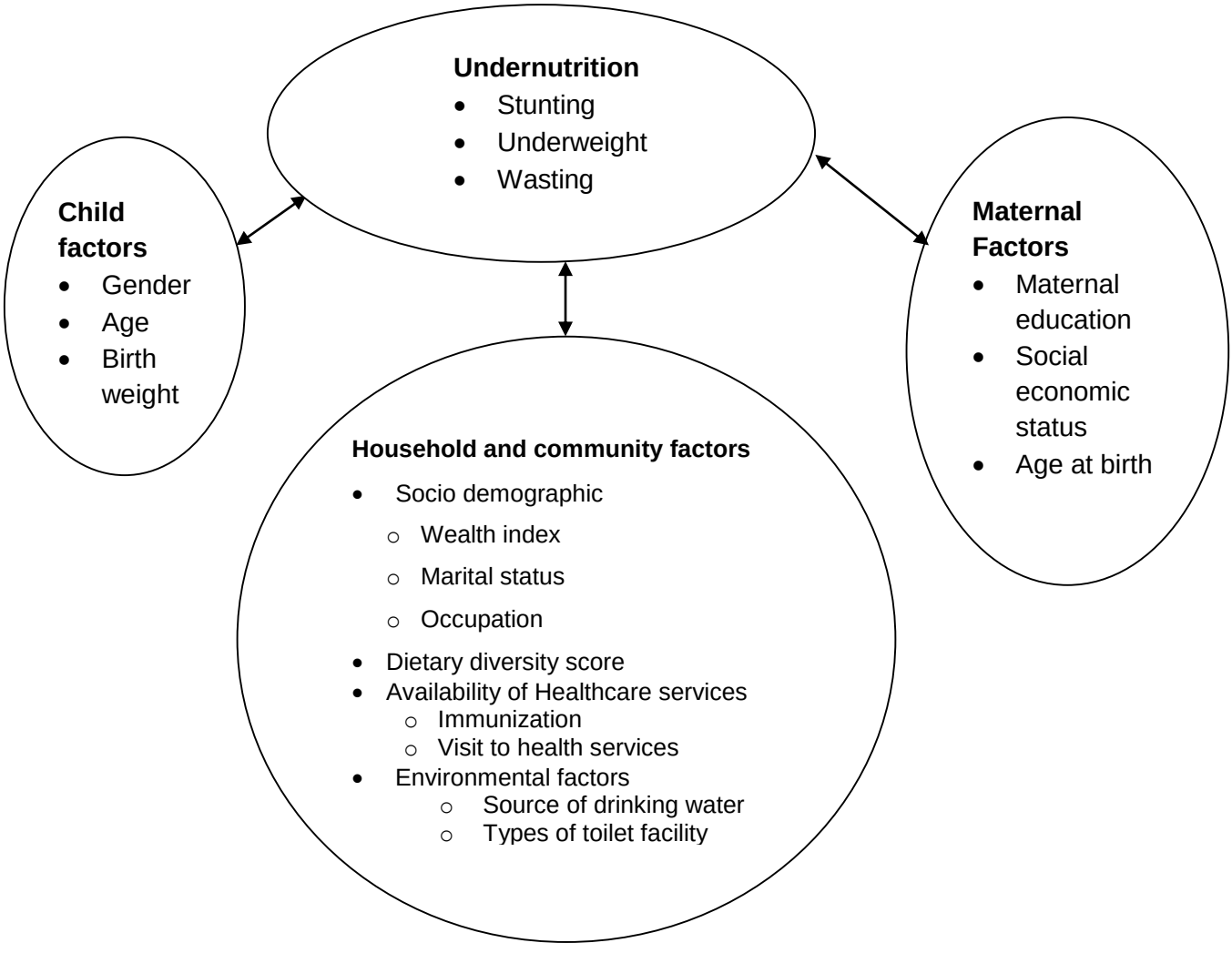

Figure 1.1: Factors associated with undernutrition
Source: Adapted from UNICEF (1997).

1.7 Research Methodology

1.7.1 Description of the study area

A total of 330 kilometers separate the Gairo district from Dar es Salaam, 132 from Dodoma, and 132 from Morogoro Municipality. The agro-ecological zones affect the council's climate differently. The highest regions, which receive up to 1200mm of annual rainfall, are distinguished by sandy (clay) loam soil, which is generally fertile and well-drained. The flood plains include black clay and loam soils that are good for growing maize and receive an average rainfall of 600mm (URT, 2017).

In terms of administration, the district consists of the Gairo Township Authority, the Gairo and Nongwe divisions, 18 wards, 50 villages, and 304 hamlets. The district had a population of 193,011 individuals as per the 2012 Population and Housing Census Statistics, of which 96,206 were men and 99,805 were women with an average annual growth rate of 2.6% (URT, 2017).

Maize, millet, beans, pigeon peas, cassava, and sweet potatoes are important food crops. Ginger and sunflower are two cash crops. Food security and surplus food production have been made possible through agriculture, which has produced favorable consequences.

The expansion of healthcare facilities has led to a notable rise in the population's use of healthcare services as well as an improvement in living conditions. Medicine, medical supplies, and medical equipment are now more readily available and more easily accessible (88%). Cost-sharing regulations were put in place to ensure the continued funding of healthcare services. Likewise, ward and community health committees received training (URT, 2017).

1.7.2 Study design

To collect data at a specific moment in time and analyze the relationships between variables, a cross-sectional research methodology was used (Somerville *et al*., 2012). Because these variables answer the questions "Who?," "Where?," and "When?," which are necessary to create a community diagnosis, descriptive analysis was carried out to ascertain relationships among them (Bonita *et al*., 2006).

1.7.3 Study population

The study included children under-five years of age in Gairo district with their parents or caregivers, as they were important in providing information regarding the prevalence of undernutrition in children under the age of five years and risk the factors for it.

1.7.4 Sampling procedure and sample size determination

1.7.4.1 Sampling procedure

Simple random sampling was done, whereby Gairo district was selected among districts in Morogoro region. Then, three wards were simply randomly selected. The third step involved the selection of villages from the three wards chosen, which made a total of eight villages of households with children under-five years of age.

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1.7.4.2 Sample size determination

The determination of sample size was based on stunting prevalence in Morogoro region (26.4%) (MoHCDGEC, 2018). We used the Cochran formula proposed by Bartlett *et al*. (2001) as follows

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

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

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

$n = 0.7464 / 0.0025$

$n = 298.57$

$n = 300$

Therefore, a total of 300 children were interviewed. Households with more than two children under the age of five years were all included in the study.

1.7.5 Data collection

This study used primary data from anthropometric measurements and semi-structured questionnaires, administered to parents or caregivers of under-five children. The study made an effort to highlight a few of the factors that were gathered for each target.

Objective one: To determine the prevalence of undernutrition among under-five children
Some of the data collected were weight, height/length and age. The data were obtained through anthropometric measurements, whereby standard techniques and equipment were used for collecting anthropometric measurements, which reflect the variables of height, weight and age.

Objective two: To identify maternal factors affecting nutritional status among under-five children. Data were obtained through a semi-structured questionnaire. We gathered information on maternal education, socio-economic status, and gestational age.

Objective three: To identify child factors affecting nutritional status among under-five children. Data were obtained through a semi-structured questionnaire where the gender, age and birth weights of children were collected.

Objective four: To identify household and community factors influencing under-five children's nutritional status. Data were obtained through semi-structured questionnaires, where some of the household and community factors; environmental factors such as source of drinking water and availability of latrine, health care factors like immunization status and visits to health facilities were collected.

1.7.6 Pre-testing and administration of questionnaire

The questionnaire was completed through face-to-face interviews conducted by trained research assistants with mothers/caregivers. Data collection tools were pre-tested for efficacy in non-participating subjects in Magadu outside the study area. Subjects used for pretesting were not included in the study. Standard techniques and devices were used to collect anthropometric measurements reflecting the variables height, weight, sex, and age.

1.7.7 Anthropometric assessment

Undernutrition was determined if the child was either stunted, underweight or wasted. A Seca™ electronic scale model number 803 was used to measure weight. The device was held on a flat floor and standardized to zero at the start of each day. For children who were unable to stand alone, mothers or caregivers were asked to step on the scale, without the child and the scale was set to zero then the mother with a child's weight was measured. The scale was read to the nearest 0.1 kg with light clothing and with no shoes.

Recumbent length was measured for children under the age of 2 years. The child was laid horizontally on a wooden measuring board. The subject was laid upward with the head toward the fixed end and the body parallel to the long axis of the board and measured to the nearest 0.1cm. For children above 24 months heights were measured on standing height using a wooden measuring board to the nearest 0.1 cm. The age and birth weights of the children were taken from children's clinic cards.

1.7.8 Anthropometric calculations

Input and analysis of data were made using Statistical Package for the Social Sciences Version 20. Nutritional data were entered and analyzed using WHO Anthro software. The dependent variable was undernutrition (stunting, underweight and wasting), in which the anthropometric indices were used to obtain CIAFs for considering all children who were found to have any form of anthropometric failure as suggested by Svedberg (2000) and Nandy *et al*. (2005). Independent variables were child information (such as sex, age), maternal information (such as education level, age, and marital status), household and community and dietary diversity, which adopted the seven food groups from USAID/AED/ FANTA/UCDAVIS/IFPRI/UNICEF/WHO (2008), whereby food groups ≥ 4 were considered as a minimum dietary diversity. Chi-square tests were used to compare group differences for categorical variables. The association between the outcome variables (height-for-age, weight-for-age, and weight-for-height) and the independent variables was examined using a binary logistic regression model. The last level of each independent variable was controlled. The model's outputs were reported by interpreting p-values for testing the significance of the association, confidence intervals and odds ratios. All statistical tests were set at $p \leq 0.05$ level of significance.

1.8 Ethical Consideration

The vice chancellor of the Sokoine University of Agriculture granted ethical approval for the study to the Ethics Committee of the National Institute of Medical Research (NIMR) in Tanzania (certificate No. NIMR/HQ/R.8a/Vol. IX/3926). Permission to undertake the study in Gairo district was obtained from the regional and district health authorities. Data collection was carried out after receiving approval and ethical clearance letters from the District and NIMR. Informed written and verbal consent was filled in by each study participant before data were collected.

1.9 Inclusion and Exclusion Criteria

Inclusion criteria; mothers/caregivers with their children under-five years of age were included.

Exclusion criteria; mothers or caregivers of children over five years of age, children with chronic illnesses and physical disabilities were excluded.

1.10 Dissemination of Results

The findings were disseminated to the Sokoine University of Agriculture. Moreover, a copy of the dissertation was sent to the regional and district administrative secretary offices. Some extracts of the dissertation were published in peer-reviewed journals.

1.11 Organization of the Dissertation

The dissertation used a publishable manuscript format organized into five chapters, whereby chapter one presented the introduction part which sets the background information of the dissertation and the methodologies used. Chapter two presented a manuscript number one combined objectives number one, two and three which gave information on the prevalence of undernutrition by using the internationally recommended Z-scores (conventional indicators), and relate the child and maternal factors associated with undernutrition. Chapter three formed manuscript number two which involved objectives number one and four on household and community factors and dietary diversity scores as risk factors for undernutrition by using a composite index of anthropometric failure. Chapter four presented the general discussion of the dissertation and chapter five drew the general conclusions and recommendations of the study.

CHAPTER TWO

Prevalence and Factors Associated with Undernutrition among Underfive Children in Gairo District in Morogoro, Tanzania

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Prevalence and factors associated with undernutrition among under-five children in Gairo district in Morogoro, Tanzania

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Abstract

Background: In Tanzania, under-nutrition is of most public concern as it affects human productivity in several areas like increasing economic costs to families and the country as a whole and impairing learning. Therefore this study aimed at assessing the prevalence and factors associated with undernutrition among under-five children in Gairo district, Morogoro. Findings from the study will help policymakers, and local and international organizations in designing appropriate nutrition policies and interventions to address undernutrition in rural areas.

Methods: A household-based cross-sectional study was employed involving 300 under-five children with their mothers/caretakers in three wards in Gairo district. A structured questionnaire was used and anthropometric measurements were performed using standard procedures. Odds ratio with a 95% confidence interval and p-value at <=0.05 was used to identify factors associated with undernutrition.

Results: The study revealed that the prevalence of stunting was 54.3% (severe stunting 26.3% and moderate stunting 28%), underweight 23.3% (severe underweight 7% and moderate underweight 16.3%) and wasting 3.7% (severe wasting 1.3% and moderate wasting 2.4%).

Conclusion: The main factors that showed positive association were being a male, maternal occupation, child's age, maternal education, birth weight, and illness in the past one month, area of residence, maternal age, and time of introduction of solid foods and leaving a child when being outside. The prevalence of stunting and underweight in the study area was higher compared to the national and regional prevalence. Thus due attention is needed while much attention should be given to the factors that showed a positive association.

Keywords: *Factors, undernutrition, under-five, Tanzania, Gairo*

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Background

Malnutrition is a leading cause of morbidity and mortality in children under-five years of age. It contributes to between 3.5 and 5 million annual deaths among under-five children. According to World Health Organization (WHO), about 60% of deaths occurring among under-five children in developing countries are contributed by malnutrition (WHO, 2013). Undernutrition also results in several effects. Apart from its effect on physical growth, child undernutrition affects cognitive development and the Intelligence Quotient (IQ) of the child, resulting in delayed enrolment, higher absenteeism and poor performance in school. Evidence has shown that there is irreversible physical and cognitive damage due to undernutrition which is a major threat to human development (Martins *et al.*, 2011).

in the year 2016, it was estimated that globally, 22.9% of approximately 154.8 million children under the age of five years were stunted which decreased from 32.6% in 2005. Out of these, 7.7% were wasted and 20 million children were underweight (UNICEF/WHO/WB, 2017). In the year 2017, it was

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estimated that around 150.8 million children were stunted and 50.5 million were wasted (Fanzo, *et al*., 2018).

An approximated 35.6% of children under the age of five years in In East Africa were stunted and 6.5% were wasted (Onis & Branca, 2016; WHO, 2017). The Uganda Demographic and Health Survey of 2011 indicated four in ten Ugandan children under five years of age (33 %) were stunted (short for their age), six per cent were wasted (thin for their height), and fourteen per cent were underweight (low weight- for -age). (UDHS, 2011). In Kenya, according to Kenya Demographic and Health Survey 2014 reports, 26% of children under-five years were stunted, 4% were wasted and 11% were underweight (RK, 2014).

According to the Tanzania National Nutrition Survey (MoHCDGEC, 2018) about 31.8% of children under-five were stunted, 14.6% of children under-five were underweight and 4% were wasted. The prevalence of undernutrition in Morogoro region in 2018, 26.4% stunted, 12.1% underweight and 3.8% wasted (MoHCDGEC, 2018). With this prevalence in Tanzania, data on levels and patterns of undernutrition at district levels is limited. This study therefore aimed at assessing the prevalence and factors associated with undernutrition among under-five children in Gairo district in Morogoro. The study area was selected because there are limited studies that have investigated the prevalence and factors associated with undernutrition in the Gairo district.

Methodology

Study area

The study was conducted in three wards of Gairo district which were Gairo, Kibedya and Mandege. The study area was selected because there are no studies that have investigated the prevalence and factors associated with undernutrition in Gairo district. The district lies about 330 km west of Dar es Salaam, 132 kilometres east of Dodoma and 132 kilometres west of Morogoro Municipal. (URT, 2013). Agricultural production has been showing positive results by ensuring food security and surplus production with the major crops being maize, millet, beans, cassava, sweet potatoes and pigeon pea while the cash crops are sunflowers and ginger.

Initially, there was no district hospital but currently, there is a district hospital and health centres and dispensaries in Chakwale, Nongwe, Ibuti and Songambele. The increase in health facilities has resulted in a remarkable increase in the population in need of health services and an improvement in the standard of living. Thus diseases like malaria and infant mortality have been reduced from 13,545 patients to 5,065 patients and from 31 to 8 per 1,000 respectively from 2015 to 2017.

Study design

A cross-sectional study design was used to conduct this study. A simple random technique was used to select three wards from two divisions of Gairo district. A sample was estimated by using Cochran's formula as adopted by Bartlett *et al*. (2001). Based on the prevalence rate of stunting in Morogoro region of 26.4% (MOHCDGEC, 2018), the standard normal distribution of 95% and absolute error of 5% were used to obtain the sample size of 300 mothers/ caregivers and their children aged 6-59 months.

Data collection and instruments

The study used a semi-structured questionnaire on socio-demographic characteristics, child and maternal factors and anthropometric measurements using standard procedures. A Seca™ electronic weighing scale was used to measure weight. The device was held on a flat floor and standardized to zero at the start of each day. For children who were unable to stand alone, the mother or caregiver was asked to step on the scale, without the child and the scale was set to zero then the mother with a child's weight was measured. The scale read to the nearest 0.1 kg with light clothing and no shoes. Recumbent length was measured for children under the age of 2 years who refused to stand alone.

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For children above 24 months were measured at standing height using a wooden measuring board to the nearest 0.1 cm.

Ethical consideration

The study was granted by the National Institute for Medical Research, ***(NIMR/HQ/R.8a/Vol. IX/3926).*** Informed consent was obtained from each mother/caretaker. All information was kept confidential.

Data analysis

Anthropometric data were entered and processed using WHO Anthro Software version 3.2.2. The obtained results with the data from the questionnaire were coded, entered and analysed using Statistical Package for the Social Sciences (SPSS) software version 20, whereby frequencies and percentages were generated to categorize socio-demographic characteristics, child factors and maternal factors for children under five years of age. The indices for nutrition status such as stunting (height for age), underweight (weight for age) and wasting (weight for height) were converted from weight and height measurements, in terms of standard deviation (SDs) being below or above standard measures (WHO,2006). Chi-squared tests and odds ratios were used to compare group differences for categorical variables. Independent variables were significant if (p-value equal to or less than 0.05).

Results

Socio-demographic characteristics.

Three hundred (300) respondents were interviewed, 100 from each ward (Gairo, Kibedya and Mandege). Nearly half of mothers/caregivers aged 25-34 years were from Mandege ward. The majority of respondents were married, had primary education and were farmers. (Table 1).

Table 1: Socio-demographic characteristics of respondents from Gairo district (N=300)

		Wards		
		Gairo (N=100)	Kibedya(N=100)	Mandege (N=100)
Socio-demographic characteristics		n (%)	n (%)	n (%)
Maternal/caregiver age	15-24 years	33 (33.3)	37 (37.0)	39 (39.0)
	25-34 years	46 (46.0)	45 (45.0)	42 (42.0)
	Above 35 years	21 (21.0)	18 (18.0)	19 (19.0)
Maternal marital status categories	Married	62(62.0)	64 (64.0)	79 (79.0)
	Single	38 (38.0)	36 (36.0)	21 (21.0)
Maternal occupational status	Farmer/pastoralist	56 (56.0)	95 (95.0)	95 (95.0)
	Government employed	1 (1.0)	2 (2.0)	1 (1.0)
	Casual labor	25 (25.0)	2 (2.0)	3 (3.0)
	Housewife	18 (18.0)	1 (1.0)	1 (1.0)
Maternal education status	Primary school	57 (57.0)	61 (61.0)	65 (65.0)
	Secondary school	25 (25.0)	15 (15.0)	2 (2.0)
	Tertiary	1 (1.0)	0 (0.0)	2 (2.0)
	Illiterate	17 (17.0)	24 (24.0)	31 (31.0)
Father occupational status	Farmer/pastoralist	58 (58.0)	86 (86.0)	94 (94.0)
	Government employed	7 (7.0)	1 (1.0)	4 (4.0)

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Casual labor	35 (35.0)	12 (12.0)	2 (2.0)

N=Total number of respondents, n= Total number of respondents in each category and %= percentage

Nutritional Status of Children

The overall prevalence of stunting in the Gairo district was 163(54.3%), the prevalence of underweight was 70 (23.3%) and the prevalence of wasting was 11 (3.7%) (Fig. 1 and 2). The nutritional status of children in Gairo district by wards is presented in Table 2. There was a significant difference in stunting and underweight among wards (p=0.000 and 0.008 respectively).

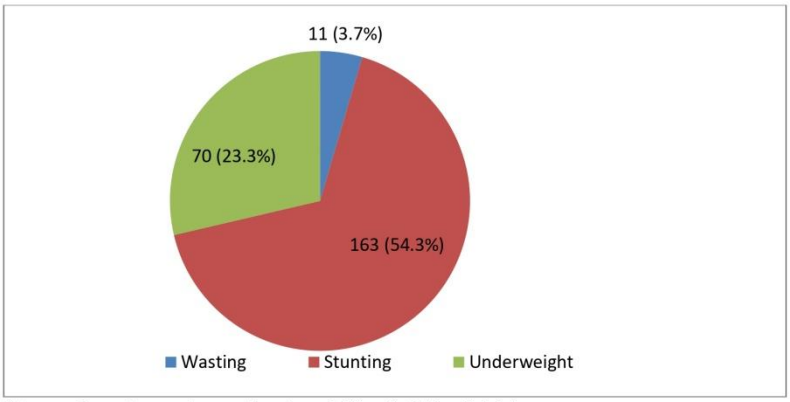

Figure 1: Overall prevalence of undernutrition in Gairo district

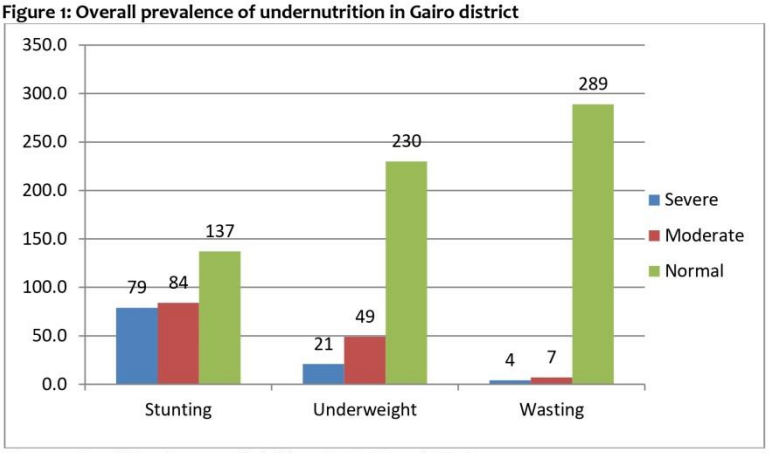

Figure 2: Nutritional status of children by SAM and MAM

Table 2: Nutritional status of children by wards

	Gairo	Kibedya	Mandege	Total	P-value
Variables	**n (%)**	**n (%)**	**n (%)**	**n(%)**	**P <or = 0.05**
Wasting	3 (27.3)	4 (36.4)	4 (36.4)	11 (3.7)	0.910
Underweight	13 (18.6)	26 (37.1)	31 (44.3)	70 (23.3)	0.008

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Stunting	39 (23.9)	54 (33.2)	70 (42.9)	163(54.3)	0.000

Child Factors Associated with Undernutrition

Majority of male children were stunted and underweight while female children were wasted. Children aged 24- 36 months and those who started solid foods at 3-4 months were undernourished. And children with a birth weight greater or equal to 2.5kg majority were wasted, underweight and stunted. (Table 3).

Table 3: Child factors associated with undernutrition

		Wasting		Underweight		Stunting	
Child factors		**n (%)**	**P-value**	**n (%)**	**P-value**	**n (%)**	**p-value**
Child's sex	Male	4 (36.4)	0.758	36 (51.4)	0.160	88 (54.0)	0.079
	Female	7 (63.6)		34 (48.6)		75 (46.0)	
Child's age	6-11 months	2 (18.2)	0.550	3 (4.3)	0.122	9 (5.5)	0.030
	12-23 months	3 (27.3)		14 (20.0)		40 (24.5)	
	24-59 months	6 (54.5)		53 (75.7)		114 (70.0)	
Birth weight	Not reported	2 (18.2)	0.486	8 (11.4)	0.512	21 (12.9)	0.816
	>=2.5kg	9 (81.8)		53 (75.7)		126(77.3	
	<2.5kg	0 (0.0)		9 (12.9)		16 (9.8)	
Illness in the past month	Yes	6 (54.5)	0.625	35 (50.0)	0.610	78 (47.9)	0.844
	No	5 (45.5)		35 (50.5)		85 (52.1)	
Age started solid foods	3-4 months	5 (45.5)	0.517	35 (50.0)		88 (54.0)	
	5-6 months	6 (54.5)		35 (50.0)	0.337	75 (46.0)	0.701

Maternal Factors Associated with Undernutrition

Maternal factors associated with undernutrition are shown in Table 4. Majority of stunted, underweight and wasted children were from farmers/pastoralist mothers, married mothers/caregivers, mothers who had primary education and mothers aged 25- 34 years.

Table 4: Maternal factors associated with undernutrition

		Wasting		Underweight		Stunting	
Maternal Factors		**n (%)**	**p-value**	**n(%)**	**p-value**	**n (%)**	**p-value**
Maternal/caregiver age	15-24 years	3(27.3)	0.399	26 (37.1)	0.610	63 (38.7)	0.656
	25-34 years	7(63.6)		28 (40.0)		70 (42.9)	
	Above 35 years	1 (9.1)		16 (22.9)		30 (18.4)	
Maternal marital status	Married	7(63.6)	0.733	53 (75.7)	0.129	117(71.8)	0.162
	Single	4 (36.4)		17 (24.3)		46 (28.2)	
Maternal occupational	Farmer/pastoralist	11 (100)	0.286	65 (92.9)	0.026	145(89.0)	

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	Employed	0 (0.0)		3 (4.3)		13 (8.0)	0.002
	Housewife	0 (0.0)		2 (2.9)		5 (3.0)	
Maternal education	Primary level	8 (72.7)	0.710	42 (60.0)	0.452	101(62.0)	0.517
	Secondary/tertiary	1 (9.1)		8 (11.4)		21 (12.9)	
	Illiterate	2 (18.2)		20 (28.6)		41 (25.2)	
Age at pregnancy	Less than 18yrs	2(18.2)	0.575	4 (5.7)	0.046	22 (13.5)	0.637
	18yrs or greater	9(81.8)		66 (94.3)		141(86.5)	
When an outside child is with	Older siblings	6(54.5)	0.397	19 (27.1)	0.007	51 (31.3)	0.004
	Neighbors	0 (0.0)		4 (5.7)		5 (3.0)	
	Others(specify)	3 (27.3)		18 (25.7)		50 (30.7)	
	Go with my baby	2 (18.2)		29 (41.4)		57 (35.0)	

The odds ratio of undernutrition in maternal and child factors

The factors that were significantly associated with wasting, underweight and stunting are shown in Table 5.

Table 5: Odds ratio of undernutrition on maternal and child factors

	Odds ratios		
Variable	**Wasting**	**Underweight**	**Stunting**
Ward	0.570	2.700	3.294
Maternal age	0.974	1.188	1.180
Age at pregnancy	1.032	0.272	1.076
Child's sex	0.506	1.025	1.543
Child's age	1.537	0.620	0.650
Illness within one month	1.274	0.978	0.720
Age started solid food	0.757	0.721	0.787
Marital status	0.801	1.302	1.226
Maternal occupation	3.719	1.746	1.653
Maternal education	1.069	0.850	1.012
Child's birth weight	1.991	0.769	0.838

Discussion

The study aimed at assessing the prevalence and factors associated with undernutrition in Gairo district. Undernutrition was significantly associated with the sex of the child, age of the child, time of introducing complementary food, areas of residence, maternal occupation, working outside the home, age at pregnancy, marital status and child's birth weight.

Prevalence of stunting was found to be above the WHO acceptable level (30%), the national and regional prevalence (MoHCDGEC, 2018). Out of that per cent, there were severely and moderately stunted children with the highest prevalence of stunting in Mandege ward. These results corroborate with those reported by Mrema *et al*. (2021) in which highland areas had the highest prevalence of stunting among under-five children. The reason for this higher prevalence of stunting especially in Mandege could either be because it is a high land area thus, being disadvantaged from all kinds of basic services like access to improved water sources, access to health services, good infrastructures and sanitation services that can trigger various infections thus poor nutritional status (Black *et al*., 2011).

In the binary logistic regression model, the child's sex was significantly associated with stunting since the majority of male children were stunted compared to their female counterparts. These findings were consistent with the findings in previous studies (Bork & Dialo, 2017; Thurstans *et al.,* 2020) in which male children were stunted compared to their female counterparts. This may be

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explained by the following reasons; favouritism towards daughters occurs as a result of lowered socioeconomic status, male children are known to be more hungry than female children which leads to early weaning for male children and lastly, female children spend much time at home than male and having more access to the kitchen. This makes female children more nutritionally advantaged than their male counterparts (Wamani *et al*., 2007).

This study revealed that children aged 24-59 months had a significantly high risk of being stunted compared to children aged 6-23 years. Similarly to the findings reported in previous studies (Nyaruhucha *et al*., 2006; Chirande *et al*., 2015) that older children had a higher prevalence rate of stunting than young children. This may be due to inadequate quality or quantity of food given to children during the weaning period. It is well known that malnutrition and the weaning period coexist since children grow well in the first months of their lives before shifting to solid foods (Nyaruhucha *et al*., 2006). In this study, the most weaning food was maize porridge and the most illness were diarrhoea and intestinal worms which were likely the cause of the increased rate of stunting at that age.

It is known that birth weight is usually linked with undernutrition, as children with low birth weights were more likely to be undernourished than normal birth weight children. This study showed a majority of children with normal birth weight were stunted compared to children with low birth weight. Consistency with the findings from Mtoi in Pangani reported that low birth weight babies were well nourished compared to normal birth weight babies (Mtoi & Nyaruhucha, 2019). This can be explained as due recall bias since a large proportion of mothers lost their children's clinic cards thus birth weight could be wrongly reported.

This study found that children who started solid foods at 3-4 months were stunted compared to children who started at 5-6 months. Similarly to the study conducted in Kwale, Kenya (Adeladza, 2009). The binary logistic regression revealed that maternal/caretaker age, age during pregnancy and marital status were associated with stunting. Similar statistics emerged from several studies as maternal age, the age of the mother during pregnancy and marital status were the predictors of stunting (Gebre *et al*., 2019; Kassie & Workie, 2020; Menalu *et al*., 2021).

There was a significant difference between maternal/caregiver occupation, leaving a child to another person when working outside the home and stunting. Contrary to a previous study conducted in Ethiopia in which undernutrition was highly reported in children who were left by their mothers without adequate care (Mutisya, 2019).

Also, this study revealed that children from farmers/pastoralists were more stunted than children from other occupations. This could be because almost all of the participants in the study area were farmers therefore, rely solely on produce from their farms to meet household food needs leading to a monotonous diet household (Mutisya, 2019). They also need to sell the crops they had harvested from their farms with the money raised spent on non-food items. Therefore, it has contributed to the poor nutritional status of children of farming mothers.

The prevalence of underweight was above the national and regional prevalence which are is14.6% and 12.1% respectively (MoHCDGEC, 2018). Underweight was significantly associated with the area of residence with the highest prevalence of underweight being in Mandege ward. These results are similar to the findings reported by Mrema in Kilosa (Mrema *et al*., 2021).

There was a significant relationship between underweight and maternal occupation. Consistency with the study conducted in Ethiopia in which women who had insufficient time to care for their children, their children had a high risk of being undernourished compared to women who had time to care for their children (Mutisya, 2019). The explanation for this, Majority of study participants were farmers who spent much of their time on their farms while carrying/ leaving their children with nothing to eat until they came back, therefore, leaving the child starving for many hours could lead to undernutrition.

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This study showed that maternal age during pregnancy is a significant factor for underweight in which the highest percentage of underweight children been in mothers who were above 18 years compared to mothers who were below 18 years. Similar to findings conducted in Maharashtra, India in which mothers aged 20 years and above their children were likely to be underweight compared to mothers below 20 years of age (Murarka *et al*., 2020).

The findings showed that mothers/caregivers being with their children when working outside the home, their children had higher values of underweight compared to children left at home with their siblings or relatives. This was because mothers/caregivers were busy farming, they don't even give their children something to eat before they left home otherwise their children need to wait until the time of lunch, and after that they wait until it is dinner time.

Also, food insecurity could be the reason for this higher prevalence since they depend on their production which is not as much as enough for ensuring the stability of food in the household therefore, a household was able to have only one meal per day regardless of having children in the household. Similar to the findings conducted in Kiteto in which underweight was prevalent in children from busy mothers (Maleya, 2015).

Prevalence of wasting was shown to be below the national and regional averages (4% and 3.8% respectively) (MoHCDGEC, 2018). The prevalence of wasting is highly pronounced in Kibedya and Mandege.

Maternal education, child's birth weight, child's age, illness in the past month and the introduction of solid food was shown to be significantly associated with wasting. In line with the findings conducted in Bangladesh that older children were likely to be wasted compared to younger children (Alom *et al*., 2012). Also, the study conducted in South Ethiopia revealed that children who started complementary food before the age of six months were likely to be wasted compared to children who started complementary foods after six months (Asfaw *et al*., 2015).

Also, children from educated mothers had low chances of being wasted as education makes mothers informed about nutritional benefits of food and aware with child growth (Galgamuwa *et al*., 2017). The study revealed that children with normal birth weight and above were likely to be wasted different from the study done by Arthur, that low birth weight babies were wasted more than normal birth weight babies (Arthur, 2019).

Limitation of the study

The causal effect might not be strong as the study employed was a cross-sectional study design. Also recall bias might occur when reporting the birth weight of children, the time a child was introduced to solid foods as well as the history of illness within one month.

Conclusion and recommendation

In conclusion, this study reveals that undernutrition especially stunting and underweight were most prevalent in the study area than wasting. The factors associated with undernutrition were being male, maternal occupation, child's age, maternal education, birth weight, illness in the past one month, area of residence, maternal age and time of introduction of solid foods and leaving a child when working outside the home. The findings of this study suggest that policies and programs aiming at reducing undernutrition levels should pay attention to synergistic interventions that involve both sectors. Also, researchers should consider other factors associated with undernutrition that was not included in this study.

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CHAPTER THREE

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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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.

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CHAPTER FOUR

4.0 GENERAL DISCUSSION

4.1 Prevalence of Undernutrition Using Conventional Indicators

In Gairo district, undernutrition among children under the age of five years is a serious health issue. Using conventional measures, the prevalence of undernutrition was higher than what MoHCDGEC (2015–16) stated, with stunting rates of 54.3%, underweight rates of 23.3%, and wasting rates of 3.7%.

The study found a significant relationship between undernutrition and area of residence. Mandege was reported to have the highest prevalence of undernutrition out of the three wards where the study was done. Mandege is less likely than other wards to receive social services like improved sanitation and clean and safe drinking water.

As older children were more likely to be undernourished than younger children, age was found to be a risk factor for undernutrition among children under the age of five years in Gairo district. Children that were breastfed during that time grow better than during the weaning period, since breast milk has the entire essential nutrients the child needs for growth and development, but once the child shifts to solid food he/she misses some of the essential nutrients required for growth and development which could lead to undernutrition (Nyaruhucha *et al*., 2006; Chirande *et al*., 2015). It may also be due to the fact that younger children receive more attention and feeding efforts from their parents as compared to older children (Gudu *et al*., 2020).

However, a child's sex was substantially linked to stunting and underweight. The study found that male children had higher rates of stunting and underweight than female children. These results were in line with those of earlier investigations. (Bork & Dialo, 2017; Thurstans *et al.,* 2020). The reason may either be due to favoritism towards daughters caused by low social economic status (Wamani *et al*., 2007).

There was a significant association between undernutrition and maternal occupation. These results are similar to findings from Ethiopia in which women who had insufficient time to care for their children were undernourished (Mutisya, 2019). Therefore, leaving the child starving for many hours could lead to undernutrition.

4.2 Prevalence of Undernutrition Using Composite Index of Anthropometric Failure

When CIAF was used the prevalence of undernutrition was 57.3% (61% had single failures, 36% had double failures and 2.9% had multiple failures). The rate was greater than the 38.2% undernutrition prevalence reported by Khamis *et al*. (2020).

The source of drinking water and the type of toilet substantially impacted the prevalence of undernutrition. The root factors that can result in infection and undernutrition are unsafe drinking water and inadequate latrines (Clasen *et al*., 2014).

A significant association between undernutrition and the location of the delivery and the closest medical facility was found. These results agreed with those of Khamis and colleagues (2020) in which undernutrition was higher in children born at home. Also, Shahid *et al*. (2022) reported that when the distance to health facilities increases undernutrition also increases.

As children of married mothers or caregivers were less likely to be undernourished, it was discovered that marriage was substantially connected with undernutrition. These findings corroborate those of Khamis *et al*. (2020). Married mothers/caregivers are expected to be in a good socio-economic status as their partners help them in income generation and childcare which made married mothers have good choices of food and care for their children.

Additionally, this study discovered a link between birth weight and undernutrition. Compared to low birth weight babies, children with birth weights ≥ 2.5kg were more likely to be undernourished. These results concur with those from Islam and Biswas (2019).

CHAPTER FIVE

5.0 GENERAL CONCLUSIONS AND RECOMMENDATIONS

5.1 General Conclusions

In conclusion, the results of this investigation showed that, according to both conventional measurements and CIAF estimates, the prevalence of undernutrition was notably high in the studied area. In a CIAF assessment of undernutrition, the prevalence of undernutrition among children under the age of five years was higher than conventional measures of stunting, underweight, and wasting.

The use of CIAF helps to identify children with multiple failures which were missed by the conventional indicators. Identifying children with multiple failures helps to save the lives of these children, as they are at higher risk of morbidity and mortality. Despite identifying children with multiple failures, it provides a single number of the overall estimate of undernutrition instead of categorizing it into stunted, underweight, and wasted only.

Therefore, in Gairo district, undernutrition is still a serious health concern for children under the age of five years. Male gender, mother's occupation, marital status, child's age, area of residence, place of delivery, source of drinking water, type of latrine, proximity to the health facility, birth weight, and method of solid waste disposal were some risk factors for undernutrition.

5.2 General Recommendations

5.2.1 Local government authorities at district level

i. Health workers especially nutritionist at district levels should provide their nutrition knowledge to members at district especially in rural areas/villages since majority of undernourished children are from rural areas. While ensuring that the services offered at district level reaches most members in villages
ii. They should also provide adequate knowledge to village members on the use of available health services, while giving them the benefits of using available health services in reducing undernutrition, to remove traditional obstacles that prevent people from using healthcare services provided.

5.2.2 Policy makers

i. The Government through the Ministry of Health, Community Development, Gender, Elderly, and Children should improve the living environment of children by ensuring that all children have equal access to safe drinking water and accessible healthcare services, so that children from villages also benefit the same services offered to urban children.

5.2.3 Further researches

i. The study recommends that Tanzania Demographic and Health Survey and researchers should use CIAF in their studies while determining the likelihood of undernutrition in children under the age of five years, as the CIAF aids in visualizing the severity of undernutrition.

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APPENDIX

Appendix 1: A copy of household questionnaire to be used in the research

SOKOINE UNIVERSITY OF AGRICULTURE

COLLEGE OF AGRICULTURE

DEPARTMENT OF HUMAN NUTRITION AND CONSUMER SCIENCES

My names are Tausi Mtonga Mohamed, a M.Sc. student at Sokoine University of Agriculture, Morogoro, Tanzania. The interview is part of the study on **Prevalence and Factors associated with undernutrition among under-five children in Gairo, Morogoro.** I would like to ask you some questions related to factors associated with undernutrition among under-five children. This study will involve weight and height measurements of under-five children and taking information from their mothers or caregivers. 30 – 40 minutes will be taken for the interview. Please, be free to give out your opinions as the information you give will be confidential and used for the MSc research study only.

A. PRELIMINARY INFORMATION

S/No	Item	Details/ Response
1.	Date of interview	
2.	Respondent Number	
3.	Ward	
4.	Village	
5.	Area of residence	

B. SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

1. Maternal/ caregiver age?
   a. 15- 24 years
   b. 25- 34 years
   c. Above 35 years
2. Maternal marital status
   a. Married
   b. Single
   c. Divorced
   d. Widowed
   e. Cohabiting
3. Maternal occupational status
   a. Farmer/ pastoralist
   b. Government employed
   c. Daily labor
   d. Housewife

4. Maternal education status
   a. Primary school
   b. Secondary school
   c. Tertially
   d. Illiterate
5. Husband occupation status
   a. Farmer/ pastoralist
   b. Government employed
   c. Daily labor
6. Family number in household
   a. Less than 5 members
   b. Greater than 5 members

C. MATERNAL FACTORS

1. Age at pregnancy of the targeted child
   a. Less than 18 years
   b. Greater or equal to 18 years
2. If working outside who is taking care of your child?
   a. Older siblings
   b. Neighbors
   c. Others (specify)……
   d. Going with my child

D. CHILD FACTORS

1. What is the sex of the child?
   a. Male
   b. Female
2. What is the child's age?
   a. 6-11 months
   b. 12-23 months
   c. 24-59 months
3. i. What was the child's birth weight?.....
   ii. Weight verified from children's clinic card?
   a. Yes
   b. No
4. Did the child get any illness in the past one month?
   a. Yes, which?.....
   b. No
5. At which age the child started other foods/ fluids?
   a. 3- 4 months
   b. 5- 6 months
   c. After 6 months
6. Type of foods/ fluids started……

E. HOUSEHOLD AND COMMUNITY FACTORS

1. What is the number of under-five children in the household?
   a. 1
   b. 2
   c. Greater than 2

2. Which parent does the child live with?
    a. Father only
    b. Mother only
    c. Father and mother
    d. Others
3. Have ever used family planning?
    a. Yes
    b. No
4. Have ever attended antenatal clinic?
    a. Yes

b. No, why?.....

5. If yes, at what frequency?
    a. Once
    b. 2- 3 times
    c. 4 and above
6. Have ever take folic acid supplements during pregnancy of the targeted child?
    a. Yes
    b. No
7. What was the place of delivery of the targeted child?
    a. Health facility
    b. Home, why?.....
8. What is the immunization status of your child?
    a. Not immunized
    b. Full immunized
    c. Currently on immunization
9. What is the main food source?
    a. Own production
    b. Own production and purchase
    c. From food aid
10. What is the source of drinking water?
    a. Improve water sources
    b. Un improve water sources
11. What water treatment practice do you use?
    a. Boil
    b. Add chlorine
    c. None
12. Which type of latrine do you usually use in your household?
    a. Pit latrine
    b. Improve pit latrine
    c. No latrine
    d. Others (specify)……..
13. How do you dispose the household solid wastes?
    a. Collected by municipality
    b. Burying
    c. Dispose in compound
    d. Burning

14. What is the type of health facility available near to your household?
    a. Hospital
    b. Dispensary
    c. Community or village health center
    d. Others (specify)
15. How far is the nearest health facility?.....
16. How do you go to the nearest health facility?
    a. Walking
    b. Motorcycle
    c. Public transport
    d. Others, (specify)
17. Where do you seek treatment when your child gets sick?
    a. Government health facility
    b. Pharmacy or drug store
    c. Local herbs or traditional healer
    d. Others, (specify)

F. ANTHROPOMETRIC INFORMATION OF THE CHILD

Date of birth
Sex a. Male b. Female
Current weight(cm)
Current height(cm)
MUAC(cm)
Bilateral pitting edema a. Yes b. No

G. 24 HOURS FOOD RECALL FOR THE CHILD

Usual number of meals for a child**……**

Time	**Food**	**Ingredients**	**Amount consumed**
Morning			
Mid-morning			
Afternoon			
Mid afternoon			
Evening			

Dietary Diversity Score

From foods reported in the 24 hour food recall,“1” will be placed if the food in the particular group will be consumed and “0” if the food in the particular group will not be consumed

Food Group	Score
Any food from cereals (e.g. rice, wheat, stiff porridge, African donat, chapatti, bread)?	
Any potatoes, yams, cassava or any other foods made from tubers and roots?	
Any vegetables and fruits?	
Any beef, pork, lamb, goat, rabbit, wild game, chicken, duck or other birds, liver, kidneys, hearts or other organs	
Any fresh or dried fish or shellfish or sardines?	
Any food made from beans, peas, lentils or nuts?	
Any eggs?	
Any cheese, yogurt, milk or other milk product?	
Any food made with oil, fat or butter?	
Any sugar or honey?	

THANK YOU VERY MUCH FOR YOUR COOPERATION