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Original Article

Prevalence and Factors Associated with Undernutrition Among Children Aged Between 0 and 59 Months in Musanze District, Rwanda.

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Abstract

Background: Undernutrition remains a major public health concern, particularly among children under five years, and contributes to morbidity and mortality worldwide. In Rwanda, stunting affects 33% of under-five children, with higher rates in rural districts such as Musanze. This study examined the prevalence and determinants of undernutrition among children aged 0–59 months in Musanze District.

Methods: A cross-sectional study was conducted among 374 children, selected through multistage sampling from four health centers. Caregivers provided data through structured questionnaires, and anthropometric measurements (weight, height, MUAC) were taken and interpreted using WHO Z-score standards. Descriptive statistics estimated prevalence, while bivariate and multivariate logistic regression analyses identified factors associated with undernutrition using SPSS version 27.

Results: Overall undernutrition prevalence was 38.2%, with stunting (23.8%), underweight (9.6%), and wasting (4.8%). Multivariate analysis revealed that children of mothers employed as casual laborers were 16.6 times more likely to be undernourished (AOR = 16.60; 95% CI: 3.27–84.18). Dependence on farming increased the risk of undernutrition (AOR = 2.51; 95% CI: 1.53–4.12), while children from low-income households had reduced odds of adequate nutrition (AOR = 0.09; 95% CI: 0.02–0.54).

Conclusion: Undernutrition among children under five in Musanze District is alarmingly high and strongly influenced by socio-economic factors. Interventions promoting women's economic empowerment, improving household livelihoods, and providing nutrition education are essential to reduce undernutrition and enhance child health outcomes in rural Rwanda.

Keywords: Undernutrition, Stunting, Wasting, Underweight, Under-five children, Socioeconomic factors, Rwanda

Introduction

Undernutrition in children under five years of age rests a major global health concern, contributing significantly to childhood morbidity and mortality. Despite sustained efforts to reduce malnutrition worldwide, it continues to affect millions, particularly in low- and middle-income countries. According to the World Health Organization (WHO, 2023), children affected by undernutrition manifesting as stunting, wasting, or underweight experience impaired physical growth, delayed cognitive development, and weakened immune function, increasing their vulnerability to infections and premature death. These adverse outcomes can extend into adulthood, resulting in diminished educational achievement, lower productivity, and the perpetuation of poverty across generations (Black et al., 2021). Globally, undernutrition has declined in recent decades, yet it continues a pressing issue. The Global Nutrition Report (2022) and the Food and Agriculture Organization (FAO, 2022) estimate that approximately 149 million children under five are stunted, 45 million are wasted, and nearly 37 million are underweight. Despite these gains, progress has been uneven, particularly in low-resource settings where economic disparities, recurrent food shortages, climate-related shocks, and weak health systems persist. The COVID-19 pandemic further disrupted access to nutritious food and essential health services, aggravating the risk of malnutrition among children (UNICEF, 2021). Consequently, undernutrition remains a leading preventable cause of death among children under five. In sub-Saharan Africa (SSA), the prevalence of undernutrition is particularly high. The region accounts for about one-third of the world's stunted children, with nearly 31% of children under five affected by stunting and around 6% experiencing wasting (UNICEF, WHO, & World Bank, 2023). Factors contributing to this high burden include widespread poverty, household food insecurity, low maternal education, and recurrent disease outbreaks. Many families rely on rain-fed subsistence agriculture, which produces unstable food supplies and limits dietary diversity. Poor sanitation, unsafe water, and suboptimal feeding practices further exacerbate child undernutrition (Akombi et al., 2017). Despite regional policy efforts to reduce malnutrition, SSA ruins off track to achieve Sustainable Development Goal 2 (SDG 2), which aims to eliminate hunger and all forms of malnutrition by 2030 (FAO et al., 2022).

Within Rwanda, significant progress has been made in improving child health; however, undernutrition continues to pose a major challenge. The Rwanda Demographic and Health Survey (RDHS, 2019–2020**)** reports that 33% of children under five are stunted, 8% are underweight, and 1% are wasted. Although stunting has declined from 38% in 2015, rural communities stay disproportionately affected (National Institute of Statistics of Rwanda [NISR], 2020). Factors contributing to undernutrition include inadequate dietary diversity, maternal undereducation, household poverty, and limited access to nutritious foods. The Rwandan government has implemented interventions such as the National Food and Nutrition Policy (2014–2024) and the Community-

Based Nutrition Program, aiming to enhance household food security and child nutrition (Ministry of Health [MoH], 2014). Nevertheless, disparities persist, with Northern and Western Provinces reporting the highest prevalence of undernutrition (NISR, 2020).

Musanze District, located in Northern Rwanda, typifies rural settings where poverty, limited food diversity, and food insecurity intersect. Most households rely on subsistence farming, yet small landholdings and low crop variety result in insufficient and nutritionally inadequate diets. Reports from the Musanze District Health Office (2022) indicate that stunting rates in the district exceed national averages, demonstrating persistent nutritional deficiencies among children. Socioeconomic factors, including low household income, maternal unemployment, limited sanitation, and inadequate caregiver knowledge on child feeding, contribute to the continued burden of undernutrition. Although national surveys provide a general overview of child nutrition trends, they often fail to capture district-level determinants of undernutrition. Limited research has explored how local socioeconomic and environmental factors influence child nutrition in Musanze District. Addressing this knowledge gap is critical for designing effective, context-specific interventions. Therefore, this study aimed to determine the prevalence of undernutrition and identify factors associated with nutritional status among children aged 0–59 months in Musanze District, Rwanda. The findings are expected to inform policymakers, health professionals, and community stakeholders in developing targeted strategies to reduce child malnutrition and advance Rwanda's progress toward SDG 2: Zero Hunger.

Research Methods

Study Design

This research adopted a cross-sectional design aimed at assessing the prevalence of undernutrition and identifying the factors associated with it among children aged 0–59 months in Musanze District, Northern Rwanda. This design was considered appropriate because it enables data collection from participants at a single point in time, thereby providing a clear overview of the nutritional status of the study population. Furthermore, the cross-sectional approach facilitates the identification of existing patterns, associations, and potential determinants of undernutrition within the community context, which can inform evidence-based interventions (Cochran, 1977; Kish, 1965).

Study Setting

The study was carried out in Musanze District, situated in Rwanda's Northern Province. Musanze is largely rural, with semi-urban areas that reflect diverse socio-economic and environmental conditions. The district is characterized by an agriculture-driven economy, and most residents depend on subsistence farming for their livelihoods. Despite its agricultural potential, many households experience food insecurity and variable access to

healthcare services. This setting was chosen because it represents a typical Rwandan rural environment where nutritional disparities are common, thus providing a relevant context for investigating the underlying factors contributing to undernutrition among children under-five children (NISR, 2020).

Study Population

The study population consisted of children aged 0 to 59 months who were residents of Musanze District, as well as their primary caregivers, predominantly mothers or guardians. Children in this age group were targeted because they are at a critical stage of growth and development, making them more vulnerable to the effects of poor nutrition. Caregivers were included as key respondents since their knowledge, feeding practices, and socio-economic conditions directly influence the nutritional wellbeing of their children (WHO, 2006).

Inclusion and Exclusion Criteria

Children were eligible for participation if they were aged between 0 and 59 months at the time of data collection, had resided in Musanze District for at least six months, and had caregivers who voluntarily provided written informed consent for their participation in the study (NISR, 2020). Children were excluded if they had chronic illnesses or congenital anomalies known to affect nutritional status, had lived in the area for less than six months, or if their caregivers were unable to provide informed consent due to cognitive impairment or language barriers (WHO, 2021).

Sampling Procedure

A multistage sampling technique was utilized to ensure representativeness and minimize sampling bias (Kish, 1965). In the first stage, health centers within Musanze District were stratified based on their geographical location as either rural or urban. From these strata, four health centers were randomly selected—Kinigi and Rwaza representing rural areas and Kimonyi and Muhoza representing urban areas. This approach ensured that both rural and urban populations were adequately represented in the study, recognizing potential variations in access to health services and food availability between these settings. During the second stage, participant recruitment took place at the selected health centers. Eligible children were identified during child immunization and growth monitoring clinics. Caregivers attending these services were approached by trained research assistants who explained the study objectives, obtained informed consent, and enrolled their children. When multiple children from the same household met the eligibility criteria, one child was selected randomly to avoid duplication and ensure fairness in representation (Cochran, 1977).

Sample Size Determination

The required sample size was calculated using Cochran's (1977) formula for cross-sectional studies, assuming a 95% confidence level, a 5% margin of error, and an estimated undernutrition prevalence of 33% based on the Rwanda Demographic and Health Survey (NISR, 2020). The computation yielded a sample size of 340 participants. To compensate for potential non-response, a 10% adjustment increased the final sample size to 374 participants. The final sample was proportionally allocated to the selected health centers according to their catchment population, with 60% drawn from rural areas and 40% from urban areas, as outlined below:

Table1.List of Health Centers

Health Center	Location	Sample Size
Kinigi	Rural	111
Rwaza	Rural	111
Kimonyi	Urban	76
Muhoza	Urban	76
Total	4 Centers	**374**

Data Collection Procedures

Data collection involved three main components: structured questionnaires, caregiver interviews, and anthropometric measurements. Standardized measuring equipment was used to record each child's height or length and weight. These measurements were analyzed in accordance with the WHO Child Growth Standards, classifying children as stunted, wasted, or underweight (WHO, 2006). Structured interviews were administered to caregivers to gather information on socio-demographic characteristics, child feeding habits, healthcare access, and household food security. Additionally, the questionnaires included sections on maternal education, sanitation conditions, and recent illnesses that may influence nutritional outcomes. All data were collected by trained research assistants under close supervision to maintain quality and consistency.

Data Collection and Quality Control

Data were collected using structured interviewer-administered questionnaires covering socio-demographics, feeding practices, and health access. Anthropometric measurements (weight, height/length, MUAC) were taken using calibrated equipment following WHO (2006) Z-score criteria:

Stunting: Height-for-age < -2 SD

Wasting: Weight-for-height < -2 SD

Underweight: Weight-for-age < -2 SD

To ensure quality, data collectors received three days of training, and all tools were pretested in a neighboring district. Supervisors verified data daily for completeness and consistency.

Data Analysis

Data were coded and entered into SPSS version 27 for analysis. Descriptive statistics, including frequencies, means, and percentages, were used to summarize socio-demographic characteristics and determine the prevalence of stunting, wasting, and underweight among children. To examine associations between undernutrition and explanatory variables such as maternal education, household income, and child feeding practices, Chi-square tests and binary logistic regression analyses were employed. Statistical significance was determined at a p-value < 0.05, and results were presented in tables and charts for clarity and interpretation (Cochran, 1977; Kish, 1965).

Validity and Reliability

To ensure validity, the questionnaire and measurement procedures were reviewed by public health and nutrition experts to confirm relevance and content accuracy. A pilot study was conducted in a neighboring district to assess clarity, flow, and cultural appropriateness, after which minor adjustments were made (WHO, 2021). Reliability was maintained through standardized data collection protocols and uniform training for all field staff. Anthropometric measurements were performed using calibrated instruments, and data were double-checked during entry to minimize transcription errors.

Ethical Considerations

Ethical clearance for this study was obtained from the Mount Kenya University Ethical Review Committee. Participation was voluntary, and informed written consent was obtained from all caregivers after explaining the study's objectives, procedures, potential risks, and benefits. Participants were assured of anonymity and confidentiality; no identifying information was included in reports or publications. Caregivers were also informed of their right to withdraw from the study at any time without penalty. To safeguard participant welfare, children identified with severe undernutrition were referred to local healthcare providers for appropriate clinical management. All procedures adhered strictly to the ethical principles of respect for persons, beneficence, and justice (WHO, 2021).

Results

4.1 Demographic and Socioeconomic of the Respondents and Child Characteristics

Among the 374 children surveyed, the majority (58.3%) were under three years old, with the largest age group being 12–24 months (33.4%). Females predominated, representing 64.7% of the sample. Most caregivers were

aged 35–44 years (47.6%), followed by 25–34 years (27.0%) and 45 years or older (22.7%), with only 2.7% aged 18–24 years. Educational attainment was highest at the primary level (62.8%), with 24.6% completing secondary school and 7.2% tertiary education; 5.3% had no formal education. The majority of caregivers were married (78.3%). Occupationally, participants were primarily teachers (29.9%), farmers (29.4%), or health professionals (25.4%), with smaller proportions engaged in casual work or business. Household income predominantly ranged between 50,001–150,000 Rwf, with farming and salaried work as main income sources. Access to clean water was reported by 55.1% of households. Most families had 1–4 children, and household sizes varied, with 39.0% having 4–6 members, reflecting the distribution of care and resources relevant to child nutrition.

Table 2. Demographic and Socioeconomic of the Respondents and Child Characteristics

Variable	Category	Frequency (n)	Percent (%)
Child Age (months)	12–24	125	33.4
	25–37	93	24.9
	38–50	65	17.4
	51–59	91	24.3
	Total	**374**	**100.0**
Child Gender	Male	132	35.3
	Female	242	64.7
	Total	**374**	**100.0**
Respondent Age	18–24	10	2.7
	25–34	101	27.0
	35–44	178	47.6
	45+	85	22.7
	Total	**374**	**100.0**
Education Level	No formal education	20	5.3
	Primary education	235	62.8
	Secondary education	92	24.6
	Tertiary education	27	7.2
	Total	**374**	**100.0**
Marital Status	Single	81	21.7
	Married	293	78.3
	Total	**374**	**100.0**
Mother's Occupation	Business	19	5.1
	Casual work	38	10.2
	Farmer	110	29.4
	Health professional	95	25.4
	Teacher	112	29.9
	Total	**374**	**100.0**
Primary Source of Household Income	Business	86	23.0
	Farming	105	28.1
	Remittances	60	16.0
	Salaried work	105	28.1
	Others	18	4.8

	Total	**374**	**100.0**
Monthly Household Income (Rwf)	< 50,000	18	4.8
	50,001–100,000	173	46.3
	100,001–150,000	165	44.1
	150,001+	18	4.8
	Total	**374**	**100.0**
Access to Clean Drinking Water	Yes	206	55.1
	No	168	44.9
	Total	**374**	**100.0**
Number of Children in Household	1–4	223	59.6
	5–8	95	25.4
	9+	56	15.0
	Total	**374**	**100.0**
Number of People in Household	≤ 3	124	33.2
	4–6	146	39.0
	7+	104	27.8
	Total	**374**	**100.0**

Distribution of Factors Related to Household Conditions and Child Health Status Among Children Aged 0–59 Months in Musanze District (N = 374)

The assessment of household conditions and child health status revealed several important insights. A significant majority of respondents 70.3% (n = 263) reported having access to electricity in their homes, while 29.7% (n = 111) did not. Regarding food security, 60.2% (n = 225) of households stated they never experienced food shortages, whereas 39.8% (n = 149) occasionally faced such challenges. Concerning chronic illnesses, 34.5% (n = 129) of children had been diagnosed with at least one chronic condition, while the remaining 65.5% (n = 245) had not. When asked about recent health experiences within the past six months, diarrhea was the most commonly reported issue, affecting 55.1% (n = 206) of children. Vomiting was reported in 38.0% (n = 142) of cases, followed by fever (3.5%, n = 13), cough 2.1%, (n = 8), malaria (1.1%, n = 4), and other conditions (0.3%, n = 1). Hospitalization rates were also notable, with 45.2% (n = 169) of children having been hospitalized in the past six months, while 54.8% (n = 205) had not. In terms of routine health check-ups, only 15.2% (n = 57) of children received them regularly, whereas 83.7% (n = 313) received them occasionally, and a small proportion (1.1%, n = 4) did not receive any check-ups. Alarmingly, only 15.2% (n = 57) of children had received immunizations as per the recommended schedule, leaving a vast majority 84.8%, (n = 317) unimmunized according to national guidelines.

Table 3. Distribution of Factors Related to Household Conditions and Child Health Status Among Children Aged 0–59 Months in Musanze District (N = 374)

Variable	Category	Frequency	Percent (%)
Access to electricity in home	Yes	263	70.3
	No	111	29.7
Household food shortages	Occasionally	149	39.8
	Never	225	60.2
Child diagnosed with chronic illnesses	Yes	129	34.5
	No	245	65.5
Child experienced in past 6 months	Cough	8	2.1
	Vomiting	142	38.0
	Diarrhea	206	55.1
	Fever	13	3.5
	Malaria	4	1.1
	Others	1	0.3
Child hospitalized in past 6 months	Yes	169	45.2
	No	205	54.8
Child received routine health check-ups	Yes, Regularly	57	15.2
	Yes, Occasionally	313	83.7
	No	4	1.1
Child received immunizations per schedule	Yes	57	15.2
	No	317	84.8
Total Respondents		**374**	**100.0**

Distribution of Feeding Practices, Child Health, and Household Food Security Characteristics Among Caregivers of Children Aged 0–59 Months in Musanze District, Rwanda (N=374)

Most children (89.8%) were fed infant formula, with only 10.2% receiving breast milk. Feeding frequency was low, as 55.3% ate a few times per week, while 44.7% ate daily. Households mainly consumed beans/legumes (78.6%) and staple grains (14.7%), with limited intake of meats, fruits, and vegetables. About 60% of caregivers followed feeding guidelines and had nutrition knowledge, though 44.4% lacked formal nutrition education. Children's health was mostly rated "somehow healthy" (61.0%). Handwashing practices were poor, and most families relied on home remedies when ill. Food sources were split between homegrown (55.3%) and markets (44.7%), with 79.9% perceiving food security.

Table 4. Distribution of Feeding Practices, Child Health, and Household Food Security Characteristics Among Caregivers of Children Aged 0–59 Months in Musanze District, Rwanda (N=374)

Variable / Question	Category	Frequency (n=374)	Percent (%)
Type of food child typically consumes daily	Breast milk	38	10.2
	Infant formula	336	89.8
Frequency child consumes food	Daily	167	44.7
	Few times a week	207	55.3

Types of food commonly available in household	Beans or legumes	294	78.6
	Meats or Fish	6	1.6
	Fruits	9	2.4
	Staple grains	55	14.7
	Vegetables	6	1.6
	Processed food	4	1.1
Following particular feeding practices	Yes	225	60.2
	No	149	39.8
Overall health of child	Healthy	17	4.5
	Somehow healthy	228	61.0
	Very healthy	129	34.5
Knowledge about child nutrition and feeding	Somewhat knowledgeable	150	40.1
	Very knowledgeable	224	59.9
Received nutrition education/information in the past	Yes, from community program	207	55.3
	No	166	44.4
	Missing / Not specified	1	0.3
Advice from healthcare providers regarding child health	Often	57	15.2
	Sometimes	317	84.8
Action when child is ill	Seek medical attention immediately	57	15.2
	Use home remedies	317	84.8
Handwashing with soap before preparing child's food	Always	38	10.2
	Sometimes	336	89.8
Family members unable to eat healthy/nutritious food	Rarely	150	40.1
	Never	224	59.9
Usual source of food for household	Buy from market	167	44.7
	Grow own food	207	55.3
Overall food security of household	Secure	299	79.9
	Moderate secure	75	20.1

Distribution of Nutritional Status of Children Based on Different Anthropometric Measurements.

A total of 374 children aged 0–59 months in Musanze District were evaluated for nutritional status using standard anthropometric measures. Acute malnutrition, assessed through wasting, was present in 4.5% of children, whereas 21.4% were underweight, indicating both short- and long-term nutritional deficits. Chronic malnutrition, measured by stunting, affected 29.9% of the participants. Most children maintained adequate weight for height (95.5%) and age (78.6%), and 69.3% were not stunted, with a small proportion (0.8%) missing height-for-age

data. These results highlight ongoing challenges in child nutrition, particularly chronic and moderate undernutrition, underscoring the need for interventions to improve growth outcomes in the district.

Table 5. Distribution of Nutritional Status of Children Based on Different Anthropometric Measurements.

Nutritional Status Category	Subcategory	Frequency	Percent (%)
Weight-for-Height	Wasting	17	4.5
	Not wasted	357	95.5
	Total	374	100.0
Weight-for-Age	Underweight	80	21.4
	Not Underweight	294	78.6
	Total	374	100.0
Height-for-Age	Stunted	112	29.9
	Non-stunted	259	69.3
	Missing System	3	0.8
	Total	374	100.0

Prevalence of undernutrition among children

Among the 374 children assessed in Musanze District, 143 children (38.2%) were identified as undernourished, indicating they exhibited signs of nutritional deficiency based on the study criteria. In contrast, 231 children (61.8%) were not classified as undernourished, suggesting that the majority maintained adequate nutritional status. These findings reveal that undernutrition affects more than one-third of the children in the district, highlighting a significant public health concern that requires ongoing attention and intervention.

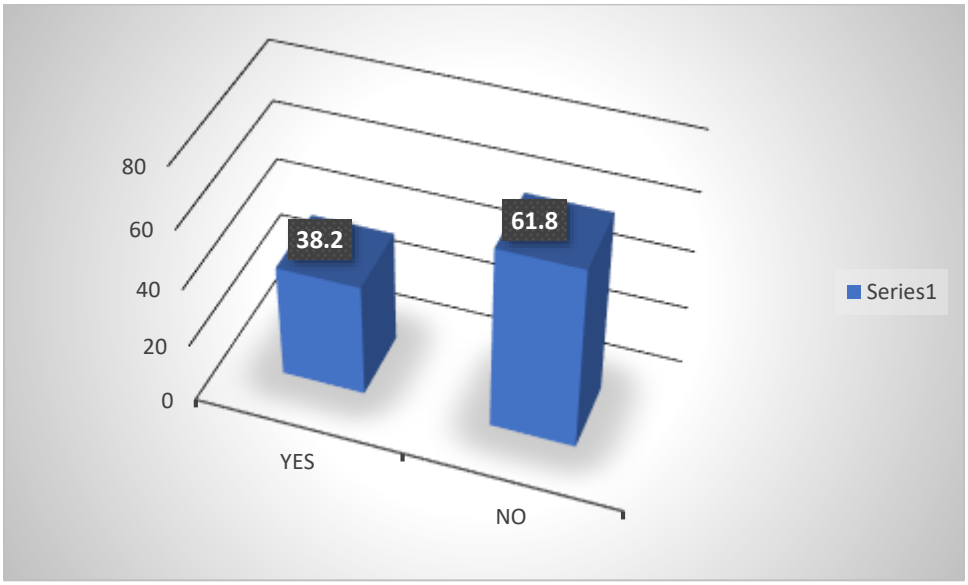

Figure 1 Prevalence of undernutrition among children

Bivariate analysis of the factors associated with undernutrition among under 5 years' children attending at the health centers in Musanze District, Rwanda.

Bivariate analysis of 374 children in Musanze District showed significant associations between undernutrition and caregiver education ($\chi^2 = 12.82$, $p = .005$), maternal occupation ($\chi^2 = 10.05$, $p = .040$), household income ($\chi^2 = 15.61$, $p = .001$), and access to clean water ($\chi^2 = 4.36$, $p = .037$). Children of caregivers with no formal education had the highest undernutrition (75%) versus 29.6% among those with tertiary education. Children of casual laborers and farmers were more affected, and low-income households (<50,000 Rwf) showed higher prevalence (77.8%) than higher-income families (16.7%). Child age, gender, marital status, household size, and electricity access were not statistically significant.

Table 6. Bivariate analysis of the factors associated with undernutrition among under 5 years' children attending at the health centers in Musanze District, Rwanda.

Variable	Category	Undernutrition Yes, n (%)	Undernutrition No, n (%)	χ^2 (df)	p-value
Child Age (months)	12–24	52 (41.6)	73 (58.4)	1.81 (3)	.613
	25–37	37 (39.8)	56 (60.2)		
	38–50	24 (36.9)	41 (63.1)		
	51–59	30 (33.0)	61 (67.0)		
Child Gender	Male	48 (36.4)	84 (63.6)	0.30 (1)	.582
	Female	95 (39.3)	147 (60.7)		

Respondent's Age	18–24	4 (40.0)	6 (60.0)	3.22 (3)	.359
	25–34	46 (45.5)	55 (54.5)		
	35–44	63 (35.4)	115 (64.6)		
	≥45	30 (35.3)	55 (64.7)		
Education Level	No formal education	15 (75.0)	5 (25.0)	12.82 (3)	**.005**
	Primary	88 (37.4)	147 (62.6)		
	Secondary	32 (34.8)	60 (65.2)		
	Tertiary	8 (29.6)	19 (70.4)		
Marital Status	Single	35 (43.2)	46 (56.8)	1.08 (1)	.298
	Married	108 (36.9)	185 (63.1)		
Mother's Occupation	Business	2 (10.5)	17 (89.5)	10.05 (4)	**.040**
	Casual work	14 (36.8)	24 (63.2)		
	Farmer	38 (34.5)	72 (65.5)		
	Health professional	37 (38.9)	58 (61.1)		
	Teacher	52 (46.4)	60 (53.6)		
Primary Income Source	Business	37 (43.0)	49 (57.0)	3.60 (4)	.463
	Farming	34 (32.4)	71 (67.6)		
	Remittances	24 (40.0)	36 (60.0)		
	Salaried work	43 (41.0)	62 (59.0)		
	Others	5 (27.8)	13 (72.2)		
Monthly Income (Rwf)	< 50,000	14 (77.8)	4 (22.2)	15.61 (3)	**.001**
	50,001–100,000	65 (37.6)	108 (62.4)		
	100,001–150,000	61 (37.0)	104 (63.0)		
	≥150,001	3 (16.7)	15 (83.3)		
Access to Clean Water	Yes	69 (33.5)	137 (66.5)	4.36 (1)	**.037**
	No	74 (44.0)	94 (56.0)		
Number of Children	1–4	85 (38.1)	138 (61.9)	0.75 (2)	.688
	5–8	34 (35.8)	61 (64.2)		
	≥9	24 (42.9)	32 (57.1)		
Household Size	≤3	45 (36.3)	79 (63.7)	0.34 (2)	.844
	4–6	58 (39.7)	88 (60.3)		
	≥7	40 (38.5)	64 (61.5)		
Access to Electricity	Yes	101 (38.4)	162 (61.6)	0.01 (1)	.918
	No	42 (37.8)	69 (62.2)		

Associations Between Undernutrition Status and Child-Related Factors Among Children in the Study Sample (N = 374)

The study assessed associations between undernutrition and child-related factors among 374 children. Most variables, including household food shortage frequency ($\chi^2 = 1.68$, $p = .194$), hospitalization in the past six months ($\chi^2 = 0.52$, $p = .470$), routine health check-ups ($\chi^2 = 2.60$, $p = .273$), immunization status ($\chi^2 = 0.06$, $p = .814$), feeding practices, and caregiver nutrition knowledge, were not significantly linked to undernutrition. In contrast, chronic illness showed a significant association ($\chi^2 = 5.71$, $p = .017$), with affected children more likely to be undernourished. Recent illness episodes had a borderline effect ($\chi^2 = 9.60$, $p = .088$; likelihood ratio $p = .048$), highlighting the multifactorial nature of child undernutrition.

Table 7. Associations Between Undernutrition Status and Child-Related Factors Among Children in the Study Sample (N = 374)

Variable	Category	Undernutrition Yes, n (%)	Undernutrition No, n (%)	χ^2 (df)	p-value
How often does your household experience food shortages	Occasionally	51 (35.7)	98 (42.4)	1.68 (1)	.194
	Never	92 (64.3)	133 (57.6)		
Has your child been diagnosed with any chronic illnesses	Yes	60 (41.9)	69 (29.9)	5.71 (1)	.017*
	No	83 (58.1)	162 (70.1)		
Child experienced any of the following in past 6 months	Cough	6 (4.2)	2 (0.9)		
	Vomiting	50 (35.0)	92 (39.8)		
	Diarrhea	80 (55.9)	126 (54.5)	9.60 (5)	.088
	Fever	6 (4.2)	7 (3.0)		
	Malaria	0 (0)	4 (1.7)		
	Others	1 (0.7)	0 (0)		
Has your child been hospitalized in the past 6 months	Yes	68 (47.6)	101 (43.7)	0.52 (1)	.470
	No	75 (52.4)	130 (56.3)		
Child receives routine health check-ups	Yes, Regularly	21 (14.7)	36 (15.6)		

	Yes, Occasionally	122 (85.3)	191 (82.7)	2.60 (2)	.273
	No	0 (0)	4 (1.7)		
Child receives immunizations as per recommended schedule	Yes	21 (14.7)	36 (15.6)	0.06 (1)	.814
	No	122 (85.3)	195 (84.4)		
Type of food child typically consumes daily	Breast milk	14 (9.8)	24 (10.4)	0.04 (1)	.852
	Infant formula	129 (90.2)	207 (89.6)		
How often does child consume food	Daily	67 (46.9)	100 (43.3)	0.45 (1)	.501
	Few times a week	76 (53.1)	131 (56.7)		
Types of food most commonly available in household	Beans or legumes	108 (75.5)	186 (80.5)		
	Meats or Fish	4 (2.8)	2 (0.9)		
	Fruits	4 (2.8)	5 (2.2)		
	Stample grains	20 (14.0)	35 (15.2)	6.91 (5)	.228
	Vegetables	4 (2.8)	2 (0.9)		
	Processed food	3 (2.1)	1 (0.4)		
Do you follow any particular feeding practices	Yes	92 (64.3)	133 (57.6)	1.68 (1)	.194
	No	51 (35.7)	98 (42.4)		
How would you rate overall health of your child	Healthy	5 (3.5)	12 (5.2)		
	Somehow healthy	94 (65.7)	134 (58.0)		
	Very healthy	44 (30.8)	85 (36.8)	2.36 (2)	.308
Do you feel about child nutrition and feeding practices	Somewhat knowledgeable	54 (37.8)	96 (41.6)	0.53 (1)	.467
	Very knowledgeable	89 (62.2)	135 (58.4)		

Association Between Household and Caregiver Factors and Child Undernutrition Status (n = 374)

The study examined household and caregiving factors associated with child undernutrition. Community nutrition education showed no significant effect ($\chi^2 = 1.03$, $p = .598$), nor did caregiver health-seeking behaviors ($\chi^2 = 0.06$,

p = .814), handwashing practices ($\chi^2 = 0.04$, p = .852), or perceived household food security ($\chi^2 = 0.78$, p = .377). However, frequent advice from healthcare providers was significantly associated with better nutrition ($\chi^2 = 12.19$, p < .001). Food acquisition methods also influenced outcomes, with market-purchased foods linked to lower undernutrition ($\chi^2 = 13.01$, p < .001). These findings indicate professional guidance and food access play key roles in child nutritional status, while other household behaviors had limited impact.

Table 8. Association Between Household and Caregiver Factors and Child Undernutrition Status (n = 374)

Variable	Category	Undernutrition Yes, n (%)	Undernutrition No, n (%)	χ^2 (df)	p-value
Information or education about child nutrition	Yes, from community program	76 (53.1)	130 (56.3)	1.03 (2)	.598
	No	67 (46.9)	100 (43.3)		
	Missing	0 (0.0)	1 (0.4)		
Advice from healthcare providers about child health	Often	10 (7.0)	47 (20.3)	12.19 (1)	.001
	Sometimes	133 (93.0)	184 (79.7)		
What do you do if your child is ill?	Seek medical attention	21 (14.7)	36 (15.6)	0.06 (1)	.814
	Use home remedies	122 (85.3)	195 (84.4)		
Handwashing with soap before preparing food	Always	14 (9.8)	24 (10.4)	0.04 (1)	.852
	Sometimes	129 (90.2)	207 (89.6)		
Family members unable to eat healthy and nutritious	Rarely	54 (37.8)	96 (41.6)	0.53 (1)	.467
	Never	89 (62.2)	135 (58.4)		

How do you usually get food for your household?	Buy from market	47 (32.9)	120 (51.9)	13.01 (1)	.001
	Grow own food	96 (67.1)	111 (48.1)		
Your rating of overall food security of your household	Secure	111 (77.6)	188 (81.4)	0.78 (1)	.377
	Moderate secure	32 (22.4)	43 (18.6)		

Multivariate Logistic Regression Analysis of Factors Associated with Child Undernutrition, in Musanze District

In this study, 38.2% of children aged 0–59 months in Musanze District were found to be undernourished, with stunting (23.8%) being the most common manifestation, followed by underweight (9.6%) and wasting (4.8%). Maternal occupation and household income were key determinants; children of mothers working as casual laborers were significantly more likely to be undernourished (AOR = 16.60; 95% CI: 3.27–84.18), and dependence on subsistence farming increased undernutrition risk (AOR = 2.51; 95% CI: 1.53–4.12). Low-income households were less likely to maintain adequate child nutrition (AOR = 0.09; 95% CI: 0.02–0.54). Additional factors included limited health guidance and chronic illnesses. These results underscore the need for socioeconomic and nutrition-focused interventions.

Table 9. Multivariate Logistic Regression Analysis of Factors Associated with Child Undernutrition, in Musanze District

Variable	Category	Undernourished n (%)	Not Undernourished n (%)	AOR (Exp(B))	95% CI for AOR	p-value
Education Level						**.007**
	No formal education **(Ref)**	50 (34.9%)	58 (25.1%)	—	—	—
	Primary	55 (38.5%)	72 (31.2%)	0.306	[0.069, 1.357]	.119
	Secondary	25 (17.5%)	56 (24.2%)	2.037	[0.655, 6.336]	.219
	Tertiary	13 (9.1%)	45 (19.5%)	2.932	[0.863, 9.954]	.085
Monthly Income (RWF)						.061
	<20,000 **(Ref)**	68 (47.6%)	49 (21.2%)	—	—	—

	20,000–50,000	45 (31.5%)	68 (29.4%)	0.092	[0.016, 0.538]	**.008**
	50,001–100,000	20 (14.0%)	55 (23.8%)	0.360	[0.095, 1.361]	.132
	>100,000	10 (7.0%)	59 (25.5%)	0.322	[0.085, 1.218]	.095
Access to Clean Water	Yes	93 (65.0%)	170 (73.6%)	1.317	[0.769, 2.256]	.316
	No	50 (35.0%)	61 (26.4%)	—	—	—
Mother's Occupation						**.002**
	Unemployed **(Ref)**	29 (20.3%)	41 (17.7%)	—	—	—
	Farmer	45 (31.5%)	55 (23.8%)	16.601	[3.274, 84.181]	.001
	Trader	27 (18.9%)	35 (15.2%)	2.511	[1.058, 5.963]	.037
	Casual laborer	33 (23.1%)	61 (26.4%)	2.422	[1.206, 4.865]	.013
	Civil servant	9 (6.3%)	39 (16.9%)	1.073	[0.563, 2.043]	.831
Child Diagnosed with Chronic Illness	Yes	18 (12.6%)	49 (21.2%)	0.418	[0.233, 0.751]	.004
	No **(Ref)**	125 (87.4%)	182 (78.8%)	—	—	—
Health Advice Frequency	Often **(Ref)**	10 (7.0%)	47 (20.3%)	—	—	—
	Sometimes	133 (93.0%)	184 (79.7%)	3.235	[1.491, 7.021]	**.003**
Household Food Source	Buy from market **(Ref)**	47 (32.9%)	120 (51.9%)	—	—	—
	Grow own food	96 (67.1%)	111 (48.1%)	2.507	[1.525, 4.119]	**.001**
Constant	—	—	—	1.067	—	.941
Model Summary	-2 Log Likelihood	Cox & Snell R^2	Nagelkerke R^2			
	420.860	0.185	0.252			

Discussion

The study identified that 38.2% of children aged 0–59 months in Musanze District were undernourished, exceeding the national stunting rate of 33% reported in the Rwanda Demographic and Health Survey (NISR, 2020). Maternal occupation, household income, and primary food source were key determinants of child nutritional outcomes. Children whose mothers were engaged in formal or income-generating work were less likely to be undernourished. Interestingly, receiving health-care advice was associated with higher rates of undernutrition, indicating that advice might often be provided reactively to already malnourished children. Children with chronic illnesses were less likely to be undernourished, possibly reflecting targeted support for this vulnerable group.

The observed prevalence aligns with rates reported in sub-Saharan Africa, where undernutrition frequently affects 30–40% of children (Ararsa et al., 2023; World Bank, 2025). Employment of mothers has been shown to improve child nutrition through increased household resources, better access to nutritious foods, healthcare, and improved hygiene practices (Kyanjo et al., 2025). Low-income households continue to experience higher malnutrition risks due to limited access to diverse foods and healthcare services (Okutse, 2025). Reliance on subsistence farming was linked to poorer nutritional outcomes, likely due to restricted dietary diversity and seasonal food shortages (Shibeshi, 2024; FAO, 2023). The association between health-care advice and undernutrition may result from reverse causality: undernourished children receive more guidance. Families growing their own food may face reduced dietary variety, which contributes to micronutrient deficiencies. Chronic illness may prompt frequent health facility visits, providing nutritional support that lowers malnutrition risk. Maternal employment improves household income, though childcare quality and time allocation may also influence outcomes (Melaku et al., 2024).

Causal relationships cannot be established due to the cross-sectional design. Self-reported variables, including income, occupation, and feeding practices, may be prone to bias. Important determinants such as maternal nutrition, detailed dietary diversity, sanitation, and cultural feeding practices were not measured, limiting interpretation. The sample may not be generalizable beyond Musanze District. Findings emphasize the need for multisectoral interventions targeting maternal empowerment, income diversification, and nutrition-sensitive agriculture. Strengthening preventive health-care guidance and nutrition education, along with improved access to diverse foods, can reduce undernutrition and support progress toward SDG 2—Zero Hunger.

Conclusion

This study demonstrates that undernutrition remains a significant and multifactorial public health challenge among under-five children in the study area. The findings indicate that socioeconomic determinants, particularly maternal occupation and household income, exert a substantial influence on children's nutritional outcomes. Moreover, the study identified that patterns of healthcare engagement and household food sourcing significantly affect nutritional status, highlighting the complex interplay between social, economic, and environmental factors. While the study acknowledges limitations inherent to its cross-sectional design and constraints in data availability, the results provide critical insights into the key drivers of undernutrition. These findings underscore the need for targeted interventions that address both the immediate and underlying determinants of poor child nutrition in similar rural settings.

Recommendations

The study recommends several strategies to reduce undernutrition among children under five. Empowering women economically is essential, as maternal employment and income improve household food security and

child nutrition. Poverty alleviation and increased household income can further lower undernutrition prevalence. Preventive nutrition education by healthcare providers should be prioritized, emphasizing optimal feeding practices. Promoting dietary diversity through diversified agriculture can reduce reliance on subsistence farming. Strengthening healthcare systems for routine nutritional screening, including support for chronically ill children, is critical. Additionally, longitudinal research is needed to explore causal factors like sanitation, maternal nutrition, and cultural feeding practices.

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Conflict of Interest

The researcher declares that there is **no conflict of interest** associated with the design, implementation, or publication of this study.

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