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Prevalence and Factors Associated with Stunting among Children Aged 6-59 Months in Musanze District of Rwanda

Delphine Dusingizimana[1], Abenezel Niyomurengezi[2], Lucie Uwimana[3], Amanuel Kidane Andegiogish[3]

[1]Rwanda Military Medical Insurance, [2] Rwanda Social Security Board, [3]Mount Kenya University

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Abstract: **Background: Stunting in children is a chronic condition resulting from prolonged insufficient intake of essential nutrients. It remains a major public health concern, particularly in low- and middle-income countries, where it is strongly associated with increased morbidity and mortality. In Rwanda, 33% of children aged 6–59 months are stunted, posing a substantial burden on national health and economic systems. Despite this, limited data exist on the factors contributing to stunting at the district level. This study aimed to assess the prevalence of stunting and its associated factors among children aged 6–59 months in Musanze District, Rwanda.**

Methodology: A community-based cross-sectional study was conducted among 374 children aged 6–59 months in rural areas of Musanze District. Nutritional status was assessed using WHO Anthro software version 3.2.2. Data analysis was performed using SPSS 25.0. Bivariate analysis (crosstabs) was used to identify variables associated with stunting at a 5% significance level. Variables with significant associations were entered into a binary logistic regression model using the Enter method to control for potential confounders. Ethical approval was obtained from the Mount Kenya University Review Board and Musanze District authorities, and informed consent was secured from all participants' guardians.

Results: The prevalence of stunting was found to be 35.8%. Key factors significantly associated with stunting included the mother's occupation (p=0.005), child's birth weight (p=0.001), child morbidity (p=0.047), and household practices related to drinking water treatment (p=0.013).

Conclusion: Stunting remains highly prevalent among children aged 6–59 months in Gacaca Sector of Musanze District. Targeted interventions addressing maternal employment, early child health, and household water safety practices are essential to reduce the burden of stunting in this area and contribute to broader national efforts in Rwanda.

Abbreviations: BMI: Body Mass Index, HAZ: Height for Age, PEM: Protein Energy Malnutrition

Keywords: **(MeSH): Factors Associated, Prevalence, Stunting, 6-59 Months Children.**

1. BACKGROUND

Optimal child nutrition and appropriate feeding practices are fundamental for healthy growth and development during early childhood (Gebre et al., 2019). Stunting—a form of chronic malnutrition—results from prolonged inadequate intake of essential nutrients, impairing linear growth and developmental potential. The World Health Organization (WHO, 2024) defines stunting as a height-for-age Z-score (HAZ) below -2 standard deviations from the WHO Child Growth Standards median. It typically occurs within the first five years of life, particularly during the critical first 1,000 days from conception to a child's second birthday, when unmet caloric and nutrient demands hinder normal growth and metabolic function (Fatima et al., 2020). Stunting has both primary and secondary causes. Primary causes are often rooted in poverty-related factors such as food insecurity, poor maternal nutrition, and limited access to healthcare and education

(Tafesse et al., 2021). Secondary malnutrition arises from disease conditions that impair nutrient absorption or increase energy requirements, including frequent infections, congenital abnormalities, gastrointestinal issues, diarrhea, vomiting, and food allergies. Other contributing factors include suboptimal feeding practices, poor maternal-child interaction, limited parental care, maternal illiteracy, prematurity, low birth weight (LBW), and high birth order within the household (Mohseni et al., 2022).

Globally, stunting remains a major public health issue (Dukhi, 2020). According to UNICEF (2024), over 90% of the world's stunted children reside in Africa and Asia, with thirteen countries accounting for approximately 80% of all stunted children aged 6–59 months. Sub-Saharan Africa and South Asia alone contribute 79% of global cases. In Sub-Saharan Africa, 16% of children aged 6–59 months are affected. Stunting significantly increases under-five mortality, contributing to over half of childhood deaths, with particularly high mortality associated with infections such as diarrhea and measles (Fatima et al., 2020). Country-level data reflect stark disparities. In the Democratic Republic of Congo, stunting prevalence is 40%, linked to conflict, poverty, poor infrastructure, and high disease burden (Akilimali, 2022). Uganda saw a decline in stunting from 38.3% in 1995 to 29% in 2016, though some regions, such as Karamoja and West Nile, experienced increases in wasting. Risk factors include rural residence, child illness, unsafe water, inadequate hygiene, and poor dietary practices (Buzigi, 2018). In Tanzania, stunting declined by 30% over 25 years, yet remained associated with low birth weight, inconsistent breastfeeding, and children in female-headed households (Sunguya, 2019). In Kenya's Siaya District, 47% of children under five were stunted, with predictors including early food introduction, illness, incomplete immunization, and living with non-biological parents (Murgia et al., 2020). Burundi reports the highest stunting prevalence in East Africa at 53%, with contributing factors including maternal illiteracy, home deliveries, household size, and low socioeconomic status (Nkurunziza, 2017).

In Rwanda, malnutrition is among the top ten causes of death in children aged 6–59 months, with stunting implicated in over 50% of these deaths (Akilimali, 2022). Despite progress in reducing wasting and infant mortality, stunting remains a persistent challenge. The 2019–2020 Rwanda Demographic and Health Survey (RDHS) reported a stunting prevalence of 33%, down from 51% in 2005. However, this figure remains above the national target of 19% by 2024 (National Institute of Statistics of Rwanda, 2023). Stunting is more prevalent in rural areas, where food insecurity and limited access to healthcare and education are more pronounced. Stunting distribution varies regionally within Rwanda. In 2020, the Northern and Western provinces reported the highest stunting rates (40.5% and 40.2%, respectively). Seven districts—including Musanze, Gicumbi, Rubavu, and Burera—had stunting rates exceeding 40%. Encouragingly, 25 districts recorded reductions in stunting between 2015 and 2020, with seven achieving reductions of over 10 percentage points. However, five districts, including Musanze and Gicumbi, experienced an increase in prevalence during the same period (National Institute of Statistics of Rwanda, 2023).

The consequences of stunting extend beyond immediate health effects. It hampers cognitive development, school performance, and future productivity, posing a significant economic burden through lost human capital. These long-term impacts threaten Rwanda's goal of becoming a middle-income country, as outlined in its Vision 2050 agenda, which prioritizes reducing stunting and improving food security, particularly in rural communities (Dukhi, 2020). In 2020, an estimated 149.2 million children under five were stunted globally, with Africa accounting for 40% of cases (WHO, 2020). In Rwanda, although national efforts have led to measurable progress, high rates persist in specific regions such as Musanze District. Limited data exist on the district-level determinants of stunting, despite its high prevalence and public health significance. Understanding the underlying causes of persistent stunting in Musanze District is critical for designing effective, evidence-based interventions. This study aimed to assess the prevalence of stunting and identify the associated socio-economic, environmental, and health-related factors among children aged 6–59 months in Musanze District, Northern Rwanda. The findings are intended to support targeted strategies to reduce stunting and improve child health outcomes in alignment with national and global development goals.

2. METHODOLOGY

A community-based cross-sectional study utilizing a quantitative approach was conducted to assess the prevalence and associated factors of stunting among children aged 6–59 months in Gacaca Sector, Musanze District, Northern Rwanda. Musanze is one of five districts in Rwanda's Northern Province, characterized by high population density, rural agricultural activity—particularly Irish potato farming—and a notable prevalence of childhood stunting.

Study Area and Population

Gacaca Sector was purposively selected due to its high number of children under five and its representative rural characteristics. According to the 2022 Rwanda Population and Housing Census, Gacaca Sector had 3,968 children aged 6–59 months. The study population comprised children within this age range residing in the sector.

Sample Size and Sampling Techniques

The sample size was calculated using the Fisher et al. (1998) formula for cross-sectional studies, based on a national stunting prevalence of 33% (RDHS, 2019–2020), a 95% confidence level, and a 5% margin of error. The initial sample size of 340 was increased by 10% to account for non-response, yielding a final sample of 374 participants. A multistage sampling strategy was applied. Gacaca Sector, comprising four cells—Karwasa, Gakoro, Gasakuza, and Kabirizi—was selected purposively. Within each cell, the sample was stratified into two age groups (6–23 months and 24–59 months) to ensure proportional representation. Simple random sampling using Microsoft Excel was employed to select the final participants.

Data Collection Instruments and Procedures

Data were collected using a structured questionnaire developed in English and translated into Kinyarwanda. The tool consisted of four sections: (1) socio-demographic characteristics; (2) anthropometric measurements; (3) maternal and child health-related factors; and (4) environmental factors. Anthropometric data were obtained using standardized procedures, and height-for-age Z-scores were calculated using WHO Anthro software version 3.2.2 to determine stunting status (HAZ < -2). Data collection was facilitated by trained research assistants and community health workers (CHWs). Caregivers were invited to their respective cell offices, where anthropometric assessments and interviewer-administered questionnaires were conducted following informed consent procedures.

Reliability and Validity

Instrument reliability was assessed through test-retest (correlation = 0.8) and internal consistency using Cronbach's alpha ($\alpha = 0.75$). Content validity was ensured via expert review, while face validity was confirmed through pre-testing with a sample of the target population.

Data Analysis

Data were analyzed using SPSS version 25. Descriptive statistics summarized demographic and health-related variables. Bivariate analysis using Pearson's Chi-square test was used to examine associations between stunting and independent variables. Variables with p-values <0.05 were included in multivariate logistic regression to identify independent predictors of stunting. Findings were presented using tables and pie charts.

Ethical Considerations

Ethical approval was obtained from Mount Kenya University. Additional permissions were secured from Musanze District and Gacaca Sector authorities. Written informed consent was obtained from all participants. Confidentiality and data security were strictly maintained, with all data anonymized and stored securely. Participants bore no risk and received transportation and lunch support during data collection.

3. RESULTS

Demographic Characteristics of Participants

Descriptive statistical analysis was conducted to describe the demographic and socio-economic characteristics of children aged 6–59 months and their caregivers (Table 1). The sample consisted of 374 children, with the majority being female (57.0%) and males comprising 43.0%. The children were categorized by age group: 12.5% were infants (6–11 months), 30.2% were toddlers (12–23 months), 30.2% were preschoolers (24–36 months), and 31.8% were in the 36–59 months age range. The mean age of children was 25.6 months (SD = 14.7). Most mothers had completed primary school (n=282), while 53 had no formal education, 49 had secondary education, and only 3 had university-level education. In terms of marital status, 244 mothers were married or cohabiting, 110 were single, and 20 were separated or divorced. The majority of households (60.2%) had five or fewer members. Agriculture was the predominant occupation for mothers (n=297), with 68 unemployed and 9 formally employed. Household income was generally low, with 66.3% earning below 50,000 Rwandan Francs per month.

Prevalence of Stunting

Anthropometric data analyzed using WHO Anthro software (version 3.2.2) revealed that 35.8% of children in the study were stunted (Figure 1). Stunting was defined by a height-for-age Z-score below -2 standard deviations. While a considerable proportion of children were stunted, the majority (64.2%) exhibited normal growth.

Factors Associated with Stunting

Chi-square analysis was used to assess associations between stunting and socio-demographic variables (Table 2). The child's age group did not show a statistically significant association (p=0.094), although the preschool age group (24–36 months) had the highest proportion of stunted children (54.2%). Similarly, the mother's education level (p=0.212), marital status (p=0.460), and household size (p=0.832) were not significantly associated with stunting. However, occupation showed a significant relationship (p=0.005), with children of agriculturally employed mothers more likely to be stunted (35.5%) compared to those whose mothers were employed (25.0%) or unemployed (25.0%). Although household income did not reach statistical significance (p=0.534), children from the lowest-income group had the highest prevalence of stunting (37.5%). Table 3 shows child health-related factors and their association with stunting. Late initiation of breastfeeding was nearly significantly associated with stunting (p=0.054). Birth weight showed a strong association, with children born weighing less than 2500 grams being significantly more likely to be stunted (73.1%, p=0.001). Children with a history of malaria (50.0%) or diarrhea (43.3%) had higher rates of stunting (p=0.047). Other variables, including feeding frequency, birth order, and immunization status, were not significantly associated. Table 4 summarizes environmental factors. Among them, only water treatment methods were significantly associated with stunting (p=0.013). Other environmental variables did not show statistically significant associations. Binary logistic regression (Table 5) identified low birth weight (<2500 grams) as a significant predictor of stunting. Children in this category were 4.8 times more likely to be stunted compared to those with normal birth weight (AOR = 4.764; 95% CI: 1.908–11.899).

4. DISCUSSION

This study assessed the socio-demographic, child health, and environmental factors associated with stunting among children aged 6–59 months in Musanze District, Rwanda. The findings reveal that stunting remains a significant public health concern in the region, with a prevalence of 35.8%, aligning closely with the national average of 33% reported in the Rwanda Demographic and Health Survey (RDHS, 2020), but still above desirable levels. The slightly higher prevalence observed in this study may stem from regional disparities in socio-economic status, access to health services, or dietary diversity compared to national aggregates.

The gender distribution in this study was skewed toward females (57.0%). While this differs from findings such as those in Southern Rwanda that reported an almost even split (Nkurunziza et al., 2017), it likely does not affect stunting prevalence significantly. Prior studies, including Agofure (2018), found no consistent association between gender and stunting, although some have reported that boys are more biologically vulnerable. For instance, studies in Ethiopia and Kenya observed higher stunting among boys, possibly due to biological and hormonal differences in early growth (Akilimali, 2022; Siham, 2024). The gender discrepancy in stunting rates remains inconsistent across studies, indicating that contextual factors may override biological predispositions. The age-related trend in stunting observed in this study supports earlier findings that stunting risk peaks between 24 and 36 months, a critical transition period when children are weaned and become more exposed to environmental and dietary risks (Victora et al., 2010). A comparable study in Ethiopia confirmed this trend, showing elevated stunting in the 24–35-month age group (Gebre et al., 2019). This consistency suggests that suboptimal complementary feeding practices and increased exposure to infections during this window remain significant contributors to growth faltering in young children across diverse settings.

Maternal education, though not significantly associated with stunting in this study, still showed important trends. Children of mothers with no formal education had the highest stunting rates. This aligns with global and regional evidence emphasizing maternal education as a protective factor against malnutrition due to improved health knowledge, child care, and resource management (Murgia et al., 2020). A study in Uganda found significantly lower stunting among children of mothers with secondary or higher education (Akilimali, 2022). The lack of significance in our study could be attributed to the limited number of mothers with higher education, which may have reduced statistical power. The association between maternal occupation and stunting was statistically significant, with higher stunting observed among children whose mothers were engaged in agriculture. This may reflect time constraints, limited child supervision, and unstable income in subsistence farming. These findings echo those of Mulugeta et al. (2018), who reported that rural agricultural occupations often correlate with poor child nutritional outcomes due to limited access to diverse foods and health services.

A major finding in this study was the strong association between low birth weight and stunting. Children born weighing less than 2500 grams were 4.8 times more likely to be stunted (AOR=4.764; 95% CI: 1.908–11.899), consistent with findings from Indonesia (Yushananta & Ahyanti, 2022) and Rwanda (Nshimyiryo et al., 2019), suggesting that intrauterine growth restriction and poor maternal nutrition are critical contributors to early childhood stunting. This supports the need for prenatal interventions targeting maternal health and nutrition. Child morbidity, particularly recent episodes of diarrhea and malaria, was also significantly associated with stunting (p=0.047), consistent with findings from Tafesse et al. (2021) in Ethiopia, where diarrhea was a strong predictor of stunting. The underlying mechanisms include nutrient malabsorption, appetite suppression, and inflammation, which impair growth.

Among environmental factors, the use of untreated water was associated with higher stunting rates (AOR=1.783; 95% CI: 1.088–2.92), mirroring findings from Indonesia where unimproved water sources were strongly linked to malnutrition (Yushananta & Ahyanti, 2022). This highlights the importance of water, sanitation, and hygiene (WASH) interventions in reducing stunting risk. Overall, while the prevalence of stunting in Musanze is similar to national trends, it underscores persistent socio-economic and health system challenges. The findings suggest the need for multi-sectoral strategies focused on maternal education, prenatal care, child health services, and environmental sanitation to sustainably reduce stunting.

5. CONCLUSION

In Musanze District, the prevalence of stunting among children aged 6 to 59 months was 35%, slightly higher than the national average of 33%. Key factors associated with stunting included maternal civil status and occupation (socio-economic), lack of water treatment (environmental), and child-related factors such as low birth weight and illnesses like malaria and diarrhea. To reduce stunting, targeted efforts should focus on improving maternal and child nutrition during and after pregnancy, promoting the use of safe water through household water treatment, and enhancing sanitation and hygiene to prevent infections that impair child growth.

Conflict of interest

There is no conflict of interest

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Disclaimer

This is original work with no submission to any other institution. Any individual or organization intending to use any portion of this thesis should obtain permission from the Authors.

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Table 1. Socio-demographic characteristics of study participants

Variable (N=374)	Frequency (N)	Percentage (%)
Sex of the child		
Male	161	43.0
Female	213	57.0
Child stage (completed months)		
Infants (6-11)	46	12.5
Toddler (12-23)	113	30.2
Preschooler (24-36)	95	25.2
Schooler (36-59)	119	32.1
Mean (SD)	25.6	14.7
Mother's education		
No education	53	14.2
Primary	282	74.8
Secondary	49	10.2
University	3	0.8
Mother's marital Status		
Single	110	29.4
Married/cohabitating	244	65.2
Divorced/separated	20	5.3
Number of Household members		
Below or equal 5	225	60.2

Above 5	149	39.8
Mother's Occupation		
Agriculture	297	79.4
Employed	9	2.4
Unemployed	68	18.2
Total household income per month		
Below 50,000Frw	248	66.3
50,000Frw to 100,000Frw	117	31.3
Above 100,000Frw	9	2.40

Table 2. Socio-demographic factors associated with stunting (N=374)

Variable	Stunted child			
	Yes	No	*X2- Value*	*P-Value*
Child stage (completed months)			9.403	0.094
Infants (6-11)	6(29.3)	40(70.7)		
Toddler (12-23)	40(38.8)	73(61.2)		
Preschooler (24-36)	58(54.2)	49(45.8)		
Schooler (36-59)	30(25.2)	89(74.8)		
Mother's education			7.111	0.212
No education	24(45.3)	29(54.7)		
Primary	105(33.7)	187(66.3)		
Secondary	26(30.8)	27(69.2)		
University	0 (0)	3(100)		
Mother's marital Status			1.554	*0.46*
Single	43(39.1)	67(60.9)		
Married/cohabitating	80(32.8)	164(67.2)		
Divorced/separated	8(40.0)	12(60.0)		
Number of Household members			1.467	0.832
Below or equal 5	76(33.8)	149(66.2)		
Above 5	55(36.9)	94(63.1)		
Mother's Occupation			3.704	***0.005***
Agriculture	127(35.5)	170(64.5)		
Employed	3(25.0)	6(75.0)		
Unemployed	1(25.0)	67(75.0)		
Total household income per month			0.387	0.534
Below 50,000Frw	93(37.5)	155(53.5)		
50,000Frw to 100,000Frw	34(29.1)	83(70.9)		
Above 100,000Frw	4(44.4)	5(55.6)		

Table 3. Child health factors association with stunting among study participants (N=374)

Variable	Stunted child			
	Yes	No	X^2- Value	P-Value
Timing of complementary feeding			1.958	0.576
Before 6 months	9(32.1)	20(67.9)		
After 6 months	122(35.1)	223(64.9)		
Weight of child at birth			17.776	***0.001***
Below 2500g	19(73.1)	7(26.9)		
Above or equal 2500g	112(32.2)	236(67.8)		

Child morbidity			9.64	***0.047***
Malaria	4(40.0)	6(60.0)		
Diarrhea	45(43.3)	59(56.7)		
Others diseases	33(40.7)	48(59.3)		
No illness	49 (27.4)	130(72.6)		
The number of times the child eats per day			3.197	0.67
Once	7(33.3)	14(66.7)		
Two times	67(34.5)	127(65.5)		
Three times	44(37.3)	74(62.7)		
Four times	10(33.3)	21(66.7)		
Above	3(20.0)	7(80.0)		
Birth order of the child			0.78	0.852
First born	39(32.8)	80(67.2)		
Second born	37(33.9)	72(66.1)		
Third born	26(38.2)	42(61.8)		
Above 3	29(37.2)	49(62.8)		
Immunization status			0.652	0.42
Fully vaccinated	120(34.5)	228(65.5)		
Partially vaccinated	11(42.3)	15(57.7)		
Number of under five children per household			5.236	0.073
One child	89(31.9)	190(68.1)		
Two children	39(45.3)	47(54.7)		
Above 3	3(33.3)	6(66.7)		
If the child had a separate meal at home			0.355	0.552
Yes	112(35.7)	202(64.3)		
No	19(31.7)	41(68.3)		

Table 4. Environmental factors association with stunting among children aged 6 to 59 months (N=374)

Variable	**Stunted child**			
	Yes	**No**	X^2	***p-value***
Water treatment method			8.69	***0.013***
Boiling	34(25.4)	100(74.6)		
Filter	8(44.4)	10(55.6)		
No treatment	89(40.1)	133(59.9)		
Toilet facility			0.723	0.097
Yes	130(35.2)	239(64.8)		
No	1(25.0)	4(75.0)		
Have a kitchen garden at home			2.424	0.12
Yes	29(28.7)	72(71.3)		
No	102(37.4)	171(62.6)		
Minutes to source of water			3.063	0.216
Less than 30 min	19(42.2)	26(57.8)		
30 min to 60 min	25(28.1)	64(71.9)		
Above 60 min	87(36.3)	153(63.7)		

Table 5. Predictors of stunting among children aged 6 to 59 months

Variable	AOR (95% CI)	P-value
Water treatment method		
Water treated	Ref	
No treatment	0.906(0.33-2.486)	0.848
Weight of child at birth		
Below 2500g	4.764(1.908-11.899)	**0.001**
Above or equal 2500g	Ref	
Child morbidity		
Had disease (Malaria)	Ref	
No disease	1.198(0.215-6.674)	0.837

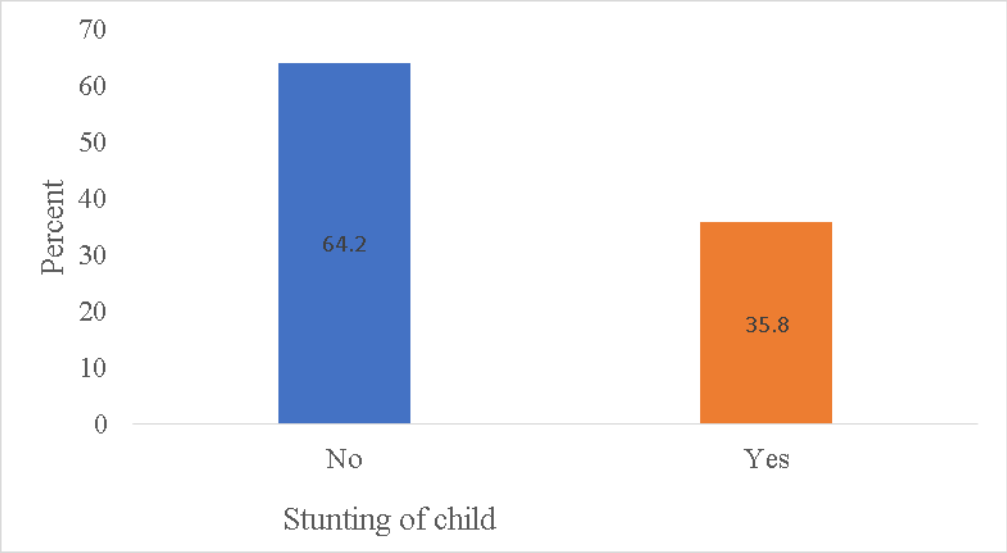

Figure 1. A Bar Chart showing stunting prevalence among study participants