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FACTORS ASSOCIATED WITH STUNTING AMONG 6-59 MONTHS OLD CHILDREN IN NGORORERO DISTRICT, RWANDA: SECONDARY DATA ANALYSIS OF RWANDA DEMOGRAPHIC AND HEALTH SURVEY 2019-2020

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Abstract: **Stunting remains a major public health challenge in Rwanda, with long-term implications for child growth, development, and survival. Despite national progress in reducing malnutrition, Ngororero District continues to experience disproportionately high levels of stunting among children under five years of age, posing a significant barrier to achieving both national and global nutrition targets. Although national surveys provide evidence on the overall burden of stunting, there is limited understanding of district-level determinants, underscoring the need for localized analyses to inform context-specific interventions. This study therefore aimed to examine child, maternal, and household factors associated with stunting among children aged 6–59 months in Ngororero District. A retrospective cross-sectional analytical study design was employed using secondary data from the 2019–2020 Rwanda Demographic and Health Survey (RDHS). A total of 120 children aged 6–59 months residing in Ngororero District were included in the analysis. Data were analyzed using SPSS version 23, and logistic regression was applied to identify factors associated with stunting. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were calculated.The prevalence of stunting was found to be 50.0%, indicating a considerably high burden relative to national averages. Child age was the only factor significantly associated with stunting, with children aged 36–47 months being six times more likely to be stunted compared to those aged 48–59 months (aOR = 6.01; 95% CI: 1.02–35.23; p = 0.04). The findings confirm that stunting in Ngororero District remains alarmingly high, with preschool-aged children representing a particularly vulnerable group. Targeted interventions to strengthen complementary feeding practices, improve dietary diversity, and promote maternal education are urgently needed.**

Keywords: **public health challenge, child growth, global nutrition targets. improve dietary diversity, promote maternal education.**

1. INTRODUCTION

1.1. Background of the study

Globally, more than 155 million children under the age of five are affected by stunting, leading to over one million fatalities and 54.9 million Disability Adjusted Life Years (DALYs) among children under the age of five globally (Takele et al, 2022).

In developed countries stunting affects roughly 3.4% of children under five in the United States, which is higher than the regional average of 3.2% for North America (Global Nutrition Report, 2020). Stunting prevalence in Europe is approximately 4.5%, which is much lower than the 22% global average (Global Nutrition Report, 2020).

In developing countries, the prevalence of stunting varies significantly across regions, with the highest rates observed in South Asia and Sub-Saharan Africa. The global trend has shown a gradual decline over the past two decades, yet the burden remains substantial, especially in low- and middle-income countries, with Africa representing 40% of this population (WHO, 2022).

Various factors such as educational attainment, maternal characteristics, nutritional status, health conditions, family size, and socioeconomic assets have been identified as influential determinants of nutrition and health outcomes in children, including stunting. Individual variables such as gender, under nutrition, infections, suboptimal breastfeeding practices among economically disadvantaged mothers, and insufficient dietary diversity have also been linked to child stunting. Additionally, geophysical factors play a role in childhood stunting, with proximity to main roads and markets serving as indicators of access to food markets and economic opportunities (Ndagijimana et al, 2023).

Acknowledging the predominantly irreversible impacts of stunting, numerous African nations have embraced the first 1000 days initiative, which seeks to avert malnutrition from conception through a child's second birthday. The African Regional Nutrition Strategy (ARNS), endorsed by member states of the African Union and aligned with the World Health Assembly's objectives, aims to reduce the prevalence of stunting in children under five by 40% by 2025(Baye et al 2020).

As a result, a range of nutrition-specific and nutrition-sensitive interventions have been deployed to differing degrees. In efforts to combat stunting among children up to 59 months old, the WHO and UN have established ambitious nutrition targets, aiming to reduce the prevalence of stunted children under five by 40% by 2025 and to achieve zero hunger by 2030. Specifically, SDG2 seeks to eliminate hunger and enhance nutrition, with goals to decrease the number of stunted children to 100 million by 2025 and 83 million by 2030 (Quamme et al, 2022).

In sub-Saharan Africa (SSA), Currently, 34% of children under the age of five are stunted, with Eastern Africa having the highest rate of stunting (37% stunted) (Nshimyiryo et al., 2019), then in Western Africa (21.4%), Central Africa (32.5%), and Southern Africa (28.1%) (WHO, 2021). In Kenya, 26% of children under the age of five suffer from stunting, as per the 2014 Kenya Demographic and Health Survey (Guyatt et al., 2020). In Uganda, 33% of children under five years old are stunted, which translates to more than 2.3 million chronically malnourished young children, 14% underweight children, and 5% wasted children (Kasajja et al., 2022).Despite a number of interventions, such as community-based nutrition programs, annual national mother and child weeks, behavior change communication, infant and young child feeding promotion programs, and home food fortification, childhood malnutrition remains a serious public health threat in Rwanda (Ndagijimana et al., 2024).

In Rwanda, there is a continuing of high rates of childhood stunting disparities. Uneven distribution has been observed in the district level stunting prevalence, and there can be significant variation even within a single district (Ngaruye et al., 2023). And According to the most recent Rwanda Demographic Health Survey (RDHS) for 2019–2020, 33.5% of children under five in Rwanda were stunted. Therefore, we aimed to assess the factors associated with stunting among under five years old children in Ngororero district.

1.2. Problem statement.

Despite the Rwandan government's ambitious goals to reduce the national rates of malnutrition and stunting to below 19% across all districts by 2024 (Weatherspoon et al., 2019). Despite national progress in reducing malnutrition, Ngororero District continues to experience disproportionately high levels of stunting among children under five years of age, posing a significant barrier to achieving both national and global nutrition targets. Although national surveys provide evidence on the overall burden of stunting, there is limited understanding of district-level determinants, underscoring the need for localized analyses to inform context-specific interventions. Addressing stunting is a key priority for Rwanda under the Sustainable Development Goals (SDGs), with concerted efforts being made to involve crucial stakeholders to reverse this trend.

Various policies and initiatives have been introduced to combat malnutrition and stunting, such as the "One Cow per Poor Family (Girinka) scheme, the Food and Nutrition Policy of 2014, the National Early Childhood Development Program (NECDP, 2017), and the provision of public healthcare services (Binagwaho et al., 2020; Nshimyiryo et al., 2019). However,despite Rwanda's recent health improvements and efforts so far made, stunting rates remain essentially unchanged, and malnutrition continues to be a significant issue for children under five, particularly in the Ngororero district (Binagwaho et al., 2020 and Kalinda et al, 2023). Therefore, the aim of this study was to assess the factors associated with prevalence of stunting among children under five years old in Ngororero district, using secondary data from the Rwanda Demographic Health Survey 2019-2020.

1.3 Study Objectives

i. To determine the prevalence of stunting among 6-59 months old children of Ngororero district.

ii. To identify the Maternal and child factors associated with childhood stunting among 6- 59 months old children of Ngororero District.

iii. To identify the Household factors and Environmental factors associated with childhood stunting among 6-59 months old children of Ngororero District.

II. METHODOLOGY

2.1. Study design

This study adopted a retrospective cross-sectional design based on secondary data from the 2019–2020 Rwanda Demographic and Health Survey (RDHS). The design enabled the assessment of the prevalence and determinants of stunting among children aged 6–59 months in Ngororero district at a specific point in time.

2.2. Study Setting

This study was conducted in Ngororero district, one of the 30 districts of Rwanda, located in the Western Province. The district is predominantly rural and characterized by hilly terrain, which limits agricultural productivity and access to infrastructure. According to the 2019–2020 RDHS, Ngororero recorded the highest prevalence of child stunting in Rwanda, with more than half of children under five years affected. The district is subdivided into 13 administrative sectors, 73 cells, and 419 villages, with an estimated population of over 330,000 people (NISR, 2021).Agriculture is the main source of livelihood, but food insecurity, limited access to clean water, and poor sanitation remain widespread. These contextual factors make Ngororero district an important area for investigating the determinants of child stunting.

2.3. Study Participants

The target population comprised all children under five years of age included in the RDHS 2019–2020 survey. For the purpose of this study, the study population was restricted to children aged 6–59 months residing in Ngororero district, together with their mothers aged 15–49 years who provided child and household information.

2.4. Sampling size

From the children's dataset, a total of 120 children aged 6–59 months from Ngororero district were included after applying inclusion and exclusion criteria and ensuring completeness of anthropometric data.

2.5. Research instrument and variables.

This study utilized secondary data collected by the National Institute of Statistics of Rwanda (NISR) in collaboration with the DHS Program. Five standardized DHS questionnaires were used in the primary survey: The Household Questionnaire, the Woman's Questionnaire, the Man's Questionnaire, the Biomarker Questionnaire, and the Fieldworker Questionnaire. These were adapted to the Rwandan context, translated into Kinyarwanda, and pretested.

2.6. Data analysis Procedures

Data analysis was conducted using SPSS version 23. The children's (KR) and household members' (PR) datasets from the 2019–2020 RDHS were merged to construct an analytical file linking child anthropometric data with maternal and household characteristics. Sampling weights provided by DHS were rescaled (v005/1,000,000) and applied in all analyses. The complex survey design was accounted for by specifying primary sampling units (v021) and strata (v022), thereby correcting for clustering, stratification, and unequal selection probabilities. Weighted descriptive statistics summarized child, maternal, household, and community characteristics. The prevalence of stunting among children aged 6–59 months was estimated accordingly. Bivariate associations between stunting and explanatory variables were tested using survey-adjusted Chi-square tests, with variables significant at $p < 0.25$ considered for further modeling. Multivariable logistic regression was then performed to identify independent predictors of stunting, and results were expressed as adjusted odds ratios (aOR) with 95% confidence intervals. Statistical significance was set at $p < 0.05$, and collinearity diagnostics were conducted prior to model fitting.

III. RESEARCH FINDINGS AND DISCUSSIONS

3.1. Distribution of Maternal socio-demographic and Child characteristics.

A total of 120 children aged 6–59 months were included in the analysis. The largest age group was 24–47 months (50.8%), followed by 6–23 months (24.2%) and 48–59 months (13.3%). Slightly more than half of the children were female (53.3%). Most mothers were aged 25–34 years (41.7%) or 35–49 years (42.5%). The majority of mothers had a height of ≤160 cm (73.3%), while only 14.1% were taller than 160 cm. With respect to education, most mothers had attained primary education (70.0%), while 14.2% had no formal education and 15.8% had secondary or higher education. More than three-quarters of mothers (76.7%) were engaged in work. Regarding religion, 48.3% of mothers were Protestant, 40.0% were Catholic, and 11.7% belonged to other denominations. Most mothers were married or living together (90.8%), while only 9.2% were unmarried or in other categories. In terms of household socioeconomic status, 64.2% of children were from the poorest/poorer households, 15.8% from middle households, and 20.0% from richer/richest households. The majority of children resided in rural areas (88.3%), compared to only 11.7% in urban areas (Table 1**)**.

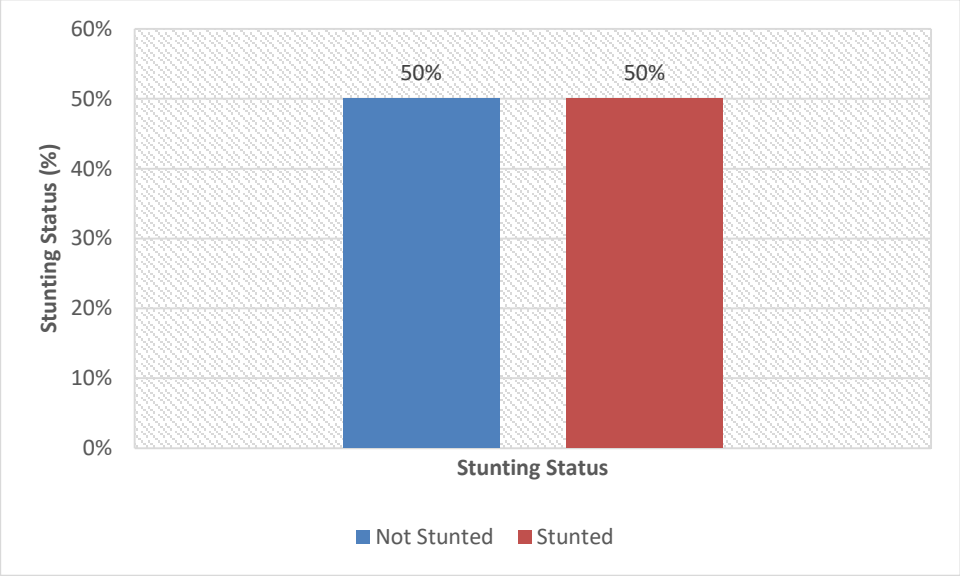
Table 1: Distribution of Maternal socio-demographic and Child characteristics (n=120, Weighted)

Characteristic	Category	n (%)
Child's age (months)	6–23	29 (24.2)
	24–47	61 (50.8)
	48–59	16 (13.3)
Child's sex	Female	64 (53.3)
	Male	56 (46.7)
Mother's age (years)	15–24	19 (15.8)
	25–34	50 (41.7)
	35–49	51 (42.5)
Mother's height (cm)	≤160	88 (73.3)
	>160	17 (14.1)
Mother's education	None	17 (14.2)
	Primary	84 (70.0)
	Secondary+	19 (15.8)
Mother's occupation	Working	92 (76.7)
	Not working	28 (23.3)
Religion	Catholic	48 (40.0)
	Protestant	58 (48.3)
	Other	14 (11.7)
Marital status	Married/Living together	109 (90.8)
	Unmarried/Other	11 (9.2)
Wealth index	Poorest/poorer	77 (64.2)
	Middle	19 (15.8)
	Richer/richest	24 (20.0)
Residence	Rural	106 (88.3)
	Urban	14 (11.7)

Source: Primary Data

3.2. Prevalence of stunting among 6-59 months old children in Ngororero.

In this study the overall prevalence of stunting among 6-59 months old children in Ngororero district was 50.0%. The figure 4.1 indicates the prevalence of stunting among 6-59 months old children.



Source: Primary data.

3.3. Factors associated with stunting among 6- 59 months old children.

3.3.1. Bivariate analysis of factors associated with stunting among 6- 59 months old children.

Table 2 summarizes the association between child, maternal, household, and environmental characteristics with stunting. None of the factors demonstrated a statistically significant association with stunting (all p>0.05).Although not statistically significant, stunting prevalence was slightly higher among children of mothers with secondary education or more (63.2%) compared to those whose mothers had no education (58.8%) or primary education (45.2%). Children of mothers, who were divorced, separated, or widowed were all stunted (100%), suggesting increased vulnerability, though the numbers in these categories were small. Stunting prevalence also appeared to peak among children aged 24–47 months (58.8–63.0%) compared to younger children (41.2–41.7%) or those aged 48–59 months (31.3%). Additionally, all children from households with unimproved toilet facilities were stunted (100%), highlighting a potential risk factor despite the lack of statistical significance.

Table 2. Bivariate analysis of factors associated with stunting among 6- 59 months old children

Variable	Category	Not Stunted n (%)	Stunted n (%)	χ^2	p-value
Child sex	Female	32 (50.0)	32 (50.0)	0.00	1.000
	Male	28 (50.0)	28 (50.0)		
Mother's education	None	7 (41.2)	10 (58.8)	2.61	0.252
	Primary	46 (54.8)	38 (45.2)		
	Secondary+	7 (36.8)	12 (63.2)		
Marital status	Married/Living together	58 (53.2)	51 (46.8)	6.16	0.241
	Never married/other	2 (16.7)	10 (83.3)		
Occupation	Working	45 (48.9)	47 (51.1)	0.19	0.666
	Not working	15 (53.6)	13 (46.4)		
Wealth index	Poor (poorest/poorer)	41 (53.9)	35 (46.1)	2.41	0.661
	Middle	8 (42.1)	11 (57.9)		
	Rich (richer/richest)	11 (47.8)	12 (52.2)		
Water source	Improved	51 (50.0)	51 (50.0)	0.00	1.000

	Unimproved	9 (50.0)	9 (50.0)		
Toilet facility	Improved	57 (48.7)	60 (51.3)	3.08	0.079
	Unimproved	3 (100.0)	0 (0.0)		
Residence	Rural	54 (50.9)	52 (49.1)	0.32	0.570
	Urban	6 (42.9)	8 (57.1)		
Mother's age (yrs)	15–24	7 (36.8)	12 (63.2)	4.64	0.200
	25–34	23 (46.0)	27 (54.0)		
	35–49	30 (60.0)	20 (40.0)		
Mother's height (cm)	≤160	43 (49.4)	44 (50.6)	5.08	0.166
	>160	12 (70.6)	5 (29.4)		
Child's age (months)	6–23	17 (58.6)	12 (41.4)	5.95	0.203
	24–47	24 (39.3)	37 (60.7)		
	48–59	11 (68.8)	5 (31.3)		

Source: Primary data.

Multivariate analysis of factors associated with stunting among 6-59 months old children.

Table 3 shows the results of the multivariable logistic regression analysis. Maternal education was not significantly associated with child stunting. Compared to mothers with secondary education or higher, children of mothers with no education had higher odds of stunting (AOR = 2.95; 95% CI: 0.39–22.52; p = 0.297), while those of mothers with primary education had lower odds (AOR = 0.49; 95% CI: 0.11–2.15; p = 0.343); however, these associations were not statistically significant. Child's age was significantly associated with stunting. Children aged 36–47 months were six times more likely to be stunted compared to those aged 48–59 months (AOR = 6.01; 95% CI: 1.02–35.23; p = 0.047). No significant associations were observed for other age groups.

Table 3.Multivariate analysis of factors associated with stunting among 6-59 months old children.

Variables		COR	P value	AOR(95% CI)	P value
Maternal education	No education	0.83(0.22-3.19)	0.277	2.95(0.39-22.52)	0.297
	Primary	0.48(0.17-1.35)	0.163	0.49(0.11-2.15)	0.343
	Secondary+	Ref	Ref	Ref	Ref
Child's age	6-11	1.57(0.33-7.48)	0.570	1.41(0.19-10.26)	0.733
	12-23	1.54(0.37-6.48)	0.555	1.29(0.21-7.77)	0.779
	24-35	3.14(0.89-11.06)	0.075	3.67(0.74-18.25)	0.112
	36-47	3.74(1.01-13.92)	0.049	6.01(1.02-35.23)	0.047*
	48-59	Ref	Ref	Ref	Ref

Source: Primary data.

3.3.2. Model Fit Statistics for the Logistic Regression Model.

The Hosmer–Lemeshow goodness-of-fit test demonstrated that the logistic regression model adequately fit the data (χ^2 = 9.35, df = 8, p = 0.31). A non-significant p-value (> 0.05) indicates no evidence of poor fit, suggesting that the predicted probabilities were consistent with the observed outcomes. The model explained approximately 30% of the variance in the dependent variable, as reflected by the pseudo R^2 value of 0.30, which indicates a moderate explanatory power.

Chi-square	df	P value	R^2
9.35	8	0.31	0.30

3.4. Discussions

This study assessed the prevalence and determinants of stunting among children aged 6–59 months in Ngororero District using data from the 2019–2020 Rwanda Demographic and Health Survey. The findings provide important evidence for local and national stakeholders working to reduce child undernutrition. This study found that the prevalence of stunting in Ngororero was 50%, far exceeding both the global average of 22.3% (UNICEF, 2022) and the sub-Saharan African average

of 35% (Takele et al., 2022). It also surpasses the East African regional estimate of 37% and the national prevalence of 33% reported in the RDHS 2019–2020 (MIGEPROF, 2020). This level places Ngororero well above the WHO threshold for a "very high" burden (>30%) and identifies it as a priority district for intervention. While Rwanda overall has achieved progress in reducing stunting from 38% in 2015 to 33% in 2020 the persistence of extreme prevalence in Ngororero highlights sharp subnational disparities. Such differences are likely driven by rural poverty, food insecurity, limited healthcare access, and poor sanitation infrastructure, which remain more pronounced in remote districts compared to urban centers.Child age was the only factor significantly associated with stunting in the multivariable analysis. Children aged 24–47 months were significantly more likely to be stunted compared to those aged 48–59 months. This finding aligns with evidence that growth faltering is most pronounced during the complementary feeding period and early preschool years, when children transition from breastfeeding to family foods and face increased exposure to infections (Kasajja et al., 2022). These results emphasize the need for targeted interventions during this vulnerable stage, including improving dietary diversity, preventing infections, and strengthening early childhood health services. Although maternal education was not statistically significant in this study, it showed a protective trend, consistent with substantial evidence from Rwanda and across sub-Saharan Africa that maternal education is strongly linked to reduced childhood stunting (Binagwaho et al., 2020; Fatima et al., 2020). The lack of statistical significance here likely reflects limited statistical power at the district level rather than a true absence of effect. Maternal education remains a key pathway through which knowledge, empowerment, and access to resources translate into better child feeding and care practices.

Other socioeconomic and environmental factors did not reach statistical significance in this analysis, but the broader literature emphasizes their importance. For example, studies in Rwanda and Ethiopia have demonstrated that poverty, unimproved sanitation, diarrheal episodes, and household crowding increase the risk of stunting (Kalinda et al., 2023; Mohammed et al., 2019). The absence of multiple significant associations in Ngororero may therefore reflect limitations of sample size and variable availability, rather than a diminished role of these structural determinants. The persistence of such a high stunting prevalence suggests that systemic barriers including poverty, rural isolation, and limited access to health and nutrition services are likely stronger drivers than individual-level risk factors. Addressing these requires coordinated, multisectoral approaches spanning health, education, agriculture, and social protection. This study has several strengths. It draws on district representative DHS data, collected using standardized and validated tools, ensuring high data quality. The focus on Ngororero District provides localized evidence that is often obscured in national estimates, while the use of multivariable regression enhanced analytical rigor by accounting for potential confounding.Nonetheless, important limitations must be acknowledged. The cross-sectional nature of DHS data restricts causal inference, as associations cannot establish temporality. The relatively small district-level sample size reduced the power to detect statistically significant associations for some factors, such as maternal education and wealth. In addition, reliance on secondary data limited the scope of analysis, excluding important determinants such as dietary diversity, child morbidity, and household food security. Finally, potential recall bias, particularly in maternal reports of child feeding and illness, may have affected measurement accuracy.

3.5. Limitations

The following drawbacks of this study were pertained to the methodological approach. A secondary analysis of the data from RDHS 2020 was used in the study. Therefore, there was a chance that some data collecting and analytic restrictions, such as missing data, was present in this study. In certain cases, mothers' self-reported data was used to collect data, which might have introduced bias into the data collection process, particularly when using the household wealth index data collection tool and misclassified the index. Consequently, all of these restrictions made it difficult to extrapolate the study's findings to different contexts. In addition, the results of this study were not national in scope because it used data from only one district. The generalizability of the findings was therefore limited by the sampling strategy.

IV. CONCLUSION AND RECOMMENDATIONS.

4.1 Conclusions

The study concludes that stunting is alarmingly prevalent in Ngororero District, far exceeding national and international benchmarks. The main determinant identified was child age, with the risk peaking between 36 and 47 months. While maternal education and environmental conditions were not statistically significant, the broader literature indicates their influence on child growth. These results emphasize the importance of interventions that safeguard child nutrition and health during the early years of life, complemented by efforts to empower mothers through education and improved living conditions.

4.2. Recommendations.

At the community level, programs should prioritize children under four years of age through improved complementary feeding, enhanced dietary diversity, and better infection prevention. Maternal education and counseling should be strengthened, with community health workers playing a central role in providing practical nutrition advice. At the district level, authorities should scale up investments in water, sanitation, and hygiene infrastructure and promote household food security initiatives to ensure sustained access to nutritious foods. At the national level, special focus should be placed on high-burden districts like Ngororero, with targeted resource allocation and a multisectoral approach that links health, education, agriculture, and social protection. Policymakers should also integrate stunting reduction into broader poverty alleviation and rural development strategies. Future research should build on these findings by exploring cultural, behavioral, and environmental drivers of stunting through qualitative studies, as well as establishing causal relationships using longitudinal designs. Further district-level analyses including variables such as food security, dietary diversity, and child morbidity will provide more comprehensive evidence to inform tailored interventions.

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