Original Article

Determinants of Stunting in Children Under Five Years: A Case Study of Nyagatare District, Rwanda

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Abstract

Background
Stunting is an indicator of chronic malnutrition. It is highly prevalent in Rwanda and negatively impacts children's survival and overall growth development.
Objective
This study aimed to investigate the determinants of stunting among children under five years in Nyagatare District, Rwanda.
Methods
A quantitative cross-sectional study was conducted in December 2021 involving 253 households with mothers of children under five years of age. The data were collected using structured questionnaires, and anthropometric measurements were taken for both children and mothers. The analyses were performed using WHO Anthro Survey Analyser and SPSS version 21. Findings were reported through frequency tables, bivariate analysis, and logistic regression.
Results
The study found that 19.1% of the children were stunted, and 7.2% severely stunted. Bivariate analysis revealed that, lower level of the mother's education was associated with stunting (p=0.025). Logistic regression analysis indicated that children whose mothers had no education had higher odds of being stunted (OR=3.6, 95%CI: 1.3–9.9, p=0.012) compared to the mothers attained secondary education. Likewise, those whose mothers had primary education had higher odds of stunting (OR=1.7, 95% CI: 0.9–3.3) than those with secondary education.
Conclusion
The prevalence of stunting in Nyagatare District remains a concern. Preventing childhood stunting in this rural area, efforts should focus on improving mothers' education.
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Keywords: Anthropometry, Malnutrition, Risk Factors, Stunting, Undernutrition

Introduction

Undernutrition occurs when an individual's intake of nutrients and energy is insufficient to meet their body's needs.[1] Primarily due to inadequate dietary intake and disease (immediate causes), food insecurity, poor childcare practices, and unhealthy environments (underlying causes), as well as poverty, education gaps, and socio-political factors (basic causes), as outlined in the UNICEF conceptual framework.[1] It encompasses various forms, including wasting, stunting, underweight, and deficiencies in vitamins and minerals. In a global context, it remains a critical public health issue, specifically in developing countries.[2] Diseases such as diarrhoea, respiratory infections, and malaria worsen undernutrition by raising nutrient needs and causing losses.[3] Limited access to nutritious food and healthcare is a major underlying cause. Stunting severely impacts individuals, especially children under five years old, by impairing physical and cognitive development, thus raising mortality rates.[4] A child is considered stunted if their height falls more than two standard deviations (SDs) below the expected height for their age.[5] This condition can lead to serious and irreversible physical and cognitive impairments. The harmful consequences of stunting can persist throughout the child's life and potentially impact future generations.[4]

According to the UNICEF 2019 Report, Worldwide, stunting affected about 149(21.9%) million children under five years of age, of whom 39% or two out of five were in Africa and 55% or more than half were from Asia. Stunting prevalence was 35.2% in the East African region, while central Africa was 37.4%, which is higher than the regional average of 30.7% for the entire Africa region.[6] As reported by the Rwanda Demographic and Health Survey (2019-20 RDHS), stunting prevalence was 33% among children under five years old. [7] The prevalence of stunting in Rwanda among children under six months was 16%, increasing to 40% among children aged 24-35 months, highlighting the invaluable role of the first 1000 days of a child's life. [7] Efforts to reduce stunting in Rwanda have shown some progress, whereby the stunting rate reduced from 44% in 2010 to 33% in 2020.[8,7] Despite the progress, stunting remains a serious issue in Rwanda, particularly in areas like Nyagatare District, where 30.7% of the children under five years are stunted.[7] Early introduction of supplementary foods, poor hygiene and sanitation, family conflict, and poverty can increase the risks of malnutrition, including stunting.[9,10] Efforts to combat stunting should target various factors, such as enhancing maternal nutrition, promoting exclusive breastfeeding, and improving environmental hygiene.

Nyagatare District, located in Rwanda's Eastern Province, is most known for its livestock. The district is a significant contributor to Rwanda's agricultural productivity, particularly in livestock breeding.[11] In addition to livestock, Nyagatare plays a crucial role in crop farming. The district produces between 130,000 and 140,000 tons of maize annually, accounting for nearly a quarter of Rwanda's total maize production.[12] This substantial output underscores Nyagatare's significant contribution to the country's food security and economic progress.

Despite its higher agricultural productivity, Rwanda's Demographic and Health Survey shows that Nyagatare district faces a significant challenge of many under-five children suffering from stunting.[13] National data mainly focuses on the overall country level and often lacks detailed insights specific to local areas like Nyagatare district. Most studies use secondary data from the RDHS to identify the determinants of stunting, but these studies typically lack in-depth district-level analysis.[14,15,16] This limits the understanding of local factors contributing to malnutrition, such as stunting, and may hinder the development of effective interventions.

This study used primary data to assess the determinants of stunting among children under five in the Nyagatare district. The study's findings offer insights for target interventions to reduce stunting and improve children's health outcomes. The findings will inform evidence-based policies and programs in Rwanda, particularly in rural areas, filling a data gap and supporting future research in similar regions to address urgent nutrition and health challenges.

Methods

Study design and Setting

The quantitative cross-sectional study was conducted in the Nyagatare district of Rwanda in December 2021. A quantitative cross-sectional study design was preferred because it collects data at a single point in time from a population or a representative sample.[17] To examine the relationships between variables and to determine the prevalence of certain characteristics or conditions within the population. The quantitative method approach involves the use of structured tools, such as surveys or questionnaires, to collect measurable data.[18] According to the National Institute Statistics of Rwanda 2012, Nyagatare district, located in Rwanda's Eastern Province, has 14 sectors, 106 cells, and 630 villages.[19] Nyagatare District was chosen due to the limited research on stunting in the area. To host the study, the Gatunda Sector was selected using a simple random sampling technique. All 14 sectors in the district were considered as potential clusters, and each was assigned a unique number from 1 to 14. These numbers were placed on separate pieces of paper, mixed, and one was randomly drawn to select the Gatunda Sector, ensuring unbiased representativeness.

Study population, sample calculation and sampling process

The target population for this study were children aged under five years, while the study participants were their mothers. The study aimed to assess the determinants of stunting among under-five children by taking their anthropometric measurements while mothers provided the necessary information. A household under five years children list, obtained from community health workers (CHWs), served as the sampling frame. This list included all households with children under five in the sampling site. To ensure an unbiased and representative sample, a computer-based random sampling method was applied. Using Taro Yamane's formula.[20] A sample size of 253 households was determined from a total of 688 households as follows.

$$n = \frac{\mathbf{N}}{\mathbf{1} + \mathbf{N}(e^2)}$$

Where:
N is the population size = 688
e is the margin of error of 0.05, assuming a confidence level of 95%.
n is the sample size = 253
The participants of households were selected through a computer-generated random selection process, where each household was assigned a number, and a randomnumber generator was used to select the required sample. This approach minimized selection bias and improved the study's reliability and validity.

Inclusion and exclusion criteria

In households with multiple children under five, the eldest child was selected. However, children with disabilities were excluded for accurate length/height measurements, and the mothers who refused to consent were also excluded to ensure voluntary participation.

Data Collection: Methods, Tools, and Ensuring Validity and Reliability

The questionnaire was adapted based on existing resources like UNICEF's Multiple Indicator Cluster Surveys (MICS).[21] Modifications were made to the socio-economic, demographic, and anthropometric sections, and irrelevant questions from the feeding practices module were removed. The questionnaire was translated into Kinyarwanda to ensure better understanding by local participants. The enumerators were final-year Human

Nutrition and Dietetics students from the University of Rwanda, trained on data collection tools before fieldwork. Before full-scale data collection, a pilot study was conducted in the Rukomo sector with a random selection of households with children under five, using the test-retest method to ensure reliability. Spearman's rank-order correlation was used to assess consistency. The pilot also helped to refine the survey questionnaire for clarity and validity, ensuring accurate data collection.

The data collection involved interviewer-administered questionnaires and anthropometric measurements, including weight and height or length. Length was measured using a length board for children under 24 months, height with a stadiometer for both children aged 24-59 months and mothers, and the weight measurements were taken using a UNICEF electronic scale for both mothers and children. Measurements were taken twice for accuracy. If the difference between the two readings exceeded 0.5 cm, their average was calculated. However, if the difference was below 0.5 cm, the first measurement was retained as the final value. Vaccination cards contain records of a child's birth date and birth weight, which are documented at birth or during the first immunization visit. During data collection, enumerators reviewed these cards to extract the birth weight and date of birth. The recorded date of birth was then used to calculate the child's exact age in months at the time of the study. Data was collected in the villages, with children and their parents or guardians participating. Daily monitoring of data collection ensured completeness and consistency throughout the process.

Data analysis

Before analysing the data, it was coded and entered into Microsoft Excel from questionnaires. Daily reviews were conducted to correct any errors, and the anthropometric data were processed using a World Health Organization software application called WHO Anthro Survey Analyser.[22] Length/Height for age z-scores were calculated using this software. Z-scores below -2SD and -3SD were classified as stunted and severely stunted, respectively. [23] The data were imported into IBM SPSS statistics for Windows version 21.0 (IBM Corp, Armonk, NY, USA) for statistical analysis. Descriptive statistics, including frequencies, means, and standard deviations, were used to summarize the study population. Bivariate and multivariable logistic regression analyses were performed to identify associations between stunting and its potential risk factors. The recorded and analyzed risk factors for stunting included maternal education level, household wealth category, child feeding practices, birth interval, maternal behaviour during pregnancy and lactation, and living environment. Other independent variables examined in the analysis included children's birth weight, household kitchen garden and access to clean water and sanitation.

The association between stunting and its risk factors was first examined using cross-tabulation and chi-square (x^2) tests, with a significance threshold set at $p < 0.05$. Variables that showed statistical significance in the chi-square tests were further analyzed using a binary logistic regression model to determine the strength and direction of the associations.

Ethical considerations

Ethical approval (no. CMHS/IRB/358/2020) was given by the Institutional Review Board(IRB) of the University of Rwanda, College of Medicine and Health Sciences. Nyagatare District also granted permission for the collection of data. Before starting data collection, study participants were given information about the study objectives and procedures. Those who agreed to participate in the study signed consent forms before the interviews started. Data collectors safeguarded participants' autonomy and privacy by assigning unique codes instead of using their real names or personal identifiers.

Results

The study involved 253 mothers and their under-five children from the Gatunda sector. The mothers who predominated were aged between 21 and 45 years and had completed secondary education. The majority of households belonged to the second wealth category, and the family head occupation was largely farming. Most households had health insurance and possessed improved toilet facilities. Most children were males, and the majority of the children were aged between 0 and 5 months (Table 1).

Table 1. Socioeconomic and demographic characteristics of the participants

Variables	Frequency	Percentage
Mother's age		
< 21 years	42	16.6
21 to 45 years	206	82.4
> 45 years	5	2
Household wealth categories		
Unknown	10	4
1st category	30	11.9
2nd category	138	54.5
3rd category	75	29.6
Family head occupation		
Farmers	230	90.9
Others	23	9.1
Mother's education		
No education	21	8.3
Primary	94	37.2
Secondary	138	54.5
Family health insurance		
Yes	240	94.9
No	13	5.1
Household toilet facilities		
Improved	232	91.7
Unimproved	21	8.3
Child age group in months		
0-5	65	25.7
11-Jun	39	15.4
23-Dec	56	22.1
24-35	38	15
36-47	29	11.5
48-59	26	10.3
Child sex		
Male	133	52.6
Female	120	47.4

Maternal health status and health-related behaviours during pregnancy and lactation, as well as their living environment characteristics, are presented in Table 2. The majority of mothers had a normal BMI, almost all the mothers were non-smokers, and most of them abstained from alcohol. Predominantly, mothers had attended more than two antenatal care visits and had received deworming treatment during pregnancy. Most children were born with normal weight. Most children were initiated into complementary feeding at 6 months meaning that, they met exclusive breastfeeding. The majority of households had access to improved source of drinking water, and most households owned a kitchen garden.

Table 2. Maternal Health Status, Health Behaviors, and Living Environment Characteristics with Frequencies and Percentages

Variables	Frequency	Percentage
Mothers BMI		
Underweight	22	8.7
Normal	174	68.8
Overweight	57	22.5
Smoking		
Yes	5	2
No	248	98
Alcohol consumption		
Yes	33	13
No	220	87
Antenatal care visits		
≤ 1 visit	15	5.9
> 2 visits	238	94.1
Deworming during pregnancy		
Yes	192	75.9
No	61	24.1
Child's birth weight(Kgs)		
< 2.5	4	1.6
≥ 2.5	249	98.4
Exclusive breastfeeding		
Yes	187	73.9
No	66	26.1
Source of drinking water		
Improved	137	54.1
Unimproved	116	45.9
The household has a Kitchen garden		
Yes	208	82.2
No	45	17.8

BMI*: Body Mass Index

Prevalence of stunting in the Nyagatare district

The study in the Nyagatare district revealed that 19.1% of children under five were stunted, indicating a short stature for their age, with 7.2% being severely stunted. Stunting prevalence rises from 16.3% in infants under six months to a peak of 22.4% in children aged 24 to 35 months, then declines to 12.2% in those aged 36 to 47 months and further to 4.1% in the 48 to 60-month age group. Moreover, stunting rates differed by sex, with 21.8% of boys affected compared to 16.7% of girls. Most variables did not show a statistically significant association with stunting. However, there was an association between the level of education and stunting (p=0.025). On the other hand, variables like household wealth categories, mothers' BMI, household head occupation, and child age and other variables did not show significant associations with stunting.

Table 3. Distribution of Stunting Status by Socioeconomic, Demographic, Maternal Health, Health Behaviors during Pregnancy, and Living Environment Variables

Variables	Stunting				P Value
	No		Yes		
	Freq	%	Freq	%	
Mother's age					
Less than 21	31	15.2	11	22.4	0.277
21 to 45	168	82.4	38	77.6	
Above 45	5	2.5	0	0	
Household wealth categories					
Unknown	9	4.4	1	2	0.509
1st category	26	12.7	4	8.2	
2nd category	112	54.9	26	53.1	
3rd category	57	27.9	18	36.7	
Mother's education					
No education	13	6.4	8	16.3	**0.025***
Primary	73	35.8	21	42.9	
Secondary	118	57.8	20	40.8	
Family health insurance					
No	9	4.4	4	8.2	0.285
Yes	195	95.6	45	91.8	
Household toilet facilities					
Yes	185	90.7	47	95.9	0.233
No	19	9.3	2	4.1	
Child age (in months)					
0-5	53	26	12	24.5	0.456
11-Jun	31	15.2	8	16.3	
23-Dec	46	22.5	10	20.4	
24-35	27	13.2	11	22.4	
36-47	23	11.3	6	12.2	
48-60	24	11.8	2	4.1	

*p-value ≤ 0.05: Statistically significant

Table 3. Continued

Variables	Stunting				P Value
	No		Yes		
	Freq	%	Freq	%	
Child sex					
Male	111	54.4	22	44.9	0.231
Female	93	45.6	27	55.1	
Childbirth weight					
Less than 2.5 kg	2	1	2	4.1	0.118
2.5 kg & above	202	99	47	95.9	
Mothers BMI					
Underweight	18	8.8	4	8.2	0.932
Normal	141	69.1	33	67.3	
Overweight	45	22.1	12	22.5	
Smoking					
Yes	2	1	2	4.1	0.118
No	202	99	47	95.9	
Alcohol consumption					
Yes	29	14.2	4	8.2	0.259
No	175	85.8	45	91.8	
Antenatal care visits					
≤ 1	10	4.9	5	10.2	0.158
≥ 2	194	95.1	44	89.8	
Deworming during pregnancy					
Yes	154	75.5	38	77.6	0.762
No	50	24.5	11	24.3	
Exclusive breastfeeding					
Yes	151	74	36	73.5	0.937
No	53	26	13	26.5	
Source of drinking water					
Improved	114	83.2	23	16.8	0.068
unimproved	90	77.5	26	22.5	
The household has a Kitchen garden					
Yes	168	82.4	40	81.6	0.906
No	36	17.6	9	18.4	

*p-value ≤ 0.05: Statistically significant

Logistic regression analysis

As indicated, Table 4 presents the logistic regression analyses considering the mother's educational level as a variable which was significantly associated with stunting. The results indicated that higher maternal education was associated with a reduced incidence of stunting in children. Specifically, children whose mothers had no education had notably higher odds of experiencing stunting (OR=3.6, 95%CI: 1.3–9.9, p=0.012) compared to those whose mothers attended primary (OR=1.7, 95%CI: 0.9–3.3) and secondary education.

Table 4. Factors independently associated with stunting

Stunting	Odds Ratio	P Value	95% CI interval	
Mother's level of education				
Secondary education (Reference)	1			
No education	3.6	0.012*	1.3	9.9
Primary education	1.7	0.126	0.9	3.3

* Significant at p<0.05

Discussion

The study aimed to assess the factors contributing to stunting in children under five years old in the Nyagatare District. It was found that 19.1% of children were stunted, with 7.2% experiencing severe stunting. These figures are lower than those from the 2019-2020 Rwanda Demographic and Health Survey (RDHS), which reported a stunting prevalence of 30.7% in the same district.[7] The reduction in stunting may be linked to interventions from both the government and non-governmental organisations (NGOs). Programs offering clean water, fortified foods such as porridge(SHISHAKIBONDO), fresh milk, micronutrient powders (MNP), enhancing district-level capabilities to execute District Plans to Eliminate Malnutrition (DPEM), school feeding programs and the Girinka (one-cow-per-family initiative) have played a crucial role in reducing stunting.[24,25] Additionally, initiatives like monthly community village kitchen ("Igikoni cy'umudugudu"), monthly growth monitoring, special child meals ("Agakono k'umwana"), and kitchen gardens ("Akarima k'igikoni") may have contributed to improving child nutrition status. The Biannual (twice a year) Maternal and Child Health (MCH) Week also plays a role in fighting malnutrition through Comprehensive health and nutrition interventions including deworming, vitamin A supplementation, family planning, malnutrition screening, immunization, health promotion, and nutrition education.[26] These combined efforts may have contributed to lowering stunting rates in Nyagatare.

The study showed that stunting is most prevalent in children under 24 months, with rates ranging from 24.5% in infants under five months to 16.3% in those under 11 months, peaking at 22.4% in the 24-35 months age group. After this peak, stunting rates dropped to 12.2% in children aged 36-47 months and to 4.1% in those aged 48-60 months. These results align with the RDHS 2019-2020, which also observed an increase in stunting from 16% in children under six months to 40% in those aged 24-35 months.[7] A cross-sectional study examining child stunting patterns across 94 low- and middle-income countries found that stunting prevalence increases among children until around 28 months of age, after which it tends to decline.[27] This pattern suggests that early nutritional interventions are crucial in preventing stunting and its long-term effects.[27] Both studies highlight the significant impact of undernutrition during the critical first 1,000 days of life, emphasizing the need for early childhood nutrition interventions to prevent long-term negative effects on growth and development.

A significant association between maternal education and stunting was found. Stunting affected 38.0% of children whose mothers had no education, compared to 22.3% of children whose mothers completed primary school and 14.4% of children whose mothers had attended secondary school (p=0.025). This mirrors findings from the RDHS 2014-2015, where stunting was more prevalent (47%) among children of mothers without formal education compared to 19% for those whose mothers had secondary or higher education.[28] Similarly, a study conducted in Indonesia showed that a low maternal

education level is linked to the likelihood of having stunted children under two years of age.[29] Likewise, a study aimed to evaluate the relative significance of various factors contributing to child anthropometric failures in 35 low- and middle-income countries also found that maternal education was significantly associated with stunting.[30] These findings indicate that maternal education plays a critical role in improving child nutrition, as educated mothers are more likely to seek healthcare, understand nutritional needs, and adopt beneficial practices for child development. This highlights the need for expanding community-based nutrition education programs in the regions with high stunting rates. Furthermore, investing in education should be a long-term solution in stunting prevention among children under five years of age.

The study found no significant association between maternal age and birth weight with stunting, which contrasts with previous research identifying younger maternal age and low birth weight as key risk factors. Studies, including research in Tamale Metropolis, Ghana, have shown that children of teenage mothers face a higher risk of stunting.[31] Similarly, data from India indicate that low birth weight significantly increases the likelihood of stunting.[32] The lack of association in this study may be due to the limited number of younger mothers in the sample, reducing statistical power. Future research with larger and more diverse samples is needed to better understand these relationships.

The study did not find a significant association between household wealth and childhood stunting, which contrasts with findings from other research. For instance, the 2015-16 Malawi Demographic and Health Survey reported a strong relationship between household wealth and childhood stunting.[33] Similarly, a study analyzing data from 47 developing countries found that stunting prevalence was related to socioeconomic status (SES), with 21% of lower SES, 17% of middle SES, and 13% of upper SES children being stunted.[34] This may be because the economic categories used do not fully capture the complexity of food security and healthcare access. Future research could benefit from examining more specific economic indicators, such as household income and food expenditure, to provide a clearer picture of their impact on child nutrition.

The study found no significant association between maternal BMI and stunting. Other studies, like the one done on child anthropometric deficiencies in 35 low- and middle-income countries, have shown that children of underweight mothers are more likely to be stunted due to inadequate nutrition.[35] The absence of a significant relationship in this study may be due to the study design used. Cross-sectional studies may not fully capture the dynamic link between maternal BMI and child stunting, and longitudinal studies could offer better insights into how maternal BMI affects child growth over time. It may be more effective to target stunting prevention efforts towards severely undernourished mothers rather than focusing solely on BMI, with a broader approach that includes dietary diversity and micronutrient intake, offering a more effective strategy.

The study did not find significant links between alcohol consumption, smoking, and stunting, which contrasts with a retrospective study conducted in Gauteng, South Africa.[36] That study found a significant association between maternal tobacco and alcohol use and stunting in children, highlighting the detrimental effects of these factors on child growth and development. The low prevalence of smoking (2%) and alcohol consumption (13%) in the study population may have reduced the statistical power to detect associations. Further research should employ larger sample sizes and longitudinal study designs to better assess the association between maternal tobacco and alcohol use and childhood stunting.

The study also found no significant association between exclusive breastfeeding and stunting. However, other similar studies conducted in Malawi focused on infants under six months and found that those who were exclusively breastfed were longer, healthier, and less likely to be stunted compared to non-exclusively breastfed infants.[37] Research indicates that inappropriate complementary feeding practices, particularly those lacking in nutritional quality and quantity, significantly increase the risk of stunting in children aged 12-24 months.[38] Cross-sectional studies capture data at a single time point, which may limit the ability to infer causal relationships. Future research should employ longitudinal studies that monitor individual growth over time. [39] to identify associations that may not be evident in a single time-point investigation. While there appeared to be differences in stunting between households with improved and unimproved water sources, they were not statistically significant. Reflecting a relatively homogeneous status in the study locality. Studies in developing countries have shown that improved water, sanitation, and hygiene practices are linked to better health outcomes, including reductions in stunting. [40] Further studies in different regions, particularly rural areas, are needed to better understand the impact of water sources on stunting. Even though these results were not statistically significant, investing in improved water infrastructure could still contribute to long-term reductions in stunting and other health issues.

The study's finding of no significant association between antenatal care (ANC) visits and deworming with stunting contrasts with the prior research, such as the study from Indonesia, which found higher stunting prevalence among children whose mothers did not attend ANC services. [41] This discrepancy may be attributed to differences in healthcare systems, coverage, and program implementation across countries. In Indonesia, barriers to ANC access, including financial constraints and limited healthcare infrastructure, contribute to lower service utilization and, consequently, inadequate maternal nutrition and deworming uptake.[42] In contrast, the high ANC attendance rate (94.1%) in Nyagatare District suggests substantial improvements in maternal health services, likely influenced by government interventions such as Community-Based Health Insurance (CBHI). [43] The widespread use of CBHI ensures the affordability and accessibility of maternal healthcare, enabling more pregnant women to receive essential services, including iron supplementation, tetanus immunization, and nutrition counselling. However, the lack of a significant association between ANC and deworming with stunting in this study suggests that other factors, such as gaps in medication supply, healthcare providers' adherence to guidelines, or maternal health literacy, may be influencing deworming uptake despite high ANC attendance. Further studies could examine the combined impact of ANC interventions, including deworming, on childhood stunting prevention.

Study limitations

This study used a quantitative cross-sectional design to assess the prevalence and association between stunting and other variables.[17] which restricts the ability to infer causality between risk factors and stunting. Other study designs, such as randomized controlled clinical trials, would be better for establishing such causal relationships. In addition, the small sample size may have had implications for the value of the findings, which may be improved by involving more participants than in the current study. Another limitation is related to the ability to generalize to the entire population of the District and elsewhere. Similar studies would contribute to a further understanding of the factors associated with stunting in other rural areas of Rwanda.

Conclusion

The prevalence of stunting remains a concern in the Nyagatare District. Maternal education emerges as a significant factor influencing stunting, with children of mothers with no education

being more likely to be affected than others. This finding highlights the importance of targeted interventions to improve maternal education for reducing stunting rates. Additionally, the study emphasizes the need for further research in rural districts to explore additional contributing factors. Overall, addressing stunting requires multi-sectoral interventions encompassing nutritional, socio-economic, and educational aspects to improve child health and well-being in the region.

Conflict interest

The authors assert that they have no conflicts of interest related to this research. They also clarify that they have not received any financial support or assistance from organizations that might influence the study's outcomes.

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