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Maternal Determinants of Stunting Among Children Under Five Years Old in Kamonyi District, Southern Rwanda

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ORIGINAL ARTICLES

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ABSTRACT

Childhood stunting persists as a major public health concern in Rwanda, characterized by significant sub-national inequalities despite broader national improvements in health indicators. This research evaluated the impact of maternal characteristics on stunting among children under five in Kamonyi District. A cross-sectional design was utilized, assessing 420 mother-child pairs selected via two-stage cluster sampling. Child nutritional status was determined using WHO standard HAZ scores, while maternal socio-demographic and health data were gathered through structured questionnaires. Statistical analysis identified a 37.1% stunting rate in the study population. Key maternal predictors significantly associated with child stunting ($p<0.05$) included limited education, short physical stature (<150 cm), underweight status (BMI <18.5 kg/m^2), and inadequate utilization of antenatal care (ANC) services. Conversely, maternal age and employment status were not statistically correlated. The study concludes that addressing structural barriers to maternal education, nutritional health, and ANC utilization is crucial in high-risk districts to interrupt the intergenerational transmission of undernutrition.

Key Messages:

- In the Kamonyi District, maternal predictors are the most significant, such as low education, short stature, undernourishment (low BMI), and poor antenatal care, due to which childhood stunting persists at a high level of 37.1%.
- To address stunting in high-burden districts, a localized, mother-centered approach to enhancing the education of women, the state of their nutrition, and ANC use should be increased to interrupt the intergenerational cycle of undernutrition.

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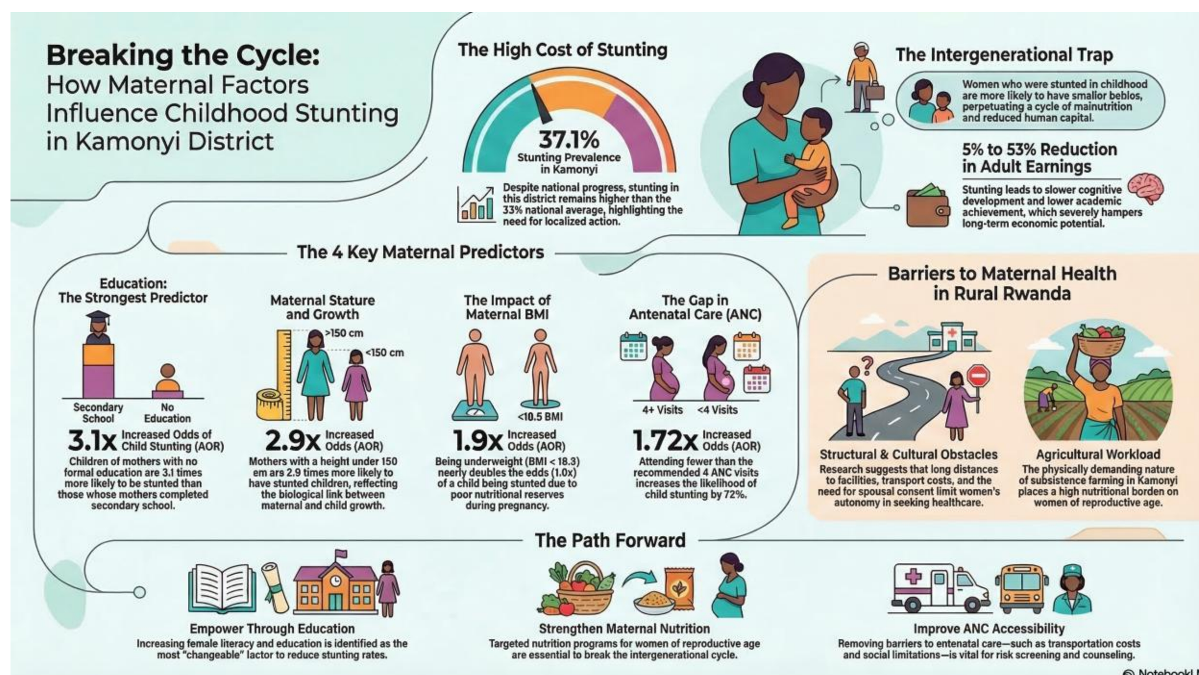
GRAPHICAL ABSTRACT



INTRODUCTION

The most important indicator of chronic malnutrition and a serious global public health problem is childhood stunting, which, according to the World Health Organization (WHO), is defined as a height-for-age z-score exceeding the median by more than 2 standard deviations. (1–3). It is an ongoing, cumulative pattern of nutritional and health deficiencies, typically beginning in utero, with severe and largely irreversible effects. (3,4). Stunting among the children under five years of age is estimated at 148.1 million children around the world, with effects including impaired cognitive development, less education, and economic productivity in adulthood, thus continuing an intergenerational cycle of poverty and malnutrition. (5,6). Stunting remains a long-standing public health issue in Rwanda, despite the country's substantial progress in national economic development and investment in the health sector. (5–7). According to the 2019/2020 Demographic and Health Survey (DHS), the national prevalence of stunting among children under the age of five years was 33% (7–9). Such a high rate underscores the issue's complexity and multifactorial nature, which is perpetuated by a network of interlinked factors, including socioeconomic status, environmental conditions, and inadequate care practices. (8,10).

Moreover, it does not affect the entire population evenly, and there are geographical disparities that require local, targeted measures. Increasingly, the literature indicates that maternal characteristics are among the most important proximal determinants of the child's nutritional status (11,12). The mother is a primary caregiver and guardian of the child's health, especially during the delicate first 1,000 days of life. Rwandan studies have continued to find several maternal risk factors to be significant contributors to stunting, such as maternal height, maternal education, the use of antenatal care (ANC), and low household wealth. (12–15). As an example of this, maternal education correlates with improved child health, and low maternal height is a powerful predictor of stunting, which is an intergenerational malnutrition transmission. (16,17).

Although several national nutrition initiatives are in place, the rate of stunting in high-burden regions such as the Southern Province, where Kamonyi District is located, remains very high. Current interventions typically employ a general expansionary approach that may be insufficient to address the district's unique underlying drivers. It is acknowledged that there is a gap in localized evidence-based studies that will explicitly examine the role of particular maternal characteristics in stunting in Kamonyi. A lack of understanding of the material qualities of the maternal determinants (education, nutritional status (height/BMI), or healthcare-seeking behavior) most closely related to stunting in this setting

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restricts policymakers' options for developing more precisely focused, cost-effective interventions. Thus, this study seeks to address this gap of critical importance by conducting a systematic study of the association between the important maternal attributes and the occurrence of stunting among children below the age of five in of Kamonyi District.

METHODS

A community-based cross-sectional design was employed to investigate the association between maternal characteristics and child stunting in Kamonyi District, Southern Province, Rwanda. The district was deliberately selected due to its chronically elevated stunting prevalence relative to the national level, as documented in the 2019/2020 RDHS. Kamonyi is predominantly rural and peri-urban with an agricultural economy and limited access to diversified nutrition interventions. The study population comprised mothers or primary caregivers of children aged 0–59 months residing in Kamonyi District. A two-stage cluster sampling approach was used. In the first stage, sectors were selected using probability proportional to size (PPS) among the 22 sectors of the district. In the second stage, eligible households were systematically selected from community health worker registers within each sector.

Sample size was determined using the standard formula for estimating a population proportion, assuming a stunting prevalence of 33% (RDHS 2019/2020), a design effect of 1.5, a 95% confidence level ($Z = 1.96$), and a 5% margin of error ($d = 0.05$), yielding a minimum sample of 535. Adjusting for a 10% non-response rate, a target of 590 mother–child pairs was set; 420 pairs were enrolled and analyzed.

Data were collected between February and April 2025 using a structured questionnaire adapted from the standard DHS modules on maternal and child health, anthropometry, and household characteristics. The instrument was translated into Kinyarwanda and back-translated. It captured: (i) maternal sociodemographic characteristics (age, education, occupation, marital status); (ii) biological characteristics (height, weight, BMI); and (iii) health-seeking behavior (ANC attendance, delivery place, postnatal care). Anthropometric measurements were conducted according to WHO protocols. All instruments were calibrated before each session.

Data were entered, cleaned, and analyzed using Stata version 17 (StataCorp, College Station, TX, USA). HAZ scores were computed using WHO Anthro software (v3.2.2). Stunting was defined as HAZ < −2 SD. Bivariate associations were assessed with Pearson chi-square tests. Variables significant at $p < 0.10$ entered the multivariate logistic regression. Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) are reported. Model fit was evaluated by the Hosmer–Lemeshow test ($p = 0.61$).

RESULTS

A total of 420 mother–child pairs were included. Mean maternal age was 29.8 ± 6.5 years; mean child age was 30.4 ± 14.2 months. Overall stunting prevalence was 37.1% (HAZ < −2 SD). Boys exhibited marginally higher stunting (39.5%) than girls (34.8%), but this difference was not statistically significant ($p = 0.214$). Table 1 summarizes participant characteristics and stunting prevalence by category.

Table 1. Sociodemographic and health characteristics of study participants with stunting prevalence by category

Variable	Category	n	%	Stunted n (%)	p-value
Maternal Education	No formal education	56	13.3	31 (55.4)	<0.001
	Primary	263	62.6	109 (41.4)	
	Secondary or higher	101	24.1	25 (24.8)	
Maternal Height (cm)	< 150 cm	31	7.4	19 (61.3)	0.001
	150–160 cm	241	57.4	87 (36.1)	
	> 160 cm	148	35.2	42 (28.4)	
Maternal BMI (kg/m^2)	< 18.5 (Underweight)	41	9.8	24 (58.5)	0.001
	18.5–24.9 (Normal)	289	68.8	94 (32.5)	
	≥ 25 (Overweight/Obese)	90	21.4	31 (34.4)	
ANC Visits	< 4 visits	221	52.6	107 (48.4)	0.002
	≥ 4 visits (recommended)	199	47.4	59 (29.6)	
Maternal Age (years)	< 20 years	38	9.0	15 (39.5)	0.821
	20–34 years	298	71.0	108 (36.2)	
	≥ 35 years	84	20.0	33 (39.3)	

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Variable	Category	n	%	Stunted n (%)	p-value
Maternal Occupation	Farmer	208	49.5	78 (37.5)	0.934
	Unemployed	123	29.3	44 (35.8)	
	Other informal work	89	21.2	34 (38.2)	

Maternal Characteristics

Most mothers (62.6%) had primary education; 24.1% had secondary or higher education; 13.3% had no formal education. Nearly half (49.5%) were farmers; 29.3% unemployed; 21.2% in other informal work. Mean maternal height was 156.2 ± 5.8 cm, and mean BMI was 22.6 ± 3.1 kg/m^2. Prevalence of underweight (BMI < 18.5 kg/m^2) was 9.8%. Only 47.4% of mothers received the recommended four or more ANC visits.

Table 2. Maternal Characteristics and Child Stunting Status bivariate (n = 420).

Maternal Characteristic	Category	Stunted % (n)	Normal % (n)	χ^2	p-value
Maternal Education	No formal education	56.4 (31)	43.6 (24)		
	Primary education	41.3 (109)	58.7 (154)	12.98	
	Secondary or higher	24.3 (25)	75.7 (76)		<0.001
Maternal Height (cm)	< 150 cm	61.3 (19)	38.7 (12)		
	150–160 cm	35.9 (87)	64.1 (154)	16.42	
	> 160 cm	28.7 (42)	71.3 (106)		0.001
Maternal BMI (kg/m^2)	< 18.5	58.1 (24)	41.9 (17)		
	18.5–24.9	32.6 (94)	67.4 (195)	14.07	
	≥25	34.4 (31)	65.6 (59)		0.001
ANC Visits	< 4 visits	48.2 (107)	51.8 (114)		
	≥4 visits	29.5 (59)	70.5 (140)	10.56	0.002
Maternal Age	< 20 years	39.5 (15)	60.5 (23)		
	20–34 years	36.2 (108)	63.8 (190)	0.373	
	≥35 years	39.3 (33)	60.7 (51)		0.821

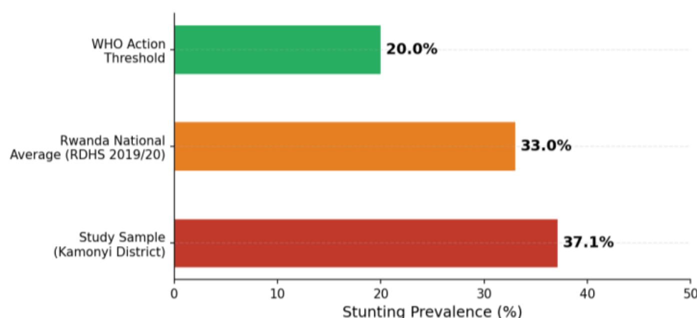

Figure 1. Kamonyi District's stunting prevalence (37.1%) is higher than the Rwanda national average (33.0%) and the WHO action threshold (20%), illustrating a critical subnational disparity.

Multivariate Logistic Regression

Table 3. Multivariate Logistic Regression: Predictors of Child Stunting (n= 420)

Maternal Characteristic	Category (Reference)	p-value	Adjusted OR (aOR)	95% CI
Maternal Education (Ref: Secondary or higher)	No formal education	<0.001	3.14	1.65 – 5.98
	Primary education	0.041	1.88	1.03 – 3.44
Maternal Height (Ref: > 160 cm)	< 150 cm	0.002	2.87	1.42 – 4.92
	150–160 cm	0.034	1.51	1.03 – 2.21
Maternal BMI (Ref: 18.5–24.9 kg/m^2)	< 18.5 (Underweight)	0.021	1.96	1.10 – 3.47
	≥25 (Overweight/Obese)	0.510	1.13	0.78 – 1.64
ANC Visit	< 4 visits	0.024	1.72	1.08 – 2.77
Maternal Age — adjusted covariate (Ref: 20–34 years)	< 20 years	0.612	0.88	0.52 – 1.49
	≥35 years	0.743	1.07	0.71 – 1.62

Maternal education, height, BMI, and ANC attendance remained significant independent predictors after full adjustment. No formal education carried the highest odds (aOR = 3.14; 95% CI: 1.65–5.98; p < 0.001), followed by maternal height < 150 cm (aOR = 2.87; 95% CI: 1.42–4.92; p = 0.002), underweight BMI (aOR = 1.96; 95% CI: 1.10–3.47; p = 0.021), and fewer than four ANC visits (aOR = 1.72; 95% CI: 1.08–2.77; p = 0.024) (Table 3). Maternal age and occupation were not significant in the adjusted model.

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DISCUSSION

This study investigated the association between maternal characteristics and stunting among children under five in Kamonyi District, Rwanda. The observed stunting prevalence of 37.1% substantially exceeds the 2019/2020 RDHS national average of 33%, confirming persistent subnational disparities and the need for locally targeted interventions.

Maternal education was one of the strongest independent predictors of child nutritional status. The probability of children of mothers who do not have any formal education being stunted was more than three times higher than that of children of mothers with secondary or higher education (aOR = 3.14; p = 0.001). This is in line with the findings of Rwanda and other low- and middle-income populations, where maternal education always becomes a highly significant protective factor (18,19). Educated mothers are more health literate, they engage in evidence-based infant feeding habits, and are more autonomous in making household decisions. The education-stunting gradient is inversely correlated with education, thus giving a strong argument in favour of long-term investment in the education of girls as a policy intervention to malnutrition between generations(20,21)

The short stature and underweight status were both greatly predicted by the increased odds of child stunting, highlighting the intergenerational malnutrition transmission. The result showed that mothers with a height below 150 cm had about three times higher chances of having stunted children (aOR = 2.87; p = 0.002), which is in line with the evidence that lack of maternal linear growth directly causes fetal growth restriction(22,23). Maternal underweight (BMI < 18.5 kg/m2), which also showed predictive value (aOR = 1.96; p = 0.021), provided evidence for the biological mechanism by which maternal energy deficiency limits intrauterine growth. Such results highlight the urgent need to enhance the nutrition of adolescents and mothers as a life-course intervention to prevent this cycle.

Poor ANC attendance was the only independent predictor of child stunting, with an odds ratio of 1.72(p=0.024). This is consistent with causes of poor ANC use in sub-Saharan Africa, where a lack of maternal nutrition education, micronutrient supplementation, and early detection of pregnancy complications were associated with poor ANC use(24,25). ANC visits are organized programs that provide combined nutrition activities, such as iron-folic acid supplementation, deworming, and nutritional diversity advice.

Child stunting was not significantly associated with maternal age or occupation in the multivariate model. Nevertheless, one should not underestimate their indirect impact. Teenage mothers are more vulnerable to socioeconomic forces, and in some cases, informal and agricultural jobs can limit the time to provide the best childcare. The non-significance can indicate homogeneity within the samples or quantifiable confounders that are not measured (e.g., food security at home)(26,27).

Such findings are widely applicable to national and regional nutrition surveys and emphasize subnational heterogeneity. The RDHS reports a net national decrease in stunting, but Kamonyi District remains under a relatively high burden, consistent with Mokori A (2025) (28). The fact that Uganda and Kenya are also experiencing comparable forms of geographical inequality supports the conclusion that stunting alleviation requires context-specific interventions sensitive to geographical factors.

The power of the findings includes the convergent need to enhance maternal education and nutrition and to increase access to quality ANC in Kamonyi District. The education, women's empowerment, and social protection frameworks should be integrated into the nutrition-sensitive policies (29,30). Community health workers can be instrumental in expanding maternal nutrition to at-risk households.

CONCLUSION

This study highlights the critical prevalence of childhood stunting in Kamonyi District, Rwanda, identifying maternal characteristics—specifically low educational attainment, short stature (<150 cm), undernutrition (BMI <18.5 kg/m^2), and inadequate antenatal care (<4 visits)—as primary, independent predictors of the condition. These findings emphasize the intergenerational nature of malnutrition and advocate a shift from solely child-centric feeding interventions to multisectoral strategies that support maternal health and empowerment. To effectively mitigate stunting in high-risk areas, policymakers must

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prioritize female education, adolescent and maternal nutrition, and the strengthening of community health systems to ensure robust antenatal care. Furthermore, future longitudinal and implementation research is warranted to establish causality, evaluate district-specific social protection measures, and investigate broader contextual determinants such as household food security and paternal involvement.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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