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Prevalence and Factors Associated with Stunting Among Children Aged 6 to 59 Months in Selected Sectors of Gisagara District, Rwanda

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ABSTRACT

Background: Stunting remains a significant global public health concern, affecting 149.2 million (22.0%) children under the age of 5 worldwide. Most of these children reside in Africa (with a 41% prevalence). In Rwanda, recent data from the 2019/2020 Rwanda Demographic Health Survey (RDHS) revealed that 33% of children under the age of 5 experience stunting with high level in rural Districts.

Aim: To determine the prevalence and factors associated with stunting among children aged 6 to 59 months.

Setting: The study was done in 6 sectors of rural Gisagara District, Southern Province of Rwanda.

Methodology: A quantitative cross-sectional study design was used to know the participants of each sector within 6 sectors by considering the sample size of 374. The World Health Organization (WHO) Anthro software version 3.2.2 was used to determine the nutritional status of the children. SPSS 29.0 was used during analysis and significance level was below 5%.

Results: This study showed that the prevalence of stunting was 35%. This study revealed that stunting was high in male gender, poor water treatment method, and children born with birth weight less than 2500 gr.

Conclusion: Efforts should be made to improve nutritional status of mother and fetus during pregnancy, to encourage mothers or caregivers on water treatment methods, to eradicate undernutrition

Contribution: the findings of this study align with the focus and scope of the African Journal of Primary Health Care and Family Medicine by addressing primary healthcare challenges and proposing actionable strategies to enhance family and community health.

INTRODUCTION

Background of the Study

Stunting refers to impaired growth and development in children due to chronic malnutrition, it is characterized by low height for where a child is too short for his or her age more than two standard deviations below the World Health Organization (WHO) Child Growth Standards median [1]. In 2020 Worldwide, 149.2 million (22.0%) children under 5 years of age were stunted, most children with malnutrition live in Africa and Asia with 41% and 53% respectively [2]. Southern Asia is home to nearly two out of every five stunted children worldwide (55.9%), Africa is the only region where the number of stunted children has increased from 49.7 million in 2000 to 57.5 million in 2019 [3]. In Africa, stunting rate among under five children varies depending on the region. In 2022, the prevalence in Eastern Africa, Middle Africa, Northern Africa, Southern Africa and Western was 30.6%, 37.4 % ,21.7% ,22.8 % ,30.0% respectively [1].

Significant progress has been made in reducing the occurrence of child stunting on a global scale. Since the initiation of consistent data collection in 1990, the number of children under the age of five experiencing stunting has declined from over 250 million, with a prevalence of 40 percent, to 144 million (22 percent) in 2020. Despite this considerable achievement, it does not meet the target set by the World Health Organization (WHO) in 2012. The goal was to decrease the number of stunted children to 100 million by 2025, representing a 40% overall reduction and a 50% reduction by 2030 [1]. According to current projections, it is anticipated that stunting will impact 127 million children by 2025, surpassing the WHO target by more than 25 percent. The issue of child growth stunting continues to pose a considerable challenge in Sub-Saharan Africa, where 34% of children under the age of five are affected [4].

This condition has various impacts on the affected children, including difficulties in learning at school, reduced earning potential in adulthood, and obstacles to active participation in their communities. These consequences have negative implications not only for individuals but also for societies [5]. As outlined in the report addressing stunting reduction in Sub-Saharan Africa, stunting typically manifests early in a child's life, posing

the greatest risk during the initial two years. Importantly, beyond this period, stunting tends to be largely irreversible. The condition is linked to diminished immune responses, exposing stunted children to heightened risks of morbidity and mortality [3]. A significant factor contributing to child mortality in children under the age of five is undernutrition, which accounts for 45% of such fatalities [6].

A study conducted across 62 lower- and middle-income countries found that in 2016, undernutrition, as evidenced by childhood stunting, wasting, and underweight, was responsible for over 1.0 million deaths. This accounted for 3.9% of years of life lost and 3.8% of disability-adjusted life years on a global scale [7]. In Rwanda, 33% of children under the age of five are stunted, indicating a condition where they are shorter than the expected average for their age [8]. Notably, Rwanda exhibits a higher prevalence of stunted children compared to its neighboring countries, with Tanzania reporting a rate of 30.0% in 2022 [9], and Uganda recording 29.0% in 2016 [9].

Different authors have identified some factors associated with stunting such as sex, age group, parental education level, parental occupation, wealth index, access to improved water, human development index, epidemics, place of residence, food insecurity, breastfeeding practice [10]. As indicated by Rwanda National Institute of Statistics, there was a significant association between birth size and nutritional outcomes. The report stated that 60% of children reported to be very small at birth exhibited stunting, in contrast to 30% of children reported to be of average or larger size at birth [8].

According to the data from RDHS 2019/2020, the prevalence of stunting in Gisagara District, the focal point of my study, was 38%. This rate surpasses the national average and stands as the second highest among all districts in Rwanda [8]. Consequently, there was a pressing need for an investigation to uncover the factors contributing to this elevated burden. The aim of this thesis was to provide valuable insights that health leaders can utilize to implement effective measures and find solutions to address the issue. Adequate nutrition enables children to attain their maximum potential, whereas children experiencing stunting are at a higher risk of cognitive issues, including learning difficulties in school. Additionally, they tend to earn less as adults and encounter obstacles

in participating fully within their communities [3]. This was also revealed by different studies that stunting adversely affects the physical and mental development of the affected children, and predisposes them to chronic diseases and low productivity in adult life, as well as premature death [11].

Rwanda has experienced a limited decrease in the stunting rate, currently standing at 33%, surpassing the WHO threshold of 20% for considering it a public health concern. The prevalence of stunting demonstrated variations based on geographic, socio-economic, and demographic factors. Stunting was more prominent in rural areas (36%) compared to urban areas (20%), in the poorest households (42%) compared to the richest households (18%), and among children whose mothers have no education (40%) compared to those with secondary or higher education (22%) [8].

Despite the progress made by the government of Rwanda through different initiatives such as leverage on Early Childhood Development (ECD) program at community level to increase knowledge on good nutrition practices and provision of MNCH services; expanding the regular monitoring of nutrition status among children and adults and increasing the private sector engagement in the production of nutrition and food commodities there was still high prevalence of stunting in under five children compared to the 19 % target in 2024, this meant unmet gap of 14 % stunting reduction [12]. Gisagara District was one of the Districts in Rwanda with a high prevalence of stunting among children under five. According to the RDHS 2019/2020, the prevalence of stunting in Gisagara District was 38%, which was higher than the national average and the second highest among all districts in Rwanda. Numerous studies have investigated the prevalence of stunting and its related factors among children under the age of five in Rwanda [13]. However, there was no information regarding the factors linked to stunting specifically in Gisagara District. Consequently, this thesis aimed to address this gap by examining the prevalence and identifying the factors associated with stunting among children aged 6 to 59 months in Gisagara District, Rwanda.

Research Methods and design

Study design

A quantitative cross-sectional study was used to get information on prevalence and factors associated with stunting at the time of study. The researcher used structured questionnaire to collect data and nutritional assessment of height and age for the children aged 6 to 59 months and to evaluate factors associated with stunting among those children.

Setting

The research was conducted in Gisagara District, Southern Province, which has 13 sectors, 69 cells, and 492 villages. Gisagara District is one of 8 Districts of Southern Province of Rwanda, it is bordered in the South and East by the Republic of Burundi, in the North by Nyanza District, and in the West by Huye and Nyaruguru Districts. It has a population of about 397,051 people, of which 52.4% are females and 47.6% are males, population density of 584 per km² [15]. The main economic activities are agriculture and livestock. Gisagara has two hospitals which are Kibilizi and Gakoma. Kibilizi hospital has ten health centers in its catchment area which are Kibilizi, Mugombwa, Gisagara, Kirarambogo, Kibayi, Gikore, Agahabwa, Kigembe, Kansi and Mugombwa refugee camp. Gakoma has five health centers which are Gikonko, Mushya, Gishubi, Save and Gakoma [15].

Study Population and sampling strategy

According to data from HMIS Kibilizi District Hospital catchment area has 26920 children aged 6 to 59 months and all with their mothers or caregivers was considered as study population of this study during data collection period. Data collection was done from 25th to 28th March, 2024. The inclusion criteria were being a child aged from 6 to 59 months, having a valid birth certificate or immunization card, living in selected sector for at least one year and having a mother or caregiver willing to participate in the study. Exclusion criteria were having no birth certificate or immunization card, Children born with congenital conditions, a period of less than one year living in the area, having mothers or

caregivers not willing to participate in the study and caregivers with mental health impairment.

This research accounted for a sample of children in two strata (aged 6 to 23 months and aged 24 to 59 months) paired with their mothers or caregivers in the period of one year (August 2023 to August 2024) who were obtained during monthly growth monitoring at community level. The sample size was calculated basing on the prevalence of stunting revealed in Rwanda Demographic Health Survey 2019-2020 where the prevalence of stunting was 33%.

The number of respondents was calculated using Fisher *et al*, 1998 formula or simple population proportion formula $n = \frac{(Z_{\alpha/2})^2 P(1-P)}{d^2}$ for cross sectional study because it studies prevalence and factors associated with a health-related problem at the same time.

where:

n= sample size

P = Prevalence of stunting in under five children (P) is 33% or 0.33 [8]

$Z_{\alpha/2}$ = Critical value of the normal distribution at $\alpha/2$ is equal to 1.96 when a confidence level is 95%, while α is equal to 0.05.

d = Margin of error (5% or 0.05),

$$n = \frac{(1.96)^2 0.33(0.67)}{(0.05)^2}$$

$$n = 339.7$$

by adding of 10% of sample size to cover non respondent subjects and then sample size to be used was 374.

Purposive sampling was utilized to choose the 6 sectors, representatives of 13 sectors in the whole district. Sectors was selected considering the location, stunting rates, and sectors with high number of children aged 6 to 59 months. The six sectors were Mugombwa, Mukindo, Kibilizi, Ndora, Kigembe, and Kansi. A cluster sampling method was used to know the study participants for each selected sector by considering the sample size of 374 divided by 6 sectors, the researcher divided again the study participants for every sector by 2 strata (6 to 23 months and 24 to 59 months) to get the study participants from each stratum. Simple random sampling method was used to

recruit participants of the study, where the researcher used Microsoft Excel to select participants.

Data Collection

In this study, we measured child height using wooden graduated height board, where children with 6 to 23 months were measured lying down and 24 to 59 months standing up and a structured questionnaire adopted from previous literature was used after being pre-tested and refined according to the feedback given. The researcher introduced the questionnaire to the caregivers to collect to predetermined information. To maintain the consistency, the researcher prepared the questionnaire in English and Kinyarwanda. The researcher used self-developed questionnaire containing close-ended questions as tool for data collection, which focused on demographic and socio-economic characteristics of child and mother, maternal, child and environmental information. Data gathering was done in march 2024 during the period of child growth monitoring. The English questionnaire was translated into Kinyarwanda language before administered to the mothers or caregivers of children aged 6 to 59 months.

Two data collectors (nutritionists) were trained on data collection tools. Then after, data collectors have gone to selected sectors at village level to collect data during the time of growth monitoring activity done by CHWs. Data collectors collected data on the days that CWHs receive under five for growth monitoring. Data collectors measured the children for those aged 6 to 23 were measured lying down and those aged 24 to 59 in standing position and after measured the child, data collector gave the questionnaire for her to fill in the answers and those who did not know to read were facilitated in order to answer properly the questionnaire.

Data Analysis

The dependent variable was undernutrition status measured as stunting. Independent variables were: demographic and socio-economic variables (child sex and age; maternal age, education, sector, ubudehe category, occupation, religion, marital status and family size), Maternal factors (conflict with partner, drinking alcohol and tobacco), child factors (illness, feeding information, birth order, immunization status) and environmental factors

(water treatment method, having toilet, handwashing practice and material used after toilet). Anthropometric measurements were entered into WHO Anthro software version 3.2.2 and converted into Z-scores indices to know nutritional status of the child, HAZ < -2 was categorized as stunting. Data entry and analysis was completed using Statistical package for social sciences software version 25. Data were entered into SPSS software and cleaned for its consistency. Descriptive analysis was done both frequencies and percentage. Bivariate analysis was done to assess association of independent variable and dependent variable (chi-Square) and multivariate logistic regression analysis was done to control confounding and examine association of multiple independent variables to dependent variable, adjusted odd ratios was used, CI:95%, P value less than 0.05 was taken as statistically significant.

Ethical Considerations

Ethical confirmation to conduct research from Mount Kenya University was given. local authorities provide permission letter to conduct the research and participating mothers consented to voluntary participate in the study. Participants were given adequate information on the purpose and benefits or harm that involving in the study might bring. The participants were guaranteed of privacy with respect to the data the provided and also their full right to withdraw at any time from the research without consequences pertaining to their decision.

RESULTS

Demographic and socio-economic characteristics of respondents

Descriptive statistical analysis (frequencies and percentages) was done using the data obtained from the questionnaire to describe demographic and socio-economic characteristics of the children and mothers or caregivers. As shown in the table 4.1.1; a significant number of the respondents were from Mugombwe sector (20.3%), Ndora (19%), Kansi (18.4%) Mukindo (18.2%) and the minority from Kibilizi 6.1%). In terms of gender, half (50.5%) of the respondents were males and many of the children were aged between 6-14 months (24.6%) and only 9.9% were between the age bracket of 51-59 months. Majority of the respondents had primary education (75.4%) and 97.1% were

farmers. Additionally, 66% of the respondents were Christians Catholics followed by Protestants (28.15). More than half of the respondents were married (65.2%), and 29.4% were single.

Table 4. 1.1: Demographic and socio-economics characteristics of the children and the mothers or caregivers (n=374)

Variables		Frequency	Percentage (%)
Sector of respondent	Mugombwa	76	20.3
	Kibilizi	23	6.1
	Kigembe	67	17.9
	Ndora	71	19
	Kansi	69	18.4
	Mukindo	68	18.2
Child sex	Female	185	49.5
	Male	189	50.5
Child age in months	6-14	92	24.6
	15-23	86	23
	24-32	51	13.6
	33-41	53	14.2
	42-50	55	14.7
	51-59	37	9.9
Respondent's education	No education	53	14.2
	Primary	282	75.4
	Secondary	39	10.4
Respondent's occupation	Farmer	363	97.1
	Self-employed	4	1.1
	Employed	4	1.1
	Unemployed	3	0.8
Religion of respondent	Catholic	247	66
	Adventist	20	5.3
	Protestant	105	28.1
	Muslim	1	0.3
	Other	1	0.3
Marital status of respondent	Single	110	29.4
	Married	244	65.2
	Separated	20	5.3
Social category of the family	Category 1	39	10.4
	Category 2	273	73
	Category 3	62	16.6
	Below 5	225	60.2

Number of persons in the household	Above or equal 5	149	39.8
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Table 4.1.2 showing child factors, where the study showed that 92.2% of children were on complimentary feeding after 6 months compare to 7.5% before 6 months. Also, 94.7% of the respondents indicated breast feeding was initiated immediately after birth and 93% of the babies had birth weight above or equal to 2500g. Additionally, the study showed that diarrhea was the leading cause of morbidity (27.8%).

Table 4.1.2: Child Factors in the study (n=374)

Variables	Frequency	Percent (%)
Timing of complementary feeding		
Before 6 months	28	7.5
After 6 months	345	92.2
Not yet started	1	0.3
Timing of breastfeeding		
Immediate after birth	354	94.7
Later	20	5.3
Weight of child at birth		
Below 2500g	26	7
Above or equal 2500g	348	93
Child morbidity (Malaria, Diarrhea or Others)		
Malaria	6	1.6
Diarrhea	104	27.8
Others	81	21.7
No illness	179	47.9
Both malaria & diarrhea	4	1.1
Feeding supportive program		

Milk	7	1.9
FBF	13	3.5
Micronutrients supplement	207	55.3
None	80	21.4
More than 1 program	67	17.9
Eating balanced diet (fruits, vegetables, potatoes, beans)		
Yes	245	65.5
No	128	34.2
Not yet eating	1	0.3
Eating animal-source protein in last 7 days (meat, egg, fish)		
Yes	297	79.4
No	76	20.3
NA	1	0.3
The number of times the child eats per day		
Once	21	5.6
Two times	194	51.9
Three times	118	31.6
Four times	30	8
Above	10	2.7
NA	1	0.3
Birth order of the child		
First born	119	31.8
Second born	109	29.1
Third born	68	18.2
Above 3	78	20.9
Immunization status of the child		
Fully vaccinated	348	93
Partially vaccinated	26	7

Number of under five children per household

One child	279	74.6
Two children	86	23
Above 3	9	2.4

If the child took deworming drugs in last 6 months

Yes	314	84
No	60	16

If the child received Vit A supplement in last 6 months

Yes	312	83.4
No	61	16.3
Don't know	1	0.3

Environmental Factors in the Study

On environmental factors, more than half (59.4%) of the respondents indicated that they do not do any form of water treatment. However, 35.8% boiled water as a method of water treated. On sanitation facilities, 98.7% had or used toilets and more than half of the respondents (73.73%) practiced handwashing after use of toilet. 42.2% of respondents who used only water for handwashing reported stunting compared to 28.1% of respondents for those who used water and soap. Additionally, 25.4% of respondents who boiled water as a form of treatment reported stunting compared to those that used filtration method.

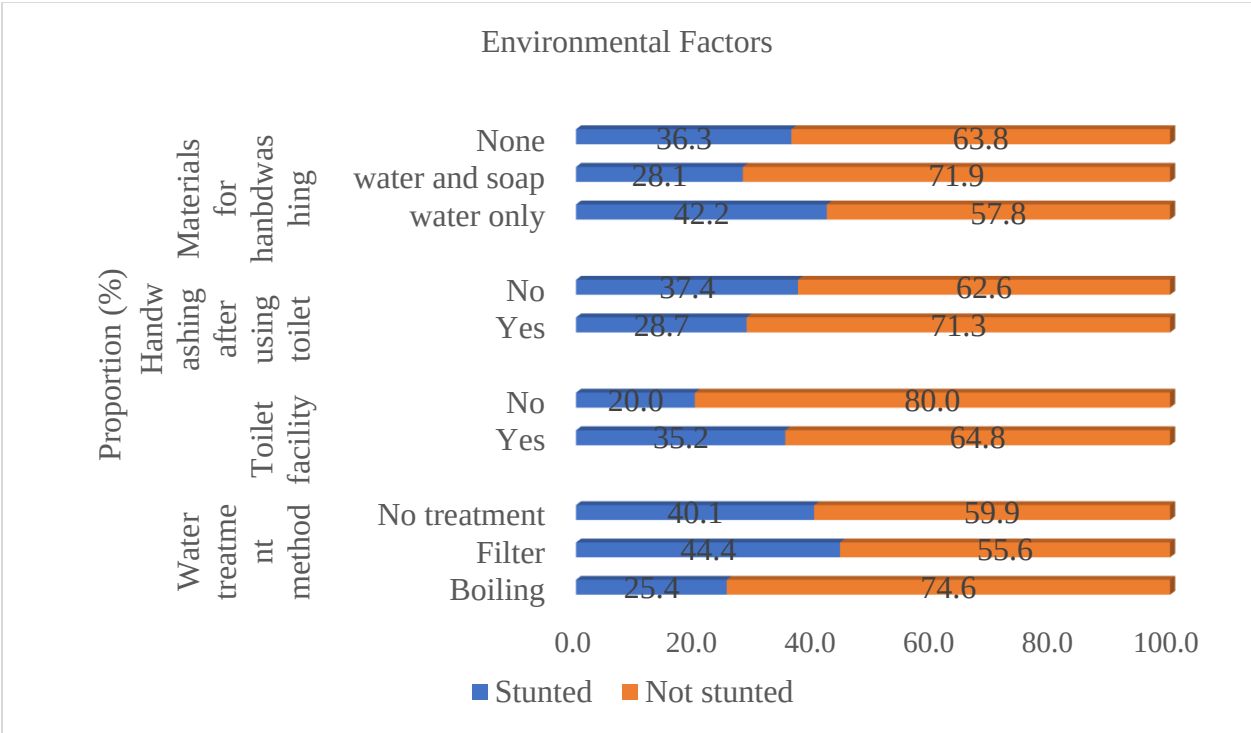


Figure 1: A bar chart showing association of environmental factors and stunting

4.1.4: Maternal Factors in the Study

On maternal factors, 92% had no family history of conflict, only 11.2% smoke tobacco and 49.2% drinks alcohol.

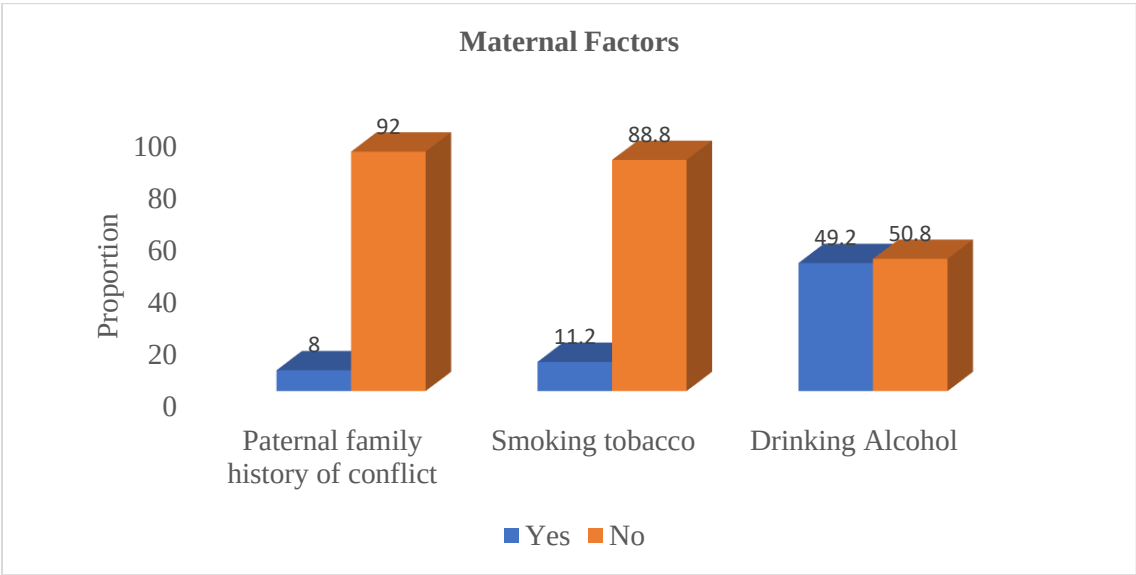


Figure 2: A bar chart showing maternal factors

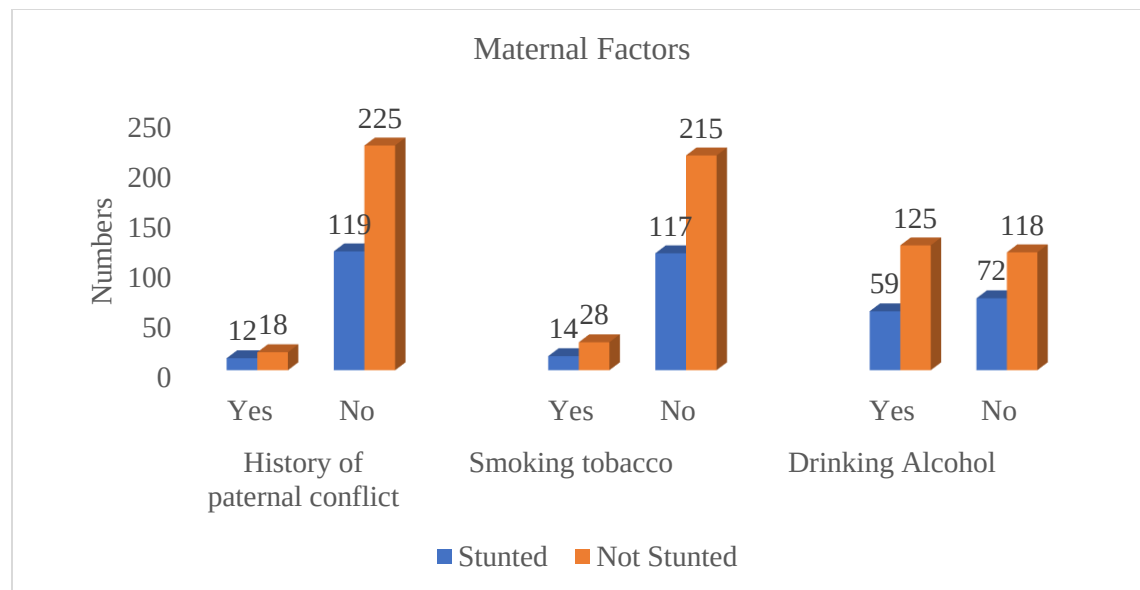


Figure 3: A bar chart showing association between maternal factors and stunting

Figure 3 shows that among respondents who had a history of paternal conflict, 12 cases of stunting were reported.

Prevalence of stunting among children aged 6 to 59 months in selected sectors of Gisagara District, Rwanda.

WHO Anthro software version 3.2.2 was used to describe the prevalence of stunting, data was obtained by anthropometric measurement (height and age). The figure 4.2.1, showed the prevalence in individual sector. Stunting was determined by using Z-score of height for age that is below minus two standard deviations (-2SD) (UNICEF, 2023).

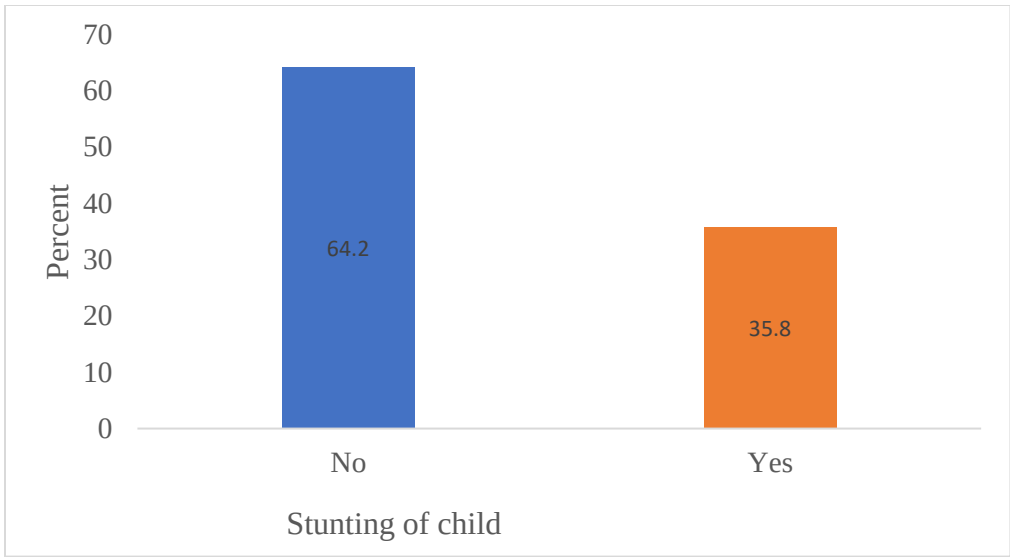


Figure 4.2.1: A Bar Chart showing stunting prevalence

According to the analysis, the overall stunting prevalence was 35.8%. However, results showed significant variations in the different sectors and far less than the overall figure, as shown in the table 4.2.2.1. in Mugombwe the prevalence rate for stunting was 22.9% which is the highest among the sectors. In Kansi, the prevalence rate was 21.4%, Mukindo was 19.8%, Kigembe was 18.3% and Kibilizi was 6.9%.

Demographic and Socio-economic factors associated with stunting among children aged 6 to 59 months

Bivariate analysis (chi-square test) was performed to analyze the relationship between variables and data was obtained from questionnaire. The table 4.2.2.1 showing the relationship between demographic and socio-economic characteristics associated with stunting, table 4.2.3.1 showing child factors associated with stunting, table 4.2.4.1 showing maternal factors associated with stunting and table 4.2.5.1 showing environmental factors associated with stunting.

Table 4.2.2.1: Demographic and socio-economic characteristics associated with stunting among children aged 6 to 59 months

Variables	Not stunted		X ²	P-value
	Stunted (%)	(%)		
Sector of respondent			9.403	0.094
Mugombwa	30(22.9)	46(18.9)		
Kibilizi	9(6.9)	14(5.8)		
Kigembe	24(18.3)	43(17.7)		
Ndora	14(10.7)	57(23.5)		
Kansi	28(21.4)	41(16.9)		
Mukindo	26(19.8)	42(17.3)		
Child Sex			4.513	0.034
Female	55(29.7)	130(70.3)		
Male	76(40.2)	113(59.8)		
Child age in months			7.111	0.212
6-14	27(29.3)	65(70.7)		
15-23	27(31.4)	59(68.6)		
24-32	20(39.2)	31(60.8)		
33-41	18(34.0)	35(66.0)		
42-50	27(49.1)	28(50.9)		
51-59	12(32.4)	25(67.6)		
Respondent's education			2.982	0.225
No education	24(45.3)	29(54.7)		
Primary	95(33.7)	187(66.3)		
Secondary	12(30.8)	27(69.2)		
Respondent's occupation			2.012	0.57
Farmer	129(35.5)	234(64.5)		
Self-employed	1(25.0)	3(75.0)		
Employed	1(25.0)	3(75.0)		
Unemployed	0(0.0)	3(100)		
Religion of respondent			1.467	0.832

Catholic	88(35.6)	159(64.4)		
Adventist	8(40.0)	12(60.0)		
Protestant	35(33.3)	70(66.7)		
Muslim	0(0.0)	1(100)		
Other	0(0.0)	1(100)		
Marital status of respondent			1.554	0.46
Single	43(39.1)	67(60.9)		
Married	80(32.8)	164(67.2)		
Separated	8(40.0)	12(60.0)		
Social category of the family			2.687	0.261
Category 1	18(46.2)	21(53.8)		
Category 2	94(34.4)	179(65.6)		
Category 3	19(30.6)	43(69.4)		
Number of persons in the household			0.387	0.534
Below 5	76(33.8)	149(66.2)		
Above or equal 5	55(36.9)	94(63.1)		

The analysis revealed that child sex was statistically associated with stunting ($p=0.034$) and all other variables were not statistically significant and most of stunted children were males 76 (40.2 %) as shown in table above.

Child factors associated with stunting among children aged 6 to 59 months

Table 2.2.3.1: Child factors associated with stunting among children aged 6 to 59 months

Variable	Stunted (%)	Not stunted (%)	X ²	p-value
Timing of complementary feeding			1.958	0.576

Before 6 months	9(32.1)	19(67.9)		
After 6 months	121(35.1)	224(64.9)		
Not yet started	1(100)	0(0.0)		
Timing of breastfeeding			3.704	0.054
Immediate after birth	120(33.9)	234(66.1)		
Later	11(55.0)	9(45.0)		
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 (Malaria, Diarrhea or Others)			9.64	0.047
Malaria	3(50.0)	3(50.0)		
Diarrhea	45(43.3)	59(56.7)		
Others	33(40.7)	48(59.3)		
No illness	49 (27.4)	130(72.6)		
Both Malaria and Diarrhea	1(25.0)	3(75.0)		
Feeding supportive program			7.274	0.122
Milk	3(42.9)	4(57.1)		
FBF	5(38.5)	8(61.5)		
Micronutrients	61(29.5)	146(70.5)		
None	31(38.8)	49(61.2)		
More than 1 program	31(46.3)	36(53.7)		

Eating balanced diet (fruits, vegetables, potatoes, beans)			2.867	0.364
Yes	81(33.1)	164(66.9)		
No	49(38.3)	79(61.7)		
Not eating	1(100)	0(0.0)		
Eating animal-source protein in last 7 days (meat, egg, fish)			2.021	0.364
Yes	105(35.4)	192(64.6)		
No	25(32.9)	51(67.1)		
NA	1(100)	0(0.0)		
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)	20(66.7)		
Above	2(20.0)	8(80.0)		
NA	1(100)	0(0.0)		
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 took deworming drugs in last 6 months		0.355	0.552
Yes	112(35.7)	202(64.3)	
No	19(31.7)	41(68.3)	

For child factors, the analysis showed weight at birth ($p=0.001$) and child morbidity ($p=0.047$) were statistically associated with stunting. The other variables were not statistically significant associated with stunting.

Maternal factors associated with stunting among children aged 6 to 59 months

Table 4.2.4.1: Maternal factors associated with stunting among children aged 6 to 59 months

Variable	Stunted n(%)	Not stunted n(%)	X ²	p-value
Paternal family history of conflict			0.354	0.552
Yes	12(40.0)	18(60.0)		
No	119(34.6)	225(65.4)		
Drinking tobacco			0.607	0.738
Yes	14(33.3)	28(66.7)		
No	117(53.3)	214(64.7)		
NA	0(0.0)	1(100)		
Drinking Alcohol			1.396	0.237
Yes	59(32.1)	125(67.9)		
No	72(37.9)	118(62.1)		

Source: researcher computations from primary data

The study showed that there was no statistically significant between maternal factors and stunting as shown in table above.

Environmental factors associated with stunting among children aged 6 to 59 months

Table 4.2.5.1: Environmental factors associated with stunting among children aged 6 to 59 months

Variable	Stunted	Not stunted	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)	3(75.0)		
NA	0(0.0)	1(100)		
Handwashing practice after using toilet			2.424	0.12
Yes	29(28.7)	72(71.3)		
No	102(37.4)	171(62.6)		
Materials for hand washing after toilet			3.063	0.216
Using water only	19(42.2)	26(57.8)		
Using water and soap	25(28.1)	64(71.9)		
None	87(36.3)	153(63.7)		

Source: researcher computations from primary data

Chi square analysis showed that water treatment method was statistically associated with stunting ($p=0.013$). All the other environmental variables are not associated with stunting.

Predictors of stunting among children aged 6 to 59 months

Binary logistic regression 'enter method' was used to determine the predictors of stunting. Additionally, to control confounders multivariate logistics regression was done. Any statistical program can easily employ the mathematical technique known as logistic regression, which yields data that can be understood as an odds ratio. The unique feature of logistic regression is its ability to account for a wide range of confounders (given a sufficiently big sample size). Because the value of this odds ratio has been modified to account for the other factors, including confounders, it is known as the adjusted odds ratio. The independent variables that showed significant association ($p < 0.05$) during analysis, 4 independent variables (sex of the child, weight at birth less than 2500gr, water treatment method and illness) were moved into multiple logistic regression analysis. The child morbidity was excluded because during multiple logistic regression p value was greater than 0.05.

Logistic regression is a model in which the log odds are linear. Hence in our study this is equivalent to saying $P(Y=1|X=x_i) = \frac{1}{1+e^{-x_i\theta}}$. If you plug this into the expression for $\ell(\theta)$, you obtain the log-likelihood for logistic regression

Table 4. 2.6.1: Predictors of stunting among children aged 6 to 59 months

Variable	category			COR (95% CI)	p-value	AOR (95% CI)	P-value
		Stunted	Not stunted				
Child sex	Female	55	130	Ref			
	Male	76	113	1.590(1.035-2.441)	0.034	1.711(1.088-2.69)	0.02
	Boiling	34	100	Ref			

Water treatment method	Filter	8	10	0.425(0.155-1.164)	0.096	1.783(1.088-2.92)	0.022
	No treatment	89	133	0.508(0.317-0.815)	0.005	0.906(0.33-2.486)	0.848
Weight of child at birth	Below 2500g	19	7	5.719(2.336-14.001)	0.001*	4.764(1.908-11.899)	0.001
	Above or equal 2500g	112	236	Ref			
Child morbidity	Malaria	3	3	Ref			
	Diarrhea	45	59	1.311(0.253-6.804)	0.747	1.198(0.215-6.674)	0.837
	Others	33	48	1.455(0.276-7.654)	0.658	1.147(0.204-6.443)	0.877
	No illness	49	130	2.653(0.518-13.591)	0.242	1.987(0.36-10.955)	0.431
	Both malaria and diarrhea	1	3	3(0.188-44.963)	0.437	2.019(0.119-34.369)	0.627

Binary logistics regression was conducted to determine factors associated with stunting. The crude odds ratio and adjusted odds ratio computed. The analysis showed that male children are almost two time more likely to be stunted compare to female children (AOR=1.711, p=0.02), households who used filtration as a water treatment method were 1.8 times less likely to have stunted children compared to their counterparties (AOR=1.783, P=0.022), and children who were born with birth weight less than 2500gr were 4.8 times more likely to be stunted compared to their counterparties (AOR= 4.764, p=0.001).

Correlation between prevalence rate and factors associated with stunting among children aged 6 to 59 months

Table 4.2.7.1: Factors correlated with stunting

Variable		Stunting
Child sex	R	.159**
	p-value	0.002
Weight of the child at birth	R	-.168**
	p-value	0.001
Water treatment method	R	.106*
	p-value	0.040
Child morbidity (malaria, diarrhea or others)	R	.142**
	p-value	0.006

Spearman correlation revealed that there was positive strong correlation between sex of child and stunting ($r=0.159^{**}$, $p=0.002$), weight of the child at birth had negative strong correlation with stunting ($r= -0.168^{**}$, $p= 0.001$) and water treatment method showed positive correlation ($r=0.106^{*}$, $p=0.040$) and child morbidity showed negative and strong correlation with stunting ($r=-0.142^{**}$, $p= 0.006$)

Discussions

The purpose of this research was to determine the prevalence and factors associated with stunting among children aged 6 to 59 months in Gisagara District, Rwanda. The general objective was developed into three specific objectives to address all research questions posed related to the main objective, and those were to determine prevalence of stunting, to establish socio-economic, child, maternal and environmental factors associated with stunting and to determine the correlation between prevalence rate and associated factors among children aged 6 to 59 months in selected sectors of Gisagara District.

The prevalence of stunting among children aged 6 to 59 months in selected sectors of Gisagara District was 35%. This prevalence was found to be higher compared to 38%. Obtained by RDHS 2019/2020 for the whole District and higher compared to the World Health Organization cut-off value $< 20\%$ of stunting [15]. The difference might be due to

sample size, study area which was rural settings, time and methodology used in this study compared to that of country level.

According to socio-economic characteristics, sex of child was variable of stunting. The high rate of stunting was among male children where males were almost two times more likely to be stunted compared to female children (AOR=1.711, $p=0.02$), which is similar to the study done in low-and middle-income countries like sub-Saharan Africa [16], where male children were 1.27 times more likely to be stunted than females (AOR = 1.27), and the study conducted in South Ethiopia echoed similar findings with the odds of stunting being significantly higher in male children than females (AOR=2.37), this difference could be due to biological differences or gender preferences in feeding practices [17].

On the child -related factors, weight at birth were also associated with child stunting where child who born with less than 2500 gr were more likely to be stunted compared to their counterparts (AOR: 4.764; 95% CI: 1.908-11.899), another study done in Indonesia [18], revealed the same result that born with low birth weight increases the chance of stunting in under five children. It was also observed consistently in the study done on factors associated with stunting in under five children in Rwanda, they revealed that children with small birth size were 2.12 times more likely to be stunted (OR= 2.12; 95% CI 1.39–3.23), which could be due to intrauterine growth restriction or prematurity [5].

Child morbidity (Malaria, Diarrhea and other) was also associated with stunting ($X^2= 9.64$, $p=0.047$), this was consistent with the study done in south Ethiopia, which showed that diarrhea in the past two weeks was associated with stunting (AOR=2.71), which could be due to the loss of appetite, malabsorption, inflammation, or dehydration [17].

Basis on environmental factors, children from families who did not use any water treatment method to prepare drinking water were more likely to be stunted compared to those form families that treat water before drinking (AOR: 1.783; 95% CI: 1.088-2.92). This was also evidenced in a study done In Indonesia on analysis of risk factors of stunting in children aged 6 to 59 months revealed that low access to sanitation , unimproved source of drinking water were significantly associated with stunting (AOR = 6.06; 95% CI: 1.25–29.35) [18].

Conclusion

In Gisagara District especially in 6 selected sectors of my study stunting was 35% among those aged 6 to 59 months compared to the national level where stunting was 33%. The only socio-economic factor associated with stunting was child sex, environmental factor was water treatment method and child factors were weight at birth and illness (malaria and diarrhea). Efforts should be made to improve nutritional status of mother and child during pregnancy and after to increase the number of children who born with normal birth weight, to encourage mothers or caregivers on water treatment method so that they can treat drinking water for their children especially under five children and again to improve the environment where children live so that it can be clean to prevent malaria, diarrhea and other diseases that compromise the growth of under five children.

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Competing interests

There are no competing interests exist

Author contributions

Marthe Uwamariya conceptualized and designed the study and supervised data collection. Jean Bosco Bigirimana contributed significantly to the analysis and interpretation of the results. Abenezel Niyomurengezi participated in data collection, performed initial data analyses, and contributed to the drafting of the manuscript. Mulugeta Tenna led the statistical analysis, validated the findings, and assisted in writing the results section. Jeanette Uwimana provided critical revisions, contributed to the discussion and conclusion sections, and offered administrative and technical support throughout the project. Boniface Ntirenganya assisted in study design and the development of survey instruments. Amos Habimana contributed to the literature review and background sections. All authors reviewed and approved the final manuscript and agree to be accountable for all aspects of the work.

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Data availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request. The data have been anonymized to protect the privacy of the participants and are available for use in further research, subject to ethical and legal considerations.

Disclaimer

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