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Factors Associated with Stunting among Children Aged 6 to 59 Months in Nyabihu District. A Case Control Study 2023

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Abstract

Introduction: *Malnutrition is a leading cause of mortality among children around the world, with over 6 million deaths occurring each year and an estimated 155 million worldwide being stunted in 2016. Rwanda has one the highest rates of child stunting in the world with 33%. Therefore, the study aimed to identify factors associated with stunting among 6 to 59 months' children in Nyabihu district, Rwanda.*

Methods: *A matched case-control study design was used to identify factors associated with stunting among children aged 6 to 59 months who attended health centers in Nyabihu district from March to April 2023.A total of 402 (134 cases and 268 control) children with 6 to 59 months of age were included in the study. Cases were selected based on WHO anthropometric measurements and matched with children of the same age and residence. Primary data on social demographic, hygiene and sanitation, feeding practices and clinical characteristics were collected using a structured questionnaire. The data were entered in Excel and exported in STATA for analysis. Both bivariate and multivariate logistic regression analysis were performed to identify associated factors. P values < 0.05 with a 95% confidence level were used to declare statistical significance.*

Results: *The following factors were significant to child's stunting: being in Ubudehe cat 1 (AOR 11.1; 95% CI 4.3–8.4), Non-parental caregivers (AOR 3.8; 95% CI 2-7.4) and having more than 2 under-five children (AOR 5; 95% CI 1.5–6.2), mostly Sell agriculture use (AOR 4.3; 95% CI 2.3–7.9), Not treating drinking water (AOR 2.4; 95% CI 1.3- 4.5), Washing hands (AOR 0.08; 95% CI 0.04- 0.1), Not attending ANC (OR 8; 95% CI 1.8– 4.7), Attending mass campaign (AOR 0.34; 95%CI 0.1–0.6).*

Conclusion: *Child stunting remains a public health problem in Nyabihu District. The findings show that the first Ubudehe category, washing hands before child feeding, treating drinking water, more number of under-five children in the household, attending ANC and vaccination campaigns were determinants of stunting. Relieving poverty, strengthening antenatal care, child vaccination and improvement in hygiene and sanitation can help to reduce the stunting rate.*

Keywords: Children, Nyabihu, Anthropometrics

Abbreviations

Afenet: African Field Epidemiology Network
AIDS: Acquired Immune Deficiency Syndrome
ANC: Anti Natal Care, AOR: Adjusted Odd Ratio
CDC: Center for Disease Control
CI: Confidential Interval
DRC: Democratic Republic of Congo
ECD: Early Childhood Development
HIV: Human Immunodeficiency Virus
IFA: Iron and Folic Acid
IRB: Institutional Review Board
IYCF: Infant and Young Child Feeding
PAC: Parliament's Public Accounts Committee
RBC: Rwanda Biomedical Centre
RDHS: Rwanda Demographic and Health Survey
MOH: Ministry of Health
SD: Standard Deviation
SDG: Sustainable Development Goals
SSA: Sub-Saharan Africa
SUN: Scaling Up Nutrition
UNICEF: United Nations Children's Fund
UR: University of Rwanda
WHO: World Health Organization
WFP: World Food Program

Introduction

Malnutrition is a leading cause of mortality among children around the world, with over 6 million deaths occurring each year and an estimated 144 million children worldwide being stunted in 2020 [1, 2] .Malnutrition is associated with stunting as well as impaired cognitive development, which can result in poor educational outcomes; it spurs, a vicious cycle of poverty, as stunted mothers are less biologically able to provide sufficient nourishment for the fetus, leading to another stunted generation [3].

At current trends, worldwide, the number of stunted children aged 6 to 59 months is projected to be 128 million in 2025, against a target of 100 million [4]. Those five sub-regions have child stunting rates that exceed 30%: western Africa (31.4%), middle Africa (32.5%), eastern Africa (37%), southern Asia (34.1%) and Oceania (38.3%; excluding Australia and New Zealand) [5].

A global review of stunting in low- and middle-income countries identified growth restriction, and lack of access to sanitation as the main drivers of stunting; but other contributing factors included ineffective child immunization, diarrhea prevalence, low uptake of deworming medication and lack of maternal iron supplementation which often coincides with a reduction in stunting [6]. Stunting is one of the 6 global nutrition targets and it has been incorporated into the Sustainable Development Goals (SDG) framework under SDG 2 "End hunger, achieve food security and improved nutrition and promote sustainable agriculture and SDG target 2.2 which states "end all forms of malnutrition for less than 5 years of age by 2030" [7].In Africa, the prevalence of stunting decreased from 38.3% in 2012 to 30.3% in 2017, although the number of stunted children has increased due to population growth [8]. At present, approximately 34% of children under the age of five in sub-Saharan Africa experience stunting, with the highest prevalence observed in the Eastern African region at 37% [9]. Regionally, the current prevalence of stunting was 34.4 % in Tanzania, 36% in DRC, Kenya (26%), 41.1 % in Uganda, Burundi (46.7%),14.4% in South Africa, Chad (35.6%), Ethiopia (53.9 %), Cameroon (25.6%), Benin (24%) and 18.7% in Senegal [10-12].

Rwanda has one of the highest rates of prevalence of child stunting in the world. The fact from National Institute of Statistics of Rwanda estimates that Rwanda's prevalence of stunting in children 6 to 59 months of age was 37.4% in 2014, 38 % in 2015 and dropping to 33% in 2020 [10-13]. The prevalence of stunting changes with age with the lowest prevalence found among children less than 6 months of age and a peak of nearly 50% among children 18-23 months of age; Boys are more likely to be stunted than girls and stunting prevalence decreases as wealth increases [14]. By province, the proportion of stunted children is highest in the West and North at 40% and 41% respectively; Nyabihu district has the second highest stunting rate in the country at 46.7%, this is a very challenging issues as Nyabihu is one of the country's top producers of Irish potatoes, vegetables as well as milk and milk products and there are no recent studies that have analyzed the determinants of malnutrition among under-five children in this area [13]. This study aims to identify stunting determinants among children aged 6 to 59 months in the Nyabihu district.

Methods

Study Area, Design and Period

A health center based facility case control study design was used to assess the factors associated with stunting among children aged 6 to 59 months in Nyabihu district from March to April 2023. Nyabihu District is composed of 73 cells and 474 villages with a population of 294, 740 composed predominantly by female covering 53.2 % [15]. In Nyabihu district, there are 1 district hospital, 12 sectors and 16 health centers and 33 health posts. It is among the Rwandan District with high agricultural production of Irish potatoes, and vegetables, food items known for their richness in nutrients [16,17]. However, during the last DHS, Nyabihu was the second district with higher prevalence of stunting with 46.7% [13].

Study Participants

All mothers with children aged 6 to 59 months and their children willing to participate in the study and residents of Nyabihu District who were attended any health center in the study area for any reason were eligible to the study. Mother disabilities (deaf and mute) were excluded from the study.

Sample Size Calculation

The sample size was computed based on James Schlesselmaflfl's formula for case-control studies [18]. with consideration of the Rwandan prevalence of delayed ANC visits (exposure) of 41% [19]. The Assumptions; a 95% confidence level, and a margin of error of 0.05, the power of the study 80%, were considered to calculate the sample size, which ended up with a sample size of 134 children after adding 2% of non-response rate.

The ratio of cases to controls is 1:2. thus the number of Cases was 134 and the control 268 which gives a total of 402 children sampled.

- **Cases:** Any child between 6-59 months old with height-for-age z-scores <-2SD.
- **Control:** The 2 children aged between 6-59 months old with normal height-for-age z-scores. The control children had the same age in months and resided in the same cell as a case.

Sampling and Data Collection Procedures

for children successively as mothers arrived at health center to reach eight cases and 16 controls. Convenience nonprobability sampling was used where all children aged 6 to 59 months were screened for stunting by taking anthropometrics measurements; a WHO child growth standard measurement were used to determine whether child is stunted or not, after identifying the cases they matched with age and residence for its corresponding controls. The total sample size was 402 for 6 to 59 months children; this indicates 25 children (8 cases and 16 controls) per health center for the total of 16 health centers in Nyabihu. However, in 2 health centers 26 children were sampled in order to reach our sample size. Mothers were interviewed by using a questionnaire with closed-ended questions regarding determinants of stunting if she could provide consent and fulfilled the inclusion criteria. The structured questionnaire was designed in English and translated into Kinyarwanda. Before being used in a study, it was shared with University of Rwanda supervisors for approval and pre-tested for inconsistency and modification. A two days re-

fresher training on measuring the children's weight, height, and age; and a common understanding of the questionnaire and other communication skills were provided to Nutritionists at health centers who helped to collect data.

Study Variables

Dependent Variable

Stunting Based on the WHO stunting framework the following independent variables were collected: Individual characteristics /social demographic factors (child's age, child's sex, child 's weight, height, history of diarrhea and or any other chronic diseases, children's main caregivers, mothers 'age, marital status, Height, weight, education level, Occupation, Ubudehe categories, and residence); Household characteristics/factors(Distance to the water source, water supply, improved latrine, household family size, number of children 6 to 59 months of age in the household income, distance to the main road and market, facing natural disasters) Feeding practices (Early initiation of breastfeeding, meal frequency, taking balanced diet in the last 2 weeks , mother's body mass index (BMI), history of smoking) ; Clinical characteristics (History of diarrhea and other infections, received required vaccinations, Vit A, and deworming tablets ; Attending ANC, Number of ANC Visits attended).

Anthropometrics Measurements

Childs' weight was measured with minimal clothing and recorded to the nearest 0.1kg using a scale. Child's Height was measured to the nearest 0.1cm with the child in the upward upright position, legs stretched to a full extent and feet at right angles with legs by using fathom (Toise). To ensure data validity and consistent, two measurements were taken for each anthropometric measure and the average were recorded.

Data Analysis Procedures

Data from questionnaires were checked for completeness and inconsistencies, and then entered in a Microsoft excel sheet, to be later imported into Stata version 14 for statistical analysis. A descriptive statistic with frequencies and summary statistics (mean, standard deviation, and percentage) were performed to explore the distribution of considered variables among study participants. Variables with P-value <0.05 in the bivariate analysis were transferred to multivariate analysis to control all possible confounders statistically. Multiple logistic regressions were done to identify an association between independents (predictors) and dependent variables. The decision to determine the statistically significant association was based on the adjusted odds ratios, 95% confidence interval and P-value ≤ 0.05(alpha).

Data Dissemination

This study will be shared with Rwanda Ministry of Health through RBC as well as Nyabihu district authorities to inform their decision-making towards stunting eradication interventions.

Results

Social –Demographic Characteristics of Study Participants Table 1 shows that a total of 402 children participated in this study and that both study groups were distributed quite similar in terms of demographic characteristics. The majority of children (62.6 %) were aged between 6-23 months with a mean age of 22 months (12.8 ± SD). Out of 402 mothers the study, 191 (47.6%) were between 30-39 years old, 34.5 % didn't attend any school, 78.9% were farmers, and 73.4% were in Ubudehe category two.

Table 1: Social-Demographic Characteristic (N=402)

Variables	Cases	Controls	Total
	n (%)	n (%)	N (%)
Residence			
Urban	0 (0)	6 (2.2)	2 (0.5)
Rural	136 (100)	260 (97.8)	400 (99.5)
Child's Sex			
Male	80 (58.8)	147 (55.2)	227 (56.5)
Female	56 (41.2)	119 (44.8)	175 (43.5)
Child's Age			
6-23 Months	83 (61.0)	169 (63.5))	252 (62.6)
24-35 Months	33 (24.2)	54 (20.3)	87 (21.8))
36-59 Months	20 (14.8)	43 (16.2)	63 (15.6)
Mothers' Age			
< 20 Years	4 (3. 0)	6 (2.2)	10 (2.4)
20-29 Years	43 (31.7)	105 (39.5)	148 (36.9)
30-39 Years	67 (49.2)	124 (46.7)	191 (47.6)
> 40 Years	22 (16.1)	31(11.6)	53 (13.1)
Mother's Educational Level			
No education	53 (38.9)	86 (32.3)	139 (34.5)
Primary incomplete	18 (13.2)	44 (16.5)	62 (15.4)

Primary complete	40 (29.5)	71 (26.7)	111 (27.7)
Secondary incomplete	22 (15.5)	37(14)	58 (14.5)
Secondary complete or higher	4 (2.9)	28 (10.5)	32 (7.9)
Mothers' Marital Status			
Married	110 (80.9)	223 (83.8)	333 (82.9)
Divorced	3 (2.2)	7 (2.7)	10 (2.5)
Widower	14(10.2)	20 (7.5)	34 (8.4)
Never married	9 (6.7)	16 (6.0)	25 (6.2)
Mothers' Occupation			
Farmer	106 (77.9)	211(79.3)	317 (78.9)
Business	6 (4.5)	14 (5.2)	20 (4.9)
No job	22 (16.1)	33 (12.5)	55 (13.7)
Salaried	2 (1.5)	8 (3)	10 (2.5)
Ubudehe Category			
Cat 1	39 (28.7)	13 (4.8)	52 (13.0)
Cat 2	87 (63.9)	208 (78.3)	295 (73.4)
Cat 3	10 (7.4)	45 (16.9)	55 (13.6)
Child's caregiver			
Parent	38 (27.9)	137 (51.5)	175 (43.5)
Other	98 (72.1)	129 (48.5)	227 (56.5)

Respondent's Household Characteristics

The table 2 summarizes main participants' household characteristics. It shows that most of the participating households '(43.8%) earn less than 10,000 Frw per month and mostly from agriculture production, while 51.9% of participants' possess domestic animals and 68.4 % had kitchen gardens

Table 2: Respondent's Household Characteristics

Variables (n=402)	Cases	Controls	Total
	n (%)	n (%)	N (%)
Number of Under 5 Children			
1	11 (8.0)	44 (16.5)	55 (13.7)
2	88 (64.8)	147 (55.2)	235 (58.5)
3	37 (27.2)	75 (28.3)	112 (27.9)
Household Size			
<4 Person	75 (55.2)	150 (56.4)	225 (55.9)
>=4 Person	61 (44.8)	116 (43.6)	177 (44.1)
Estimated Monthly Income			
< 10000 Frw	61 (44.8)	115 (43.3)	176 (43.8)
10,000-50,000 Frw	44 (32.4)	82 (30.8)	126 (31.4)
> 50,000 Frw	31 (22.8)	69 (25.9)	100 (24.8)
Distance to market			
Long	55 (40.4)	112 (42.2)	167 (41.5)
Medium	47 (34.5)	85 (31.9)	132 (32.8)
Short	34 (25.0)	69 (25.9)	103 (25.6)
Agricultural Production use			
Household diet	32 (23.5)	133 (50.0)	165 (41.0)
Selling	104 (64.5)	133 (50.0)	237 (59.0)
Agricultural Production use			
Yes	64 (47.0)	117 (43.9)	181 (45.1)

No	72 (53.0)	149 (56.1)	221 (54.9)
Using Own Money			
Yes	37 (27.1)	67 (25.1)	104 (25.9)
No	99 (72.8)	199 (74.9)	298 (74.1)
Having own cultivate land			
Yes	75 (55.1)	127 (47.7)	202 (50.2)
No	61 (44.8)	139 (52.2)	200 (49.8)
Having domestics animals			
Yes	71 (52.2)	137 (51.5)	208 (51.8)
No	65 (47.8)	129 (48.5)	194 (48.2)
Having a kitchen garden			
Yes	93 (68.3)	182 (68.4)	275 (68.4)
No	43 (31.7)	84 (31.5)	127 (31.5)

Environment, Water, Sanitation and Hygiene (Wash) Characteristics

The current study found that only 43.5% of the participants have easy access to water sources, 62.6 % and, 53.2 % use treated drink water and wash their hands before feeding respectively. The results also show that 65.2 % % of participating households use pit latrine as toilette (Table 3).

Table 3: Water, Sanitation and Hygiene (Wash) Characteristics

Variables (N=402)	Cases	Controls	Total
	n (%)	n (%)	N (%)
Distance to water source			
Short	30 (22.0)	65 (24.5)	95 (23.6)
Medium	49 (36.0)	83 (31.2)	132 (32.9)
Long	57 (42.0)	118 (44.3)	175 (43.5)
Types of toilets at home			
Flush toilet	19 (14.0)	26 (9.8)	45 (11.2)
Pit latrine	83 (61.0)	179 (67.3)	262 (65.2)
Unimproved Latrine	34 (25.0)	61 (22.9)	95 (23.7)
Treatment drinking water			
Yes	76 (55.8)	176 (66.2)	252 (62.6)
No	60 (44.2)	90 (33.8)	150 (37.4)
Washing hands before feeding child			
Yes	31 (22.7)	183(68.8)	214 (53.2)
No	105 (77.3)	83(31.2)	188 (46.8)
Area mainly affected by Disaster (like heavy rains, floods..)			
Yes	59 (43.3)	131 (49.2)	190 (47.3)
No	77 (56.7)	135 (50.8)	212 (52.7)

Feeding Practices Applied by Caregivers to the Child Aged 6-59 Months

The study findings show that out of 402 mothers 87.3% had breastfed their children within one hour after birth; 72.2 % started complementary feeding at 6 months, and 43.6% children were breastfed at least 3 times per day. In addition to that, most of the children ate different food groups such as grain root and tubers (75.1%), beans, (77.3%), milk products (32.4%), eggs and vegetables at 20.9% and 84.8% respectively within the last 2 weeks before the study (Table 4).

Table 4: Feeding Practices Applied by Caregivers to the Child Aged 6-59 Months

Table 5:Clinical Characteristics of Respondents	Cases	Controls	Total
	n (%)	n (%)	N= (%)
Feeding child other things after birth			
Yes	27 (19.8)	36 (13.5)	63 (15.7)
No	109 (80.2)	230 (86.4)	339 (84.3)
Early initiation of breastfeeding within 1 hour			
Yes	119 (87.5)	232 (87.2)	351 (87.3)
No	17 (12.5)	34 (12.8)	51 (12.7)
Child is still breastfed			
Yes	101 (74.2)	223 (83.9)	324 (80.6)
No	35 (25.8)	43 (16.1)	78 (19.4)
Starting complementary feed			
Less than 6 months	27 (19.9)	34 (12.7)	61 (15.1)
At 6 months	92 (67.6)	198 (74.4)	290 (72.2)
At 7 months	16 (11.8)	34 (12.8)	50 (12.4)
At 8 months	1 (0.7)	0(0.0)	1 (0.2)
Meal frequency			
Once per day	15 (11)	25 (9.5)	40 (9.9)
Twice per day	43 (31.6)	85 (31.9)	128 (31.9)
Thrice per day	61 (44.9)	114 (42.9)	175 (43.6)
4 times per day	17 (12.5)	42 (15.7)	59 (14.6)
Child had eaten grain root and tubers in last two weeks			
Yes	101 (74.2)	201 (75.5)	302 (75.1)
No	35 (25.8)	65 (24.5)	100 (24.9)
Child had eaten grain root and tubers in last two weeks			
Yes	101 (74.2)	201 (75.5)	302 (75.1)
No	35 (25.8)	65 (24.5)	100 (24.9)
Child had eaten milk curd, cheese, and other milk products in last two weeks			
Yes	48 (35.3)	82 (30.8)	130 (32.4)
No	88 (64.7)	184 (69.2)	272 (67.6)
Child had eaten eggs and meats in last 2 weeks			
Yes	29 (21.3)	55 (20.6)	84 (20.9)
No	107 (78.7)	211 (79.4)	318 (90.1)
Child had taken vitamin A rich fruits and vegetables in last two weeks			
Yes	108 (79.4)	233 (87.5)	341 (84.8)
No	28 (20.6)	33 (12.5)	61 (15.2)

Clinical Features Among Children Between 6 To 59 Months

Table 5 shows that 253 out of 402 of mother's (63%) had their body mass index in normal range, 96% attended antenatal care visits and majority of them had at least four visits. The same table shows that the majority study participating children (402) 79.6% received required Child's vaccinations, 67% received Vitamin A. However only 53.6 received deworming tablets (Table 5).

Table 5: Clinical Characteristics of Respondents

Variables (n=402)	Cases	Controls	Total
	n= (%)	n= (%)	N= (%)
Mother's BMI			
Underweight	8 (5.9)	6 (2.3)	14 (3.5)
Normal	84 (61.7)	169 (63.6)	253 (63.x)
Overweight	40 (29.5)	84 ((31.5)	124 (30.8)

Obesity	4 (2.9)	7 (2.6)	11 (2.7)
Attending ANC			
Yes	124 (91.2)	262 (98.5)	386 (96.0)
No	12 (8.8)	4 (1.5)	16 (4.0)
ANC Visits attended			
1 visit	11 (8.x)	21 (7.9)	32 (7.9)
2-3 visits	41 (30.3)	68 (25.6)	109 (27.2)
4 visits and above	84 (61.7)	177 (66.5)	261 (64.9)
Receiving required child Vaccinations			
Yes	110 (80.8)	210 (79)	320 (79.6)
No	26 (19.2)	56 (21)	82 (20.4)
Child's Sickness in 2weeks			
Yes	57 (42.0)	96 (36)	153 (38)
No	79 (58.0)	170(67)	249 (62)
Vit A for children in last 6 months			
Yes	98 (72)	171 (64.3)	269 (67)
No	38 (28)	95 (35.7)	133 (33)
Receiving deworming tablets in last six months			
Yes	88 (64.7)	127 (47.6)	215 (53.6)
No	48 (35.3)	139 (52.2)	187 (46.5)
Attending vaccination in campaign			
Yes	55 (40.5)	79 (29.7)	134 (33.4)
No	81 (59.5)	187 (70.3)	268 (66.6)
Ever Smoke for Mothers			
Yes	10 (7.3)	14 (5.3)	24 (6.0)
No	126 (92.4)	252 (94.7)	378(94)
Reduced child's Appetite			
Yes	65 (47.8)	120 (45.2)	185 (46)
No	71 (52.2)	146 (54.8)	217 (54)

Factors Associated with Stunting Among 6-59 Children in Nyabihu District

After controlling some confounders in multivariable logistic regression, the following factors were significantly associated with study child's stunting: Mothers who are in Ubudehe cat 1 were 11.1 times more likely to have stunted children compared to those who were in other categories (AOR 11.1; 95% CI 4.3–8.4), Children whose caregivers were not their parents had around 4 times more likely to be stunted compared to others (AOR 3.8; 95% CI 2-7.4) and Children aged 6-59 months from families with 2 under-five had 5 times more likely to be stunted than those who had 1 under-five child (AOR 5; 95% CI 1.5–6.2), Those who mostly used to sell agriculture products had 4.3 times more likely to have stunted children compared to those who used them for home consumption (AOR 4.3; 95% CI 2.3–7.9), Mothers who don't treat drinking water were 8 times more likely to have stunted children than those who treat drinking water (AOR 2.4; 95% CI 1.3- 4.5), Those who use to wash hands before child care were protected to stunting on 90% than those who wash their hands (AOR 0.08; 95% CI 0.04- 0.1), Mothers who did not attend ANC had 8 times more likely to have stunted children (AOR 8; 95% CI 1.8– 4.7), Children whose Mothers attended mass vaccination campaigns were protected to stunting on 66% than those who didn't attended the campaigns (AOR 0.34; 95%CI 0.1–0.6).

Table 6: Multivariable Logistic Regression Analysis Showing Stunting Determinants Among 6 To 59 Months' Children in Nyabihu District

Independent variables (N=402)				Bivariate			p-value	Multivariable			p-value
				COR	95% CI			AOR	95% CI		
		Cases	Controls		Lower	Upper			Lower	Upper	
Ubudehe Category											
	Cat 2	39 (28.7)	13 (4.8)	1							
	Cat 1	87(63.9)	208 (78.3)	7.1	3.6	14.09	P<0.001	11.1	4.3	8.4	P<0.001

	Cat 3	10 (7.4)	45 (16.9)	0.5	0.2	1.1	0.089	0.9	0.3	2.3	0.9
Child's caregiver											
Parental		38(27.9)	137(51.5)	1							
Non-parental		98(72.1)	129 (48.5)	2.7	1.7	4.2	P<0.001	3.8	2	7.4	P<0.001
# of under 5 children											
	1	11(8)	44 (16.5)	1							
	2	88(64.8)	147(55.2)	2.3	1.1	4.8	0.01	3	1.05	8.6	0.04
	3	37(27.2)	75(28.3)	1.9	0.9	4.2	0.08	5	1.5	6.2	0.006
Child is still breastfeeding											
	Yes	101(74.2)	223(83.9)	0.5	0.3	0.9	0.02	0.7	0.3	1.6	0.6
	No	35(25.8)	43(16.1)	1							
Agriculture Production use											
Household diet		32 (23.5)	133(50)	1							
Mostly Selling		104(64.5)	133(50)	3.2	2	5.1	P<0.001	4.3	2.3	7.9	P<0.001
Treatment of drinking water											
	Yes	76(55.8)	176(66.2)	1							
	No	60(44.2)	90(33.8)	1.5	1	2.3	0.04	2.4	1.3	4.5	0.003
Child had taken vitamin A in last 2 weeks											
	Yes	108(79.4)	233(87.5)	1							
	No	28 (20.6)	33(12.5)	1.8	1.05	3.1	0.03	0.7	0.3	1.7	0.7
Attending ANC											
	Yes	124 (91.2)	262(98.5)	1							
	No	12 (8.8)	4(1.5)	6.3	2	20	0.002	8	1.8	4.7	0.005
Washing hands											
	No	31(22.7)	183 (68.8)	1							
	Yes	105(77.3)	83(31.2)	1.3	0.08	0.2	<0.001	0.08	0.04	0.1	P<0.001
Attending Vaccination campaigns											
	No	55(40.5)	79(29.7)	1							
	Yes	81(59.5)	187(70.3)	0.6	0.4	0.9	0.03	0.34	0.1	0.6	0.002

Discussion

This case control study involved 402 children aged between 6 to 59 months, among whom stunting remains to be public health problem in Rwanda. Ubudehe categories, having two or more under-five children in the family, caregivers' washing hands before feeding their children, treating drinking water, attending ANC visits, child caregiver, attending mass vaccination and nutrition campaigns and selling agriculture production were statistically significant correlates of child stunting. Households in lower Ubudehe category were more likely to have stunted children than those in other wealth indexes. This is consistent with results from a cross sectional study conducted in 2015 in over the country, Rwanda [9]. This might be due to inadequate financial resources to provide an adequate balanced diet; poor households have reportedly been food insecure, which is a known risk factor of stunting. Previous study revealed that children in food-insecure households were more likely to be stunted than children in food-secure households [20, 21]. In support of those findings, our study, found that most of the study respondents sold agriculture production than using it for household consumption, and it affects stunting in 43%. The explanation for this is that selling food reduces the availability and diversity of foods in the household [22].

The current study revealed that an increase in the number of under-five children in a household affects significantly a child's growth. This finding is similar to the cross-sectional study done in Burundi where Being in a household with more than two under five years' children was associated with a high risk of stunting than being in a household with one or two under five years' children [11]. Our results corroborate with those on several studies conducted in developing countries [11, 23].

In Rwanda, mass vaccination and nutrition campaigns are conducted twice per year; and as a result of the study, those who attend those mass campaigns were protected from stunting. Our finding is also similar to that from a study conducted in Kenya where children without up-to-date vaccinations were more than twice as likely to be stunted than children who were with up-to-date vaccinations (OR = 2.63, 95%CI, 1.16–5.98) (24). The mechanism by which vaccination protects children from stunting might be related to reduce morbidity among vaccinated children especially due to vaccine preventable infectious diseases.

Our study found children whose home care is provided by people other than parents to be more likely prone o-9b1`stunting compared to those caregivers were their parents. The explanations for this might be due to more care that might be provided

by parents compared to caregivers. This is supported by a study conducted in Ethiopia found that teenage caregivers were more likely to have inadequate knowledge and experience in child feeding and care practices which was associated with a higher rate of stunting [11].

Washing hands before child feeding, and treating drinking water has been found to be positively associated with child stunting; those who didn't treat drinking water had 2.5 times the odds of having stunted children compared to those who treat water; Also for the mothers, washing hands before child feeding found to be protective for child stunting at 8 %, this shows some similarities to many studies which indicated that non-improved toilet facility together with poor stool disposal system; This indicates that Drinking untreated water, poor hand hygiene and sanitation, in general, exposes children to pathogens due to the higher possibility of contamination with human and animal feces, leading to diarrhea/infections, in that case, their body loses nutrients and fluids that are essential for growth and development, and loose appetite which ultimately results in under nutrition and morbidity among children [12].

Surprisingly our study didn't show the significance of stunting with child age group compared to other different studies conducted in the East African communities. This might be due to the use of cross-sectional study designs and a big sample size while our study was a case-control study design [11, 22].

Attending ANC visits also contribute significantly to child stunting where children's mothers who didn't attend ANC visits were 8 times more likely to have stunted children than those who attended. This finding is in line with the finding from the Indonesia study results [12]. The explanation is that attending ANC visits give women the chance to get information on nutrition during pregnancy, breastfeeding and childhood.

Strengths of The Study

Representative sample size was used which makes our findings precise and reliable.

More variables regarding socio-demographics, household characteristics, feeding practices, water, hygiene and sanitation, and clinical features were collected than in previous studies.

Limitations of The Study

Our study had limitation related its retro prospective, there may be a recall bias since it is a relatively long period; some information may not be remembered nature requiring respondent to go back in their past, which is known as recall bias. To minimize that, we limited our questions only to two weeks back.

Another limitation is that we were not able to collect the community, societal factors, political-economic factors which are known to affect significantly the child's growth.

Ethics Approval and Consent to Participate

The Institutional Review Board (IRB) of the University of Rwanda, College of Medicine Health Science reviewed and approved the study and its implementation (Ref N0: CMHS/IRB/120/2023) and authorized by Shyira district hospital through its ethical committee. A written signed informed consent form was obtained from each mother /caregiver before enrolling to the study. In addition, each potential participant was granted confidentially of the provided information as well as a right to voluntary participation to the study with freedom to withdraw without at any time.

Consent for Publication

Not applicable

Availability of Data and Materials

The datasets used and/ or analyzed during the current study are available from the corresponding author on reasonable request.

Competing of Interest

The authors declared that we no competing interests regarding the publication of this paper.

Funding Declaration

I will be self-sponsored

Authors contributions

All authors have contributed to this study. IHE Contributed to the beginning and design of the study, protocol preparation and search articles and data collection; conducted all analysis and data interpretation; drafted the manuscripts; and represented as corresponding author. FM and EM Contributed to the study design, reviewing and revising the manuscript, provide different comments, editing the manuscript and approving the manuscript. All authors read and approved the final manuscript.

Authors' information

Not applicable

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