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Original Article

Caregivers' Hygiene Practices and the Occurrence of Diarrhea Among Children Under Five Years in Nyabihu District, Rwanda

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Abstract

Diarrheal diseases continue to be a public health issue in developing countries, especially in Sub-Saharan Africa. In Rwanda, diarrheal diseases continue to be among the top ten leading causes of mortality and morbidity for children under 5 years. This is despite the efforts made by the Government of Rwanda including availing water and sanitation from 74% to 84%. The prevalence of diarrhea among children under five years is reported as 12% in Rwanda. This study was therefore, aimed to determine care givers'hygiene practices and diarrhea occurrence among children less than five years in Nyabihu district. A cross- sectional study design was conducted targeting all children below the age of five residing in Nyabihu district. The total sample size was 384 children less than 5 years and was selected using a multistage sampling technique. The data was collected using a questionnaire. Descriptive statistics including frequency and percentages were computed. In the bivariate analysis, Chi-square (χ^2) was used to assess the factors associated with diarrhea. Then at multivariate analysis, multiple logistic regressions were performed to determine strengths of the associations. Inference was made using a 95% confidence interval and a p-value < 0.05. The basic characteristics of the children show that more than half (57.0%) were aged between 12 to 23 months with slightly more female children (53.3%) than their male counterparts (46.7%). Regarding the level of hygiene practices about half (52.1%) scored optimum or high level of hygiene while about one tenth (12.0%) had low level of hygiene practices. The occurrence of diarrhea among children was 13.2% (95% CI = 9.8 - 17.2%). After performing multivariate analysis the following factors were significantly associated with diarrhea occurrence: children whose parents/caregivers with primary level of education [AOR; 2.45; 95%CI = 1.07-5.61; p value = 0.034] than secondary school; children staying with their relatives [AOR; 7.24; 95%CI = 2.93-17.90; p value <0.001] than their parents; children using water from temporary source of water [AOR; 6.63; 95%CI = 2.72-16.15; p value <0.001] than borehole; borehole and

children with low level of hygiene practices [AOR; 8.68; 95%CI= 2.60-28.94; p value <0.001] than with optimum level of hygiene practices. The study concluded that the level of high hygiene practices was moderate and the occurrence of diarrhea among children was relatively high.

Keywords: Caregiver hygiene practices; Childhood diarrhea; Children under five; Water, sanitation and hygiene (WASH); Rwanda

Introduction

Diarrheal illnesses continue to represent a major threat to child survival worldwide, particularly among children younger than five years. Globally, these infections account for billions of episodes each year and are responsible for an estimated two million deaths, with the greatest burden occurring in early childhood (Grimwood & Chb, 2020). Although substantial progress has been made in reducing preventable child deaths, diarrhea remains one of the most persistent causes of morbidity and mortality in this age group. According to recent estimates from the World Health Organization, diarrheal diseases contribute to approximately one in every ten deaths among children under five, highlighting the ongoing need for effective and sustainable prevention strategies (WHO, 2022). The impact of diarrheal diseases is particularly pronounced in Sub-Saharan Africa (SSA), where structural inequalities, poverty, and environmental challenges continue to undermine child health outcomes. In many SSA countries, limited access to safe drinking water, inadequate sanitation facilities, and suboptimal hygiene practices create conditions that facilitate the transmission of diarrheal pathogens. Despite improvements in health infrastructure, these underlying determinants have slowed progress in reducing diarrhea prevalence, especially in rural and economically disadvantaged communities.

Within the East African region, diarrheal diseases remain a significant public health concern in countries such as Kenya, Uganda, Tanzania, Burundi, and Rwanda. Evidence from Kenya indicates that improvements in water supply and sanitation coverage have not been sufficient to eliminate high rates of childhood diarrhea, particularly among households with low socioeconomic status (Wanyama et al., 2021). Comparable patterns have been observed in Uganda and Tanzania, where environmental exposure, household behaviors, and income disparities continue to drive the persistence of diarrheal diseases among young children. Caregiver-related practices have emerged as critical factors influencing the occurrence of diarrhea in early childhood. Studies have consistently demonstrated that inadequate hand hygiene, unsafe food preparation, and poor household sanitation substantially increase the likelihood of diarrheal illness among children under five (Odoi-Ahene et al., 2022). In Tanzania, research has shown that children living in households lacking adequate sanitation infrastructure face a markedly higher risk of diarrhea, underscoring the importance of integrated hygiene and sanitation interventions (Mbuya et al., 2023). In addition, child undernutrition intensifies the burden of diarrhea by weakening immune defenses,

while repeated diarrheal episodes further compromise nutritional status. This bidirectional relationship has been well documented, particularly in low-resource settings, where malnourished children experience more severe and recurrent diarrheal infections (Mwenda et al., 2021). Across Sub-Saharan Africa, diarrhea disproportionately affects children during the first two years of life a period characterized by dietary transitions, increased environmental exposure, and immature immune systems. Evidence from Burundi demonstrates that targeted caregiver education focusing on child feeding and hygiene practices can significantly reduce diarrhea prevalence in this vulnerable age group (Niyonzima et al., 2021). These findings emphasize the importance of interventions that address age-specific risks during early childhood.

At the national level, Rwanda has made notable investments in child health through improvements in water, sanitation, and hygiene (WASH) infrastructure and the expansion of community-based health services. National coverage of improved water and sanitation has increased from approximately 74% to 84%, reflecting substantial government commitment to public health development (NISR, 2021). Community Health Workers (CHWs) play a pivotal role in Rwanda's healthcare system by promoting hygiene practices, identifying diarrheal cases early, and facilitating timely treatment, thereby reducing the risk of severe outcomes (Haver et al., 2022). In parallel, the integration of rotavirus vaccination into the national immunization program has contributed to declines in diarrhea-related hospital admissions and deaths among young children (Nguyen et al., 2022).

Despite these advancements, diarrheal diseases continue to impose a significant burden on child health in Rwanda. National survey data indicate that approximately 12% of children under five experience diarrhea within a given reference period, and the condition remains among the leading causes of childhood illness and death (NISR, 2021; MoH, 2023). While such national-level data provide valuable prevalence estimates, they offer limited insight into household-level behaviors and contextual factors that influence diarrhea risk, particularly in districts with persistently high disease burden. Nyabihu District, located in Rwanda's Western Province, is one such area where diarrheal diseases remain a public health concern among children under five. Factors including rural living conditions, reliance on temporary or unsafe water sources, and variability in caregiver hygiene practices may contribute to the observed burden. However, empirical evidence examining how caregiver hygiene behaviors influence diarrhea occurrence at the district level is scarce. Accordingly, this study seeks to assess the relationship between caregiver hygiene practices and the occurrence of diarrhea among children under five years of age in Nyabihu District, Rwanda. By situating the analysis within a global, regional, national, and local framework, the study aims to generate context-specific evidence that can guide targeted public health interventions and support ongoing efforts to reduce the burden of childhood diarrheal diseases

Methods

Study design

A cross-sectional study using quantitative data collection approach was used. A structured questionnaire was used to collect quantitative data. The design was chosen since it meant to determine food hygiene practices and diarrhea occurrence among under five children in Nyabihu district.

Study Setting

The study was conducted in Nyabihu district. In addition, Nyabihu District occupy 532 km^2 in Western Province, has its capital in Mukamira, with 12 sectors (imirenge): Bigogwe, Jenda, Jomba, Kabatwa, Karago, Kintobo, Mukamira, Muringa, Rambura, Rugera, Rurembo and Shyira. The resident population of Nyabihu district is 330,000 of whom 157,000 are males and females 173,000. The district counts 65,855 households.

Study Participants

The study targeted all the children below the age of five residing in Nyabihu district. Since the study targeted child caregivers as respondents the target population will be 65,855 households in the area. The child caregiver was however anyone who was responsible for the child at the time of the study in that household and could have been the mother, father, house helper or any other person.

Sampling size

Sampling in research is the process of obtaining information about an entire population by examining only a part of it (Kothari, 2003). It serves the purpose of saving time and other resources and yet produces the required results. This happens by the researcher drawing inferences based on samples about the parameters of population from which the samples are taken. In this research, the sample size of 384 study participants was used as it was determined using the formula by Fisher et al., (1998). Since no similar study has been done in the region, a P of 0.5 was used to estimate sample size so as to give maximum variability for this study.

Research instrument and variables

The data was collected using a pretested semi-structured questionnaire which was in English and translated to Kinyarwanda. It was administered to the study participants with the help of 3 trained research assistants and the principal investigator. Fifteen minutes was used to administer the questionnaire. In this study, food hygiene practice level was determined through scoring of different activities regarding hygiene performed by the study participants.

Data analysis Procedures

Raw data from the questionnaire was entered into EPI data and transported into SPSS version 20 for analysis. Descriptive statistics was used to tabulate and describe the data and Bivariate analysis to assess the association between independent and dependent categorical variables was carried out using Chi square (X2). The strengths of the associations were determined with multiple logistic regressions. Inference was made using a 95% confidence interval and a p-value < 0.05. The results were presented in frequency, cross tabulation tables, and pie charts.

Results

Socio-demo and economic characteristics of the children and parents/caregivers.

Majority 199(57.0%) of the children participated in the study were aged between 12 to 23 months while there were only 36(10.3%) aged 24 months and above. Female children were slightly more 186(53.3%) than those male children 163(46.7%). Regarding the age of parents/caregivers, large percentage 314(90.0%) was within the age group of 18 to 27 years and most of them were married 307(88.0%. All the parents/caregivers were educated and majority 232(66.5%) of them attended secondary level of education whereas the remaining 117(33.5%) attained primary education. More than half 185(53.0%) of the parents/caregivers were parents and 164(47.0%) were relatives to the children participated in the study. The monthly income of the parents/caregivers was examined and most 203(58.2%) indicated 50001 to 100,000 RWF. In terms of drinking source of water, most 243(69.6%) were using borehole. As expected large percentage 270 (77.4%) had pit latrine (table.1).

Table1. Socio-demographic and economic characteristics of the children and parents/caregivers.

Characteristics	Frequency	Percent
Age of the child		
< 12 months	114	32.7
12 - 23 months	199	57
≤ 24 months	36	10.3
Sex of the child		
Male	163	46.7
Female	186	53.3
Age of the parents/caregivers		

18-27 years	314	90.0
28-37 years	35	10.0
Marital status of the parents/caregivers		
Married	307	88.0
Single	42	12.0
Level of education of the parents/caregivers		
Primary	117	33.5
Secondary	232	66.5
Relationship with child		
Mother/ Father	185	53.0
Relatives	164	47.0
Monthly income in Rwandan Franc (RWF)		
50,000 RWF and below	146	41.8
50001 to 100,000 RWF	203	58.2
Source of water		
Borehole	243	69.6
Temporary storage	106	30.4
Type of toilet		
Open (bush) defecation	47	13.5
Pit latrine	270	77.4
Flush toilet	32	9.2

Source: Primary Data

Level of hygiene practices of caregivers/parents with children less than five years.

As indicated, about half of the observed toilets were very clean 187(53.6%) while 30(8.6%) of them were dirty and 47(13.5%) did not have any kind of toilet who were using open defecation. Most of the households 201(57.6%) were putting the solid waste on the ground within their compound without covering. Regarding hand washing, majority 232(66.5%) were not washing their hands after using toilets. About one fifth 76(21.8%) reported that they were not washing their hands before and after cooking food. Big percentage 295(84.5%) claimed that they used to treat the water before drinking. Almost all 335(96.0%) of the water container were covered by a lid properly. About three quarter 260(74.5%) had hand washing facilities with water and soap. Most 302(86.5%) of the receptacles used to draw or hold water were clean. However, large percentage 321(92.0%)

indicated that they don‘t warm food again to keep hot before eaten (table.2).

Table2. Level of hygiene practices of caregivers/parents with children less than five years.

Variables	Frequency	Percent
Sanitary state of toilet (observed)		
Very Clean	187	53.6
Clean	85	24.4
Dirty	30	8.6
Open defecation	47	13.5
Storing solid waste in the plot (observed)		
Placed on the ground	201	57.6
Contained and covered in a bin	62	17.8
Contained in polythene bag	86	24.6
Always wash hands after visiting the toilet		
Yes	117	33.5
No	232	66.5
Always wash hands before and after cooking		
Yes	273	78.2
No	76	21.8
Treating water before use		
Yes	295	84.5
No	54	15.5
Continued Table 4.2		
Water container covered with lid (observed)		
Yes	335	96.0
No	14	4.0
Have hand washing facilities with a supply of water and soap (observed)		
Yes	260	74.5
No	89	25.5
Sanitary state of the receptacles used to draw water from the container (observed)		

Clean	302	86.5
Dirty	47	13.5
Warming any food to keep hot before eaten		
Yes	28	8.0
No	321	92.0

Source: Primary data.

The overall score of hygiene practices was determined using the 9 parameters of different variables presented in Table 2. The structure of the scoring system is demonstrated in figure 1 with the total score of 10 and possible minimum score was 0. Those who scored 80.0% and above were classified as having optimum hygiene practices, those who score between 50.0% and 79.0% were grouped as moderate level of hygiene practices and those with less than 50.0% were categorized as having low level of hygiene practices

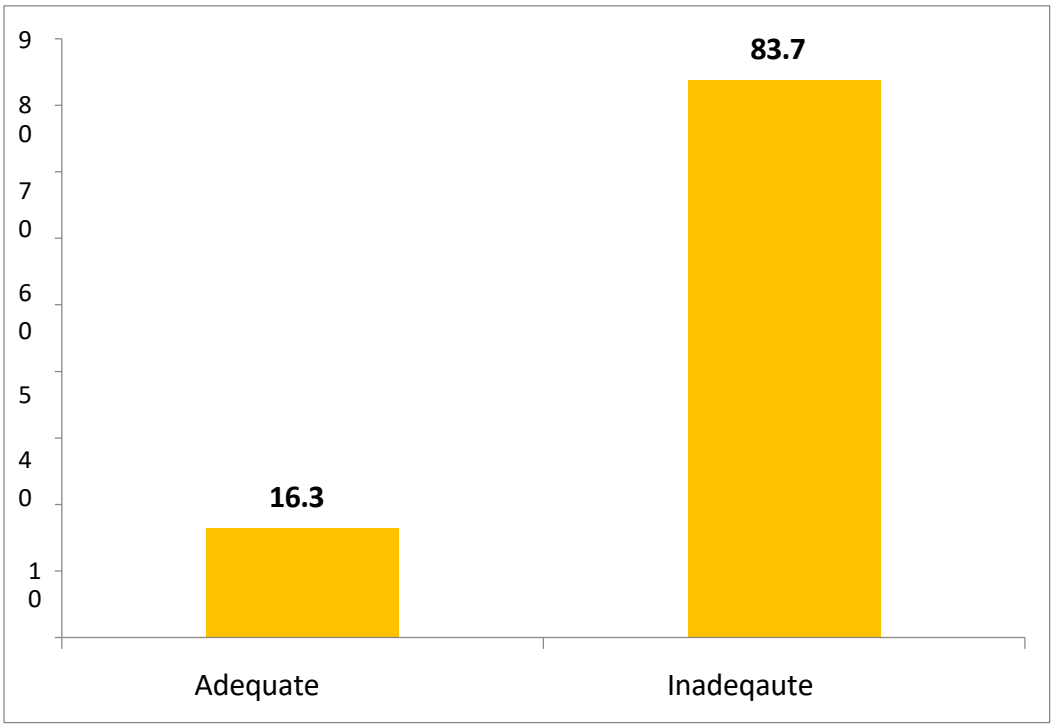

Figure 1: Level of hygiene practices.

Occurrence of diarrhea among children less than five years.

The second objective was to investigate the prevalence of diarrhea among children in the last one month from data collection. Within a total sample size of 349 participants, diarrhea was reported in 46 cases,

corresponding to 13.2% of the population. In contrast, 338 individuals, or 86.8%, reported no occurrence of diarrhea. The data also provides a 95% confidence interval ranging from 9.8% to 17.2%. This confidence interval indicates that if this study were replicated multiple times, 95% of the time, the true prevalence of diarrhea within the population would likely fall between these two percentages. These findings underscore the importance of addressing diarrhea as a public health concern, particularly considering the significant proportion of the population affected (table 3).

Table 3. Occurrence of diarrhea among children less than five year

Diarrhea Status	Number of Cases (Frequency)	Percentage (%)
Occurrence	46	13.2
No Occurrence	303	86.8
Total	349	100
Confidence Interval	**9.8% - 17.2%**	

Source: Primary data.

Socio-demographic and economic factors associated with occurrence of diarrhea

Table 4, shows variations in diarrhea occurrence among children based on age. Among children aged 0-11 months, 6 out of 114 (5.3%) experienced diarrhea, while the majority, 108(94.7%), did not. For those aged 12-23 months, 35 of 199 children (17.6%) had diarrhea episodes, with 164 (82.4%) unaffected. In the 24-35-month group, 5 out of 36 children (13.9%) reported diarrhea, while 31 (86.1%) did not. The chi-square test result ($\chi^2 = 9.64$, df= 2, $p = 0.008$) indicates a significant relationship between child age and diarrhea occurrence, with the highest prevalence among those aged 12-23 months. In terms of gender, diarrhea affected 21 out of 163 males (12.9%) and 25 out of 186 females (13.4%), with 142 (87.1%) and 161 (86.6%) remaining unaffected, respectively. The chi-square analysis ($\chi^2 = 0.02$, df = 1, $p = 0.878$) suggests no statistically significant difference in diarrhea rates between male and female children. The age of the caregiver also reveals differences in diarrhea cases among children. Among children of caregivers aged 18-27 years, 44 out of 314 (14%) had diarrhea, whereas 270 (86%) did not. For caregivers aged 28-37 years, 2 out of 35 children (5.7%) had diarrhea, while 33 (94.3%) were unaffected. However, the chi-square value ($\chi^2 = 1.90$, df = 1, $p = 0.169$) indicates no significant association between caregiver age and diarrhea occurrence among children. When examining marital status, 45 of the 307 children (14.7%) with married caregivers experienced diarrhea,

while 262 (85.3%) did not. Conversely, among children with single caregivers, only 1 out of 42 (2.4%) had diarrhea, with the remaining 41 (97.6%) unaffected. A chi-square test ($\chi^2 = 4.87$, df = 1, p = 0.027) shows a statistically significant link between caregiver marital status and diarrhea in children, with a higher occurrence among those cared for by married individuals. Education level among caregivers appears to impact diarrhea rates as well. Children whose caregivers completed primary school had a diarrhea occurrence of 22 out of 117 cases (18.8%), while 95 (81.2%) did not experience diarrhea. For caregivers with secondary education, 24 out of 232 children (10.3%) reported diarrhea, with 208 (89.7%) unaffected. The chi-square test ($\chi^2 = 4.86$, df = 1, p = 0.027) indicates a significant association, suggesting that children of caregivers with primary education face a higher rate of diarrhea. The relationship between the caregiver and the child is also notable. Among children cared for by parents, 11 out of 185 (5.9%) had diarrhea, whereas 174 (94.1%) did not. For those looked after by relatives, 35 out of 164 (21.3%) had diarrhea, while 129 (78.7%) were unaffected.

The chi-square test result ($\chi^2 = 18.01$, df = 1, $p < 0.001$) reveals a significant relationship, with higher diarrhea rates among children under the care of relatives. Household income levels similarly show an impact. In households earning 50,000 RWF or less per month, 12 out of 146 children (28.2%) experienced diarrhea, while 134 (91.8%) did not. For incomes ranging between 50,001 and 100,000 RWF, 34 out of 203 children (16.7%) had diarrhea, with 169 (83.3%) unaffected. The chi-square test ($\chi^2 = 5.40$, df = 1, p = 0.020) indicates a significant link, with higher diarrhea occurrences in lower-income households. Water source is another important factor. Among households using borehole or piped water, 19 of 243 children (7.8%) had diarrhea, with 224 (92.2%) unaffected. Conversely, households relying on temporary storage had 27 out of 106 children (25.5%) with diarrhea, and 79 (74.5%) without. The chi-square test ($\chi^2 = 20.10$, df = 1, $p < 0.001$) highlights a significant association, with higher diarrhea rates in households using temporary water storage. Lastly, the type of toilet facility used did not show a statistically significant link with diarrhea occurrence. In households practicing open defecation, 10 out of 47 children (21.3%) had diarrhea, while 37 (78.7%) did not. Households using pit latrines had a diarrhea occurrence of 32 out of 270 children (11.9%), with 238 (88.1%) unaffected. Among those with flush toilets, 4 out of 32 children (12.5%) had diarrhea, while 28 (87.5%) did not. The chi-square test ($\chi^2 = 3.12$, df = 2, p = 0.210) shows no statistically significant association between toilet type and diarrhea rates among children. In summary, significant factors related to diarrhea in this study include the child's age, marital status and education level of the caregiver, caregiver‘s relationship to the child, household income, and water source (table 4).

Table 4. Socio-demographic and economic factors associated with occurrence of diarrhea.

Variables	Diarrhea occurrence				Chi-square value	df	p value
	Yes		No				
	n	%	n	%			
Age of the child							
0 -11 Months	6	5.3	108	94.7	9.64	2	**0.008**
12 - 23 Months	35	17.6	164	82.4			
24 -35 Months	5	13.9	31	86.1			
Sex of the child							
Male	21	12.9	142	87.1	0.02	1	0.878
Female	25	13.4	161	86.6			
Age of the caregiver							
18-27 years	44	14.0	270	86.0	1.90	1	0.169
28-37 years	2	5.7	33	94.3			
Marital status of the caregiver							
Married	45	14.7	262	85.3	4.87	1	**0.027**
Single	1	2.4	41	97.6			
Level of education of the caregiver							
Primary	22	18.8	95	81.2	4.86	1	**0.027**
Secondary	24	10.3	208	89.7			
Relationship with child							
Parent	11	5.9	174	94.1	18.01	1	**<0.001**
Relative	35	21.3	129	78.7			
Monthly income caregiver							
50,000 RWF and below	12	28.2	134	91.8	5.40	1	**0.020**
50001 to 100,000 RWF	34	16.7	169	83.3			
Source of water							

Borehole/Pipe	19	7.8	224	92.2	20.10	1	**<0.001**
Temporary storage	27	25.5	79	74.5			
Type of toilet							
Open (bush) defecation	10	21.3	37	78.7	3.12	2	0.210
Pit latrine	32	11.9	238	88.1			
Flash toilet	4	12.5	28	87.5			

Source: Primary data.

Relationship between level of hygiene practices and occurrence of diarrhea.

Bivariate analysis was conducted to assess the association between the level of hygiene practices and occurrence of diarrhea among children and the data shows a distinct relationship between the level of hygiene practices among caregivers and the occurrence of diarrhea in children. In households where caregivers maintained optimum hygiene practices, only 7 out of 106 children (6.6%) experienced diarrhea, while a majority of 99 children (93.4%) remained unaffected. This suggests that an optimum level of hygiene may play a protective role in preventing diarrhea among children. In cases where caregivers practiced moderate hygiene, 24 out of 200 children (12.0%) had diarrhea, with 176 children (88.0%) unaffected. While this group showed a higher rate of diarrhea compared to those with optimum hygiene practices, the majority of children were still not impacted, which may indicate some level of protection

from moderate hygiene practices, though not as effective as optimum practices. The highest rate of diarrhea was found among children whose caregivers exhibited low levels of hygiene. In this group, 15 out of 43 children (34.9%) experienced diarrhea, while only 28 children (65.1%) were unaffected. This finding suggests that inadequate hygiene practices significantly increase the risk of diarrhea in children. The chi-square test ($\chi^2 = 21.95$, df = 2, $p < 0.001$) underscores a strong association between caregiver hygiene practices and the prevalence of diarrhea in children. The trend in this data highlights that as hygiene practices improve, the occurrence of diarrhea decreases, emphasizing the critical role of proper hygiene in child health (table.5).

Table 5. Relationship between level of hygiene practices and occurrence of diarrhea

	Diarrhea occurrence				
Variable	**Yes**	**No**	**Chi-square**	**df**	**p value**

							value
	N	**%**	**N**	**%**			
Level of hygiene practice							
Optimum	7	6.6	99	93.4	21.95	2	**<0.001**
Moderate	24	12.0	176	88.0			
Low	15	34.9	28	65.1			

Source: Primary data.

Multivariate analysis for the factors associated with occurrence of diarrhea.

To control the confounding a multivariate logistic regression was used among the variables significant at p value 0.05 during bivariate analysis. Thus, seven variables were subjected together in multivariate logistic regression using *Conditional Backward'* method and as indicated in Table 6, four variables predictors of diarrhea occurrence among children. The provided table analyzes the association between various variables and the Prevalence of diarrhea among children, showcasing both crude odds ratios (COR) and adjusted odds ratios (AOR), along with their respective confidence intervals (CI) and p-values. In terms of child age, the reference category is children aged 0-11 months. The findings reveal that children in the 12-23-month age bracket have a COR of 3.87 (95% CI: 1.57–9.50, p = 0.003), indicating they are nearly four times more likely to suffer from diarrhea compared to the reference group. Although the AOR for this age group is 5.28 (95% CI: 0.98–21.22, p = 0.057), suggesting a trend toward greater risk, it does not reach statistical significance at the conventional threshold. For children aged 24-35 months, the COR is 2.81 (95% CI: 0.81– 9.82, p = 0.105), and the AOR is 1.34 (95% CI: 0.38–4.78, p = 0.652), indicating no significant correlation with diarrhea occurrence. Regarding the marital status of the caregiver, those who are married exhibit a COR of 7.04 (95% CI: 0.95–52.49, p = 0.057) and an AOR of 7.46 (95% CI: 0.88–63.16, p = 0.065).

These figures imply that children of married caregivers may be at a higher risk for diarrhea, although these associations are not statistically significant. When examining the educational level of caregivers, those with primary education have a COR of 2.01 (95% CI: 1.07–3.76, p= 0.037) and an AOR of 2.45 (95% CI: 1.07–5.61, p = 0.034). This suggests that children whose caregivers possess only a primary education face more than double the likelihood of experiencing diarrhea compared to those whose

caregivers have completed secondary education. The relationship between caregiver and child significantly impacts diarrhea risk. Children cared for by relatives show a notably higher risk, with a COR of 9.49 (95% CI: 3.47–25.91, p < 0.001) and an AOR of 7.24 (95% CI: 2.93–17.90, p < 0.001). This finding indicates a strong association between being cared for by a relative and the likelihood of experiencing diarrhea. In terms of caregiver income, those earning between 50,001 and 100,000 RWF exhibit a COR of 2.47 (95% CI: 1.02–6.01, p = 0.046), alongside an AOR of 2.33 (95% CI: 0.92–5.31,p = 0.065). This suggests a potential link between this income range and an elevated risk of diarrhea among children, although the adjusted odds ratio is close to achieving significance. The source of water used by families reveals critical findings as well. Children relying on temporary water storage are associated with a significantly higher risk of diarrhea, reflected in a COR of 6.57 (95% CI: 2.40–18.02, p < 0.001) and an AOR of 6.63 (95% CI: 2.72–16.15,p < 0.001). This indicates a strong correlation between water source and diarrhea Prevalence. Finally, regarding hygiene practices, caregivers with moderate hygiene practices have a COR of 2.60 (95% CI: 0.85–8.01, p = 0.095) and an AOR of 2.80 (95% CI: 0.94–8.33, p = 0.063), suggesting a possible link to diarrhea occurrence, though not statistically significant. In contrast, low hygiene practices present a clear risk factor, with a COR of 9.01 (95% CI: 2.60–31.25, p = 0.001) and an AOR of 8.68 (95% CI: 2.60–28.94, p < 0.001). This Underscores the significant association between poor hygiene practices and the occurrence of diarrhea in children. Overall, the analysis highlights that several factors, including the age of the child, caregivers' relationship with the child, educational background, water source, and hygiene practices, significantly influence diarrhea rates in children. Addressing these elements is vital for improving child health outcomes and reducing the Prevalence of diarrhea (table.6).

Table 6. Multivariate analysis for the factors associated with occurrence of diarrhea

Variables	COR	95%CI		p value	AOR	95%CI		p value
		Lower	Upper			Lower	Upper	
Age of the child								
0 -11 Months	Ref				Ref			
12 - 23 Months	3.87	1.57	9.50	**0.003**	5.28	0.98	21.22	0.057
24 -35 Months	2.81	0.81	9.82	0.105	1.34	0.38	4.78	0.652
Marital status of the caregiver								

Married	7.04	0.95	52.49	0.057	7.46	0.88	63.16	0.065
Single	Ref				Ref			
Level of education of the caregiver								
Primary	2.01	1.07	3.76	**0.037**	2.45	1.07	5.61	**0.034**
Secondary	Ref				Ref			
Relationship with child								
Parent	Ref				Ref			
Relative	9.49	3.47	25.91	**<0.001**	7.24	2.93	17.90	**<0.001**
Monthly income caregiver								
50,000 RWF and below	Ref							
50001 to 100,000 RWF	2.47	1.02	6.01	**0.046**	2.33	0.92	5.31	0.065
Source of water								
Borehole/Pipe	Ref				Ref			
Temporary storage	6.57	2.40	18.02	**<0.001**	6.63	2.72	16.15	**<0.001**
Level of hygiene practice								
Optimum	Ref				Ref			
Moderate	2.60	0.85	8.01	0.095	2.80	0.94	8.33	0.063
Low	9.01	2.60	31.25	0.001	8.68	2.60	28.94	**<0.001**

AOR= Adjusted Odds Ratio; CI= Confidence Interval

Source: Primary data.

Discussion

Diarrheal illness remains one of the most persistent threats to child health in low-resource settings, particularly among children younger than five years. In this study, a diarrhea prevalence of 13.2% was observed among children in Nyabihu District, indicating a considerable public health burden. This level of occurrence is consistent with national estimates reported in Rwanda and confirms that diarrheal

diseases continue to affect a substantial proportion of young children despite ongoing investments in water, sanitation, and healthcare services (National Institute of Statistics of Rwanda [NISR], 2021).

Child age was identified as a critical determinant of diarrhea occurrence, with children aged 12–23 months experiencing a markedly higher risk compared with infants younger than one year. This age period corresponds with the transition to complementary feeding, which is often accompanied by increased exposure to contaminated food, water, and environments. In addition, the immune systems of children in this age group are still developing, making them more susceptible to enteric infections. Similar findings have been reported in other settings, where the post-weaning period has been recognized as a high-risk window for diarrheal diseases (Rosenberg et al., 2021). Caregiving arrangements were also strongly associated with childhood diarrhea in this study. Children cared for by relatives were significantly more likely to experience diarrhea than those under the care of their parents. This suggests that the caregiving context plays an important role in child health outcomes. Informal caregiving situations may involve inconsistent supervision, limited access to health information, or reduced engagement with health services, which can negatively affect hygiene practices and child care behaviors. Previous studies have similarly noted disparities in child health outcomes linked to caregiver characteristics and access to health education (Wang et al., 2019; NISR, 2021).

Caregiver education emerged as a key protective factor against childhood diarrhea. Children whose caregivers had attained only primary education faced a substantially higher risk of diarrhea compared with those whose caregivers had secondary education. Education enhances caregivers' ability to understand hygiene messages, adopt safe feeding practices, recognize early signs of illness, and seek timely medical care. This finding aligns with existing evidence demonstrating a strong association between caregiver education and improved child health outcomes, including reduced diarrheal morbidity (Adediran et al., 2022). Socioeconomic status also influenced diarrhea risk. Children from lower-income households were more likely to experience diarrheal episodes, reflecting the broader impact of poverty on child health. Limited financial resources can restrict access to safe drinking water, adequate sanitation facilities, nutritious food, and healthcare services, thereby increasing exposure to disease-causing pathogens. Similar associations between low household income and childhood diarrhea have been documented in other low- and middle-income settings (Khan et al., 2022; NISR, 2021).

The source and handling of drinking water were identified as important environmental determinants. Children living in households that relied on temporary water storage faced a significantly elevated risk

of diarrhea compared with those using borehole or piped water sources. Temporary storage increases the likelihood of contamination through unsafe containers, prolonged storage, and poor handling practices. Evidence from previous studies supports the link between unsafe water storage and increased transmission of waterborne pathogens (Bhaumik et al., 2020). Caregiver hygiene behavior demonstrated one of the strongest associations with diarrhea occurrence. Poor hygiene practices were linked to a markedly increased likelihood of diarrhea, underscoring hygiene as a highly modifiable risk factor. Inadequate handwashing, unsafe food preparation, and poor sanitation facilitate the transmission of enteric infections among young children. Effective hygiene practices have been consistently shown to reduce diarrheal disease burden in comparable settings (Hawes et al., 2021; NISR, 2021).

Several limitations should be considered when interpreting these findings. The cross-sectional design limits causal inference, as exposure and outcome were measured simultaneously. In addition, reliance on caregiver self-reports may have introduced recall and social desirability bias, potentially leading to underreporting of diarrhea episodes or overreporting of favorable hygiene behaviors. Hygiene practices were assessed primarily through interviews rather than continuous observation, which may not fully capture habitual behaviors. Furthermore, the study was conducted in a single district and did not account for seasonal variation in diarrhea prevalence, which may limit generalizability. Despite these limitations, the study provides important insights into the interconnected demographic, socioeconomic, environmental, and behavioral factors influencing childhood diarrhea. The findings emphasize the need for integrated public health strategies that combine caregiver education, hygiene promotion, safe water access, and socioeconomic support. Targeting high-risk age groups and strengthening community-based interventions may substantially reduce the burden of diarrheal diseases and improve child health outcomes in similar settings.

Conclusions

The results of this study reveal the complex interplay of various factors influencing the occurrence of diarrhea among children in Nyabihu District, Rwanda. With an observed Prevalence rate of 13.2%, it is clear that targeted interventions are necessary to address the risks associated with diarrheal diseases. Significant factors, including caregiver education, hygiene practices, water quality, and the nature of caregiver relationships, play a pivotal role in shaping child health outcomes. Addressing these determinants through comprehensive public health strategies is essential for reducing diarrhea rates and improving overall child health in the region. A multi-faceted approach that integrates education, hygiene promotion, access to safe water, and support for caregivers is vital for effectively tackling the

high rates of diarrhea among children under five. Lastly, the collaborative efforts of government agencies, NGOs, and community members will be critical in implementing these recommendations. By working together, stakeholders can achieve sustainable improvements in child health outcomes and significantly reduce the Prevalence of diarrhea in this vulnerable population.

Recommendations.

This study‘s findings lead to several actionable recommendations aimed at enhancing child health outcomes and curbing the Prevalence of diarrhea among children under five years in Nyabihu District, Rwanda. First, there is an urgent need to focus on caregiver education. Community-based educational initiatives should specifically target caregivers, especially those with only a primary education. These programs must emphasize the significance of proper hygiene practices, safe food handling, and recognizing early signs of diarrhea in children. Educating caregivers can significantly empower them to implement better health practices and seek timely medical assistance for their children. Next, promoting hygiene and sanitation practices within the community is essential. Public health campaigns should prioritize raising awareness about effective hygiene measures, including proper hand washing techniques and safe methods for storing drinking water.

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Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this article.

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