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Prevalence and associated factors of diarrhea among children under five years of age in the Western Province of Rwanda: analysis of the Rwanda Demographic and Health Survey (RDHS) 2019-2020

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Abstract

Introduction: *diarrhea is a leading cause of morbidity and mortality among children under five globally, especially in low-income countries. This study aimed to assess the prevalence and factors associated with diarrhea among children under five years in the Western Province of Rwanda using RDHS 2019-2020 data.* ***Methods:*** *a cross-sectional design was used to analyze data from 977 children under five. Bivariate and multivariate logistic regression analyses were performed using STATA 17 to identify significant socio-demographic and environmental factors associated with diarrhea.* ***Results:*** *the study found that the prevalence of diarrhea among children under five in the Western Province of Rwanda was 19%, higher than the national average of 14%. Age was a significant factor: children aged 0-5 months were less likely to have diarrhea (AOR=0.32, 95%CI: 0.14-0.76), while those aged 6-11 months (AOR=2.96, 95%CI: 1.83-4.80) and 12-23 months (AOR=2.35, 95%CI: 1.59-3.46) had an increased risk. Children using improved drinking water sources had a 41% lower risk of diarrhea (AOR=0.59, 95% CI: 0.39-0.88).* ***Conclusion:*** *diarrhea remains a significant public health concern in the Western Province, particularly for children aged 6-23 months. Interventions focusing on hygiene education and safe water handling practices are recommended.*

Introduction

Around two (2) billion instances of diarrheal diseases are reported worldwide each year, and 1.9 million children under the age of five die from diarrhea predominantly in underdeveloped nations according to the World Health Organization (WHO) and UNICEF [1]. This equates to 18% of all pediatric fatalities, or more than 5000 children every day, who pass away from diarrheal disorders. Seventy-eight percent of all diarrhea-related child deaths take place in Southeast Asia and Africa and in children under the age of five. Approximately 45% of deaths are due to nutrition-related conditions [2]. Underweight children, especially those who have severe acute malnutrition, are more likely to pass away from common childhood illnesses such as diarrhea, pneumonia, and malaria [3]. According to Claudine U *et al*. [4], diarrheal disease is the second leading cause of mortality and morbidity among children under five worldwide. In sub-Saharan Africa, diarrheal illness is the most prevalent cause of malnutrition and the second-largest cause of mortality and morbidity for Children under the age of five worldwide [4]. In 2020, sub-Saharan Africa and southern Asia were responsible for more than 80% of the world's 5 million under-five fatalities, although producing just 53% of live births. Nigeria, India, Pakistan, the Democratic Republic of the Congo, and Ethiopia accounted for half of all under-5 deaths in 2020 [5]. Nearly a third of all fatalities are caused just by Nigeria and India [4]. Globally, Rwanda is not among the countries with the highest child mortality rates due to illnesses such as diarrhea and malaria.

Like other resource-poor nations in sub-Saharan Africa, Rwanda has a very uneven distribution of child mortality [6]. In comparison to other provinces, although child mortality originating from ailments like diarrhea are currently at a worrisome magnitude, the Eastern Province of Rwanda has the greatest infant mortality (51 deaths per 1000 live births) and under-5 mortality with 86 deaths per 1000 live births [4]. Under-5 mortality is primarily correlated with poverty (84/1000 live births in the lowest wealth quintile vs. 40/1000 live births in the highest quintile), maternal education (89/1000 live births for mothers with no education vs. 43/1000 for women with secondary education or higher), and place of residence (70/1000 in rural areas vs. 51/1000 in urban areas) on a national level [7]. The distinctive features of the western province of Rwanda in terms of the location, cultural, or socioeconomic characteristics are possible reasons that are speculated to contribute to the difficulties and causes connected to the prevalence of diarrhea in that particular location. Hence, an understanding of geographic differences and

potential contributing variables unique to the Western province can be gained by comparing the prevalence and associated factors of diarrhea in the Western province with other provinces in Rwanda or internationally. This comparison analysis can aid in the improvement of therapies and the creation of a more complex understanding. Additionally, policymakers can pinpoint regions that need further investments in healthcare infrastructure, water and sanitation facilities, educational institutions, and preventive initiatives by performing research in the Western province. The study's conclusions can be used to direct the allocation of resources to the Western province's neediest regions.

Methods

Study design: this was a cross-sectional study that used secondary data from the Rwanda Demographic and Health Survey (RDHS) 2019-2020.

Study setting: this study was conducted in the Western Province of Rwanda, one of the four provinces in the country. The Western Province has a predominantly rural population with limited access to improved water and sanitation facilities. It consists of seven districts: Karongi, Nyamasheke, Rusizi, Ngororero, Nyabihu, Rubavu, and Rutsiro. The region experiences significant geographic and socioeconomic challenges, contributing to disparities in health outcomes. The Rwanda Demographic and Health Survey (RDHS) 2019-2020 provided the data used in this study, ensuring the representation of children under five across the province.

Study participants and sample size: the study included children under five years of age from the Western Province of Rwanda, sampled from 977 households. The RDHS used a stratified two-stage cluster sampling design, ensuring representativeness across the country.

Data source: data were extracted from The RDHS dataset included variables on child health, socio-demographic characteristics, and environmental factors such as sanitation and water quality. The outcome variable was the presence of diarrhea in the two weeks preceding the survey.

Variables: the study examined several variables to assess their association with diarrhea among children under five in the Western Province of Rwanda. The dependent variable was whether the child had experienced diarrhea in the two weeks preceding the survey. Independent variables included child demographic characteristics such as age and sex, maternal factors like age, education level, and employment status, and household factors such as wealth status, distance to health facilities, and access to health information. Additionally, environmental factors, including the source of drinking water and type of sanitation facilities, were analyzed to determine their impact on diarrhea prevalence. These variables were selected to provide a comprehensive understanding of the socio-demographic and environmental factors influencing diarrhea in the region.

Bias: to minimize recall bias, the study focused on diarrhea episodes reported within the two weeks preceding the survey, a relatively short recall period, which improves the accuracy of self-reported data. Selection bias was reduced by using the Rwanda Demographic and Health Survey (RDHS) dataset, which employed a stratified two-stage cluster sampling design, ensuring that the sample was representative of the entire Western Province.

Statistical methods: data were analyzed using STATA 17. Descriptive statistics were used to summarize socio-demographic and environmental characteristics. Bivariate analysis using Chi-square tests identified associations between variables and diarrhea. Significant variables ($p < 0.05$) were included in a multivariate logistic regression model to estimate adjusted odds ratios (AOR) for diarrhea risk factors.

Ethical considerations: the RDHS was conducted with ethical approval from the National Health Research Ethics Committee of Rwanda, and informed consent was obtained from participants. The DHS program granted permission to use the dataset for this study.

Results

Demographic characteristics of children under five years in the Western Province who participated in DHS: the findings indicated that more than half (58.98%) of the children were aged between 24-59 months, followed by those 12-23 at 19.86% and only 10.03% were aged 6-11 months. Most children were female (50.26%). Most of the children´s mothers (60.90%) were aged between 20-34 years of age, and only 1.54% were less than 20 years. Sixty-four point thirty-eight percent (64.38%) of their mothers had basic primary education with just 3.07% of them having tertiary education, 53.94% were formally employed, 53.22% were protestants and 48.11% were poor. Seventy-six point five percent (76.05%) of the respondents said the distance to the health facility was not a very big challenge to them, and over three in five (64.89%) had no information source to get the health care information (Table 1).

The prevalence of diarrhea among children under 5 years old in Western province of Rwanda: the prevalence of diarrhea was reported by the mothers, indicating that the child had diarrhea in the two weeks preceding data collection. The observed prevalence of diarrhea among children under 5 years of age in the western province in Rwanda is 19% within the confidence interval of (16.60% - 21.52%).

Socio-demographic characteristics associated with diarrhea among children under 5 years old in Western province: the results indicated that the age of the child is one of the most important factors in the occurrence of diarrhea among children under five years of age. The bivariate results revealed that among those children that had diarrhea, most of them (47.57%) were aged between 24-59 months of age and only 3.24% of them were between 0-5 months. This association of age and diarrhea was strongly significant with a Chi-square value of 47.475 and a p-value of <0.001 which was less than the 5% level of significance. The age of the child´s mother is also another vital element in the growth and health of the young kid. The findings revealed that among those children that had diarrhea, most of them (62.16%) had their mothers aged between 20-34 years followed by those aged 35-49 years at 34.05% and those less than 20 years only had 3.78% of the diarrhea cases. This was significantly associated with diarrhea (p = 0.016), which is below the 0.05 significance threshold. The wealth status of the family is also relevant as it dictates the quality of life the household members live through. The results revealed that more than half (52.97%) of the diarrhea cases were among poor households, 24.86% among the rich, and 22.16% were among the middle-income earners. Wealth status was also significantly related to diarrhea status, as its p-value of 0.029 was less than a 5% significant level. Additionally, where the household members get the health care information also helps in the quality of life they live. The findings revealed that most of the diarrhea cases were observed among those households that did not have any information source at 72.97%, 20.54% among those that had radios, and only 6.49% among those that had televisions. This was also associated with diarrhea with a p-value of 0.021 (Table 2).

Environmental characteristics associated with diarrhea among children under 5 years in Western province: the water source was classified as the improved or unimproved water source. Improved water sources included those who got water from piped sources, and boreholes among others, and unimproved included those who got water from unprotected wells, lakes, and rivers among others. The results showed that most of the diarrhea cases (78.92%) were observed among

those who got water from an unimproved water source. The water source was also significantly related to diarrhea cases from the Chi-square results with a p-value, of 0.047 less than a 5% significant level (Table 3).

The multivariable: regression analysis of the factors associated with diarrhea: the variables that were significant at the bivariate level were adjusted in a binary logistic regression model to identify which factors were associated with diarrhea. The analysis indicates that children aged 6-11 months are 68% less likely to develop diarrhea compared to those aged 0-5 months (AOR: 0.32, 95% CI: 0.14-0.76, p = 0.009). However, as children grow older, the risk of diarrhea increases significantly. Specifically, children aged 12-23 months are nearly three times more likely to develop diarrhea compared to those aged 0-5 months (AOR: 2.96, 95% CI: 1.83-4.80, p < 0.001). Similarly, children aged 24-59 months are more than twice as likely to experience diarrhea compared to the youngest age group (AOR: 2.35, 95% CI: 1.59-3.46, p < 0.001). Regarding the source of drinking water, children who drink from unimproved sources are 41% less likely to develop diarrhea compared to those who consume water from unimproved sources (AOR: 0.59, 95% CI: 0.39-0.88, p = 0.010) (Table 4).

Discussion

In this study, we examined the prevalence, socio-demographic, and environmental factors associated with diarrhea among children under five years of age from the Western province of Rwanda using RDHS data of 2019-2020. The prevalence of diarrhea was approximately 19% (95%CI: 16.60-21.52) among children in the western province of Rwanda. This prevalence is in line with the one found by RDHS of 2019-2020 [8], which indicated that the diarrhea prevalence was 14.3% at the national level. The prevalence was also lower than that found in Nyarugenge District, which was 26.7% [9]. This prevalence is quite higher than the 14% and 14.5% that were found in under-fives in Indonesia and Bahir Dar city, North-west Ethiopia respectively [10,11]. Additionally, a study in Southern Ethiopia had a prevalence of two weeks´ prevalence as 13.6% (95%CI: 10.7-16.5) which was also much lower than that of the western province of Rwanda from this study. The higher prevalence in our study may be attributed to poor sanitation practices in the Western Province of Rwanda. It is also slightly less than the 22% (95%CI: 19-25) that was observed among the under-fives in a meta and systematic analysis conducted in Ethiopia [10].

Our study found out that some of the socio-demographic factors for diarrhea were the children´s age. Those who were more likely to have diarrhea were those aged between 6-11 months (AOR= 2.96, 95%CI: 1.83-4.80), and those aged between 12-23 months of age (AOR= 2.35, 95%CI: 1.59-3.46). Those aged between 0-5 months (AOR= 0.32, 95%CI: 0.14-0.76) were less likely to have diarrhea [12]. These findings were similar to various studies that found that the child´s age was significant. A study that used DHS data in Nepal had similar findings [13,14]. The studies were also similar to another study in Rwanda that found children's age to be associated with diarrhea [4]. From the environmental factors, those who had drinking water from unimproved sources were less likely to have diarrhea (AOR= 0.59, 95%CI: 0.0.39-0.88) as compared to those from improved sources. This may be so because those who get water from unimproved sources tend to treat or boil the water before drinking, as they are aware that they got it from poor sources. This may not be the case for those who get water from improved sources, as they may assume that the water is very safe and clean for drinking. This may be also related to the father of epidemiology theory for the spread of cholera from the street pump [15].

Our findings contrast with a study in Nigeria that found out that those from unimproved sources had 1.16 more odds of getting diarrhea than the improved source [16]. This study also further saw a significant relationship with the type of toilet

facility, but however, this was not related to diarrhea in our study. This difference may also be attributed to the difference in the ranking of the two countries: middle-income versus the low-income country. Furthermore, a study from Ethiopia also found that the type of drinking water source was associated with diarrhea in under-fives [17]. The overall prevalence of diarrhea in the Western Province is higher than the national average. And therefore, policies targeting improved sanitation and health care information including teaching mothers how to take care of the younger ones should be brought near the people in the western province to curb the vice. Children between the ages of 6-24 should be given more attention and care by their parents as it seems to be a more dangerous stage.

Study limitation: the study's reliance on self-reported data and its cross-sectional design limits the ability to establish causality, but it offers valuable insights into the prevalence and associated factors of diarrhea in the Western Province of Rwanda.

Conclusion

The study concludes that diarrhea remains a prevalent health issue among children under 5 years old in the Western Province of Rwanda. The risk of diarrhea is significantly associated with the child's age, with children aged 6-23 months being at the highest risk. Additionally, the source of drinking water plays a complex role in diarrhea prevalence.

What is known about this topic

- *Diarrhea is a leading cause of mortality and morbidity among children under five, particularly in low-income countries;*
- *Children aged 6-23 months are particularly vulnerable to diarrhea due to weaning practices and exposure to contaminated food and water;*
- *Access to improved water sources and sanitation facilities significantly reduces the risk of diarrhea, but many households in low-income settings still rely on unimproved sources.*

What this study adds

- *The prevalence of diarrhea in the Western Province of Rwanda is 19%, higher than the national average of 14%, highlighting a region-specific public health concern.*
- *Children aged 6-23 months in the Western Province are at significantly higher risk of diarrhea, emphasizing the need for targeted interventions in this age group.*
- *Surprisingly, children using unimproved water sources had a lower risk of diarrhea, suggesting possible water treatment practices that require further investigation.*

Competing interests

The authors declare no competing interests.

Authors' contributions

Deogratias Kaneza designed the study, developed the methodology, and drafted the manuscript. Amanuel Kidane Andegiorgish supervised the study, while Theogene Kubahoniyesu conducted data analysis and contributed to manuscript writing. All the authors have read and agreed to the final manuscript.

Tables

Table 1: socio-demographic characteristics of the respondents

Table 2: socio-demographic characteristics associated with diarrhea among children under 5 years old in Western province

Table 3: environmental characteristics associated with diarrhea among children under 5 years in Western province

Table 4: multivariable binary regression of the factors associated with diarrhea among children aged under five years in the western province of Rwanda

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Table 1: socio-demographic characteristics of the respondents		
Variable	**Frequency (N)**	**Percentage (%)**
Age of child in months		
0-5	109	11.16
6-11	98	10.03
12-23	194	19.86
24-59	567	58.98
Sex of child		
Male	486	49.74
Female	491	50.26
Mother's age in years		
0-19	15	1.54
20-34	595	60.90
35-49	367	37.56
Mother's education status		
No education	161	16.99
Primary	629	64.38
Secondary	157	16.07
Tertiary	30	3.07
Mother's employment status		
Not employed	166	16.99
Formally employed	527	53.94
Informally employed	284	29.07
Respondent's religion		
Catholic	285	29.17
Protestant	520	53.22
Adventist	135	13.82
Others	37	3.79
Wealth status		
Poor	470	48.11
Middle	184	18.83
Rich	323	33.06
Immunization status		
No	12	1.96
Yes	601	98.04
Information source		
None	634	64.89
Radio	235	24.05
Television	108	11.05
Distance to the health facility		
Big problem/challenge	234	23.95
Not a challenge	743	76.05
Overall	977	100
Source: Analysis of RDHS 2019-2020		

Table 2: socio-demographic characteristics associated with diarrhea among children under 5 years old in western province				
Variable	**Diarrhea status n, (%)**		**Chi-square**	**p-value**
	yes (n=185)	No (n=792)		
Age of child in months			47.475	<0.01
0-5	6 (3.24)	103(13.01)		
6-11	34 (18.38)	64 (8.08)		
12-23	57 (30.81)	137 (17.30)		
24-59	88 (47.57)	448 (61.62)		
Sex of child			0.104	0.747
Male	94 (50.81)	392 (49.49)		
Female	91 (49.19)	400 (50.51)		
Mother's age in years			8.323	0.016
0-19	7 (3.78)	8 (1.01)		
20-34	115 (62.16)	480 (60.61)		
35-49	63 (34.05)	304 (38.38)		
Mother's education status			6.14	0.105
No education	25 (13.51)	136 (17.17)		
Primary	133 (71.89)	496 (62.63)		
Secondary	24 (12.97)	133 (16.79)		
Tertiary	3 (1.62)	27 (3.41)		
Mother's employment status			4.947	0.084
Not employed	30 (16.22)	136 (17.17)		
Formally employed	89 (48.11)	438 (55.30)		
Informally employed	66 (35.68)	218 (27.53)		
Respondent's religion			8.182	0.571
Catholic	47 (25.41)	238 (30.05)		
Protestant	106 (57.30)	414 (52.27)		
Adventist	26 (14.05)	109 (13.76)		
Others	6 (3.24)	31 (3.91)		
Wealth status			7.103	0.029
Poor	98 (52.97)	372 (46.97)		
Middle	41 (22.16)	143 (18.06)		
Rich	46 (24.86)	277 (34.97)		
Immunization status			3.965	0.066
No	0 (0.0)	12 (2.59)		
Yes	150 (100.0)	451 (97.41)		
Information source			7.774	0.021
None	135 (72.97)	499 (63.01)		
Radio	38 (20.54)	197 (24.87)		
Television	12 (6.49)	96 (12.12)		
Distance to the health facility			0.265	0.607
big problem/challenge	47 (25.41)	187 (23.61)		
Not a challenge	138 (74.59)	605 (76.39)		
Source: analysis of RDHS 2019-2020				

Table 3: environmental characteristics associated with diarrhea among children under 5 years in Western province				
Variable	**Diarrhea status n, (%)**		**Chi-square**	**p-value**
	yes (n=185)	**No (n=792)**		
Hand washing place with water			0.344	0.557
No water	96 (73.28)	408 (70.71)		
Water present	35 (26.72)	169 (29.29)		
Type of toilet			0.59	0.745
Improved	136 (73.51)	572 (72.22)		
Unimproved	44 (23.78)	204 (25.76)		
Open defecation	5 (2.70)	16 (2.02)		
Location of toilet facility			2.409	0.301
In own dwelling	1 (0.56)	12 (1.55)		
In own yard/plot	70 (38.89)	335 (43.17)		
Elsewhere	109 (60.56)	429 (55.28)		
Source of drinking water			3.954	0.047
Unimproved	146 (78.92)	568 (71.72)		
Improved	39 (21.08)	224 (28.28)		

Table 4: multivariable binary regression of the factors associated with diarrhea among children aged under five years in the western province of Rwanda				
Variable	**COR (95%CI)**	**p-value**	**AOR (95%CI)**	**p-value**
Age of child in months				
0-5	1*			
6-11	0.32 (0.14-0.76)	<0.001	0.32 (0.14-0.76)	0.009
12-23	2.95 (1.83-4.73)	<0.001	2.96 (1.83-4.80)	<0.001
24-59	2.31 (1.57-3.39)	<0.001	2.35 (1.59-3.46)	<0.001
Wealth status				
Poor	1*			
Middle	1.09 (0.72-1.64)	0.601	1.14 (0.73-1.78)	0.554
Rich	0.63 (0.42-0.92)	0.379	0.75 (0.47-1.21)	0.245
Information source				
None	1*			
Radio	0.71 (0.48-1.06)	0.091	0.72 (0.46-1.12)	0.142
Television	0.46 (0.25-0.87)	0.183	0.58 (0.27-1.21)	0.245
Source of drinking water				
Unimproved	1*			
Improved	0.68 (0.46-0.99)	0.032	0.59 (0.39-0.88)	0.010
1*reference category, Source: analysis of RDHS 2019-2020				