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Social and Environmental Determinants of Diarrheal Diseases among Children Under Five Years in Epworth Township, Harare

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Abstract: Children five years or younger in low- and middle-income countries (LMICs) are severely affected by diarrheal disease, especially in the sub-Saharan region. Hence, the study aimed at determining the prevalence and determinants of diarrhea disease among children under 5 years in Epworth Township, Zimbabwe. A descriptive cross-sectional study was conducted at a local clinic in Epworth Township, Harare. A convenience sampling strategy was used to recruit study participants for participation and 386 children were enrolled in the study. The majority were male children (*n*=229; 59.3%), while there were more female caregivers (*n*=370; 95.9%) than male caregivers (*n*=16; 4.1%). The prevalence of diarrhea disease in the study was 25.1%. The determinants associated with diarrhea were being partially vaccinated (OR 2.38, CI 95% 2.80–8.22), collecting water more than 1 kilometre from a household (OR 4.55; CI 95% 2.10–9.85) and using untreated water (OR 6.22; CI 95% 2.13–18.20). The age of the caregiver and using a clean water container (OR 0.05; p=0.020) were protective factors. Provision of primary health care, especially prevention of disease through immunization and rendering environmental health services could reduce the prevalence of diarrhea in disadvantaged townships.

Keywords: social determinant; environmental determinants; diarrheal diseases; children; low- and middle-income country

1. Introduction

Diarrhea is one major preventable childhood disease and mortality worldwide and especially in low-and middle-income countries (1). According to World Health Organization, it is estimated that there are 1.7 billion cases of diarrheal disease reported annually among children under 5 years (2). The sub-Saharan region is the most affected in the world. While in Zimbabwe diarrheal disease accounts for 10%-15% of deaths among children under 5 years old annually (3).

In low- and middle-income countries, diarrhea is associated with environmental determinants, socio-economic status, and lack of access to primary health services (4). Scientific evidence shows that a lack of sanitation facilities, urbanization, clean drinking water, proper waste disposal (including sewage), and living conditions contribute to the occurrence of diarrheal diseases. Furthermore, social determinants such as household economic status, parents' characteristics and behaviour have been linked to diarrheal disease (5,6).

Diarrheal disease can cause a significant financial burden on households and the health care system. It is estimated that caregivers can incur costs ranging from $26 to $136 for a child diagnosed with diarrheal disease (7). Children from low- and middle-income countries are the most affected by this condition. Childhood diarrheal disease may lead to severe health effects such: as stunted physical growth, cognitive impairment, malnutrition and death especially in LMICs such as Zimbabwe (8–10).

Diarrheal diseases and their complications are among the most cause of death in Zimbabwean children under the age of five (2). Yet, there are numerous prevention and treatments (such as oral rehydration solutions, antibiotic treatment, immunization and feeding practices) to prevent high

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mortality and morbidity (7). Furthermore, most parents do not take their children for medical attention and most cases end up not being diagnosed (2). In Zimbabwe, the lack of basic sanitation and water infrastructure has resulted in a significant incidence of diarrhea cases (11). As a result, the focus of the study was on determining the prevalence and determinants for diarrhea in children under the age of five in Epworth's peri-urban area.

2. Materials and Methods

A descriptive cross-sectional study was conducted to achieve the following objectives: 1) To describe the prevalence of diarrheal diseases in children under five in Epworth; 2) to determine the social and environmental determinants of diarrheal diseases in children under five in Epworth; and 3) to establish a relationship between diarrheal diseases with social and environmental determinants in the study population.

2.1. Study setting and population

The study was conducted in Epworth Township (characterized by an informal settlement setting) b within the city of Harare, Zimbabwe. A highly dense impoverished township with limited primary health services, access to water, sewage services and cleaner energy (12,13). The population is estimated to be 167 462, according to the 2012 census survey (14). The study population was selected because of the living condition, lack of access to services and diarrheal cases reported in other studies with similar conditions. The targeted study population were children under the age of 5 years that were presented to the local clinic.

2.2. Sampling and Sample Size

A convenient sampling strategy was implemented to recruit participants for study participation. Caregivers presenting with children under the age of 5 years at a local clinic were approached until the sample size was met and only a mother/caregiver or guardian older than 18 years were interviewed. The sample size was estimated using EpInfo, with the assumption of a 21.5% prevalence of diarrhea amongst children under 5 years in the target study site with a 5% margin of error, 95% confidence level and 5% standard deviation. The ratio between those with diarrhea and no diarrhea was set at 1:1. Therefore, the estimated sample size was 395.

2.3. Data Collection

A structured questionnaire was used to collect data. The questionnaire was designed in English and translated into Shona the local language. Trained research assistants administered the questionnaire. It was used to collect the following information: participants' socio-demographic characteristics (including caregivers' details), the prevalence of diarrhea, participants' behaviour, environmental factors, and socio-economic status. Diarrhea was defined as having experienced the following symptoms in the last 14 days: passing three or more liquid/loose stools, and bowel movements in a 24-h period. The questionnaire was piloted in a similar setting to assess its validity, reliability, duration of completion and participants' understanding of the questions.

The Mid-Upper Arm Circumference (MUAC) was determined by taking the weight and height of the participants. The MUAC was used as a nutritional indicator which forms part of the health screening. It was then categorized as 1) less than 12 and 2) 12 & above. The health screening included: vaccine status, and suffering from chronic illnesses.

2.4. Data Analysis

The collected was captured, cleaned, coded, and analysed using IBM SPSS version 27. Descriptive statistics (frequencies and percentages) were used to describe the distributions of demographic characteristics, behavioural patterns, social characteristics, and socio-economic and environmental factors. The binary logistic regression model was adopted. Variables (determinants) that were statistically significant in the bivariate analyses were included in the final model. A

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backward likewise multivariate binary logistics regression was used to determine the effect of determinants on diarrheal cases. The significance was set at P<0. 05.

2.5. Ethical Considerations

The study obtained ethical clearance from the University of Johannesburg Research Ethics Committee (REC-1654-2022). The study was conducted ethically throughout. was conducted in Epworth Town within the city of Harare, Zimbabwe. Consent was obtained from the mother/caregiver before commencing the study.

3. Results

3.1. Study Participants' Socio-demographic Characteristics

There were 386 participants that participated in the study. Most of the children were aged between 12-22 months (32.4%, n=125) in this study. There were more male children (59.3%, n=229) than female children (40.7%, n=157). Most of the caregivers were female (95.9%, n=370). While the majority of them were aged between 16 – 30 years (78.5%, n=303). In this study, 83.9% (n=324) of the caregivers indicated that they are the child's mother, and 1.6% (n=6) indicated that they are the child's father. Looking at the highest level of education of the caregivers, 140 (36.3% had secondary school education. In this study, most households earn between 50 to 100 USD per month (52.6%, n=203). The findings showed that most households lived in three-room houses (42.3%, n=163), and most indicated that more than 4 people were in each household (72.8%, n=281). Lastly, most caregivers indicated that there are 2 or more children under 5 years (59.3%, n=229) in their household. Table 1 shows a detailed caregiver's socio-demographics and responses.

Table 1. Detailed Description of Socio-demographic Characteristics

Environmental factor	Frequency (*n*)	Percentage (%)
	Child Gender	
Male	229	59.3%
Female	157	40.7%
	Child Age	
0-5 months	63	16.3%
6-11 months	40	10.4%
12-22 months	125	32.4%
23-35 months	49	12.7%
36-59 months	109	28.2%
	Child still breastfeeding	
Yes	111	28.8%
No	275	71.2%)
	Child Weaned	
Less than 6 months	47	12.2%
6 – 18 months	185	47.9%
24 – 36 months	9	2.3%
Still breastfeeding	111	28.8%
Not sure	34	8.8%
	Child exclusively breastfed	
Yes	200	51.8%
No	186	48.2%
	Gender of caregiver	
Male	16	4.1%
Female	370	95.9%
	Age of caregiver	
16-20	165	42.7%

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21-30	138	35.8%
31-40	56	14.5%
41-50	27	7%
	Relationship with child	
Mother	324	83.9%
Father	6	1.6%
Grandparent	29	7.5%
Aunt/Uncle	2	0.5%
Other	25	6.5%
	Highest level of education	
Uneducated	92	23.8%
Primary School	115	29.8%
Secondary school	140	36.3%
Diploma	33	8.5%
Degree	6	1.6%
	*Family Income**	
Less than 50	170	44%
50 to 100	203	52.6%
100 to200	11	2.8%
Above 200	2	0.5%

* US dollar currency was used as it is the current preferred currency of trade in Zimbabwe(15)

3.2. Prevalence of Diarrheal l Diseases

There were 97 (25.1%) children who had experienced diarrhea and 74.9% did not experience diarrhea. Therefore, the prevalence of diarrhea in this study was 25.1 %. Participants (n = 97; 25.1%) that reported having experienced diarrhea were asked about condition duration, stool characteristics, treatment, and type of treatment received, as shown in Appendix A (Table A1). Further analysis showed that 72.2% (n=70) reported to have had watery diarrhea and 20.6% (n = 27) had mucoid diarrhea. Regarding the duration of diarrhea, most of the children had diarrhea for less than 3 days (n=70; 72.2%). The survey indicates that most participants (n = 93; 95.9%) sought treatment from a health facility. The most treatment received by children who had experienced diarrhea was oral rehydration therapy (n = 91; 93.8%).

3.3. Social and Environmental Related Determinants

Households with more than four people had a high number of Diarrheal cases (n = 205; 70.9%). There were diarrheal cases from households that used a community borehole (n = 51; 52,6%), collected water in a distance of more than 1 kilometre (n = 62; 63.9%), and spent more time collecting water (n = 75; 77.3%). The bivariate analysis showed statistical significance when comparing participants with diarrhea and those with no diarrhea for the following determinants (p < <0.001); drinking water collected outside the household (p <0.001), untreated water (p <0.001), untreated water (p <0.001), sharing a toilet (p = 0.027), and using a toilet with no hygiene facilities (p <0.001).

Table 2. Social and Environmental related determinants in the Study.

Determinants		Diarrhea		Total n (%)	Chi-squared p-value
		Yes n (%)	No n (%)		
Number of people per household	2	6 (2.1%)	-	6 (1.6%)	0.334
	3	28 (9.7%)	8 (8.2%)	36 (9.3%)	
	4	50 (17.3%)	13 (13.4%)	63 (16.3%)	

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	More than 4	205 (70.9%)	76 (78.4%)	281 (72.8%)	
What is the main water source	Shallow well	43 (44.3%)	93 (32.3%)	136 (35.2%)	0.105
	Community borehole	51 (52.6%)	176 (61%)	227 (58.8%)	
	Personal borehole	1 (1%)	12 (4.2%)	13 (3.4%)	
	Council tapped water	2 (2.1%)	8 (2.8%)	10 (2.6%)	
Covered water container	Yes	97 (100.0%)	289 (100.0%)	386 (100%)	
Distance to water source	Within household	35 (36.1%)	187 (64.8%)	222 (57.5%)	<0.001*
	More than 1 kilometre	62 (63.9%)	102 (35.3%)	164 (42.5%)	
Time Spent collecting water	30 minutes	22 (22.7%)	67 (23.2%)	89 (23.1%)	0.919
	1 hour	75 (77.3%)	222 (76.9%)	297 (76.9%)	
How is water drawn from storage container	Dipping scooper	32 (33%)	87 (30.1%)	119 (30.8%)	0.594
	Pouring out	65 (67%)	202 (70%)	267 (69.2%)	
Do you normally empty/clean containers?	Yes	58 (59.8%)	133 (46.1%)	191 (49.5%)	0.019
	No	39 (40.2%)	156 (54%)	195 (50.5%)	
Is the water treated for drinking?	Yes	45 (46.4%)	233 (80.6%)	278 (72%)	<0.001*
	No	52 (53.6%)	56 (19.5%)	108 (28%)	
How is water treated	Chlorination	15 (15.5%)	62 (21.6%)	77 (19.9%)	<0.001*
	Boiling	31 (32%)	171 (59.2%)	202 (52.3%)	
	No treatment	51 (52.6%)	56 (19.5%)	107 (27.7%)	
Is there a toilet	Yes	97 (100%)	289 (100%)	386 (100%)	
Is the toilet shared?	Yes	81 (83%)	209 (72.3%)	290 (72.3%)	0.027*
	No	16 (16%)	80 (27.7%)	96 (27.7%)	
How many times is the latrine cleaned in a week	Daily	97 (100%)	286 (99.0%)	383 (99%)	0.602
	2-3 times	-	1 (0.3%)	1 (0.3%)	
	4-6 times	-	2 (0.7%)	2 (0.7%)	
	When spoiled/dirty	-	-	-	
	other	-	-	-	
Are there hand washing facilities with soap near the toilet	Yes	15 (15%)	186 (64.4%)	201 (64.4%)	<0.001*
	No	82 (84%)	103 (35.6%)	185 (35.6%)	

* p-value significant at 0.050

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3.4. Health Status of the Children

In this study, some children had not received the rotavirus vaccine and were categorized as being partially vaccinated. Most of the children were fully vaccinated (61.1%, n=236), while 132 (34.2%) were partially vaccinated. Most of the children had no chronic illness (99.5%, n=384) and 2 (0.5%) children were recorded to have known chronic illness. Mid-upper arm circumference (MUAC) was used for the assessment of the nutritional status of the children and 68 (17.6%) children had a MUAC of less than 12.

Table 1. Distribution of health-related variables

Health Variable	Frequency (*n*)	Percentage (%)
	Vaccination Status	
Full Vaccinated	236	61.1%
Unvaccinated	18	4.7%
Partially vaccinated	132	34.2%
	Chronic illness	
23-35 months	49	12.7%
36-59 months	109	28.2%
	MUAC	
Less than 12	68	17.6%
Above 12	318	82.4%

3.5. Determinants influencing diarrhea in the study population

The multivariate analysis showed that diarrhea was associated with being unvaccinated (p = 0.022), the households that collected water at a distance and using untreated water (p < 0.001). However, age of the caregiver (21-30 years old (COR:0.22; 95% CI 0.12-0.40), 31-40 years old (p < 0.001) and 41-50 years old (p = 0.007), (p < 0.001), using clean water containers (COR: 05; 95%CI 0.02-0.13) were protective factors in the study.

Table 2. Logistic regression model determinants of diarrheal disease among under-five children.

Determinants		Univariate Model		Multivariate Model	
		COR (95% CI)	P-Value	COR (95% CI)	P-Value
Vaccination Status of child	Fully Vaccinated			Ref	
	Unvaccinated	0.80 (0.32-2.03)	0.003	1.32 (0.39-4.41)	0.402
	Partially vaccinated	0.67 (0.47-0.95)	<0.001*	2.38 (1.08-5.25)	0.022*
Age of caregiver	16-20			Ref	
	21-30	0.22 (0.14-0.34)	<0.001*	0.22 (0.12-0.40)	<0.001*
	31-40	0.06 (0.02-0.18)	<0.001*	0.06 (0.02-0.23)	<0.001*
	41-50	0.13 (0.04-0.42)	0.008*	0.10 (0.02-0.44)	0.007*
Distance To Water	Within household			Ref	
	More than 1 kilometre	0.61 (0.44-0.83)	<0.001*	4.55 (2.10-9.85)	<0.001*
Clean Container Usage	No			Ref	
	Yes	0.25 (0.18-0.36)	0.020*	0.05 (0.02-0.13)	<0.001*
Treatment Method	Chlorination			Ref	

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Boiling	0.18 (0.12-0.27)	0.407	0.34 (0.18-0.63)	0.194
No treatment	0.91 (0.62-1.33)	<0.001	6.22 (2.13-18.20)	0.001*

* p-value significant at 0.050

4. Discussion

This study aimed to determine the prevalence of diarrhea and associated factors among Epworth's under-five children. In this study, the prevalence of childhood diarrheal diseases was 22.5% over two weeks. This finding is higher than studies conducted elsewhere in the SADC region (6,16). A study conducted in a South African low-and middle-income township (Soweto) found a diarrheal disease prevalence of 20.9% among children under-5 years old (16). This study's prevalence was higher when compared to a study in Mozambique with a similar population that find a prevalence of 10.6%. of the 10026 children under the age of five had diarrhea (6). However, it was lower when compared to a conducted in Zambia, with a prevalence of 29 .1% (17). In the areas where the prevalence is low, the communities had access to basic needs such as access to water, which is not the same in Epworth Township. This could explain the variation between the different sites.

In this study, having an older caregiver and using a clean water container were protective factors. The findings are consistent with previous studies. A study in Nigeria found that children born to mothers aged 25-34 were 15% less likely to have diarrhea than children born to mothers aged 15-24 (18). It is believed that older women may have more experience in childcare, and younger mothers may have less understanding and knowledge about diarrheal disease, mode of transmission, and pathogens spread in the household than the older ones (19). This is an important find for preventing diarrhea in children under the age of five, health education interventions should include young mothers as one of the target audiences.

Children that were partially vaccinated were at a higher risk (COR 2.38; 95%CI: 1.08-5.25) of suffering from diarrheal disease. This finding is important as it highlights the impacts of being vaccinated in preventing diarrheal disease in low- and middle-income countries (20). A long-term study in Fiji showed a reduction of 81% in diarrhea mortality cases among children under 5 years (21). Therefore, healthcare workers and policymakers need to ensure access to preventive care for the protection of vulnerable groups such as children under 5 years old.

Children from households who travelled more than a kilometre to water sources were 3.55 times more probable to have diarrhea than those children from households who travelled more than a kilometre. Our findings are similar to a study that reported that distance to water sources showed a strong association with under-five childhood diarrhea morbidity (22). This could be because most water sources near households are shallow wells which risk being contaminated by faecal material. Lastly, using untreated water was a risk factor ($p > 0.001$) in the study. This has been proven in previous studies (23–27), contaminated water collected in the shallow wells (n = 136; 35.2%), community borehole (n =227; 58.8%) and personal borehole (n = 13; 3.4%) were neither chlorinated nor boiled before use. There is a need for environmental health services to ensure preventive measures such as the provision of safe water and health education on how to clean water before use.

5. Strength and Limitations

The key strength of the study was that the respondents were obtained from the local clinic, making it simple and efficient. Hence the study was quick to conduct. Therefore, the research question was addressed in a short space of time. The data in this study was gathered using a cross-sectional survey, which only represented a part of the population of Epworth at that particular time and also only the individuals that use that particular clinic. It was difficult to account for seasonal variations in the occurrence of child diarrhea because the predictor variables and the outcome variable were measured at the same time. Lastly, the study cannot be generalized to other townships in Zimbabwe.

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6. Conclusions

Environmental and infrastructural deficits, such as water accessibility, the presence and use of latrines, the availability of hand washing facilities, and waste disposal methods. As a result, there is a need to improve access to these facilities and health education awareness on the prevention of diarrhea in Epworth through an integrated and comprehensive approach to reducing diarrheal-related morbidity and mortality among children under the age of five.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Research Ethics Committee of the University of Johannesburg (REC-1654-2022).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to ethical reasons.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Further analysis of diarrheal cases reported in the study.

Diarrhea signs and actions		Frequency (*n*)	Percentage (%)
How long has child had diarrhea	Less than 3 days	70	72.2%
	4-7 days	20	20.6%
	8-14 days	7	7.2%
The diarrhea is generally	Watery	70	72.2%
	Mucus and Bloody	27	27.8%
Was treatment sought	Yes	96	99%
	No	1	1.%
Where was treatment sought?	Health Facility / Clinic / Hospital	93	95.9%
	Pharmacy	2	2.1%
	At home	2	2.1%
What treatment did they receive?	Oral Rehydration Therapy	91	93.8%
	Other medication	5	5.2%
	Home Remedies	1	1%

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