International Journal of Basic and Applied Sciences, 9 (1) (2020) 1-6

International Journal of Basic and Applied Sciences

Website: www.sciencepubco.com/index.php/IJBAS

Research paper

Studies on diarrhea prevalence in selected communities in greater Monrovia, Liberia

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Abstract

Diarrhea is an epidemic that threatens the livelihood of children less than five years in developing countries. Control and mitigation pose a severe challenge in these countries. The subjective of the study is to assess the prevalence of and factors associated with diarrhea among families in Greater Monrovia. The study recruited 257 families from three communities and geographically and randomly assigned to the two groups (A & B). Socio-demographic survey and knowledge and behavior questionnaires on diarrhea prevalence were used to collect data. Reports from the study indicate that family in Group A (93%) and Group B (83.6%) have significant knowledge associating contaminated drinking water and contaminated food with diarrhea; X2 =11.2, p = 0.001. The family behavior shows that Group A (33%) and Group B (51%) do not treat their drinking water before consumption. The findings from this study recommend an education and awareness intervention on diarrheal and related illnesses to increase family knowledge and improvement of the behavior community public health improvement process.

Keywords: *Diarrhea; Greater-Monrovia; Developing-Countries; Knowledge; Behavior Score.*

1. Introduction

Every year, there are approximately 2 million diarrheal-related deaths as a result of drinking unsafe water, inadequate sanitation, and poor hygiene [1]. Diarrheal diseases remain a significant cause of death among children less than five years old, mostly in developing nations [2]. Diarrheal conditions cause a tremendous burden of illness in developing countries, killing an estimated 1.8 million children under the ages of five years worldwide [3, 4]. The provision of quality drinking water is critical for the reduction of diarrhea prevalence and transmission [5]. It is widely recognized that the risk of exposure to diarrheal pathogens in developing nations is correlated with the quality of drinking water, availability of toilet facility, housing conditions, level of education, economic status of a household, sanitary conditions, storage and handling practices of drinking water [6]. Unsafe drinking water is a significant source of pathogens, which causes waterborne illness among children less than five years in developing nations. The waterborne disease accounts for approximately 21% of death among children in developing countries [7]. In most developing nations, the treatment of drinking water is rare.

Access to safe drinking water can result in many positive health benefits, thereby reducing diarrhea prevalence. However, the maintenance of adequate and reliable drinking water is among the many challenges facing developing nations. Globally, many communities do not have access to clean drinking water supplies. In Liberia, many urban and rural communities rely on groundwater (water from dug-out wells) or surface water (water from creeks or rivers) for drinking and other domestic uses. On average, about 80% of residents in developing nations or low-income countries rely extensively on groundwater [8].

Getting drinking water from clean water sources followed by proper transportation, storage handling, and use of drinking is pivotal to the mitigation or the reduction of diarrheal disease prevalence in developing countries. Adequate storage and transport of drinking water and handwashing are associated with decreased odds of children under the age of five-year having reported diarrhea cases [9]. A study conducted in Southern Nepal demonstrated that diarrheal illness was associated with the consumption of untreated water and improper storage of drinking water [10]. Therefore, the study set out to define the current diarrhea prevalence among families in Greater Monrovia and to identify the level of knowledge and behavioral factors associated with the disease.

2. Materials and methods

2.1. Study area

The study was conducted in Paynesville City, which is east of Monrovia and part of Greater Monrovia, with an estimated population of 980, 000 people [11].

2.2. Recruitment

The study recruited 257 families in three communities within Paynesville City and divided them into two groups: Group A (Cowfield and Shara) and Group B (Soul Clinic). The two groups were randomly assigned as Group A and Group B representing the selected communities. The division ensured that group A and group B are geographically separated and to minimize the exchange of knowledge across the groups or families.

2.3. Procedure

This study was initiated by having town hall meetings with the selected communities. These town hall meetings were followed by the collection of baseline socio-demographic information, such as education, occupation, knowledge, and behavior on diarrhea and how to control and mitigate the illness. Socio-demographic survey, knowledge, and behavior questionnaires on diarrhea were used to collect data followed by educating parents or families in both groups on the handling and management of drinking water and food, whose poor handling and management are associated with diarrheal disease. The level of education related to diarrhea control or mitigation was (i) proper storage and handling of drinking water and food, (ii) adequate hygiene, (iii) hygienic ways or methods of collecting drinking water from storage containers, (iv) proper handling of storage containers, (v) drinking water storage period and location in the home or household.

2.4. Knowledge assessment

The knowledge assessment was done through questionnaires administered to families in both Group A and Group B. The results could provide information on scholarly communities, concerning diarrhea and diarrhea-related illness. The knowledge assessment questionnaire covers topics on the causes, symptoms, diagnosis, treatment, prevention and health effect, and health outcome (prognosis) of diarrhea. The results showed the potential for the identification of communities that might need further education on diarrhea in future research.

2.5. Behavior assessment

The behavior questionnaires were designed to engage both family groups on potential activities that may be associated with diarrheal disease. Some of the activities included in the surveys were the handling and management of drinking water, food, and sanitation.

2.6. Statistical analysis

Summary statistics were calculated to describe the sample profile. Chi-square and t-tests were used to detect differences between both groups for categorical and continuous variables, respectively. The outcome variables of interest were the results in (a) score of the quiz on diarrhea knowledge, (b) the storage and handling of drinking water and food, (c) hygiene, and (d) collecting drinking water from storage container from-household.

3. Results

3.1. Sample profile

The data in Table 1-3 compared the two groups of families who completed the study on their social demographic aspect, and knowledge and behavior factors associated with diarrheal prevalence. A total of 257 households participated in the study, with a 99% response rate. Majority of the respondents were females, 60.5% (n = 156) and 61.8% (n = 162) (Table 1) from Group A and Group B respectively. Out of the 257 households, 30.2% (n = 13) of Group A and 32.9% (n = 85) of Group B (Table 3)had diarrheal two-week before the survey, provided a prevalence rate of 8.2% with children under five years at the highest risk factors. 61.6% (n = 172) and 54.6% (n = 143) of Group A and Group B respectively had children less than five-year as part of the family.

From Table1 (socio-demography), no significant differences between Group A and Group B were found for ages, gender, employment status, and residency. Of participants, 60.5% (n = 156) and 61.8% (n = 162) were females in Group A and Group B respectively. The educational status of participants illiteracy was 7% (n = 18) from Group A and 21% (n = 55) from Group B. Besides, an association between parent's education and the control of diarrheal was observed, $X2 = 52.5$, p-value = 0.0001.

An independent samples t-test was conducted to compare variables between Group A and Group B (Table 1). There was a significant difference in the scores for the number of people per family in Group A ($M = 6.94$, $SD = 4.11$) and Group B ($M = 7.85$, $SD = 4.07$); $t = -2.40$, $p = 0.013$; the number of children less than five-year in the Group A ($M = 1.61$, $SD = 0.97$) and Group B ($M = 1.94$, $SD = 1.14$); $t = -2.61$, $p = 0.009$; and number of children between 5 – 10 years in the Group A ($M = 1.43$, $SD = 0.79$) and the Group B ($M = 1.77$, $SD = 1.20$); $t = -3.11$, $p = 0.002$.

3.2. Knowledge score

A Chi-square test statistic was conducted to compare the knowledge score between Group A and Group B (Table 2). There was a significant difference in the ratings for the drinking of contaminated water between Group A and Group B, $X2 = 11.2$, $p = 0.001$. The results also show that 93% and 83.6% of family members in Group A and Group B respectively significantly have good knowledge that diarrheal diseases are associated with the consumption of contaminated drinking water. Cases of diarrheal have been associated with the consumption

of contaminated water or poor quality of water, estimating 15% - 20% of waterborne illnesses [12]. The safety of drinking water has been a challenging issue globally, with developing nations working to meet country demands [13].

There was also a significant difference in the scores for the use of contaminated food between Group A and Group B, X2 = 14.9, p = 0.0001. The percentage of people who knew or understood that contaminated food causes diarrheal was 91.1% in Group A and 84.4% Group B (Table 2). Inadequate and poor preparation of food is associated with diarrheal prevalence among children less than five years [14]. Studies have shown that poor hygiene practices, contaminated water, and food increase the risk of diarrheal by 70% [15].

The knowledge score associating with the increase of mortality rate with diarrheal was slightly differentiated among Group A and Group B. The results also show that 55.4% and 40.8% of families in Group A and Group B respectively know that diarrheal is the leading cause of mortality rate for children less than five years old; X2 = 11.0, p = 0.001 (Table 2). With such closeness in the percentages between the two groups, a community-based educational intervention is critical. The results from Table 2 also indicated that the knowledge in associating animal feces to diarrheal illness was very poor in both Group A (8.9%) and Group B (15.6%). Animals in developing nations, especially dogs, roam freely in search of food creating risk for public health [16, 17].

Table 1: Demographic Details of Family (Categorical Variable)

Variable	Group A n (%) or Mean ± SDEV	Group B n (%) or Mean ± SDEV	χ^2 Test or T-Test (p-value)
Gender			
Male	102 (39.5)	100 (38.2)	0.75 (0.79)
Female	156 (60.5)	162 (61.8)	
Relationship			
Husband	34 (13.2)	48 (18.3)	
Wife	92 (35.7)	100 (38.2)	
Son	62 (24.0)	42 (16.0)	
Daughter	62 (24.0)	64 (24.4)	8.86 (0.12)
Other	6 (2.30)	8 (3.10)	
Education			
Illiterate	18 (7.00)	55 (21.0)	
Primary	4 (1.60)	12 (4.60)	
Intermediate	32 (12.4)	52 (19.8)	
Secondary	96 (37.2)	90 (34.4)	52.5 (0.0001)***
Tertiary	106 (41.1)	47 (17.9)	
Children < 5 Yrs.			
No	99 (38.4)	104 (39.7)	12.3 (0.001)**
Yes	159 (61.6)	158 (60.3)	
Employment			
No	86 (33.3)	119 (45.4)	7.95 (0.005)**
Yes	172 (66.7)	143 (54.6)	
Residency			
0 – 5 Yrs.	100 (38.8)	101 (38.5)	
6 – 10 Yrs.	62 (24.0)	50 (19.1)	2.63 (0.27)
> 10 Yrs.	94 (36.4)	111 (42.4)	
Age of Respondent	33.12 ± 13.1	35.52 ± 15.2	-1.92 (0.056)*
# of People per Family	6.94 ± 4.11	7.85 ± 4.07	-2.49 (0.013)*
# of Children < 5 Years	1.61 ± 0.97	1.94 ± 1.14	-2.61 (0.009)**
# of Children 5 – 10 Yrs.	1.43 ± 0.79	1.77 ± 1.20	-3.11 (0.002)**

*, **, *** statistically significant. * P-value < 0.05; ** p-value < 0.005; ****p-value < 0.0005

For continuous variables, mean (± SD) and for categorical variables n (%) are reported. To report group differences for continuous variables, the t-test is used; for categorical variables, the chi-square test is used

3.3. Behavior score

The chi-square test statistic was conducted to compare the behavior score between Group A and Group B (Table 3). There was a significant difference in the scores between Group A and Group B, for families that allow children under five years to defecate in the bathroom X2 = 5.17, p = 0.015. The poor attitude towards the treatment of water poses a serious public health challenge among the two groups. Group A (67.1%) and Group B (49.6%) do treat their water before drinking. This leaves a significant number of people who do not treat their water before drinking. A study conducted in Southern Nepal by Acharya et al. (2018) associated diarrheal diseases with improper handling and management of safe drinking water, inadequate hygiene, and poor handling of child food [18]. It has been reported that 97% of the improper handling of food is associated with foodborne diseases [19]. According to the CDC (Center for Disease Control and Prevention), drinking water sources are subject to contamination and require appropriate treatment to provide safe drinking water for the family and the community.

Table 2: Knowledge Related Questions and Percentage of Diarrheal Prevalence Among Group A and Group B

Variable	Group A		Group B		χ^2 Test (p – value)
	N (% No)	N (% Yes)	N (% No)	N (% Yes)	
Diarrheal leading cause of death for children < 5 Yrs.	115 (44.6)	143 (55.4)	155 (59.2)	107 (40.8)	11.0 (0.001)
Does diarrheal seriously affect childhood growth?	107 (41.5)	151 (58.5)	154 (58.8)	108 (41.2)	15.6 (0.0001)
Does diarrheal have an impact on children's cognitive development?	124 (48.1)	134 (51.9)	181 (69.1)	81 (30.9)	23.7 (0.0001)
Is diarrheal caused by drinking contaminated water?	18 (7.0)	240 (93.0)	43 (16.4)	219 (83.6)	11.2 (0.001)

Is diarrheal caused by eating food that has been open with flies sitting on the food?	23 (8.9)	235 (91.1)	41 (15.6)	221 (84.4)	14.9	(0.0001)
Do you think animal feces near a drinking water source can cause diarrheal	235 (91.1)	23 (8.9)	221 (84.4)	41 (15.6)	5.46	0.23)

4. Discussion

Diarrhea remains a significant source of the increased mortality rate in developing nations, especially the vulnerable population. Diarrheal illnesses are one of the major public health issues in developing countries. According to the National Public Health Institute of Liberia (NPHIL), bloody diarrhea is among the top ten death-causing diseases in Liberia. However, childhood diarrheal has declined in recent years because of the increasing use of oral rehydration solution (ORS) [20-23]. Diarrheal remains a significant challenge in children's health in developing nations due to low socioeconomic status, parents' education, lack of safe potable water, and poor sanitation [14]. Consumption of fecal contaminated drinking water is associated with increased diarrheal disease in a developing nation [24]. In developing countries, sanitation is seen as a commodity affecting the poor and needed [25]—faeces in the environment impact drinking water, especially during the rainy season.

Table 3: Behavior Related Questions and Percentage on Diarrheal Prevalence Among Group A and Group B

Variable	Group A N (% No)	Group A N (% Yes)	Group B N (% No)	Group B N (% Yes)	χ^2 Test (p-value)
Do you treat your drinking water?	85 (32.9)	173 (67.1)	132 (50.4)	130 (49.6)	0.06 (0.85)
Do you use a narrow-mouthed container to collect drinking water from the source to household	67 (26.0)	191 (74.0)	141 (53.8)	121 (46.2)	0.14 (0.93)
Do children have direct access to storage drinking water	171 (54.7)	141 (45.3)	125 (47.7)	137 (52.3)	0.02 (0.93)
Do you wash hands before collecting drinking water	29 (11.2)	229 (88.8)	63 (24.0)	199 (76.0)	0.64 (0.81)
Does family member < 5 years defecate in bathroom	182 (70.5)	78 (29.5)	171 (65.3)	91 (34.7)	5.17 (0.015)
Store drinking water in narrow mouthed container	86 (33.3)	172 (66.7)	98 (37.4)	164 (62.6)	0.04 (0.93)
Do you dip a cup in a storage container to collect drinking water	181 (70.2)	77 (29.8)	146 (55.7)	116 (44.3)	0.42 (0.52)
Do members of your family wash hands before eating	65 (25.2)	193 (74.8)	95 (36.3)	167 (63.7)	0.16 (0.70)
Do you or family members wash hands after defecation	40 (15.5)	218 (84.5)	74 (28.2)	188 (71.8)	0.99 (0.33)
Family use open defecation for toilet	176 (68.2)	82 (31.8)	203 (77.5)	59 (22.5)	0.06 (0.84)
Diarrhea cases in the last two months	30 (69.3)	13 (30.2)	173 (67.1)	85 (32.9)	0.065 (0.85)

The CDC attributes 80% of diarrhea-associated mortality to the consumption of unsafe drinking water, inadequate sanitation, and insufficient hygiene [26]. From Table 3, 29.8% and 44.3% of the family in Group A and Group B, respectively, dip utensils into storage drinking water, when collecting water for drinking or other uses. Even safe and quality/clean drinking water, collected from clean water sources, can be contaminated, in the household by immersing unhygienic hands, utensils such as cups, in stored water, storage container, to collect water for drinking, the transfer of drinking from one container to another and children having direct access to drinking water [27, 28]. Both Group A (45.3%) and Group B (52.3%) somewhat allowed their children to have direct access to drinking water stored in the home. This suggests that both family groups need more education on the proper storage and how to use drinking water in the house. The provision of drinking water of adequate quality remains a significant public health concern in developing countries, where diarrheal diseases continue to cause extensive morbidity and mortality [29]. The morbidity reports nation-wide health studies indicated that diarrheal conditions are a significant public health issue that needs immediate attention in Liberia. The Liberia Demographic Health Survey (LDHS) conducted in 2013 reported that 22% of children under five years, and 32% of children between 12-23 months had diarrhea. Also, according to the Institute for Health Metrics and Evaluation report (2016), diarrhea was consistently placed as the number one cause of infant mortality in Liberia from 1990-2016 [30, 31]. Despite reports and nation-wide health surveys which show that diarrheal illnesses are serious public health issues, there is a limited study that has documented the prevalence of risk factors of diarrhea among children aged 12-60 months old in Liberia.

Table 4: Odds Ratio (OR) (95% Confident Interval) of Knowledge and Behavior Factors Associated with Diarrhea Cases in the Last Two Months

Variable	Diarrhea cases in the last two-month Yes	Diarrhea cases in the last two-month No	OR (95% CI)	P-value
Treat drinking water				
Yes	103	223	0.95 (0.67 – 1.37)	0.80
No	76	157		
Children at household having direct access to drinking water				
Yes	95	204	0.70 (0.49 – 0.99)	0.04
No	84	176		
Washing hand before feeding children				
Yes	121	280	2.80 (0.38 – 0.81)	0.002
No	71	91		
Use of open defecation as toilet				

Yes	50	101	1.05	0.81
No	132	280	(0.71 – 1.56)	
Drinking contaminated water				
Yes	132	101	7.32	0.0001
No	50	280	(4.92 – 10.89)	

5. Conclusion

In Liberia, well-water remains a critical drinking water source for over 90% of Liberians in urban communities. The data in this study indicate that education on diarrheal diseases and other infectious diseases could help to prevent the occurrence of any potential water-related disease outbreaks. The improvement of the treatment and handling of drinking and improve sanitation is associated with the livelihood in the community. This study found that both Group A and Group B lack the necessary knowledge and attitude in the fight against diarrheal and water-related diseases. An intervention study on the education and awareness about the causes, control, mitigation, and treatment of diarrheal and related diarrheal diseases is vital to the improvement of the public health sector in Liberia.

Acknowledgement

We thank the Vice President for Academic Affairs, Dr. Moses Zinnah, of the University of Liberia for sharing the computer lab of the University of Liberia with the research team to analyze the research data.

Conflict of interest

All authors declare they have no actual or potential competing financial interest.

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