Hygiene and sanitation risk factors of diarrhoeal disease among under-five children in Ibadan, Nigeria

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Abstract

Background: Diarrhoea diseases are among the leading causes of morbidity and mortality in under-five-children (U-5C) in Nigeria. Inadequate safe water, sanitation, and hygiene account for the disease burden. Cases of diarrhoea still occur in high proportion in the study area despite government-oriented interventions.

Objective: To determine the hygiene and sanitation risk factors predisposing U-5C to diarrhoea in Ibadan, Nigeria.

Methods: Two hundred and twenty pairs of children, matched on age, were recruited as cases and controls over a period of 5 months in Ibadan. Questionnaire and observation checklist were used to obtain information on hygiene practices from caregivers/mothers and sanitation conditions in the households of 30% of the consenting mothers/caregivers. Data were analysed using descriptive and inferential statistics.

Results: Caregivers/mothers' mean ages were 31.3 ±7.5 (cases) and 30.6 ±6.0(controls) years. The risk of diarrhoea was significantly higher among children whose mothers did not wash hands with soap before food preparation (OR=3.0, $p<0.05$), before feeding their children (OR=3.0, $p<0.05$) and after leaving the toilet (OR=4.7, $p<0.05$). Factors significantly associated with diarrhoea were: poor water handling (OR=2.0,CI=1.2-3.5), presence of clogged drainage near the house (OR=2.1,CI=1.2-3.7) and breeding places for flies (OR=2.7,CI=1.6-4.7). The mean risk score among cases and controls from the sanitary inspection of drinking water sources were 5.4 ± 2.2 and 3.2 ± 1.9 ($p<0.05$) and household storage containers were 2.4 ± 1.8 and 1.2 ± 0.7 ($p<0.05$) respectively

Conclusion: Hygiene and sanitation conditions within households were risk factors for diarrhoea. This study revealed the feasibility of developing and implementing an adequate model to establish intervention priorities in sanitation in Ibadan, Nigeria.

Key Words: Diarrhoea, Drinking water, Hygiene Risk Factors, Sanitation, Under five children

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Introduction

Diarrhoeal diseases are among the leading causes of morbidity and mortality in young children in developing countries[1]. Each year, an estimated 2.5 billion cases of diarrhoea occur among children under five years of age, and estimates suggest that overall incidence has remained relatively stable over the past two decades. Africa and Asia account for over half the cases of childhood diarrhoea which is ranked as the fourth leading cause of mortality among under five children in Nigeria [2]. Every single day, Nigeria loses about 2,300 under- five year olds and this makes the country the second largest contributor to the under–five mortality rate in the world. Preventable or treatable infectious diseases such as malaria, pneumonia, diarrhoea, measles and HIV/AIDS account for more than 70 per cent of the estimated one million under-five deaths in Nigeria[3].

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The incidence of diarrhoeal diseases varies greatly with the seasons and a child's age. The youngest children are most vulnerable with incidence been highest in the first two years of life though declines as the child grow older[1]. The infection is endemic and outbreaks are not unusual in Nigeria. In the last quarter of 2009, it was speculated that more than 260 people died of cholera, the acute form of diarrhoea, in four Northern states [4]. The 2010 outbreak of cholera and gastroenteritis in some regions of Nigeria: Jigawa, bauchi, Gombe, Yobe, Borno,Adamawa, Taraba, FCT, Cross River, Kaduna, Osun and Rivers brought to the forefront the vulnerability of poor communities and most especially children to the infection[5].

Lack of safe water, basic sanitation and hygiene may account for as much as 88% of the disease burden due to diarrhoea[6]. Sanitation provision in Ibadan (Nigeria's largest city and capital of Oyo State in the southwest of the country) is grossly deficient, as in most cities in sub-Saharan Africa. Most people do not have access to a hygienic toilet; large amounts of faecal waste are discharged into the environment without adequate treatment; this is likely to have major impacts on infectious disease burden and quality of life[7]. This case control study was therefore designed to determine the hygiene and sanitation risk factors for diarrhoea among Under five Children (U-5C in Ibadan).

Methods

Study area

Ibadan, the capital of Oyo state Nigeria was selected as the study area because of its varied socio-economic condition and access to health care facilities by the residents. Ibadan is the largest city in West Africa and second largest in Africa covering an area of 240km^2. The city is located on longitude 3^{0}5'E and latitude 7^{0}20'N [8]. It is situated 125.5Km inland from Lagos, and is a prominent transit point between the coastal region and the areas to the north. The city ranges in elevation from 150m in the valley area, to 275m above sea level on the major north-south ridge which crosses the central part of the city. It has a population of about 3.8million according to 2006 estimates[9]. The health system in Nigeria is structured along three levels of care: primary, secondary and tertiary. The system is run concurrently such that all the three levels of government - local, state and federal, even though they hold primary responsibility for only one level of the system each, can exceed it and provide services at any of the other two levels of care[10]. All these levels are available in the study area and the facilities selected for this study are secondary and tertiary centres.

Study Design.

This prospective case-control study was carried out in Otunba Tunwase children emergency ward of University College Hospital and Oni Memorial Children's Hospital in Ibadan. 220 children with diarrhoea (cases) and 220 children with malaria and respiratory tract infections (controls) were consecutively recruited over a period of 5 months. Cases of diarrhoea were defined as children under the age of 5 with history of passage of loose bowel stool three or more times within 24 hours while controls were children of the same age with other disease condition except diarrhoea (malaria and respiratory tract infections) presenting in the same health facility.

Sample size determination

The sample size for the study was calculated based on the following assumptions:

1.$P_0 = 0.572$ which is the proportion of the exposure factor (unsafe drinking water) among the controls (from proportion of controls using safe drinking water source (0.428) in Nigeria. (National Population Commission (NPC) [Nigeria] and ORC Macro, 2004).

2. OR = 1.7 which is the Odds ratio of diarrhoea among those not using safe drinking water source, (given that there is 42% reduction in diarrhoea morbidity with safe drinking water source. (EHP, UNICEF/WES, USAID, World Bank/WSP, WSSCC, 2004).

Using these assumptions and probability of type 1 error and type 2 error taken as 1.68 and 0.84 respectively, the sample size was calculated to be 200 each for cases and controls. Allowing a 10% non- respondent rate gives a total of 440 for both cases and controls.

Study population

The study population comprised children under-five years of age who presented with signs and symptoms of diarrhoeal disease in the two selected health facilities. A similar number of 'controls' were randomly selected from children with diseases which are of similar severity to diarrhoea and which are unrelated to the exposure of interest. These were children less than five years with malaria and Acute Respiratory Infection (ARI).

Eligibility criteria for study participants

Inclusion criteria (cases) were: children above one month but less than 5 years of age with permanent residence in Ibadan, who had three or more loose and watery stools within a 24 hour-period in the past one month including the day of visit to the clinic and whose parents are ready to allow home visit if need be.

Exclusion criteria (cases) were: children with non-infectious diarrhoea with mal-absorption disorder such as celiac disease, lactose intolerance, fructose mal-absorption, short bowel syndrome secondary to surgery/

resection of bowel (as diagnosed by their physician) and potential refusal of home visit.

Inclusion criteria (controls) were: children above one month but less than 5 years of age with permanent residence in Ibadan and children who consulted the participating hospitals for non- diarrhoeal complaints in keeping with diagnosis of malaria and acute respiratory infection and whose parents are ready to allow home visit if need be.

Exclusion Criteria (controls) were: children with complaint of diarrhoea in the past one month; children belonging to the same household as the case.

Case selection: Children in the group of one month to 59 months diagnosed by the physician on duty, to have diarrhoea (passage of loose and watery stools at least three times in a 24 hour–period with or without abdominal pain, fever and vomiting) in the past one month including the day of visit to the clinic were selected consecutively over a period of 5 months as cases until a sample size of 220 was achieved.

Summary of Study Participants

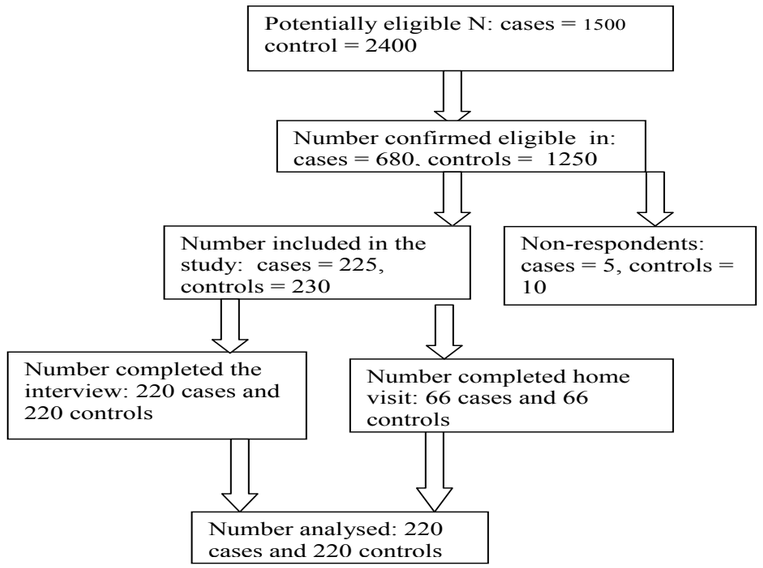

Figure 1: Study Participants

Control selection: Controls included in the study were children in the group of one month to 59 months of age who visited or were admitted at the participating hospitals for non-diarrhoeal diseases specifically malaria and acute respiratory infection during the study period. In order to avoid any gross imbalance in the case distribution, the controls were stratum matched with cases according to age group in months (1-6, 7-12, 13-18, 19-24, 25-30 etc.)

Method and instrument for data collection

A semi-structured questionnaire developed by the research team was administered to mothers/caregivers of recruited cases and controls with the aid of trained research assistants. A pilot test was done at Adeoyo maternity hospital, Yemetu Ibadan after which the final version of the protocol was defined. After receiving their informed consent, a pre-tested, semi-structured questionnaire was administered to mothers/caregivers of recruited cases and controls to elicit information on: socio-demographic characteristics and hygiene practices of mothers/caregivers; child's baseline characteristics; and environmental/sanitation factors in the households. The Hygiene practices were scored between 0 and 3 depending on the type of variable. The hygiene practice score was categorized into unhealthy practice for score below 50th percentile and healthy practice for score within and above 50th percentile. A 10-item observation checklist developed by the research team was used to assess hygiene practices and sanitation conditions in the households of 30% of the consenting mothers/caregivers (66 each) within 24hrs of recruitment. Each visit lasted for 3-4 hours during which an inventory of behaviours, hygiene practices and condition of sanitary facilities (such as water supply, human and solid waste disposal etc.) was recorded.

Data analysis

The results obtained were analysed using t-test, chi-square and logistic regression. Measures of association were expressed as odds ratios (ORs) for disease with their 95% confidence intervals (CIs) for categorical variables.

Results

Caregivers/mothers' mean ages for cases and controls were 31.3 ±7.5 and 30.6 ±6.0 years respectively. More cases (66.4%) than controls (59.5%) did not exclusively breastfeed their children in the first six months of life. Results showed that there were significant associations between diarrhoea incidence among U-5C and: low birth weight (OR=1.67, p=0.018); fathers' education (OR=0.50, p=0.02); parents being married (OR=0.58, p=0.007); low household monthly income (OR=2.11, p=0.000) and increased household size (OR=11.5, p=0.000).

Table 1 shows the socio-demographic characteristics of caregivers / mothers for the cases and controls. All these were similar in both except for the educational and marital status, household income and size where there were significant differences.

Table 1: Relationship between socio-demographic characteristics of caregivers/mothers and diarrhoea disease occurrence among under five children.

Demographic Characteristics	Cases (n = 220)	Controls (n = 220)	OR (95% CI)	P-value
Age in years				
≤30	123 (55.9%)	133 (60.5%)	0.83 (0.57-1.21)	0.334
≥30	97 (44.1%)	87 (39.5%)		
Gender of caregiver				
Female	212 (96.4%)	218 (99.1%)	0.24 (0.05-1.15)	0.055
Male	8 (3.6%)	2 (0.9%)		
Relationship with child				
Mother	196 (89.1%)	207 (94.1%)	0.51 (0.25-1.04)	0.059
[a]Other Caregivers	24 (10.9%)	13 (5.9%)		
Mother's Educational Status				
At least Secondary	163 (74.1%)	179 (81.4%)	0.66 (0.42-1.03)	0.067
[b]Others	57 (25.9%)	41 (18.6%)		
Father's Educational Status				
At least Secondary	185 (84.1%)	201 (91.4%)	0.50 (0.28-0.90)	0.020*
[b]Others	35 (15.9%)	19 (8.6%)		
Marital Status				
Married	129 (58.6%)	156 (70.9%)	0.58(0.39-0.86)	0.007*
[c]Others	91 (41.4%)	64 (29.1%)		
Household income (Naira/Month)				
Low income (<20000)	102 (46.4%)	64 (29.1%)	2.11 (1.42-3.12)	0.000*
≥2000	118 (53.6%)	156 (70.9%)		
Household size				
≥7	21 (9.5%)	2 (0.9%)	11.50 (2.67-49.68)	0.000*
<7	199 (90.5%)	218 (99.1%)		

afather, aunt, grandmother, [b] no formal education, primary, not complete secondary, [c]Single, divorced, separated or widowed, *=p<0.05

Table 2 shows the relationship between cases / controls and baseline factors. All were similar except for birth weights where there were significant differences.

Table 2: Relationship between diarrhoeal disease and child baseline factors

Child's Characteristics	Cases (n = 220)	Controls (n = 220)	OR (95% CI)	p-value
Sex				
Male	113 (51.4%)	102 (46.4%)	1.09(0.75-1.59)	0.633
Female	107 (48.6%)	118 (53.6%)		
Birth Weight(kg)				
< 2.5	70 (31.8%)	48 (21.8%)	1.67(1.09-2.57)	0.018*
≥ 2.5	150 (68.2%)	172 (78.2%)		
Child Exclusively Breastfed				
Yes	74 (33.6%)	89 (40.5%)	0.75(0.51-1.10)	0.139
No	146 (66.4%)	131 (59.5%)		
Birth order				
5th and above	9 (4.1%)	3 (1.4%)	3.09 (0.82-11.55)	0.079
1st – 4th	211 (95.9%)	217 (98.6%)		
Immunization status				
Complete	105 (47.7%)	103 (46.8%)	1.04 (0.71-1.51)	0.849
Others**	115 (53.2%)	117 (53.2%)		

***=p<0.05 **= Not immunized or incomplete**

Table 3 shows the relationship between level of hygiene practice of caregivers/ mothers and diarrhoeal incidence. The results show that the mean hygiene scores are 24.57±4.0326.70±3.26 for cases and controls respectively. There was lower risk of diarrhoea among children having mothers with healthy hygiene practices (OR=0.414, p<0.05).

Table 3: Relationship between level of hygiene practice of caregivers/ mothers and diarrhoeal incidence

Level of hygiene practice on childhood diarrhoea.	Cases (n = 220)	Controls (n = 220)	OR (95% CI)	T	P-value
Healthy (≥26)	100 (45.5%)	147 (66.8%)			
Unhealthy (<26)	120 (54.5%)	73 (33.2%)			
Mean	24.57±4.03	26.70±3.26	0.414	-6.088	0.000*
Min	12	15	(0.281-0.609)		
Max	32	33			

***=p<0.05**

The association between hand-washing practices of caregivers/mothers and diarrhoeal disease incidence is shown in Table 4. The risk of diarrhoea was significantly higher among children whose mothers did not wash hands with soap before food preparation (OR=3.002, p<0.05), before feeding their children (OR=3.011, p<0.05) and after leaving the toilet (OR=4.667, p<0.05).

Table 4: Relationship between hand-washing practices of caregivers/mothers and diarrhoeal disease incidence

Item	Case n= 220	Control n= 220	OR (95% CI)	P-value
Hand-washing before preparing food.				
Always	91 (41.4%)	126 (57.3%)	0.526	0.001*
Others**	129 (58.6%)	94 (42.7%)	(0.360-0.768)	
Hand-washing before food preparation.				
Water only	146 (69.5%)	95 (43.2%)	3.002	
Soap and water	64 (30.5%)	125 (56.8%)	(2.018-4.464)	0.000*
Hand-washing before feeding the child				
Always	120 (54.5%)	139 (63.2%)	0.699	
Others**	100 (45.5%)	81 (36.8%)	(0.478-1.024)	0.066
Hand-washing before feeding the child				
Water only	171 (78.8%)	121 (55.3%)	3.011	
Soap and water	46 (21.2%)	98 (44.7%)	(1.977-4.585)	0.000*
Hand-washing after defecation				
Always	173 (78.6%)	192 (87.3%)	0.537	0.016*
Others**	47 (21.4%)	28 (12.7%)	(0.322-0.895)	
Hand-washing materials				
Water only	80 (36.4%)	24 (10.9%)	4.667	0.000*
Soap and water	140 (63.6%)	196 (89.1%)	(2.816-7.733)	

***=p<0.05 **= Often, Sometimes and Never**

Table 5 shows the response of mothers to household water treatment, safe storage and handling. Even though there was reduced risk of diarrhoea among children whose caregivers/mothers used jars with covers for storing drinking water, analysis showed an increased risk of diarrhoea among children whose caregivers/mothers collected drinking water from the storage by dipping in any container (OR=3.2, p=0.000). The situation was the same for those: sharing toilet with other households (OR=2.1, p=0.001); using paper for cleaning after defecation (OR=2.0, p=0.411); had dirt (OR=3.5, p=0.011) or foul smell (OR=2.4, p=0.001) around their toilets. However, there was a reduced risk of diarrhoea among children whose caregiver/mothers had adequate water for toilet use (OR=0.287, p=0.011) (Table 4).

Table 5: Relationship between reported water treatment options, storage, and handling and diarrhoeal disease incidence.

Variables	Case n=220	Control n=220	OR (95% CI)	Df	P-value
Treatment drinking water					
Yes	68 (30.9%)	90 (40.9%)	0.646 (0.436-0.957)		
No	152 (69.1%)	130 (59.1%)		1	0.029*
Treatment options					
Boiling					
Yes	14 (6.4%)	17 (7.7%)	0.812 (0.390-1.690)	1	0.576
No	206 (93.6%)	203 (92.3%)			
Filtration					
Yes	19 (8.6%)	23 (10.5%)	0.810 (0.428-1.533)	1	0.516
No	201 (91.4%)	197 (89.5%)			
Use of water guard					
Yes	18 (8.2%)	26 (11.8%)	0.665 (0.353-1.251)	1	0.204
No	202 (91.8%)	194 (88.2%)			
Chlorination					
Yes	20 (9.1%)	26 (11.8%)	0.746 (0.403-1.381)	1	0.350
No	200 (90.1%)	194 (88.2%)			
Decantation					
Yes	10 (4.5%)	20 (9.1%)	0.476 (0.218-1.042)	1	0.059
No	210 (95.5%)	200 (90.1%)			
Storage/container for drinking purpose					
Jar with cover	37 (17.9%)	56 (28.6%)	0.592 (0.372-0.943)	4	0.027*
Big plastic container	79 (38.2%)	83 (42.3%)			(1)
Small plastic container	80 (38.6%)	52 (26.5%)			
Metal tank	7 (3.4%)	4 (1.9%)			
Clay pot	4 (1.9%)	1 (0.5%)			
Material for collecting drinking water from storage					
Cup with handle	84 (40.6%)	128 (65.3%)			
Use of tap	12 (5.8%)	3 (1.5%)			
By pouring	35 (16.9%)	34 (17.3%)			
Dipping in any container	76 (36.7%)	31 (15.5%)	3.218 (2.010-5.151)	3	0.000*

*=p<0.05

The results (Table 7) also showed that there was increased risk of diarrhoea among children whose caregivers/mothers used community dumping method (OR=1.7, p=0.011) as against those using government waste management outfit (OR=0.63, p=0.022). Also, there was increased risk of diarrhoea among children with clogged drainage near or around their house (Table 6). There was also a statistical association between diarrhoea among U5-C and presence of breeding places for flies/insects (OR=3.7, p=0.000) and having animals near/around the house (OR=1.7, p=0.005).

Table 6: Relationship between reported excreta disposal method of caregivers/mothers and diarrhoeal disease incidence among under five children.

Human waste disposal	Cases N=200	Controls N=220	OR (95% CI)	df	P-value
Latrine available in the house					
Yes	205 (93.2%)	211 (95.9%)			
No	15 (6.8%)	9 (4.1%)	0.583 (0.250-1.362)	1	0.208
Latrine type					
Pit	78 (38%)	61 (28.9%)	1.432 (0.956-2.145)	3	0.081
Aqua privy	1 (0.5%)	1 (0.5%)			(1)
Pour flush	23 (11.2%)	17 (8.1%)			
Water closet	103 (62.6%)	132 (62.6%)			
Latrine for more than one household					
Yes	166(81%)	70 (33.2%)	2.113 (1.345-3.319)	1	0.001*
No	39 (19%)	141 (66.8%)			
Latrine condition					
Adequate ventilation					
Yes	188 (91.7%)	200 (94.8%)	0.608 (0.278-1.332)	1	0.210
No	17 (8.3%)	11 (5.2%)			
Adequate water					
Yes	189 (92.2%)	206 (97.6%)	0.287 (0.103-0.798)	1	0.011*
No	16 (7.8%)	5 (2.4%)			
Dirt around					
Yes	16 (7.8%)	5 (2.4)	3.488 (1.253-9.705)	1	0.011*
No	189 (92.2%)	206 (97.6%)			
Faeces on the floor					
Yes	7 (3.4%)	0 (0%)	0.966	1	0.007*
No	198 (96.6%)	211 (100%)			(No)
Wet floor					
Yes	31 (15.1%)	20 (9.5%)	1.701 (0.935-3.096)	1	0.079
No	174 (84.9%)	191 (90.5%)			
Foul smell					
Yes	45 (22%)	22 (10.4%)	2.416 (1.392-4.195)	1	0.001*
No	160 (78%)	189 (89.6%)			
Clean surrounding					
Yes	172 (83.9%)	187 (88.6%)	0.669 (0.380-1.177)	1	0.161
No	33 (16.1%)	24 (11.4%)			

*=p<0.05

Table 7: Relationship between reported solid waste disposal method of caregivers/mothers and diarrhoeal disease incidence.

Method of solid waste disposal	Cases N=220	Controls N=220	OR	P-value
Community dumping				
Yes	74 (33.6%)	50 (22.7%)	1.723 (1.131-	
No	146 (66.4%)	170 (77.3%)	2.627)	0.011*
Burning				
Yes	86 (39.1%)	80 (36.4%)	1.123 (0.764-	0.555
No	134 (60.9%)	140 (63.6%)	1.652)	
Pit				
Yes	6 (2.7%)	1 (0.5%)	6.140 (0.733-	0.057
No	214 (97.3%)	219 (99.5%)	51.430)	
Collected by garbage truck				
Yes	66 (30%)	89 (40.5%)	0.631 (0.425-	0.022*
No	154 (70%)	131 (59.5%)	0.936)	
Throw into nearby river				
Yes	10 (4.5%)	15 (6.8%)	0.651 (0.286-	0.303
No	210 (95.5%)	205 (93.2%)	1.482)	

*=p<0.05

Table 8: Relationship between diarrhoeal incidence and reported wastewater disposal method and housing sanitation of caregivers/mothers.

Variables	Cases N=220	Controls N=220	OR	P-value
Wastewater disposal				
Wastewater is managed by use of				
Hygienic (Drainage, Soak away pit)	179 (81.4%)	196 (89.1%)		
Unhygienic (others)	41 (18.6%)	24 (10.9%)	0.535 (0.311-0.920)	0.022*
Clogged drainage around or near the house				
Yes	91 (41.4%)	40 (18.2%)	3.174 (2.054-4.905)	0.000*
No	129 (58.6%)	180 (81.8%)		
Housing sanitation				
Breeding places for flies/insects near the house				
Present/dirty	106 (48.2%)	44 (20%)	3.719 (2.436-5.679)	0.000*
Absent/clean	114 (51.8%)	176 (80%)		
Domestic animals near/around the house				
Present	114 (51.8%)	85 (38.6%)	1.708 (1.169-2.495)	0.005*
Absent	106 (48.2%)	135 (61.4%)		

*=p<0.05

Discussion

This study identified six important risk factors (among others) that could predispose U5-C to the incidence of diarrhoea. The factors include: poor drinking water handling; lack of hand- washing with soap after defecation and before food preparation; clogged drainage around or near the house; breeding places for flies/insects near the house; and total hygiene practice level.

Poor handling of drinking water was significantly associated with increased risk of childhood diarrhoea. Oloruntoba and Sridhar[11] concluded in one of their studies in Ibadan that bacteriological quality of drinking water significantly deteriorated at the household level after collection and storage as a result of poor handling. Trevett at al.,[12] reiterated that there are multiple points between drinking water collection and use sequence where pollution could occur. Also, Jagal et al[13] identified unhygienic domestic water handling practices as possible sources of household drinking water contamination. Jinadu et al[14] in a study carried out in Ondo state of Nigeria revealed that poor storage of drinking water was significantly associated with the high incidence of childhood diarrhoea. Knight et al[15] also stated that regardless of where or how the water is collected, storage in vessels with wide openings such as pots or buckets easily allow contamination with faeces through introduction of cups, dippers, or hands.

Simple hygiene behaviours, especially hand-washing with soap, have been suggested to reduce the occurrence of water-washed infections. The outcome of this study about the association between inadequate hand-washing with 'water and soap' and incidence of diarrhoea disease among U5-C is in line with various studies[16 - 18] concluded that hand- washing practice of mothers before food preparation was associated with a lower risk of diarrhoea among children. Also, a case-control study by Nguyen[19] demonstrated that the incidence of diarrhoea among children was significantly higher in families where mothers less often washed their hands before feeding their children. Takanashi et al[20] also demonstrated that the risk of diarrhoea was higher among children whose mothers do not always wash their hands with soap before feeding (Adjusted OR=1.38, CI=0.34-5.61). Also, a study on maternal hand-washing behaviour in relation to disposal of faeces and feeding of children by Omotade et al.,[21] revealed that hand-washing behaviours after cleaning a child who just defecated and after disposal of faeces were observed only in 29.3% episodes, while hand-washing before feeding the child occurred in 12.4% of observations.

This study also revealed that availability of water for anal and hand cleaning after using the toilet, presence of dirt and faeces on toilet floors, and foul smell around the toilet were important factors predisposing children to diarrhoea. Knight et al[15] reported in a case- control study carried out in rural Malaysia that having no latrine in the house was not associated with diarrhoea, (OR=1.7, $p>0.05$) while unavailability of water for washing the anus and hand in those houses which had latrine was significantly associated with diarrhoea (OR=2.8, $p<0.05$). The result of sanitary inspection of toilet within selected households corroborated this. Most toilets smelled due to the fact that these facilities were not always flushed or washed immediately after use; thus attracting houseflies and suggesting poor hygiene practices. The presence of these flies and faecal matter on the toilet floor are potential risk factors for diarrhoea and other faecal-oral disease transmission. Ekanem et al[22] also reported that presence of faeces around households in Iwaya community, Lagos, Nigeria was associated with significant increase in diarrhoeal incidence.

During the study, it was also discovered that some households kept their waste bins in the house while others kept theirs in the perimeter of the houses. Most waste bins were not covered and therefore attract houseflies. The poor waste handling methods exposes children to risk of contamination of food by flies. This might have been responsible for the increase in incidence of diarrhoea U5-C selected for the study as it is an important aspect of faecal-oral route of disease transmission. Similar to this finding, Ekanem et al[22] reported in a study carried out in Iwaya community of Lagos state that indiscriminate disposal of solid waste was associated with significant increase in diarrhoeal incidence.

The environmental sanitation in the selected household was very poor. Forty one per cent of cases as against 18% of controls had clogged drainages around or near the house. The percentage of cases with breeding places for flies/insect near the house and domestic animals near/around the house was also higher for cases than controls. All these showed lack of adequate environmental sanitation which could trigger transmission of faeco-oral diseases such as diarrhoea. This study is in line with the finding of Huangprasert et al[23] that housefly breeding places, housefly control and its aggravating conditions such as wastewater drainage and cattle excreta in the perimeter of the house were most influential factors associated with diarrhoea. Heller et al[24] also reported a significant association between presence of vectors in the house and incidence of diarrhoea. Knight et al[15] also reported presence of animals inside the house to be significantly associated with diarrhoea.

Limitations

The fact that severity of the dependent variable diarrhoea was not accessed in this study coupled with selection of 30% of the participants for home visit to observe the environmental sanitation conditions of households are potential limitations of this study. The latter might have resulted in an underestimation of the established risk. Also, following recruitment it was possible that participants might have gone home to tidy up their environment. However this was circumvented to some extent by visiting participants homes within 24 hours of recruitment and not given definite period for visitation.

Conclusion

The study revealed poor drinking water handling and storage within household, hand-washing without soap before food preparation and after defecation are major risk factors for diarrhoea among children less than five years. Inadequate sanitation factors such as presence of clogged drainage near/around the house and breeding places for flies/insects near the house increase the risk of diarrhoea among children less than five years. In all, hygiene practice among the mothers/caregivers of children with diarrhoea was poor. The study concludes that improvement in hygiene; water handling practices and sanitation within households are important factors in the elimination of diarrhoea.

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Conflict of Interest Disclosure

The authors declare that there was no conflict of interest during this study

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