EPIDEMIOLOGY OF DIARRHEAL DISEASES AMONG CHILDREN AGED LESS THAN 5 YEARS IN SHENDAM LOCAL GOVERNMENT AREA OF PLATEAU STATE, NIGERIA

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Abstract

Diarrheal diseases remain one of the major causes of high morbidity and mortality among children aged less than 5 years in sub-Saharan Africa. Epidemiological data on the disease provides additional knowledge on the treatment/management approach and public health information on the preventive measures. A total of 420 stool specimens were analyzed by standard methods. 14 different enteropathogens were identified. Entamoeba histolytica and Salmonella spp predominate in both the diarrheic and control patients, 71(32.3%) vs 15(24.6%) and 39(17.7%) vs 10(16.4%), while the helminthes (Ascaris, hookworm, Taenia spp and Hymenolepis nana) featured prominently among the control patients. The prevalence of enteropathogens and diarrheic cases peaked among children within the age-group 25-36 months. Demographic characteristics of the mothers showed that age-group and educational status, exclusive breast feeding, source of water and toilet used were statistically significant (<0.01). In conclusion, though the enteropathogens identified were in agreement with other studies, the high prevalence of rotavirus and candida spp are of public health concern because of the associated health implication. The high prevalence of helminths among the control patients requires an aggressive deworming programme in the community.

Keywords: Diarrheal, children, enteropathogens, epidemiology, Shendam LGA, Nigeria

{Citation: Aguoru CU, Okafor CI, Amuta EU, Denue BA, Ladan J, Onah JO, Okon KO. Epidemiology of diarrheal diseases among children aged less than 5 years in Shendam local government area of Plateau State, Nigeria. American Journal of Research Communication, 2015, 3(2): 50-66} www.usa-journals.com, ISSN: 2325-4076.

Introduction

Diarrheal disease is one of the most common clinical episodes that are frequently seen in both hospital and community setting worldwide. However, the incidence is higher in developing countries of Asia and sub-Saharan Africa among children aged less than 5 years, resulting in high morbidity and mortality (Kosek et al, 2003). It is acquired through faeco-oral route, contact or exposure to contaminated water and food, poor sanitary conditions and improper disposal of human and animals waste. The WHO reports approximately 16% of death in sub-Saharan African children under 5years is attributed to diarrheal diseases (Snyder and Merson 1982, Bern et al, 1992, Reither et al, 2010). However, in community with improvement in their personal hygiene, sanitation and provision of portable water, had recorded a reduction in the incidence of diarrheal diseases.

Etiological agents responsible for diarrheal diseases are diverse, which includes, bacterial pathogens, parasites, viruses and fungi (Guerrant et al, 1990,Reither et al 2010), however, the prevalence of the etiological agents varies with geographical locations, meteorological characteristics, severity of infections, and laboratory techniques employed (Reither et al, 2010).

In diarrhea episode, the excessive loss of body fluid alters the hemostasis; in some cases could results in high morbidity and mortality. The WHO initiative of Oral Rehydration Therapy (ORT), which involves body fluid and electrolyte replacement and stabilization of hemostasis, had achieved tremendous success in both rural and urban setting. Consequently, epidemiological understanding of the enteropathogens associated with diarrheal diseases and community-based predisposing risk factors become imperative as baseline for effective treatment /management and public health preventive approach.

Shendam, is a semi-cosmopolitan town and the headquarter of the local government authority in Plateau state of Nigeria. Meteorological characteristic of Shendam is similar to that Jos, the state capital, which is relatively temperate year round. Majority of the peoples are mainly farmers, involved in cultivation of tubers and domestication of ruminant animals like cattle, sheep, goat and pigs for economic purposes. The study examined the epidemiology of diarrheal diseases among children aged less than 5 years in Shendam local government of Plateau state, Nigeria.

Methodology

Study site: This cross-sectional descriptive study was conducted in 2 hospitals in Shendam local government of Plateau state Nigeria, between July and December, 2013. A total of 320 diarrheic patients aged less than 5 years were recruited from the two hospitals. The children were reviewed by the attending physician in the hospitals and referred to the laboratory for stool analysis. 100 apparently age-matched control patients with no evidence of diarrhea were recruited from two primary schools in the same Shendam LGA. Demographic variables presented in study questionnaires were administered by interview on the mothers, and the information entered into the study database accordingly. The stool specimens were collected in sterile McCartney bottle, divided into 2 for immediate culture and examination (2g) and for virological studies (1g diluted 1:5 in phosphate buffered saline).

Microscopic examination: This was used to detect the ova and trophozoites of parasites and was carried out by Formol- ether concentrate, and modified Kinyoun's acid-fast stain for Cryptosporidial oocyst. Rotavirus was detected by preparing a 10% suspension of each fecal sample in phosphate buffered saline (PH7.4) and centrifuging at 2000g for 15 minutes. The fecal supernatant collected was tested for the presence of rotavirus antigen using a latex slide agglutination method (Cowan, 1974).

Fecal samples were cultured for pathogenic *E. coli, Salmonellae, Shigellae,* and *Candida spp* on the following media: Oxide MacConkey agar, Sorbitol MacConkey agar, Desoxycholate citrate agar (DCA), Xylose desoxycholate citrate, agar (XDCA), Salmonella, Shigella (SS) agar, Thiosulphate citrate Bile salt (TCBS) agar and Sabouraud's dextrose agar. Specimens were also innoculated into Phosphate Buffered Saline (PBS). All innoculated media were incubated at 37^{o}C for 18-24h. Presumptive bacterial colonies were identified by standard methods (Kelly et al, 1985).

Data Analysis

The demographic variables and identified enteropathogens were collated and analyzed, using SPSS version 16.0. The values were expressed in means and percentages. Comparison of demographic variables was determined by chi-square test. The level of significance of $p<0.05$ was employed

Results

A total of 420 fecal specimens were analyzed (n=320, % diarrheic, n=100, % control), 281(66.9%) yielded at least one enteropathogens and 139(33.1%) no pathogens identified. The mean age of diarrheic patients was 24.3+10.3 months and 35.14+10.4months for control patients. Gender distribution, diarrheic patients, 125(56.8%) were males and 95(43.2%) females, giving M:F ratio of 1:1.3, while control patients, 36(59.0%) males and 25(41.0%) females(<0.001).The demographic characteristics of the mother of diarrheic and control patients as entered into the study questionnaires and analyzed (table 1), the age-group, educational background of the mothers, exclusive breastfeeding status of the child, source of water and type of toilet used were statistically significant(<0.01).

A total of 14 different enteropathogens were identified, 9(64.3%) parasites, 3(21.4%) bacterial pathogens and 1(7.1%) each of rotavirus and fungi respectively. Entamoeba histolytica and Salmonella spp predominate in both diarrheic and control patients, 71(32.3%) vs 15(24.6%) and 39(17.7%) vs 10(16.4%). High prevalence of hookworm, E.coli, S.aureus, rotavirus and Candida were recorded in diarrheic patients as presented in figure 1. The prevalence of enteropathogens identified as presented in table 2, showed an increasing trend of enteropathogens with the age-group that peaked at 25-36months in both cases, diarrheic cases <12months(21.4%), 12-24months(22.3%) and 25-36months(23.2%) versus 12-24months(1.6%) and 25-36months(50.8%) in control patients. E. histolytica, hookworm, bacterial pathogens, rotavirus and candida spp featured prominently within these age-group of diarrheic patients , in contrast to E. histolytica , Giardia lamblia, helminthes, Salmonella spp and Candida spp among the control patients.

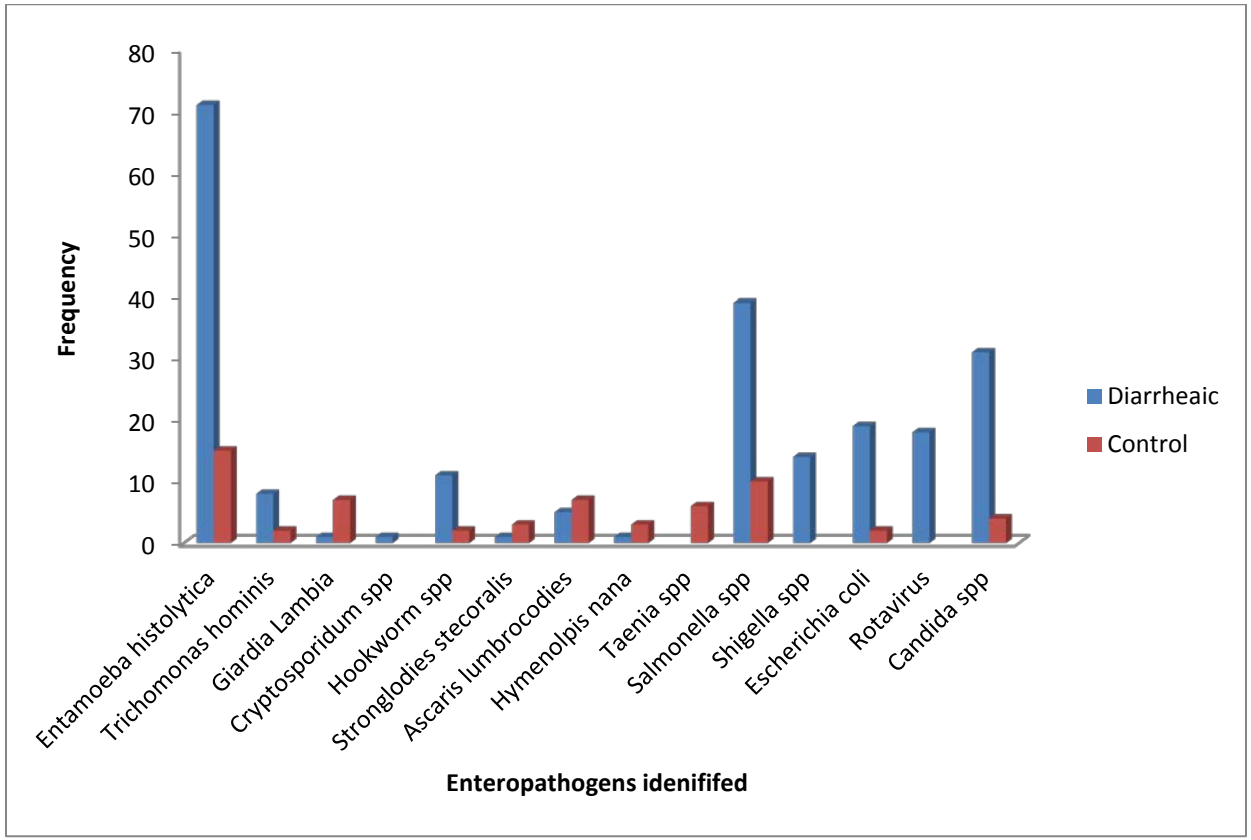

Figure 1: Frequency of occurrence of enteropathogens in diarrheal and control subjects.

Table 1: Demographic variables of diarrheal and control subjects

Demographic variables	Diarrheal	Control	p-value
Mother age-group			
<20years	39	5	
20-30	86	25	0.001
31-40	80	30	
41-50	13	1	
>50	2	-	
Occupation			
Civil servant	54	10	
Farmer	80	25	
Trader	62	6	0.07
Housewife	24	20	
Education status			
Primary	80	14	0.01
Secondary	91	31	
Tertiary	40	16	
Marital status			
Married	153	41	
Divorced	35	8	0.61
Widow	32	12	
Family size			
Monopoly	150	18	0.4
Polygamy	70	53	
Position of the child			
1	22	37	
2	38	11	0.06
3	69	5	
4	91	8	
Child care giver			
Mother	79	15	
Sibling	129	10	0.56
Nanny	12	36	

Breastfeeding practice			
Exclusive	146	43	0.01
Inclusive	74	18	
Toilet used by the children			
Water system	70	8	
Pit	60	35	0.01
Bush	50	10	
Poe	40	8	
Source of water			
Tap	147	10	
Well	53	36	
Pond	20	15	

Discussion

In this study, the overall prevalence of enteropathogens identified was 68.9% from diarrheic patients and 61% from control patients. The high prevalence level of 68.9% is consistent with the levels reported in Nigeria (Ogunsanya et al, 1994, Akinyemi et al, 1998, Olowe et al, 2003, Okon et al, 2014). Although, higher prevalence level(>70%) have been reported in other studies in Ghana (Reither et al, 2010), Tanzania(Vargas et al 2004, Moyos et al 2011) and in Asia(Nair et al 2010). Several factors may contribute to the observed variation in the prevalence level of enteropathogens such as geographical location, studied population, seasonality and laboratory methods employed.

Table 2: Enteropathogens Versus age-group (months) of diarrheic and control subjects

	Diarrheic						Control				
	<12	**12-24**	**25-36**	**37-48**	**49-60**	**Total**	**12-24**	**25-36**	**37-48**	**49-60**	**Total**
Parasites											
Entamoeba histolytica	14	11	18	10	18	71	1	8	5	1	15
Trichomonas hominis	2	-	3	2	1	8	-	2	-	-	2
Giardia lamblia	-	1	-	-	-	1	-	4	2	1	7
Cryptosporidium spp	-	1	-	-	-	1	-	-	-	-	-
Hookworm	1	1	5	3	1	11	-	1	1	-	2
Strongylodies stercoralis	-	1	-	-	-	1	-	3	-	-	3
Ascaris lumbricoides	-	4	1	-	-	5	-	4	1	2	7
Hymenolepis nana	-	-		-	1	1	-	-	1	2	3
Taenia spp	-	-	-	-	-	-	-	2	1	3	6
Bacteria											
Salmonella spp	6	10	7	2	14	39	-	5	4	1	10
Shigella spp	5	3	3	-	3	14	-	-	-	-	
Escherichia coli	4	3	3	3	6	19	-	-	1	1	2
Virus											
Rotavirus	7	6	4	1	-	18	-	-	-	-	
Fungi											
Candida spp	8	8	7	2	6	31	-	2	1	1	4
Total	47(21.4)	49(22.3)	51(23.2)	23(10.5)	50(22.7)	220	1(1.6)	31(50.8)	17(27.9)	12(19.7)	61

Apart from the geographical location and others factors, age, gender, demographic variables, clinical conditions also influenced the prevalence level and outcome of diarrheal infection (Nair et al 2010). In this study, 14 different enteropathogens were identified, which has been reported in other studies but differs in the percentage frequency (Ogunsanya et al, 1994, Reither et al 2010, Nair et al 2010 Okon et al, 2014). In our study, Entamoeba histolytica and Salmonella spp predominate in both diarrheic and control patients,

in contrast to Entamoeba histolytica and E.coli reported in most documented studies in Nigeria (Ogunsanya et al 1994 , Olowe et al 2003, Okon et al 2014), and other African countries (Moyo et al Rethier et al 2010). In Asia, Vibrio cholera, Shigella, Campylobacter spp and rotavirus are the most frequently reported pathogens in most studies, depending on the geographical location and seasonality (Nair et al, 2010).

Although, Salmonella spp accounts for 17.7% of the total enteropathogens identified, the level is higher than what was reported in other studies (Nair et al 2010, Ansari et al 2012, AlAyed et al, 2013, Okon et al 2014). In contrast, the prevalence of E.coli (8.6%) is lower when compared to similar studies. In a typical African settlement and community, domestication of ruminant animals forms a part of family and source of economic income. Over the years, zoonotic infections are emerging trends in public health globally, responsible for high morbidity and mortality rate. The public health attention of zoonotic infection is associated with increase prevalence of multidrug resistant pathogens like methicillin resistant Staphylococcus aureus and Extended spectrum beta-lactamase producing gram-negative bacteria in ruminant animals worldwide. In this study, 39(%) and 10(%) Salmonella spp were identified in both diarrheic and control patients, this relatively high level may be attributed to zoonotic infection as human salmonellosis have been associated with close proximity with domestic ruminant, particularly, Salmonella typhimurium (Adesiyun et al, 1993). Similarly, the public health implication of E.coli in gastroenteritis and diverse clinical conditions has also been well documented. The E.coli prevalence rate of 19(8.6%) in diarrheic patients should be considered a public health concern, because of its clinical consequences, which is its association with hemolytic uremic syndrome in children.

The association of Shigella spp with diarrhea has been documented in many similar studies (Vargas et al, 2004, Moyos et al 2010), but the frequency varies and the serotypes. Different Shigella serotypes have been reported in diarrheal studies in Asia (Wasito et al 1999, Nair et al 2010), while Shigella flexneri serotype in Tanzania (Vargas et al 2004). Basically, high level of shigellosis is an indicator of poor sanitary condition of the community (Datta P et al 1999, Albert et al 1999). The prevalence rate of 6.8% in this study is higher than level in Saudi Arabia (Nair et al 2010, AlAyed et al 2013).

Cryptosporidium, is a zoonotic parasite associated with childhood diarrhea worldwide, but the prevalence varies with many studies(Reither et al 2010, Moyo et, Vargas et al).In this study, only one isolate was recorded compared to high prevalence level in other studies(Ogunsanya et al 1994, Reither et al 2010, Moyos et al,2011).

Rotavirus is one of leading cause of childhood diarrhea in Africa, responsible for a high mortality rate of approximately 145,000death/year. (Vargas et al, 2004). In this study, the rotavirus prevalence rate was 8.2%, which is lower when compared to studies in conducted in Africa (Ogunsanya et al, 1994, Vargas et al, 2004, Reither et al 2010). Even though, meteorological characteristic influenced the isolation rate of rotavirus, as other enteropathogens associated with diarrhea diseases, laboratory techniques and quality of clinical specimens plays an important role. Of public health concern, is the relatively high prevalence of Candida spp isolated from both diarrheic and control patient. Even though Candida is commonly associated with opportunistic infections, the study questionnaire did not evaluate the immune status of the mother and the child.

In the breakdown of the enteropathogens, we observed high prevalence of E. histolytica, hookworm, bacterial pathogens, rotavirus and candida spp among the diarrheic patients compared to helminths among the controls patients. The helminths (Ascaris, Taenia, hookworm, Hymenolepis nana) have been closely associated with ruminant animals like cattle, goat, sheep and pig that are locally domesticated for economic purposes, which raise the possibility of zoonotic infections. From public health perspective, the result among the control patients revealed that helminthiasis is endemic in the community. High helminthic infections in children have been known to cause under nutrition, anemia, cognitive impairment and related organ-dysfunction (Booker et al 2007). Therefore, public health approach to this problem is anti-helminthic program by providing deworming drugs to all children less than 5 years within the community.

As observed in other studies, age and gender factors are known to influence the epidemiological pattern and outcome of diarrheal diseases. In our study, we found out that the prevalence level of diarrheal disease and associated enteropathogens peaked at 36 month in diarrheic and control patient. Factors that might be play a part in such epidemiological pattern are, (i)susceptibility of the children to enteropathogens infection due to relatively low level of maternal antibodies (Sherchand et al 2009),(ii) continuous exposure and contact with contaminated food and water due to lack of parent protection and (iii) low level of hygiene in most community. Also, we recorded high prevalence of diarrheal and enteropathogen among the male, with a male to female ratio of 1:1.3 which is consistent with other studies (Alayed et al, 2013, Okon et al 2014).

In evaluating the effect of community based demographic variables as predisposing risk factors for the development of diarrheal disease, the age-group and educational status of the mothers, breast feeding practices, source of water and type of toilet used were highly significant(<0.01). Primarily, diarrheal is known to be acquired by faeco-oral route through contaminated food and water. We are of opinion that the public health knowledge of the mothers and guardian of the children, in the area of improvement in personal hygiene and provision of portable water to the children are the cardinal preventive approaches (Khourby et al 2011, Youssef et al 2000). In studies conducted in Saudi Arabia, they found out that there is a relationship between the prevalence of diarrheal diseases and the mother educational status and age (Moawed and Saeed 2000, Bani et al 2002). Therefore, the public health knowledge of the mothers may play a pivotal role in interrupting diarrheal diseases transmission chain in the communities.

In conclusion, the findings had revealed diverse range of enteropathogens associated with diarrheal diseases and its demographic characteristics. The epidemiological information provided is of valuable indices for health care workers and public health educationist in the treatment, management and policy formulation for effective preventive measure in the community setting. With particular reference to the high prevalence of helminthiasis and candidiasis among the control patients, this requires urgent public health intervention because of clinical and societal consequences. However, in such community based study, there are limitations, (i) answers provided during interview might not be correct as it bears on their social and family status, (ii) the health status of control patient were not fully evaluated as evident in the prevalence of candida spp and (iii) the possibility of pre-medication before collection of fecal specimen cannot be verified.

Acknowledgements

We acknowledged the staff and management of the hospital and school where the stool specimens were collected from, and support from the parents and guardian of the children in providing the demographic information used in the study.

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