Global Journal of Public Health and Epidemiology

ISSN: xxxx-xxxx Vol. 1 (1), pp. 027-031, December, 2013. © Global Science Research Journals

Full Length Research Paper

Cryptosporidiosis among children in some rural parts of Imo state, Nigeria

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Accepted 10 September, 2013

The public health importance of cryptosporidiosis has not been widely reported among rural children in Imo State, South Eastern Nigeria. The prevalence of cryptosporidiosis among children was assessed in some rural parts of Imo State, Nigeria between November 2006 and October 2007 using standard parasitological techniques. Stool specimens from consenting subjects accessing primary health care facilities in the area were prepared using formalin/ether concentration methods, stained with modified acid fast stain and examined microscopically for oocyst of *Cryptosporidium parvum*. The overall prevalence of 14.3% was recorded. No oocysts were identified in asymptomatic control group (n=20). More male children (15.4%) were infected than female (13.4%) ($p<0.05$). The highest prevalence (20.3%) was noted among children within the age group of 0 to 5 years, while those within the age group of 11 to 14 years yielded the least prevalence (11.5%). Prevalence decreased as age increased ($p<0.05$). More so, infection was more prevalent among children in primary schools (16.4%) followed by those in daycare centres (14.5%), while those in post primary schools yielded the least (6.7%) prevalence. Prevalence rates of 13.4 and 13.9% were recorded for children at home (not enrolled into school) and nursery schools, respectively. There was significant difference as regards school related prevalence rates ($p<0.05$). The present results show that cryptosporidiosis poses a public health challenge in children found in the rural parts of Imo State, Nigeria, though it has not attained epidemic proportion. This warrants intensified effort towards awareness of the disease and its public health significance as well as prevention and control strategies in the area.

Key words: Cryptosporidiosis, widely reported, rural children.

INTRODUCTION

Cryptosporidiosis is a parasitic disease caused by an ampicomplexan protozoon of the genus *Cryptosporidium*. In humans, the specific infective agent is *Cryptosporidium parvum*. The disease affects the microvillus regions of epithelial cells lining the respiratory and digestive organs of vertebrates (Fayer and Ungar, 1986; O'Dongue, 1995). Cryptosporidiosis is acute but self limiting in immuno-competent individuals generally abating within 8 to 10 days (Fayer and Ungar, 1986; Juranek, 1995). Conversely, the illness may manifest as gastrointestinal infection and eventually results to death in immuno-compromised individuals. Potential sources of infection include pets and farm animals, association with individuals already infected, contaminated foods and

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water while transmission is via fecal-oral route. *C. parvum* being the specific infective agent has also been noted as an important etiologic agent of diarrheoa especially in young children (Mbanugo and Agu, 2006). It is the only coccidian parasite known to infect man (Curds, 1992). First identified in laboratory mice early in the last century, it was considered unimportant and virtually ignored for the next 60 years. The first human case of cryptosporidiosis was reported by Meisel et al. (1976), but the awareness of the public health importance of the organism came to the fore in 1980s, partly due to its association with HIV/AIDS infected individuals.

Numerous outbreaks of cryptosporidiosis have been reported among children in day-care centres (Alpert et al., 1984). Similarly, outbreak traceable to contaminated water has also been reported (Current, 1999). In Nigeria, public health importance of cryptosporidiosis has not been widely reported. It is true that several studies have been carried out focusing on the prevalence and epidemiology of the disease in some parts of the country (Okafor and Okunji, 1994, 1996; Nwabuisi, 2001; Njoku, 2003; Banwart et al., 2003; Mbanugo and Agu, 2006; Dozie et al., 2011), yet these reports are not enough for a detailed understanding of the epidemiological profile of the disease among children in southeastern part of Nigeria, hence the present study, which was designed to fill this gap especially in Imo State. It is expected that the outcome of this study will be useful in appreciating the public health implications of the disease especially among children in the area. It will also provide baseline information on prevention and control strategies especially among children.

METHODOLOGY

Study area

This cross-sectional study was carried out between November 2006 and October 2007 in some rural parts of Imo State, Nigeria. Imo State which is located in South Eastern Nigeria lies between latitude 5 10` and 5 51`North, longitutude 6 35` and 7 28` east and comprises 27 local government areas with a total land mass area of 5,289.49 km^2 and a total population of 3,928,634 (Imo State Statistical Year Book, 2011). The mean annual rainfall is between 1800 and 2500 mm per year while the average relative humidity is about 74%. Farming is a predominant occupation among the rural dwellers. Three primary health care facilities from each of the three senatorial zones (Owerri, Orlu and Okigwe) making up the state were enlisted as the study sites. These facilities were selected because they serve primary health purposes and are therefore a good contact point for symptomatic patients required for this study.

The sources of drinking water in the study area include streams, ponds (mostly in dry season), boreholes and sachet water. Pipe borne water supply was unavailable in the area. General sewage disposal in the area and environmental sanitation favours transmission of infectious pathogens. Animal to person contact takes place, as many residents have pets and other domestic animals. In some cases faecal materials inadvertently contaminate sources of drinking water. Furthermore, the use of bush/grassland near human habitation for such purposes as defecation is common. Sometimes children are forced by circumstances to defecate in nearby vegetable gardens which serve as sources of food. Pit latrines were also used for defecation in this area.

Participants and specimens

A total of 400 children (3 months to 14 years) comprising of 162 (40.5%) males and 238 (59.5%) females of different age groups who presented with diarrhoea and/or abdominal pains at the selected primary health facilities between November 2006 and October 2007 participated in the study. The samples collected for the investigation included diarrhoeic stool samples. At these same health facilities, 20 control patients with normal stools and without abdominal pain were also recruited and specimens were also collected from them. This control group was of the same age group (3 months to 14 years) with the study participants and from the same geographical location with the study group.

Sample collection

Fresh stool samples uncontaminated with urine were collected from the participants for examination. The specimens were collected using a dry sterile leak-proof plastic ice packed containers, washed free of traces of antiseptics and disinfectants. About 25 g of solid stool or 10 g of diarrhoeal stool was collected from each subject using specimen bottles containing 10% buffered formalin and/or storage medium containing aqueous potassium dichromate (2.5% w/v final concentration). The specimens were transported to the laboratory after collection and processed within 48 h.

Adequate precaution was taken by preserving the specimen in 10% buffered formalin (SAF) to render the oocysts nonviable, because the oocyst of *Cryptosporidium* species in stool specimens (fresh storage media) remain infective for extended periods of time. In addition, the usual safety measures (wearing of hand gloves, avoiding oral contact) for handling potentially infectious materials were adopted.

Macroscopic examination

The samples were examined macroscopically to note their colour, consistency (whether formed, soft or watery), presence of blood or mucus, and if blood was present, whether it was mixed with the faeces and whether the specimen contained adult worms.

Specimen processing and staining of smears

Stool specimens were concentrated prior to staining and microscopic examination in order to maximize oocyst recovery. Formalin-ethyl acetate sedimentation technique was the stool concentration method used (Ukaga et al., 2002). A drop of the deposit from the concentration technique was placed on a glass slide, air-dried, fixed with alcohol and stained with modified acid-fast staining and examined under the microscope using oil immersion objective. Oocyst of *C. parvum* if present appears as red round bodies against a blue-green background.

Data collection

Demographic, behavioral and environmental data was collected using researcher administered questionnaires.

Ethical consideration

The Institutional Review Board (IRB) of Imo State University Owerri

Table 1. Gender related prevalence of cryptosporidiosis among the population studied.

Gender	N	n	Prevalence (%)
Male	162	25	15.4
Female	238	32	13.4
Total	400	57	14.3

N=number examined, n=number infected.

Table 2. Age related prevalence of cryptosporidiosis among the population studied.

Age	N	n	Prevalence (%)
3 Months-5 years	59	12	20.3
6-10 years	202	29	14.4
11-14 years	139	16	11.5
Total	400	57	14.3

N=number examined, n=number infected.

Table 3. School related prevalence of cryptosporidiosis among the population studied.

Level of education	N	n	Prevalence (%)
Home(not enrolled)	67	9	13.4
Daycare	76	11	14.5
Nursery	93	13	13.9
Primary	134	22	16.4
Postprimary	30	2	6.7
Total	400	57	14.3

N=number examined, n=number infected.

reviewed and approved this study. Informed consent was obtained from the parents/guardians of all study participants after the objectives of the study were explained to them.

Statistical analysis

The data obtained from the study were analyzed using Chi-square test statistics. The level of significance was fixed at 0.05.

RESULTS

Of the 400 symptomatic study patients, 57 (14.3%) were infected with oocyst of *C. parvum*. Conversely, the symptom-free control group of 20 children yielded no oocyst. More male children were infected than their female counterparts (15.4% versus 13.4%), though there was no significant difference ($p<0.05$) (Table 1).

Age group of 0 to 5 years yielded the highest (20.3%) prevalence of oocyst followed by age group of 6 to 10 years (14.4%), with the lowest prevalence (11.5%) noted for children in the 11 to 14 years age group. Statistical difference exist between the prevalence rates among the three age groups ($p<0.05$) (Table 2).

Table 3 shows school related prevalence of the infection. Those in primary school yielded the highest prevalence (16.4%), while those in post primary yielded the lowest (6.7%) prevalence. Children at home, nursery school, and day-care centre recorded 13.4, 13.9 and 14.5% prevalence, respectively ($p<0.05$).

DISCUSSION

The result of this study shows that cryptosporidiosis is present among children in rural communities of Imo State, Nigeria and is of public health significance though epidemic proportion has not been recorded in this area. Previous researcher in this area (Njoku, 2003) reported a prevalence of 5.2% among residents of Owerri and its environs though his study was restricted within a part of the state and did not focus on children alone. The present study which focused on children in the entire state recorded a higher prevalence among children thereby corroborating the report of Mbango and Agu (2006) who reported a prevalence of 14.0% among children of ages 3 months to 15 years in Anambara State, South Eastern Nigeria. This contrasts the result of Dozie et al. (2011) who reported a total prevalence of 19.9% among children and adult population in the area. Another researcher (Nchito, 1998) has also reported a higher prevalence of 18.0% among children in Luzata, Zambia. The present result therefore depicts that the disease is gradually gaining health importance in this area. This may be attributed to poor awareness of the disease and its mode of transmission coupled with rural nature of majority of the parts of the area and the associated human habits that favour fecal-oral transmission of the pathogen. For instance, systematic observation during the study revealed that most of the children, especially in the rural communities pick and eat fallen fruits like mango without washing. They also tend to play outdoors more often thereby predisposing themselves to contaminated foods and soil. Furthermore, the public health significance of cryptosporidiosis has equally been reported in this area (Dozie et al., 2011) and other parts of the world (Fayer and Ungar, 1986; Rose, 1990; Juranek, 1995).

Although no significant difference was noted in sex related prevalence of infection, the observed prevalence of 15.4 and 13.4% among male and female supports the results of Mbanugo and Agu (2006) who reported that more males were infected than females in a prevalence study among children of ages 3 months to 15 years in Anambara State, South Eastern Nigeria. This result therefore shows that human factors that predispose humans especially children, to infection in this part of the world is not a function of gender as noted by previous researchers (Okafor and Okunji, 1996; Chukwuocha et al., 2009; Dozie et al., 2011). In this area, some human

habits as noted among children are similar in both sexes. Key informant discussion and systematic observation revealed that hand hygiene is poor among children in this area mostly at play grounds and schools when they are not within the reach of their guardians. During this outdoor lifestyle, they are inadvertently exposed to contaminated food and water that favour fecal-oral transmission of the pathogen. This finding corroborates a report by the centre for disease control and prevention (CDC, 1996) which underscored the role of contaminated water in some outbreaks of cryptosporidiosis in the United States of America.

Prevalence of cryptosporidiosis according to age group of children revealed that infection was most among children within the age group of 3 months to 5 years followed by age group of 6 to 10 years, while those within 11 to 14 years age group yielded the least prevalence. Statistical difference was recorded among the various prevalence rates. Prevalence rate declined as age increased. This suggests that the relationship between age and immunity is linear in children rather than u-shaped. More so, older children tend to have improved knowledge, attitude and practice vis-a-vis disease transmission than the younger children. For instance, hand to mouth attitude is predominant among the age group of 3 months to 5 years and may be correlated with high prevalence recorded for this age group. This result depicts that, as children grow in age, they acquire knowledge which leads to change of attitude and practice, hence the least prevalence rate (11.4%) recorded for the age group of 11 to 14 years. Immature immunity in the younger age group and degenerating immunity in the older age group has been reported by previous researchers in this area (Dozie et al., 2011).

This study established varied prevalence rates for children at home (not enrolled into school), nursery, primary, daycare and post primary schools, respectively. *C. parvum* infection varied significantly according to level of education of the children examined for oocyst. This finding supports the earlier report of previous researchers (Mbanugo and Agu, 2006; Dozie et al., 2011) who also obtained varied prevalence rates in all diarrhoea cases among children in various levels of education. The highest prevalence of *C. parvum* infection recorded for primary school children may be attributed to the fact that chances of exposure to the pathogen is high among primary school age children since this population tend to play outdoors most, especially at school play grounds (Dozie et al., 2011). Systematic observation and key informant discussion revealed that teachers especially in rural areas do send school children to cultivate in farm lands thereby exposing them to contaminated soil. Most of the school children are house helps who are always under duress to do unhygienic house chores that have the potential of spreading oocyst of *C. parvum* and other pathogens. Since farming is a predominant occupation in these rural settings, school children also accompany their parents to farm lands where they inadvertently get infected via contaminated soil and nearby contaminated ponds and streams which they are forced by circumstance to drink from. It was further observed systematically that these streams and ponds are prone to contamination by agricultural runoff from grazing lands. By this, they acquire the potential to propagate oocyts. More so, children imitate and aid in house cores including cleaning of the toilets which in rural areas are pit latrines, thereby exposing themselves to infectious oocyst (Dozie et al., 2001). Similarly, prevalence of 14.5% recorded among children in daycare centres also shows that daycare centre is significant in disseminating the oocyst of *C. parvum.* This could be attributed to playing and eating habits of the children and poor hygienic practices adopted by some caregivers. This contrasts the result of Mbanugo and Agu (2006) who in their study reported that children sampled from daycare centres yielded the highest prevalence than other groups. No significant difference exists between the prevalence rates of children in nursery school and those who have not been enrolled; probably they have common attitude and practice. The least prevalence recorded among post primary school children might be attributed to improved knowledge which in turn results to the right attitude and practice. Other researchers have noted that children are reservoirs for parasitic infections and therefore are important in perpetuating their transmission (Ejezie, 1981). The result of the present study therefore shows that primary school children living in Imo state are often exposed to pathogens due to their living conditions and that the right attitude and practice expected for prevention and control of infectious diseases are lacking in most of the children.

Absence of *C. parvum* oocyst in the stool samples of 20 control respondents probably indicates that *C. parvum* could be strongly implicated in the incidence of diarrhoea in children, because the infected stools were mostly diarrhoea stools while non-infected stools were non-diarrhoea stools. Similarly, previous researchers have reported high oocyst recovery in watery and semi formed stool samples (Okafor and Okunji, 1994; Mbanugo and Agu, 2006; Dozie et al., 2011).

Summarily, the results of this study depict that cryptosporidiosis is prevalent among children in this local population and therefore could pose a public health challenge to the populace. Thus, prompt intervention geared towards adopting adequate preventive and control strategies is necessitated in this part of the world. Researchers in this area should intensify effort in studying this organism and also diversify the scope of their study design vis-à-vis the public health significance. The findings of this study will help government, non-governmental organizations and other policy makers including stakeholders to articulate and adopt strategies aimed at preventing outbreak of the disease especially among children in the area. It will also help parents, teachers and caregivers to improve on human habits that

favour transmission of the pathogen. It is recommended that parents should start on time to enlighten their children on hand hygiene, domestic sanitation and health education so as to minimize fecal-oral contact inherent among children. Improved water supply should also be ensured at homes, schools and daycare centres. Caregivers should ensure proper hand washing while attending to children in daycare centres.

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