Cryptosporidium infection among children attending some hospitals in Funtua Local Government Area, Katsina State, Nigeria

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Abstract

Four hundred stool samples (76 watery and 324 soft-formed) obtained from children attending three hospitals in Funtua Local Government Area of Katsina State were examined for *Cryptosporidium* oocysts. A structured questionnaire was administered to determine the factors that enhance the prevalence of infection. Stool samples were examined for *Cryptosporidium* oocysts using formol-ether concentration technique and the modified Ziehl Neelson staining technique. The overall prevalence of infection obtained was 4%. The results showed that 10.5% watery stools and 2.5% soft-formed stools contained *Cryptosporidium* oocysts (p<0.05). Children between the ages of 3-5 years had the highest prevalence of infection compared to 0-2 years and 6-8 years age groups (p>0.05). More male children were infected (4.9%) than females (3.2%), but the difference was not statistically significant (p>0.05). Infection was more prevalent in children who defaecated in open fields than those who used pit latrines and water closets (p>0.05). This study showed that source of drinking water, eating of food served in the same plate, washing of hands prior to eating, washing of fruits and vegetables before eating, washing of hands after use of toilet, contact with animals as well as other children did not influence *Cryptosporidium* infection.

Keywords: *Cryptosporidium*; immunocompetent; immunocompromised; microvilli.

Accepted: 27 April, 2018.

Introduction

Cryptosporidium, an intestinal coccidian protozoan parasite, is known to infect the microvilli of the epithelial cells of the gastrointestinal tract of all vertebrates including humans (Fayer and Xiao, 2008). Molecular evidence has shown that two main species, *Cryptosporidium hominis* and *Cryptosporidium parvum*, are the most widely distributed. The high resistance of *Cryptosporidium* oocysts to disinfectants, such as chlorine bleach, enables them to survive for long periods and still remain infective (Carpenter *et al* 1999).

Infection is acquired through ingestion of contaminated materials such as soil, uncooked food or food that has been contaminated with the faeces of an infected individual or animal, insufficiently treated water and water that is used for recreational purposes (Mahdi and Ali, 2002; Mathieu *et al* 2004; Fayer and Xiao, 2008; Ponka *et al* 2009 and Artieda *et al* 2012).

Cryptosporidium species are significant entero-pathogens that cause acute or severe but often self-limiting diarrhoea that may last for a few weeks in immunocompetent individuals (Harvey *et al* 2007). In immunocompromised individuals, such as organ and bone marrow transplant patients, AIDS patients, children and old persons, the disease is more protracted and severe and can cause death (Hunter and Nichols, 2002; Mor and Tzipori, 2008).

In children and immunocompetent persons, symptoms of the disease may be mild or severe and may include watery diarrhoea, stomach pain, fever, nausea, vomiting, malabsorption, dehydration, anorexia and weight loss (Burton and Engelkirk, 1998; Leav *et al* 2003).

In Nigeria, *Cryptosporidium* infection has been reported in children by some previous workers such as Mbanugo and Agu (2006), Obiukwu *et al* (2009), Molly *et al* (2010) and Babatunde *et al* (2013).

The aim of this study was to determine the prevalence of *Cryptosporidium* infection among children attending some hospitals in Funtua Local Government as well as the influence of some perceived risk factors on the prevalence of the infection among children so as to provide baseline information which could be used as an aid in medical intervention in form of sanitation and chemotherapy.

Materials and methods

Four hundred stool samples (76 watery and 324 soft-formed) were collected between July 2011 and April, 2012 from children aged 0-8 years attending the General Hospital, Comprehensive Health Centre and the New Funtua Clinic, all in Funtua Local Government Area (11º32′N and 7º19′E). Ethical approval was obtained from the Health Services Management Board, Katsina

http://dx.doi.org/10.4314/tzool.v16i1.1
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(KHSMB/S130/VOL-IIIBP111) as well as the prospective health centres in Funtua Local Government Area before samples were collected.

The samples were collected in sterile, wide-mouthed, labelled specimen bottles with screw caps. The samples were preserved in 10% formalin and taken to the Parasitology and Entomology Laboratory of the Department of Biological Sciences, Ahmadu Bello University, Zaria, for analysis. A structured questionnaire was administered from which information including age, gender, type of toilet facility, regular source of water supply, sanitation, demographic variables and outdoor activities of the children were obtained.

In the laboratory, the stool-samples were concentrated using the formol-ether concentration technique and *Cryptosporidium* oocysts were detected using the modified Ziehl Neelson staining technique. C*ryptosporidium* oocysts were confirmed using the oil immersion objective of the microscope as pinkish-red spherules on a blue background (Fayer and Xiao, 2008). Data obtained were analysed using the *chi*-square (x^2) test to determine the association between the prevalence of *Cryptosporidium* infection with age and gender, Odd's Ratio (OR) was used to determine any association or otherwise, between the prevalence of infection and other risk factors in the questionnaire.

Results

A total of 16(4%) of the 400 children examined were infected with *Cryptosporidium*. Eight (10.5%) of the 76 children with watery stool were infected while, eight (2.5%) of the 324 children with soft-formed stool were infected with *Cryptosporidium* (Table 1). There was a significant difference between prevalence of infection between children with watery stool and those with soft-formed stool ($p<0.05$).

Table 1. Prevalence of *Cryptosporidium* infection in relation to type of stool.

Type of stool	Number examined	Number positive	Prevalence (%)
Watery	76	8	10.5
Soft-formed	324	8	2.5
Total	**400**	**16**	**4.0**

The prevalence of *Cryptosporidium* in relation to age of the children showed that the highest prevalence was obtained in the 3-5 years age-group (4.7%), followed by the 6-8 years age-group (4.4%), while the 0-2 years age-group had the lowest with 2.6%. The differences obtained were not statistically significant ($p>0.05$) (Table 2). The prevalence in males was higher than in females but the difference was not significant ($p>0.05$) (Table 2).

The prevalence of *Cryptosporidium* infection in relation to type of toilet facility (Table 3) and regular source of water supply (Table 4) did not reveal any statistically significant difference ($p>0.05$).

The relationship between *Cryptosporidium* infection and some other risk factors are summarised in Table 5. Analysis of responses elicited by the questionnaire showed that there was a statistically significant difference between children who did not wash their hands prior to eating and those who washed their hands prior to eating. No significant difference was obtained among children ate from the same plates and those who ate from different plates. A statistically significant difference was obtained between children who did not wash their fruits and vegetables and those who washed their fruits and

Table 2. Prevalence of *Cryptosporidium* in relation to age and gender.

Age-groups (Years)	Sex					Prevalence (%)
	Male		Female			
	Number examined	Number positive	Number examined	Number positive	Total positive	
0-2	46	1	70	2	3	2.6
3-5	69	5	79	2	7	4.7
6-8	78	3	58	3	6	4.4
Total	**193**	**9**	**207**	**7**	**16**	**4.0**

Table 3. Prevalence of *Cryptosporidium* infection in relation to type of toilet facility.

Toilet facility	Number examined	Number positive	Prevalence (%)	Odds ratio	95% confidence interval
Open field	64	5	7.8	2.48	0.83-7.40
Others	336	11	33		
Pit latrine	333	11	3.3	0.46	0.15-1.36
Others	67	5	7.5		
Water closet	3	0	0		
Others	397	16	4.0		

Table 4. Prevalence of *Cryptosporidium* infection in children in relation to source of water supply.

Source of water	Number examined	Number positive	Prevalence (%)	Odds ratio	Confidence interval (95%)
Well	128	9	7.0	2.86	1.04-7.87
Others	272	7	2.6		
Pipe borne	105	4	3.8	0.93	0.30-2.96
Others	295	12	4.1		
Borehole	167	3	1.8	0.31	0.87-1.10
Others	233		5.6		

Key: Others – summation of the other risk factors.

Table 5. Some factors predisposing children to *Cryptosporidium* infection.

Risk factor	Number examined	Number positive	Prevalence (%)	OR	95% C. I.
Hands washed prior to eating					
No	210	9	4.3	1.71	0.43-3.21
Yes	190	7	3.7		
Food served in the same plate					
Yes	281	9	3.2	0.53	0.19-1.46
No	119	7	5.9		
Fruits and vegetables washed					
No	208	11	5.3	2.03	0.55-7.43
Yes	192	5	2.7		
Hands washed after toilet use					
No	288	13	4.5	1.72	0.48-6.15
Yes	112	3	27		
Animals at residence					
Yes	220	12	5.5	2.54	0.80-8.01
No	180	4	2.2		
No. of children in a room					
4 and above	210	12	5.7	2.82	0.89-8.89
1 – 3	190	4	2.1		

Key: OR – odd's ratio, CI – confidence interval.

vegetables before eating. There was a significant difference between children who did not wash hands after use of toilet and those who washed their hands after toilet use. Presence of animals at home was not associated with prevalence of infection. It was also discovered that the number of children living in a room did not significantly influence the prevalence of infection.

Discussion

The relatively low prevalence of *Cryptosporidium* in this study corroborates the reports of some previous workers in other parts of the world including Africa (Albraiken *et al* 2003; Gatei *et al* 2006; Mederle *et al* 2010). Higher prevalence of *Cryptosporidium* had earlier been reported in Nigeria (Mbanugo and Agu, 2006; Obiukwu *et al* 2009; Molly *et al* 2010; Babatunde *et al* 2013). The higher prevalence obtained in the southern part of Nigeria compared to the lower prevalence obtained in this study (northern Nigeria) may possibly be due to heavy rainfall, flooding and higher humidity in the south which may lead to contamination of water and soil due to sewage, agricultural waste or urban run-off in the former (WHO, 2009). Also, higher levels of contamination of water, food stuff, feeding and toilet habits as well as contact with animals, are important factors in the dissemination of the parasite (Leech *et al* 2000). Nevertheless; it is known that the use of immunological or molecular techniques, which are more sensitive and specific yield higher prevalence (Fayer and Xiao, 2008; Molly *et al* 2010).

In this study, it was observed that children with watery stool were more infected than those with soft-formed stool. This confirms the fact that *Cryptosporidium* is a significant causative organism of diarrhoea (WHO, 2009).

The highest prevalence observed in children aged 3-5 years could be attributed to the lack of protective immunity within this age-group, poor hygiene practices as well as exposure to contaminated food, water and surfaces when they play (Obiukwu *et al* 2009). The difference in prevalence in relation to gender was not statistically significant. This might be due to the similar exposure of males and females to the risk factors. This corroborates the findings of Mbanugo and Agu (2006) and Obiukwu *et al* (2009).

In this study, children who defaecated in open fields had a higher prevalence than those who used pit latrines and water closet. The difference observed with respect to prevalence of *Cryptosporidium* in relation to type of toilet facility might be attributed to the level of contamination of the toilet facility, toilet habits of the children which are traceable to the clean-up exercise after defaecation, finger sucking and finger nail nibbling. The zero (0%) prevalence recorded in children whose main toilet facility was water closet could be attributed to lack of sufficient data on the children who used this particular type of toilet facility (3 out of 400).

The highest prevalence of *Cryptosporidium* infection obtained in children who used well as their main source of water supply may be attributed to the fact that most of the wells in the study-area had low edges and were left uncovered thereby making it possible for sewage and run off from grazing lands to be washed into them. Moreso, the high microbial contamination in wells (Luka *et al* 2006) as well as the ability of wells to harbour high concentrations of oocysts (Gatei *et al* 2006) might have influenced the prevalence of *Cryptosporidium* infection obtained among children in the study-area.

The highest prevalence of infection obtained among children who ate food which is served in the same plates might be attributed to contraction of infection from other children. The highest prevalence of *Cryptosporidium* infection obtained in children who did not wash their hands after toilet use may be due to insufficient knowledge on washing of hands with soap and water; forgetfulness and non-use of toilet paper which is a common practice in the study-area.

The non-significant association obtained between prevalence of *Cryptosporidium* infection and contact with animals might be attributed to the rarity of animals such as cows, goats, and sheep which may act as a risk factor in zoonotic transmission in Funtua because of its semi-urban settlement status. The findings of this study also show that number of children living in a room does not influence *Cryptosporidium* infection. This corroborates the findings of Pereira *et al* (2002).

The findings of this study shows that *Cryptosporidium* infection occurs in children in Funtua Local Government Area. Therefore, people should be enlightened on personal hygiene as well as the risk factors associated with the infection so as to prevent the spread of the infection. Search for *Cryptosporidium* oocysts should be included as part routine microbial examination.

Acknowledgements

The authors are grateful to staff of General Hospital, Comprehensive Health Centre and New Funtua Clinic all in Funtua Local Government Area of Katsina State, for their permission and assistance in collection of the stool samples. We also thank Malam Saleh Usman and Mr. Onuche Oche Gabriel of for their technical assistance.

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Citation: Agba, A. A., Aken'Ova, T. O. and Audu, P. A.
Cryptosporidium infection among children attending some hospitals in
Funtua Local Government Area, Katsina State, Nigeria.
http://dx.doi.org/10.4314/tzool.v16i1.1

The Zoologist, 16: 1-5 December 2018, ISSN 1596 972X.
Zoological Society of Nigeria.