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Mini Review

Cryptosporidium Zoonosis in Nigeria

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ABSTRACT: *Cryptosporidium* is a coocidian parasite that infects a wide range of vertebrate hosts including man. The parasite is now of potential significance from both clinical and public health perspectives in that it causes severe diarrhoea in immunocompromised individuals and can be transmitted from livestock to man. This paper critically examines all the published evidence of *cryptosporidium* infection in man and animal in Nigeria, in order to ascertain the presence of the zoonosis cycle of the disease. There were ten publications on the prevalence of cryptospodiosis in human patients between 1987 and 2008 in Nigeria, while there yet to be a single evidence of the presence of the disease in animals. All the studies neither identified nor characterized the species of *cryptosporidium* in their findings and none of the published data examined the possibility of animals being the source of the infection to humans. The limitation of the published studies and the implication of the findings are discussed in this review.

Key Words: *Cryptosporidiosis; Zoonosis; Genotype; Prevalence*

INTRODUCTION

Cryptosporidium species are intracellular protozoan parasites that infect a wide range of vertebrates, causing potentially fatal diarrhea in immuno-compromised individuals especially in AIDS patient, It is self-limiting but often causes prolonged diarrheal disease in the immuno-competent patients (man and animal). (Crawford *et al*., 1988; Current, 1986a; Current *et al*., 1983; Fayer *et al*., 1986).

The link between human and animal *cryptosporidium* infections has been a question that has dominated much of the research effort and there is considerable epidemiological data demonstrating strong links between contact with infected livestock and human infections (Fayer *et al*., 1986).

However, most published reports are of limited value in determining the zoonotic potential of the infection; since they only relied on prevalence data that were conducted using morphological criteria to identify oocysts and generally presented results for *Cryptosporidium spp* without specifying the genotypes involved.

Recent molecular epidemiologic studies conducted using genotyping tools have helped in understanding the transmission and public health significance of the disease. Two most commonly detected genotypes in human clinical specimens are the human (or type I; now recognised as a distinct species, *C. hominis*) and cattle (or type II; *C. parvum*) genotypes (McLauchlin *et al*., 2000). The human genotype (*C. hominis*) is restricted to humans (and possibly primates) (Mallon *et al*., 2003; Morgan-Ryan *et al*., 2002), while the cattle genotype is infective to most mammals (Alves *et al*.., 2001; Graczyk, 2001; McLauchlin *et al*., 2000; Siefker *et al*., 2002); and there are data suggesting that *Cryptosporidium* zoonotic transmission of the bovine genotype of *C. parvum* occurs, both as a waterborne zoonosis and by direct contact with farm animals (Mallon *et al*., 2003; McLauchlin *et al*., 2000). Lack of host specificity of *Cryptosporidium* makes the potential for zoonotic infection a genuine problem (Fayer *et al*., 1986).

The methods for detecting of *Cryptosporidium* spp in feces usually involve microscopic examination of stained fecal smears (modified Ziehl-Neelsen, safranin methylene blue, auramine-phenol), antigen detection

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(immmunofluorescence, ELISA) or genome detection (PCR amplification of the 18S rRNA gene) (Carreno *et al*., 2001; Current *et al*., 1991). Each varies in sensitivity and specificity and there is no universally accepted "gold-standard" (Tzipori, 1983).

Cryptosporiosis in Nigeria

Several epidemiologic studies have demonstrated that *Cryptosporidium* is more prevalent in developing countries (5% to >10%) than in developed countries (<1% to 3%) (Current *et al*., 1991); this is not a surprising as most developing nations are faced with the challenges of enforcing strict hygienic standards. However, Cryptosporidiosis is also a significant cause of diarrheal diseases in developed nations (Sulaiman *et al*., 2005); like USA, New Mexico and England (Gallaher *et al*., 1989; Hayes *et al*., 1989; Rush *et al*., 1987; Smith *et al*., 1989), where pubic water supply treatment facilities operate strictly within the established Environmental Protection Agency guidelines.

In view of the fact that there well documented evidences about the *Cryptosporidium* species (genotypes) and the nature of transmission (zoonotic or anthroponotic cycle) of Cryptosporidiosis in developing countries like Malawi, Kenya and Uganda (Current *et al*., 1991), this paper therefore reviews the evidence so far on *Cryptosporidium* infection in Nigeria based on the available publications.

To ascertain the evidence of the Published articles on cryptosporidiosis in Nigeria, articles were obtained from Medline search using the keywords cryptosporidium, diarrheal disease, gastrointestinal parasites and Nigeria. Additional information was also obtained by searching the medical and veterinary libraries for journal not listed in the Medline search.

Articles reviewed were grouped into four categories, those focusing on cryptosporidiosis in: human population, animal population, both human and animal population, Method of detection and species identification / characterization. Each group was reviewed with major emphasis on the description of studies, the laboratory method used in identifying the parasite, the prevalence of the disease as reported in the studies. All these criteria were used in analyzing each group except where required data were not available.

Prevalence studies

The search revealed that between 1987 and 2008 only ten articles have been published on cryptosporidiosis in Nigeria. All the papers dealt with *Cryptosporidium* infection in humans, while to the best of our knowledge none addressed the prevalence of the disease among animals and there is also no evidence of the possibility of transmission between man and animals. No study either identified or characterized the species of *cryptosporidium* they were dealing with in their findings.

The disease was reported in only 7 out of the 36 (16.7%) states of the Federation (Table 1). Three of these studies were community based (Banwat *et al*., 2003; Ikeh *et al*., 2007; Okafor *et al*., 1996) and the others where conducted in the hospital. Three studies focused on children (Banwat *et al*., 2003; Nwabuisi, 2001; Okafor *et al*., 1996), while only two investigated the prevalence of the disease in patients with AIDS (Adesiji *et al*. 2007, Nwokediuko *et al*., 2002). The prevalence of infection were observed to be higher in Plateau (29%) Ikeh *et al*., 2007), Enugu (25.7%) (Okafor *et al*., 1996), Kaduna (21%) (Kwaga *et al*., 1988), and Kwara (15.1%) (Nwabuisi, 2001) than in the other states of Nigeria.

Table 1

Summary of reports (1987 - 2008) of *Cryptosporidium sp* oocysts in stool specimens from different geographic study populations in Nigeria

State	Species	No. Patients	% positive	Reference
Ogun	Humans	479	5.3	(Reinthaler *et al*., 1987)
Kaduna	Humans	75	21	(Kwaga *et al*., 1988)
Lagos	Humans	890	0	(Oyerinde *et al*., 1989)
Enugu	Humans	413	2.5	(Okafor *et al*., 1994)
Enugu	Humans	373	25.7	(Okafor *et al*., 1996)
Kwara	Humans	198	15.1	(Nwabuisi, 2001)
Enugu	Humans	189	0	(Nwokediuko *et al*., 2002)
Plateau	Humans	340	4.8	(Banwat *et al*., 2003)
Plateau	Humans	204	25	(Ikeh *et al*., 2007)
Osun	Humans	150	52.7	(Adesiji *et al*., 2007

The prevalence of infection was mostly observed to be higher in children that were either diarrhoeic and/or malnourished (Banwat *et al*., 2003; Nwabuisi, 2001; Okafor *et al*., 1996), except in one study where it was observed to be higher in adult (Okafor *et al*., 1994).

However, a study (Oyerinde *et al*., 1989) with the highest sample population (890 patients) collected over a period of one year recorded no positivity. One of the two studies conducted on HIV positive patients recorded no positive case of cryptosporidiosis (Nwokediuko *et al*., 2002), While the other on the contrary reported high prevalence of the disease in HIV positive patients (52.7% of the 100 HIV positive samples) (Adesiji *et al*. 2007) .

Detection methods and species identified

All the investigations were conducted using basic staining techniques such as, Modified cold Ziehl-Neelsen, Formalin-methylene blue (FMB) and Safranin-methylene blue (SMB). The stained slides were observed under the light microscope for the detection of *cryptosporidium* oocysts.

There is no evidence of identification and characterization of species in all the studies published on cryptosporidiosis in Nigeria. All the reports relied on morphological criteria using microscopic methods to generate prevalence data.

Overview of the situation in Nigeria

From the foregoing, it is clear that available information on human and especially animal Cryptosporidiosis in Nigeria is scanty. The reason for this is not known. But one could speculate that some of the reports may be unpublished, while some may have been published in journals that are not well disseminated. However, it is very obvious that cryptosporidiosis in Nigeria is under-investigated and has not yet received the necessary attention from human and veterinary parasitologists in Nigeria.

Six out the eight available studies on humans in Nigeria showed that the disease in present (Banwat *et al*., 2003; Kwaga *et al*., 1988; Nwabuisi, 2001; Okafor *et al*., 1994; Okafor *et al*., 1996 ; Reinthaler *et al*., 1987) and is of possible significance in diarrhoeic patients (Kwaga *et al*., 1988; Nwabuisi, 2001; Okafor J.I., 1996), while two studies reported that the disease did not occur in normal diarrhoeic human patients (Nwokediuko *et al*., 2002) and those with HIV (Oyerinde *et al*., 1989). The discrepancy in the reports may be due to differences in their methods of detection. Although there is no available report in Nigeria on the disease in animal, it has been suggested that the prevalence of the disease is lower in animals than in humans (Mahdi *et al*., 2002).

It is rather shocking to know that there is no published work in cryptosporidiosis in animals in spite the fact that the infection has adverse influence on animal growth, feed conversion efficiency, and milk production (Esteban *et al*., 1995; Thompson *et al*., 2005). The infection in cattle has also been suggested to be the major infection source to humans through direct contact with contaminated faeces or water and pasture run-off. (LeChevallier *et al*., 1991).

A major problem observed in the reviewed reports is the inability of the methodology employed to identify the circulating species of *Cryptosporidium* in Nigeria, since it is impossible to assign Cryptosporidia to species on the basis of microscopic morphology alone. This also implies that the investigations cannot detect the existence of a zoonotic cycle in the dynamics of the disease. Furthermore, considerable experience with the concentration and staining techniques and magnification of about x 100 oil magnification are often required to obtain an accurate diagnosis, or else yeast cells and debrils or other cyst forming protozoans (like *Cyclospora sp*) could be mistaken for *Cryptosporidium* cyst when using the basic staining techniques (Current *et al*., 1991).

While the published data on cryptosporidiosis in Nigeria remains helpful indicators that the infection may be present in Nigeria, more so that most of the risk factors for the disease are also present, the circulating species of *Cryptosporidium* and possible zoonosis remains a speculation; pending the time when procedures that will identify *cryptosporidium* specific polyclonal or monoclonal antibodies (e.g. Enzyme linked immunosorbent assay, fluorescence microscopy, direct immunofluorescence assay), and Molecular based techniques are used.

In conclusion, as the perception of *Cryptosporidium* changed from that of a rare opportunistic pathogen to that of an important worldwide cause of diarrheal illness in humans and domesticated animals, the disease merits further investigation in Nigeria. For this reason, collaborative works with researchers in the developed nations are encouraged. Also worth mentioning is the need to establish viable research networking between the human and veterinary, clinicians, epidemiologists, molecular biologists, and parasitologists in order to have an integrated approach that will undoubtedly lead to a better understanding of zoonotic cryptosporidiosis in Nigeria.

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