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RESEARCH ARTICLE

Occurrence of *Cryptosporidium* species and other zoonotic parasites among humans in Jos, Plateau State, North-Central Nigeria

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ABSTRACT

This study determined the occurrence of *Cryptosporidium* species and other zoonotic parasites amongst Apparently Healthy Individuals (AHI) and People Living with HIV/AIDS (PLWHA) in Jos, using the formol ether concentration, saturated sodium chloride floatation techniques and the modified Ziehl-Neelsen staining method. A total of 600 human stool samples were analyzed; 300 each from AHI and PLWHA. The overall prevalence of *Cryptosporidium* species observed was 27% (162/600), while that observed amongst AHI and PLWHA were 24.7% (74/300) and 29.3% (88/300) respectively. The difference between the prevalence rates of AHI and PLWHA was statistically insignificant ($p>0.05$).For PLWHA prevalence rates for *Cryptosporidium* species in relation to age groups were highest 11% (33/300) and lowest 1.7% (5/300) for 0-10 and 31-40 years respectively. The age groups 11-20 and 21-30 recorded prevalence rates of 8.0% (24/300) and 3.0% (9/300) respectively while both 41-50 and >60 both revealed prevalence rates of 2.0% (6/300). Males recorded slightly higher prevalence 15% (45/300) than females 14.3% (43/300) which was statistically insignificant ($p>0.05$). For the AHI, prevalence rates were highest 9.7% (29/300) and lowest 1.3% (4/300) for age groups 11-20 and 41-50 years respectively. The age group 0-10 revealed a prevalence of 7.7% (23/300), while 11-20, 31-40 and 51-60 all recorded prevalence rates of 2.0% (6/300). The overall prevalence rates of other zoonotic parasites encountered were 5.3% (32/600), 9.8% (59/600), 3.0% (18/600), 5.2% (31/600), 5.0% (30/600) and 7.5% (45/600) for *Giardia intestinalis, Entamoeba histolytica, Hymenolepis nana, Taenia saginata, Ascaris lumbricoides* and *Ancylostoma duodenale* respectively. The overall prevalence rates of parasitoses observed was 56.7% (170/300) and 68.9% (207/300) for AHI and PLWHA respectively which was highly statistically significant ($p<0.05$). This study confirmed the increased risk of immunocompromised individuals to parasitic infections.

Keywords: Occurrence, Cryptosporidium, zoonotic parasites, humans, HIV/AIDS.

1. INTRODUCTION

Cryptosporidium is a protozoa belonging to the phylum apicomplexa, subclass coccidia and is related to other medically important coccidian parasites such as *Toxoplasma gondii, Isospora belli,* and *Plasmodium* species.[1] The organism was discovered early in the twentieth century, by Tyzzer in 1907, but its importance was only realized in the 1970s by veterinary workers. The pathogenic potential of the parasite was not fully

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appreciated until 1982, when the prevalence figures began to rise, largely as a result of the onset of the AIDS epidemic. In 1997, it was identified at the John Hopkins School of Medicine as the causative agents of human Cryptosporidiosis.[2] *Cryptosporidium* species are now known to be enteric pathogens with a world-wide distribution. Infection rates are predicted to be highest in developing countries and in children.[3, 4]

Cryptosporidium species are known to be the most common enteric parasites of humans and domestic animals, and are being increasingly recognised as parasites of a diverse range of wildlife species.[3] Their clinical significance is largely restricted to humans and young livestock.[5] The significance of *Cryptosporidium* was initially recognised to be one of the opportunistic pathogen in AIDS patients but the impact of such infections is now lessening, at least in developed countries, with the advent of retroviral therapies. Although *Cryptosporidium* infections are usually of short duration and self-limiting in individuals with an intact immune system the lack of effective anti-cryptosporidial drugs means the very young and elderly may be at risk of severe disease.[6]

The life cycle includes an asexual phase of proliferation on the mucosal surface and a sexual phase of reproduction. The infective stages of both parasites are encysted when released in the faeces and capable of prolonged survival in the environment. Re-infection is possible through the ingestion of water, food, or arthropods contaminated with cysts or oocysts. The link between human and animal infections has been a question that has dominated much of the research of *Cryptosporidium*. Since organisms can be transmitted in water, the source of water contamination remains a critical issue for water authorities throughout the world.[6] The role that animal infections may play in this regard remains controversial, particularly that of livestock and wildlife because of their potential role as zoonotic reservoirs of infection.

Gastro-intestinal parasites of humans have been incriminated as the causes of diarrhoea especially in children and the immunocompromised individuals. This study was designed to determine the prevalence of *Cryptospordium* species and other zoonotic gastro-intestinal parasites in apparently healthy individuals and people living with HIV/AIDS in Jos, Plateau State, Nigeria. This information with be useful in the initiation of essential veterinary education that will help in preventing the spread of these parasites as well as institution of prevention and control strategies against these parasites.

2. MATERIALS AND METHODS:

Study area

The study was carried out in Jos and covered two Local Government Areas in Jos metropolitan namely Jos North and Jos South. Jos is formed on a basement complex of rocks, which have produced the characteristic iceberg landscape. The Plateau highland stands at an average height of 1200 meters above the sea level. The highland is slightly undulating and rises from the escarpment of the riverside plains of the river Benue. Located in the Middle Belt zone of the country, Jos Plateau State is thus situated in the North-east area of North Central Nigeria. It lies between latitude 9'55'N and longitude 8' E of the Greenwich Meridian. The landscape is guinea savannah; mostly rocky, but with chains of hills and many captivating rock formations. The temperate climatic condition is greatly influenced by its strategic location on the Plateau, making Jos climate the nearest equivalent to the temperate climate in Europe and America. Temperature ranges from 11 ^{O}C to 30 ^{O}C with an annual rainfall of 150cm, lasting between 6 and 7 months. The months of December through February are particularly cold and dry.

Ethical issues

Ethical clearance was obtained from the management of Faith Alive Foundation before the commencement of this research. Consent forms were given to the patients to seek their permission before been sampled and only patients that agreed by signing the consent form that were sampled for this study.

Faecal sample collection and processing

A total of 600 individuals were sampled for this study. A total of 300 stool samples each were collected from AHI and PLWHA that visited the Faith Alive Foundation for HIV counselling and testing, check up and receipt of anti-retroviral drugs. Individuals were sampled based on their age group, sex, and HIV/AIDS status.

Human stool samples were collected in properly labelled sterile wide-mouthed plastic bottles and transported in Coleman icebox to the Parasitology Laboratory of the National Veterinary Research Institute, Vom, Nigeria for further analysis. Processing of samples commenced immediately but all unprocessed samples were preserved in 10% formalin solution and refrigerated till analysis was done within a week.

Faecal samples were screened for gstro-intestinal parasites using two methods namely; formol ether concentration and the saturated sodium chloride floatation techniques. The MacMaster counting technique was used for counting the frequency of occurrence of oocysts. Oocysts of *Cryptosporidium* species were identified using smears stained with the modified Ziehl-Neelsen method following concentration by the formol ether oocysts concentration technique as described by [7].

Data collated at the end of the study were subjected to statistical analysis. Prevalence rates were calculated by dividing the number of infected individuals by the total number of individuals examined and expressed as

percentages. This was done for sex, age groups and HIV status. Chi square test (X^2) was used to test for differences in prevalence rates of the disease based on the above variables.[8] Values of $p<0.05$ were considered significant.

3. RESULTS AND DISCUSSION:

Of the 600 human stool samples analyzed by this study, 300 each were from AHI and PLWHA. The overall prevalence of *Cryptosporidium* species observed was 27.0% (162/600) as shown in Table 3, while that observed amongst AHI and PLWHA were 24.7% (74/300) and 29.3% (88/300) respectively and was statistically insignificant (Table 2). For PLWHA, prevalence rates for *Cryptosporidium* species in relation to age groups were highest 11.0% (33/300) and lowest 1.7% (5/300) for 0-10 and 31-40 years respectively (Table 2). The age groups 11-20 and 21-30 recorded prevalence rates of 8.0% (24/300) and 3.0% (9/300) respectively while both 41-50 and >60 years revealed prevalence rates of 2.0% (6/300) as shown in Table 2. Males recorded slightly higher prevalence 15% (45/300) than females 14.3% (43/300) which was statistically insignificant. (Table 2). For the AHI, prevalence rates were highest 9.7% (29/300) and lowest 1.3% (4/300) for age groups 11-20 and 41-50 years respectively (Table 1). The age group 0-10 revealed a prevalence of 7.7% (23/300), while 11-20, 31-40 and 51-60 all recorded prevalence rates of 2.0% (6/300) as presented in Table 1. The prevalence rates of other zoonotic parasites encountered were 5.3% (32/600), 9.8% (59/600), 3.0% (18/600), 5.2% (31/600), 5.0% (30/600) and 7.5% (45/600) for *Giardia intestinalis, Entamoeba histolytica, Hymenolepis nana, Taenia saginata, Ascaris lumbricoides* and *Ancylostoma duodenale* respectively (Table 3). The overall prevalence rates of parasitoses observed was 56.7% (170/300) and 68.9% (207/300) for AHI and PLWHA respectively which was highly significant statistically (Table 3).

Age group (Years)	Number of individuals examined	Number of individuals positive	Prevalence (%)
0-10	40.0	23.0	7.7
11-20	50.0	29.0	9.7
21-30	62.0	6.0	2.0
31-40	59.0	6.0	2.0
41-50	49.0	4.0	1.3
51-60	40.0	6.0	2.0
>60	0.0	0.0	0.0
Total	**300**	**74**	**24.7**
Sex			
Male	150	38.0	12.7
Female	150	36.0	12.0
Total	**300**	**74.0**	**24.7**

Table 1: Age and sex based prevalence of cryptosporidiosis in apparently healthy individuals in Jos, Plateau State

SEX: $X^2 = 0.07$, P = 0.7888, Odd Ratio = 1.0744, 95%CI = 0.6355,1.8165

Age group (Years)	Number of HIV/AIDS patients examined	Number of HIV/AIDS patients positive	Prevalence (%)
0-10	57	33	11.0
11-20	44	24	8.0
21-30	50	9	3.0
31-40	40	5	1.7
41-50	40	6	2.0
51-60	42	5	1.7
>60	27	6	2.0
Total	**300**	**88**	**29.3**
Sex			
Male	152	45	15.0
Female	148	43	14.3
Total	**300**	**88**	**29.3**

Table 2: Age and sex based prevalence of cryptosporidiosis in people living with HIV/AIDS in Jos, Plateau State

SEX: $X^2 = 0.01$, P = 0.9165, Odd Ratio = 1.0270, 95%CI = 0.6246,1.6884

Parasites encountered	No. of AHI individuals positive (n=300)	Prev. (%)	No. of PLWHA individuals positive (n=300)	Prev. (%)	Overall Prev. (%)
Cryptosporidium species	74.0	24.7	88.0	29.3	27.0
Giardia intestinalis	11.0	3.7	21.0	7.0	5.3
Entamoeba histolytica	19.0	6.3	40.0	3.3	9.8
Hymenolepis nana	11.0	3.7	7.0	2.3	3.0
Taenia saginata	16.0	5.3	15.0	5.0	5.2
Ascaris lumbricoides	16.0	5.3	14.0	4.7	5.0
Ancylostoma duodenale	23.0	7.7	22.0	7.3	7.5
Total	**170.0**	**56.7**	**207.0**	**68.9**	**62.8**

Table 3: Prevalence of *Cryptosporidium* species and other zoonotic parasites in Apparently Healthy Individuals (AHI) and People Living with HIV/AIDS (PLWHA) in Jos

$X^2 = 9.77$, P = 0.0018, Odd Ratio = 0.5875, 95%CI = 0.4204,0.8211

Opportunistic intestinal parasitic infections constitute a major health problem in the immunocompromised patients such as people living with HIV/AIDS,[2, 9] and the commonest are *Cryptosporidium* species that are associated with diarrhoea in this group of people.[6] Other workers have reported cryptosporidiosis in apparently healthy individuals and people living with HIV/AIDS in Nigeria[10, 11] and elsewhere.[12] The involvement of *Cryptospridium* species and other zoonotic intestinal parasites in the causation of diarrhoea and mortality in children in developing countries has been reported.[13, 14, 15]

The overall prevalence (27.0%) of *Cryptosporidium* species recorded by this study is higher than the findings of Egberongbe *et al*.[11] and Dozie *et al*.[16] who reported prevalence rates of 19.9% and 21.4% respectively in

Nigeria. The works of Yal *et al*.[17] and Zaidah *et al*.[12] reported prevalence rates of 3.0% and 16.0% respectively in Malaysia. The higher prevalence recorded by this study may not be unconnected with poor sanitation and personal hygiene, feeding habits such as eating in commercial food areas as well as the availability of vegetables and their high consumption in the study area.

The prevalence observed in people living with HIV/AIDS (29.3%) though not statistically significant, was higher than that amongst apparently healthy individuals (24.7%). This can be explained by the low level immunity associated with this group of immunocompromised individuals. This group of people are reported to have higher risk of infection with opportunistic parasitic infections with cryptosporidiosis been inclusive.[2, 11] The prevalence observed in PLWHA is quite lower than that reported by Adesiji *et al*.[10] in HIV infected patients with diarrhoea in Osun State, Nigeria. These large differences in prevalence rates is said to be due to reasons such as variations in levels of contamination of water and foodstuff and contact with animals, which are important factors in dissemination of the parasite.[18]

The observation of higher prevalence rates in apparently health younger individuals (0-10 and 11-20) may be explained by indiscriminate eating habits of these groups and their inability to maintain personal hygiene. The low level immunity associated with younger children and HIV infection may be the probable reason for the higher prevalence of cryptosporidiosis recorded in the age group 0-10 years among PLWHA. In addition, stress resulting from malnutrition in these age groups may be another contributing factor.[19] Other workers also reported high prevalence of cryptosporidiosis in very young children.[11, 16]

Sex based prevalence showed higher prevalence of cryptosporidiosis in males than females in both the apparently healthy individuals and people living with HIV. The common practice of men eating in commercial food houses may be a possible explanation. This finding agrees with the reports of Egberongbe *et al.*[11] and Dash *et al.*[20] that reported higher prevalence of cryptosporidiosis in males than females in Nigeria and United Arab Emirates respectively, but contradicts the reports of Dozie *et al.*[16] who reported higher prevalence of the disease in females than males in Imo State, Nigeria.

The zoonotic intestinal parasites encountered have been reported by other workers.[21, 22, 23, 24, 25,] The overall prevalence (5.3%) of giardiasis observed by this study is lower than the 10.1% and 41.45% reported in Nigeria by Ejiofor *et al*.[27] and Inabo *et al.*[23] in children from Kaduna and Awka respectively and the 26.6% reported in Ethiopian children by Tigabu *et al.*[27] The 5.3% prevalence of giardiasis recorded by this study is within the range of 2-7% documented for developed countries, but lower than the 20-60% range documented for developing countries in which Nigeria belongs.[28] This might be due to improved hygiene and sanitation in the study area which may probably arise from increased awareness of the populace to this infection. Giardiasis also recorded a higher prevalence among people living with HIV/AIDS (7.0%) than apparently healthy individuals (3.7%) which might be due to compromised immunity among PLWHA.

The 5.2% prevalence of human taeniasis observed in this study though higher than the 4.2% reported by Biu and Hena[22] in Maiduguri, Nigeria may be considered low. However, considering the risk of human carriers spreading the infection through environmental contamination,[29] and the ability of the larval stage (*Cysticercus bovis*) to impair vision by invading the ocular tissues as well as causing neurocysticercosis that is incriminated in epilepsy in Africa by invading the brain tissues poses a serious threat to public health.[30] *Entamoeba histolytica* showed an overall prevalence of 9.3% which is lower than the 21.6% and 52.1% reported in Pakistan by Tasawar *et al.*[31] and Ejaz *et al.*[32] (2011) respectively.

The study also revealed a 5.0% prevalence of human ascariasis which is higher than the 0.2% reported by Dangana *et al*.[24] among primary school pupils in Jos South Local Government Area of Plateau State, Nigeria. Human ancylostomiasis has also been reported in Nigeria[21] and elsewhere.[25] The 7.5% prevalence recorded by this study is lower than the findings of Adenusi and Ogunyomi,[21] in Nigeria and Ngui *et al*.[25] in Malaysia who reported prevalence rates of 21.9% and 9.1% respectively.

Generally the variations in the prevalence rates of the zoonotic gastro-intestinal parasites observed when compared with the findings of other workers may not be unconnected with levels of sanitation and personal hygiene as well as variations in locations, levels of contamination of water and foodstuff as well as contact with animals. Environmental factors such as temperature, humidity and moisture are also determinants for the survival of eggs and oocysts of parasites in the environment prior to infection; this might also be a possible contributory factor for these differences.

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Conflict of Interest: None Declared

