



The Prevalence and Risk Factors of *Cystoisospora belli* in Diarrheic Stool of Children: A Cross-Sectional Study at Rivers State University Teaching Hospital

Onosakponome Evelyn Orevaoghene^{1*}, Nyenke Clement Ugochukwu¹, Roseanne Adah Ikpeama¹, Ndifrekeabasi Itek Robinson² and Stephenson Danagogo Lawson²

¹Department of Medical Laboratory Science, Pamo University of Medical Sciences, Port Harcourt, Nigeria

²Department of Medical Microbiology and Parasitology, Rivers State University, Port Harcourt, Nigeria

***Corresponding Author:** Onosakponome Evelyn Orevaoghene, Department of Medical Laboratory Science, Pamo University of Medical Sciences, Port Harcourt, Nigeria.

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Onosakponome Evelyn Orevaoghene, et al.

Abstract

Cystoisospora belli is a protozoan parasite that lives intracellularly in the intestines of its host, leading to acute to severe diarrhea, predominantly in children. This study aims to assess the prevalence and risk factors related to *Cystoisospora belli* in the diarrheal stools of children admitted to Rivers State University Teaching Hospital. A cross-sectional study was conducted with stool samples from 150 children suffering from diarrhea, who were admitted to the children's emergency ward and the children's ward at the hospital. Parental consent and ethical approval from the Rivers State Teaching Hospital's Ethics Committee were obtained prior to sample collection. Diagnostic methods included the Modified Ziehl Neelsen staining technique and direct wet mount using normal saline and iodine. Socio-demographic data and risk factors were gathered through well-structured questionnaires. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS). The study found a 14.0% prevalence of *Cystoisospora belli* in children with diarrhea, a statistically significant finding. There was no statistically significant correlation between cystoisosporiasis and gender or awareness. However, a significantly higher prevalence was observed among children under five years of age. The study also revealed a significant association between cystoisosporiasis and specific risk factors, such as personal hygiene and nutritional practices. Due to the high levels of *Cystoisospora* oocysts in children, health campaigns should be implemented to educate parents and guardians on healthy practices to help reduce the incidence of cystoisosporiasis in children.

Keywords: *Cystoisospora belli*; Risk Factors; Diarrheic Stool; Children; Prevalence

Introduction

Cystoisospora belli, formerly known as *Isospora belli*, is an intracellular obligate protozoan parasite that primarily inhabits the intestines of its hosts, leading to significant gastrointestinal disturbances [1]. It is known to cause acute to severe diarrhea in humans, particularly affecting children, immunocompromised individuals, and those in resource-limited settings [2]. The impact of this parasite on public health, especially in regions with inadequate sanitation and healthcare facilities, is profound, contributing to morbidity and, in severe cases, mortality [1,2]. *Cystoisospora belli* infection, commonly referred to as isosporiasis, holds significance as a causative agent of traveler's diarrhea, particularly prevalent in tropical regions. The prevalence of *C. belli* infection

varies across different populations and geographic regions. Studies have shown that the prevalence of *C. belli* in children presenting with diarrhea can be substantial. For example, a study in Iran reported a prevalence of 9.2% among patients with colorectal cancer, highlighting the potential burden of this parasite in certain vulnerable groups [3,4]. The infection is particularly more prevalent in tropical and subtropical regions, where environmental conditions favor the survival and transmission of the parasite [2,4]. Risk factors for *C. belli* infection include immunosuppression, malnutrition, and exposure to contaminated water and food [4,5]. These factors are prevalent in many parts of Nigeria, exacerbating the burden of the disease among children [6]. *C. belli* is known to cause outbreaks of diarrheal illness, especially in areas with poor sanitation and

limited access to clean water [3,5]. The clinical manifestations of *C. belli* infection include prolonged diarrhea, steatorrhea, abdominal pain, and weight loss [1,2,5]. Risk factors for infection include immunosuppression (such as HIV infection), malnutrition, and inadequate sanitary conditions [5,6]. The infection arises through the oral ingestion of infective oocysts, which typically mature within 24 hours following excretion in stool [1,7]. Transmission of *Cystoisospora belli* occurs through fecal-oral route by ingesting food or water contaminated with oocysts. *Cystoisospora belli* can also be transmitted from person to person through feces, consumption of contaminated food, additionally it has been described that water constitutes a vehicle for this parasite, since it resists the purification techniques [3-5]. Oocysts can cause autoinfection [2,3]. The lifecycle of *I. belli* begins with non-infective oocysts that become infectious after exposure to the external environment outside the human body. *I. belli* cannot be transmitted between humans and animals, as humans are the only definitive host, eliminating the need for an intermediate host [3,4]. Diarrheal diseases remain a leading cause of childhood morbidity and mortality worldwide, particularly in developing countries where access to clean water, sanitation, and healthcare is limited [7,8]. In Nigeria, diarrheal diseases pose a significant health challenge, contributing substantially to the high rates of pediatric hospital admissions. Understanding the prevalence and associated risk factors of intestinal parasites like *C. belli* in diarrheic children is crucial for developing effective prevention and control strategies. This study aims to investigate the prevalence and risk factors associated with *Cystoisospora belli* in the diarrheic stool of children admitted to Rivers State University Teaching Hospital.

Materials and Methods

Study area

This study on prevalence of coccidiosis in children was carried out in Port-harcourt. It is the capital and largest city in Rivers State, Nigeria. The study was specifically carried out at Rivers State Teaching hospital (RSUTH) located at 5-8 Harley Street, Old GRA. The hospital is a general hospital and receives referrals from other hospitals in Port Harcourt and outside Port Harcourt.

Study design and population

A cross-sectional study was carried out using the sample of the selected participants. Data was generated from self-structured questionnaires that were distributed to the participants who volunteered to partake in the study. The questionnaires entailed questions on socio-demographics and risk factors associated with coccidian infection. A total of 150 children between the ages of 1month - 15years who met the inclusion criteria were enrolled in

this study. The children enrolled include those admitted in children emergency ward and children ward.

Ethical considerations

Ethical approval was obtained from the Research ethical committee of the Rivers State University Teaching Hospital (RSUTH/REC/2022271). Written consent to participate in the study was obtained from participants.

Eligibility criteria

The study included children between 1 month-15 years who were not currently on antiparasitic medication but had symptoms of diarrhea, whose parents or guardians gave their consent while healthy children who were not immunocompromised, immunocompromised children and all those whose parents did not gave their consent were excluded.

Sample collection and data collection

A total of 150 Parents/guardians of children with gastrointestinal symptoms (with diarrhea) were given labeled stool containers to collect one stool sample at the time of collection. They were guided on how to collect a suitable amount of stool in the containers. The date and time of passage were provided for each specimen. The data of the patients were obtained from a properly filled questionnaire which was given to each of them. The structured questionnaire entailed questions participant's socio-demographics, such as (age, educational level, medical history, etc.) and clinical presentations such as (diarrhea, abdominal pain and dehydration).

Sample analysis

All universal precautions were strictly followed when carrying out laboratory analyses. The physical characteristic of a fresh fecal specimen was examined in determining the types of organisms present. Modified Ziehl-Neelsen staining method was used [8] it uses carbolfuchsin as a primary stain which was heated followed by decolorization with an acid-alcohol solution and methylene blue as a counterstain. When viewed under a microscope, Ziehl-Neelsen stained slides shows acid-fast organisms as reddish pink and non-acid-fast organisms as blue [3,6,9]. Physiological saline and iodine was also used to detect the presence of oocysts or sporocysts [6,9].

Statistical analysis

Questionnaires were checked for completeness. The data was analyzed using Statistical Package for Social Sciences (SPSS). Prevalence was expressed in percentages. The association between socio-demographics and variables were tested using Pearson chi-square. Statistical significance was accepted at $p < 0.05$ (95% confidence interval).

Result

A total of 150 stool samples were collected from consented children between the ages of <5years and 15years with the help of their parents/guardians. 150 structured questionnaires were also distributed for analysis containing their socio-demographics, med-

ical history, personal hygiene and nutritional practice. Out of 150 stool samples that were examined, *Cystoisospora belli* was found in 21 stool samples and having a prevalence of (14.0%) as shown in figure 1.

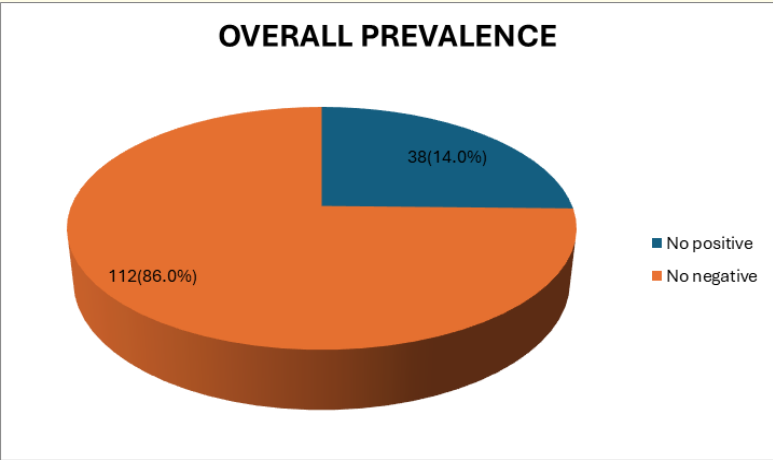


Figure 1: Overall prevalence of *Cystoisospora belli* in the study population

Table 1 shows the prevalence of *Cystoisospora belli* based on their sex and age groups. Male shows a high prevalence of *Cystoisospora belli* (17.2%) while female has a low prevalence of *Cystoisospora belli* (10.1%). The prevalence of *Cystoisospora belli* (0.24) is >0.05, therefore, there is no statistical relationship between sex and isosporiasis. Among the age groups, <5years has

the highest positive number for *Cystoisospora belli* having (19.0%). Age group 11 – 15years has the lowest prevalence of *Cystoisospora belli* (9.5%). The prevalence of *Cystoisospora belli* (0.01) is <0.05, therefore, there is a statistical relationship between age and isosporiasis.

Socio-demographic	Number examined (%)	Number Positive (%)	df	Chi square	P value
Sex					
Male	81 (54)	14 (17.2)	1	5.297	0.24
Female	69 (46)	7 (10.1)			
Age Group					
< 5 years	63 (42)	12 (19.0)	2	1.577	0.01
6 - 10 years	45 (30)	5 (11.1)			
Total	150	21 (25.3)			

Table 1: The prevalence of *Cystoisospora belli* based on sociodemographics.

C belli= *Cystoisospora belli*, df= difference, P < 0.05 is significant

Table 2 shows the association between awareness, personal hygiene and nutritional practice as risk factors and infection with *Cystoisospora belli*. The risk factors associated with cystoisosporiasis in this study were consumption of unwashed fruits and vegetables, consumption of untreated water, absence of regular deworming, consumption of infected raw or partially cooked meat and children

whose guardians or parents lacked awareness about the transmission of *Cystoisospora belli* this may be due to the absence of proper awareness and educational initiatives resulting in deficient knowledge about the parasite’s transmission, and a lack of understanding about the clinical symptoms associated with cystoisosporiasis.

Risk Factors	Response	Number Examnined (%)	Number Positive (%)	P. Value	Chi Square	df
Knowledge of coccidian	Yes	25 (16.7)	2 (8.0)	0.52	0.897	1
	No	125 (83.3)	19(15.2)			
Aware that is causes diarrhea	Yes	23 (15.3)	3 (13.0)	1.00	0.021	1
	No	127 (84.7)	18 (14.2)			
Wash fruits and vegetables	Yes	110 (73.3)	2 (1.8)	0.00	19.979	1
	No	40 (26.7)	19(47.5)			
Treats drinking water	Yes	108 (72.0)	5 (4.6)	0.00	28.129	1
	No	42 (28.0)	16(38.0)			
Deworms 3-6 months ago	Yes	111 (74.0)	3 (2.7)	0.00	45.256	1
	No	39 (26.0)	18 46.1)			

Table 2: Association between risk factors and isosporiasis.
C belli= *Cystoisospora belli*, df= difference, P < 0.05 is significant.

Discussion

This study assessed the prevalence and risk factors of coccidian parasites among 150 stool samples of diarrheic children in Port Harcourt Rivers State. The prevalence of *Cystoisospora belli* in the current study was established at (14.0%). Beije., *et al.* in a similar reseach reported a prevalence of 14% in Ibadan, Nigeria [9]. In contrast a prevalence figure of (8.0%) and 27.3% were reported by somr scholar who conducted similar investigation [10,11]. These variations in prevalence outcomes may be attributed to several factors which include differences in geographical locations, dissimilar study methodologies, variances in sample sizes, and potentially varying local environmental conditions that could influence the presence and distribution of these coccidian species. The current study gender was not significantly associated with prevalence of coccidian parasites. Noor., *et al.* 2019 aligned with this observation in a separate study conducted [10]. However; there were differenc-es in the prevalence rates reported for males and females. In males, the prevalence of *Cystoisospora belli* was (17.2%) in comparison, females exhibited slightly lower prevalence rates, with *Cystoisospora belli* at (10.1%) [9,12]. Some researchers in a related study observed that girls from families with higher socioeconomic sta-tuses and greater maternal education levels demonstrated lower infection rates. This association suggests that parents with higher educational attainment might engage in behaviors like promot-ing hygiene awareness that could reduce the risk of infections in their children [12]. The potential for educated mothers to pass on knowledge, particularly to their daughters, is suggested as a con-tributing factor. This suggests that there is an intricate dynamic interaction between gender, socioeconomic factors, and behavioral practices in the transmission of coccidian infections [12,13]. How-ever, other similar studies conducted by some other researchers re-ported higher prevalence rates in females, with figures of (65.0%) and (79.1%) respectively, compared to males with (60.0%) and (78.8%) [9,13,14].

This current study observed that Children aged less than 5 years recorded the highest prevalence of (19.0%) for *Cystoisospora belli*. This suggests that vulnerability of children in this age bracket to coccidian infections, and this can be attributed to their natural inclination to explore their surroundings, potentially encountering animal excreta, contaminated edibles, and contaminated objects that often find their way into their mouths. Tombang., *et al.* (2019) Musa., *et al.* (2014) and Aniesona and Bamaييin (2013) observed this same pattern of vulnerability among children under 5 years in similar studies. Age group of 11–15 years recorded the lowest prevalence rates of (9.5%) for *Cystoisospora belli*. This observa-tion aligns with the findings reported by Aniesona and Bamaييin, (2013) and Shinkafi and Muhammad, (2017), where they identi-fied the lowest prevalence of coccidian parasites among children above 11 years of age this may be due to the fact that children at this certain age are educated on personal hygiene and environmen-tal sanitation. However there was a significant association between the prevalence of *Cystoisospora belli* and age emphasizing that age plays a meaningful role in the dynamics of isosporiasis.as observed by [9,14].

An association was observed between awareness and the prev-alence of *Cystoisospora belli* in children. Children whose guardians or parents lacked awareness about the transmission of the coccid-ian parasite *Cystoisospora belli* recorded a prevalence of (16.3%). This observation may be due to the absence of proper awareness and educational initiatives resulting in deficient knowledge about the parasite’s transmission, and a lack of understanding about the clinical symptoms associated with cystoisosporiasis. However, Tombang., *et al.* (2019) made similar findings in their own study, further supporting the observation that poor awareness and lim-ited knowledge about coccidian parasites can contribute to higher

infection rates. Despite these findings, the current study found no statistically significant link between awareness and cystoisosporiasis, indicating that while awareness may contribute to the prevalence of cystoisosporiasis, it does not hold a strong statistical influence.

A high occurrence of *Cystoisospora belli* (47.5%) was noted among children who consume unwashed fruits and vegetables, as well as those who consume untreated water. This could be attributed to ingesting contaminated produce from unhygienic sources like open markets, consuming untreated water from sources like sachet water, boreholes, and wells, and neglecting hand hygiene practice after using the restroom. Tombang, *et al.* (2019) and Elmonir, *et al.* (2021) made similar observations in prior related research studies conducted [15,16]. Hence, inadequate personal hygiene can influence the susceptibility of children to cystoisosporiasis, as indicated by the statistical significance ($P < 0.05$). In this study, the absence of regular deworming interventions, occurring at least every three months, emerged as a significant factor influencing the prevalence of *Cystoisospora belli* (46.1%). This occurrence might be attributed to the continuous consumption of infected raw or partially cooked meat and the potential contamination of children's water bottles, plates, and utensils due to unclean hands. Similar observations were made by [15]. Hence, it becomes evident that nutritional practice contributes substantially to cystoisosporiasis in children ($P < 0.05$).

Cystoisospora belli is among the neglected diseases with association poverty particularly in developing countries. Therefore, health campaigns should be carried out to create more awareness about the infection. In addition WASH (water, sanitation and hygiene) facilities should be provided for the control and prevention of *Cystoisospora belli*.

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