



Prevalence of Human Intestinal Helminthic Infections among School-Age Children in Calabar, Cross River State, Nigeria

**Usang Anok Ukam¹, Imalele Edema Enogiomwan^{1*},
Effanga Emmanuel Offiong¹ and Osondu-Anyanwu Chinyere²**

¹*Department of Zoology and Environmental Biology, Faculty of Biological Sciences, University of Calabar, Calabar, Cross River State, Nigeria.*

²*Department of Science Laboratory and Technology, Faculty of Biological Sciences, University of Calabar, Calabar, Cross River State, Nigeria.*

Authors' contributions

This work was carried out in collaboration among all authors. Authors UAU and IEE designed the study. Authors EEO and OAC performed the statistical analysis. Author UAU wrote the first draft of the manuscript. Author EEO managed the literature searches. Author IEE designed the study. Author OAC managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The study aimed at determining the prevalence and risk factors for intestinal helminth infection among school-age children in Calabar, Cross River State, Nigeria.

Study Design: Cross-sectional observational study was conducted in two Local Government Areas (Calabar South and Calabar Municipality) in Calabar.

Place and Duration of Study: The study was carried out in Calabar, from May to October, 2018.

Methodology: Faecal samples were collected from pupils in sterile dry specimen bottles with the use of applicator sticks and analyzed using sedimentation and floatation techniques. Data obtained was analyzed using Statistical Package for Social Sciences (SPSS) version 21.

Results: Overall prevalence of intestinal helminth was 18.5%. Parasites recovered were *Ascaris lumbricoides* (9.3%), *Trichuris trichiura* (4.0%), Hookworm (2.6%), *Taenia solium* (0.9), *Enterobius*

*Corresponding author: Email: edemaeddy@gmail.com;

vermicularis (0.9), *Strongyloides stercoralis* (0.4%) and *Schistosoma mansoni* (0.4%) ($P = 0000$). Males (22.1%) were more infected than females (14.0%) in the study area ($P = 0.031$). Prevalence of intestinal helminths was lowest in age group 11-15 years (14.4%) and highest in age group 6-10 years (23.5%) ($P = 0.005$). After multivariate analysis, source of water [OR=3.355, 95% CI 1.448 – 7.770], type of sewage system [OR=7.547, 95% CI 5.011 – 8.358], hand washing before meal [OR=4.069, 95% CI 1.719 – 9.631] and hand washing after defecation [OR=2.281, 95% CI 1.059 – 4.917] were statistically associated with the detected intestinal helminthic infections in faecal samples ($p = .05$).

Conclusion: The presence of these intestinal parasites in these schools is a public health problem and there is therefore a need to prevent these infections by improving individual personal hygiene through health education, general sanitation and provision of adequate social amenities.

Keywords: Intestinal helminths; soil-transmitted helminths; school-age children; *Ascaris*; hookworm; Nigeria.

1. INTRODUCTION

Intestinal parasitic infestation represents a large and serious medical and public health problem in developing countries [1]. It is estimated that some 3.5 billion people are affected and that 450 million are ill as a result of these infections, the majority being children [2]. At highest risk of infection are pre-school, school aged children and pregnant women [3], with chronic infections reported in at least 400 million school aged children [4]. Over 10.5 million new cases are reported annually and *Ascaris lumbricoides*, hookworms, *Trichuris trichiura*, *Giardia lamblia*, *Entamoeba histolytica* and *Schistosoma* species are the most common intestinal parasites [5].

Chronic helminth infections can lead to iron deficiency anaemia, protein malnutrition, intestinal obstruction, stunting, wasting, diarrhoea and poor mental and physical development [6]. Chronic intestinal parasitic infections have become the subject of speculation and investigation in relation to the spreading and severity of other infectious disease of viral origin [7,8,9].

Infection with intestinal parasites constitute a serious health problem among Nigerian children [10,11] with symptoms ranging from malnutrition and anaemia to growth retardations, resulting in absenteeism from school with its attendant consequence of poor academic performance [12]. Research studies conducted in Nigeria have reported prevalence levels of between 17.8 to 87% in various parts of the country [13,14,15,16].

Intestinal parasites are frequently transmitted by unhygienic habits such a direct transfer of ova or

cyst from anal region to mouth and eating with unwashed hand. Several factors like climatic conditions, poor sanitation, unsafe drinking water and lack of toilet facilities are the main contributors to the high prevalence of intestinal parasites in the tropical and subtropical countries [17]. Hence, a better understanding of the above factors, as well as how social, cultural, behavioral and community awareness affect the epidemiology and control of intestinal parasites may help to design effective control strategies for these diseases [18].

Several studies have been carried out on intestinal parasites among school aged children in Nigeria [19]. Although, a few of these studies were carried out in Calabar [20, 21], sufficient baseline information is still needed on the prevalence of these infections. There is also no reliable policy existing on the control of intestinal parasitic infection compared to policies already in place on diseases such as malaria and filariasis.

This study is designed to gather information on the prevalence of these intestinal parasites and identification of the local risk factors associated with helminth infection among school-age children in the study area.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The study area, Calabar, is the capital of Cross River State. It comprises of two local government areas; Calabar South and Calabar Municipality. The climate is tropical and the vegetation is prominently tropical rain forest.

Calabar South is located within longitude 8° 15' East and 8° 25' and latitude 4° 54' North and 4° 58' North. Calabar South is one of the 18 Local Government Areas in Cross River State. It has a total land area of 264 square kilometers and a population of 191,630 [22]. Calabar South is bounded by Calabar Municipality to the North, Kwa river to the East, Marina River to the West and Creek town to the South.

2.2 Study Design and Population

This was a cross-sectional study in which a structured questionnaire was used to obtain data from guardians/caretakers of the school-age children (1–15 years old) in Calabar South Local Government Area, Calabar, between May and October 2018. Data obtained included information on socio-demographic factors, knowledge and practice of their children regarded intestinal helminth infections. A total of 227 pupils from two primary schools in the rural and urban areas was chosen for this study. 110 from a known private school (Calabar Preparatory International Nursery/Primary School) and 117 from a known public/government primary school (Government Primary School, Atu).

2.3 Sample Size Determination

A sample size of 227 was determined using the methods described by Suresh and Chandrashekar [23]. The pupils were selected using the simple random sampling technique. This was achieved by lining up the pupils in each school while each of them was given a consecutive number and selection made according to a specified sampling interval [24].

2.4 Sample Collection

Early morning stool was collected from pupils attending both schools in sterile dry specimen bottles with the use of applicator sticks. The pupils were given orientation on how to collect the samples into clean/dry, wide mouthed, screw capped, leak proof tight fitted labeled specimen bottles which was given to them. The samples were collected directly into the specimen bottles avoiding contamination with urine and other contaminants. The sample were preserved using diluted carbon fuchsin and transported immediately to the laboratory for analysis.

2.5 Faecal Sample Analysis

2.5.1 Sedimentation technique

3 g of fecal sample was measured into a container labeled 1. 40-50 ml of distilled water was poured into the container and mixed thoroughly with a string device. The fecal suspension was derived from the mixture by filtering the solution through a double layer filtering material into another container labeled 2. The filtered material was then poured into a centrifuge test tube and centrifuged at 3000 rpm for 5 minutes. The sediments were then collected and stained adding one drop of methylene blue. This was covered with a cover slide and viewed under the microscope using the 10x and 40x objectives for the presence of intestinal parasite, larvae, ova, or cysts.

2.5.2 Floation technique

3 g of fecal samples was placed in a container and 50 mls of zinc sulphate (1.15 specific gravity) was poured into the container. The mixture was then stirred thoroughly with a tongue blade and then poured into a test-tube using a double layer filtering material. The test-tube, filled to the brim with the mixture, was carefully placed in the test tube rack to stand for about 20 minutes covered with a cover slip. Afterwards, the cover slip was carefully lifted from the test-tube together with the drop of fluid adhering to it and immediately placed on the microscopic slide facing downwards. The cover slip was examined microscopically using the 10x and 40x objectives.

2.6 Identification of Parasite Species

Identification of the parasite egg and cyst were done based on structural and morphometric criteria with the help of parasitology laboratory atlas. The criteria include size, shape and possibly color of the egg and cyst [25,26].

2.7 Administration of Questionnaires

The questionnaire contained socio-demographic data and gathered information on the environmental factors and behavioral sanitary habit that can cause infection. Questions among others were on the age, sex, occupation of parents, source of drinking water and sanitary habit.

2.8 Data Analysis

Chi square values were used to determine the difference in prevalence of each parasite infection between different variables. Multivariate logistic regression was applied to identify factors that most explain patterns of infection in the study area. Statistical difference was assigned at $p \leq 0.05$. All analysis was performed using the SPSS version 21.

3. RESULTS

A total of 227 faecal samples examined in the study were obtained from 227 pupils aged 4 to 15 years, comprising 127 (56%) males and 100 (44%) females. Of these, 42 (18.5%) were positive for various intestinal parasites. *Ascaris lumbricoides*, 21 (9.3%), was the most common parasite species isolated followed by *Trichuris trichiura*, 9 (4.0%), Hookworm, 6 (2.6%), *Taenia solium*, 2 (0.9), *Enterobius vermicularis*, 2 (0.9), *Strongyloides stercoralis*, 1(0.4%) and *Schistosoma mansoni*, 1 (0.4%) (Table 1). This distribution of parasites according to the schools sampled is also given in Table 1. Intestinal helminths were more prevalent in children from Government Primary School, Atu (29.1%) than children in Calabar Preparatory Nursery/Primary School (7.3%). The distribution of intestinal helminth parasites varied significantly ($p=0.000$) between the schools sampled in the study area.

Table 2 shows the prevalence of intestinal helminths among gender and age-group. Generally, males (22.1%) were more infected than females (14.0%) in the study area. Male in both schools had the highest prevalence rate of 23(34.3%) in Government Primary School, Atu and 5(8.3%) in Calabar Preparatory Nursery/Primary School than the females

11(22.0%) in Government Primary School, Atu and 3(6.0%) in Calabar Preparatory Nursery/Primary School. Intestinal helminth infection was significantly higher in males ($p=0.031$) compared to females.

Prevalence varied among different age groups with the lowest among the age group 11-15 years (14.4%) while age group 6-10 years (23.5%) recorded the highest prevalence (Table 2). School children in the age group 6-10 had the highest prevalence rate in both schools, 17(34.0%) in Government Primary School, Atu and 6(12.5%) in Calabar Preparatory Nursery/Primary School respectively. However children in the age group 11-15 had the least prevalence in both schools, 12(23.1%) in Government Primary School, Atu and 1(2.6%) in Calabar Preparatory Nursery/Primary School respectively. Intestinal helminth infections varied significantly ($p=0.005$) across the age groups.

After multivariate analysis by using backward elimination method, source of water, type of sewage system, hand washing before meal and hand washing after defecation were statistically significant with the detected intestinal helminthic infections in faecal samples at p -value < 0.05 (Table 3). School age children who used rainwater as a source of water were 3.355 times (CI 1.448 – 7.770) more likely to be infected with intestinal helminths. According to the type of sewage disposal system used, schoolchildren who open defecated in fields or bushes were about 8 times (CI 5.011 – 8.358) more likely to be infected with intestinal helminths. Also, school children who did not wash their hands before eating and after defecating were 4.069 times (CI 1.719 – 9.631) and 2.281 times (CI 1.059 – 4.917) respectively, more likely to be infected with intestinal helminths.

Table 1. Prevalence of intestinal helminths infection among school-age children in Calabar South Local Government Area, Calabar

Parasite	Government Primary School, Atu (n=117)	Calabar Preparatory Nursery/Primary, School (n=110)	Total (%)
	Number positive (%)	Number positive (%)	
<i>A. lumbricoides</i>	16 (13.7)	5 (4.6)	21 (9.3)
<i>T. trichiura</i>	7 (6.0)	2 (1.8)	9 (4.0)
Hookworm	5 (4.3)	1 (0.9)	6 (2.6)
<i>S. stercoralis</i>	1 (0.9)	-	1 (0.4)
<i>S. mansoni</i>	1 (0.9)	-	1 (0.4)
<i>T. solium</i>	2 (1.7)	-	2 (0.9)
<i>E. vermicularis</i>	2 (1.7)	-	2 (0.9)
Total	34 (29.1)	8 (7.3)	42 (18.5)

Table 2. Prevalence of intestinal parasites according to gender and age group among school-age children in Calabar South Local Government Area, Calabar

Variables (n=227)	Government Primary School, Atu		Calabar Preparatory Nursery/Primary School		Total (%)
	No. Examined	No. Positive (%)	No. Examined	No. Positive (%)	
Sex					
Male (n=127)	67	23 (34.3)	60	5 (8.3)	28 (22.1)
Female (n=100)	50	11 (22.0)	50	3 (6.0)	14 (14.0)
Age					
1-5 (n=39)	15	5 (33.3)	24	1 (4.2)	6 (15.4)
6-10 (n=98)	50	17 (34.0)	48	6 (12.5)	23 (23.5)
11-15 (n=90)	52	12 (23.1)	38	1 (2.6)	13 (14.4)

Table 3. Risk factors of intestinal infections in school age children in Calabar South Local Government Area, Calabar

Variables	Laboratory result		OR (95% CI)	p-value
	No. Positive (%)	No. Negative (%)		
Source of water				
Borehole	11 (11.8)	82 (88.2)	1	0.035
Tap	10 (18.2)	45 (81.8)	1.657 (0.653 – 4.200)	
Rain	18 (31)	40 (69)	3.355 (1.448 – 7.770)	
Stream/River	3 (14.3)	18 (85.7)	1.242 (0.314 – 4.913)	
Sewage system				
Water closet	1 (1.1)	88 (98.9)	1	0.000
Covered pit	3 (14.3)	18 (85.7)	4.667 (1.442 – 9.134)	
Uncovered pit	6 (60)	4 (40)	2.000 (2.688 – 3.288)	
Open defecation	32 (29.9)	75 (70.1)	7.547 (5.011 – 8.358)	
Hand washing before meal				
Yes	7 (7.8)	83 (92.2)	1	0.000
No	35 (25.6)	102 (74.4)	4.069 (1.719 – 9.631)	
Hand washing after defecation				
Yes	10 (11.5)	77 (88.5)	1	0.028
No	32 (22.9)	108 (77.1)	2.281 (1.059 – 4.917)	

4. DISCUSSION

The overall prevalence of intestinal helminth infection among school children in Government Primary School, Atu and Calabar Preparatory Nursery/Primary School was found to be 18.5%. However, between both schools, Government Primary School, Atu had a higher prevalence of 29.1%. Government Primary School, Atu has a refuse dump located within the school premises where the pupils often defecate. This behaviour increases the likelihood of transmission of parasitic infections.

The following intestinal helminths were common in both schools; *Ascaris lumbricoides*, *Trichuris trichiura*, Hookworm, while *Strongyloides stercoralis*, *Schistosoma mansoni*, *Taenia solium* and *Enterobius vermicularis* were absent in Calabar Preparatory Nursery/Primary School. Reports have incriminated Ascariasis, Trichuriasis and Hookworm infection as the three major causes of soil-transmitted helminth infections in children in sub Saharan Africa [27]. The ova of *A. lumbricoides* was found to be highest in the faecal samples examined in both schools. The high prevalence of *A. lumbricoides* can be due to the fact that the ova remain viable

in moist soil for long periods [28], coupled with the fact that children from both schools practice open defecation, exposing them to the ova of the parasites released in the soil.

Parasitological examination of faecal samples obtained from the school children in the study area showed that 29.1% was positive in Government Primary School, Atu and 7.3% positive in Calabar Preparatory Nursery/Primary School. The result agreed with the report of Wokem and Wokem, who observed that the prevalence of intestinal parasites was significantly higher in public schools than in private schools reflecting a significant difference in health habit of the study populations [29]. The study also agreed with Chetana et al. [30] who reported parasitic infection to be higher in public school children (66.7%) as compared to private school children (33.3%). The higher positive rate among public school children might be due to low socio-economic status, poor hygienic habit and lack of sanitation prevailing in the school.

Prevalence of intestinal helminths was higher in males (22.1%) than in females (14.0%). The findings from this study is in line with Nzeako et al. [31] who reported that an overall total of 124(62%) pupils were infected out of which 56(45.1%) and 68(58.8%) were females and males respectively. The high prevalence of infection in males when compared to females may be attributed to the fact that males spend more time outdoors [32]. Male children tend to be more active than their female counterparts in their involvement in play, playing barefoot on sand; plucking and handling of fruits [33].

Children in the age range of 6-10 had the highest prevalence of intestinal parasitic infection in both schools. Ugbogu and Asogu [34] also reported that children in the age range of 6-10 had the highest prevalence rate of intestinal parasites with *A. lumbricoides* being the most prevalent. Children in the age range 11-15 years had the lowest prevalence of intestinal parasitic infection in both schools. Gboeloh [35] reported that the prevalence of helminthic infections decrease with increasing age. This is probably due to the fact that older children are more likely to maintain personal hygiene if other factors remain constant [36]. Children in all three age groups in the public school were more infected than those in the private school. This could be attributed to the fact that, children in private schools practice better

sanitation than those in public schools. In most public schools, the pupils are seen walking barefooted. This exposes the pupils to active helminth larvae in the soil and can easily penetrate them when picking dirt and walking barefooted around school compound. This is in agreement with Aribodor et al. [37] who stated that sanitary habits, refuse disposal, consuming fruit and vegetables without washing and water treatment showed significant effect as predisposing factors to intestinal helminth infections.

The use of tap, rain and stream/river as source of water increased the odds of intestinal helminth infection. The use of safe water is essential in preventing the re-emergence of helminth infections [38]. However, such are rarely present in poverty-stricken rural communities and urban slums [39]. In this study, students who excrete in open field were about seven ($p = 0.000$) times more likely to have intestinal helminths in their faecal samples than those who use water closet system. Activities such as open field defecation favour transmission of intestinal helminths [40]. This difference might be due to the difference in topological and environmental sanitation between the two study areas. Students who didn't wash their hands before meal were about four ($p = 0.000$) times more prone to develop intestinal helminths than those who wash their hands before meal. Teshale et al. [40] stated that the helminths might be confined into the nail of the child and may cause infections as they ingest food. In the present study, children who do not wash their hands after toilet were about 2 times more likely to be infected ($p = 0.028$). Similar association was reported from Homesha district in Ethiopia and Birbir town in Southern Ethiopia that children who lack hand washing habit before meal and after defecation were at higher risk of helminth infection [41,42].

5. CONCLUSION

The presence of these intestinal parasites in these schools is a public health problem. There is need to prevent these by improving individual personal hygiene through health education, general sanitation and provision of adequate social amenities like pipe borne water and good toilet system.

Recommendation for future research would be to repeat the same study using molecular diagnostic techniques, which are more sensitive.

CONSENT

As per international standard, parental written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Ethical approval was obtained from the Ministry of Health Ethical Committee, Calabar, Cross River State, Nigeria. Informed consent was also obtained from the head of the schools, pupils/parents and their class teachers. The study commenced after reaching out to the head of schools explaining the objectives and the possible benefit of the research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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