



Soil-transmitted helminthiasis among school-aged children in selected primary schools in southwest Nigeria: a cross-sectional study

Femi Awotokun^a, Oluyomi Abayomi Sowemimo^b, Ruqayah Olawoyin^c, Ashiat Alaba Adeleke^d

^a Department of Biological Sciences, Bamidele Olumilua University of Education, Science and Technology, Ikere-Ekiti, Ekiti State, Nigeria

^b Department of Zoology, Obafemi Awolowo University, Ile Ife, Osun State, Nigeria

^c Department of Zoology, Obafemi Awolowo University, Ile Ife, Osun State, Nigeria

^d Department of Zoology, Obafemi Awolowo University, Ile Ife, Osun State, Nigeria

Abstract

This cross-sectional study was conducted to determine the prevalence and intensity of infection of soil-transmitted helminths among school-aged children in Ife Central and Ife East Local Government Areas, Osun State, Nigeria.

Fresh stool samples were collected from 324 pupils, comprising 162 males and 162 females (aged 5-12 years). The preserved fecal samples were processed using a modified Kato-Katz technique. Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20. Of the 324 fecal samples examined, 79 (24.4%) tested positive for helminth eggs. The eggs were identified as *Ascaris lumbricoides*, with a prevalence of 22.2%, and hookworm; with a prevalence of 3.7%. Double infections were observed in 5 (1.5%) pupils. Private schools had a slightly higher prevalence (24.7%) than did public schools (24.1%). Sex-related prevalence was higher among males (25.9%) than females (22.8%), and no significant difference existed in the prevalence level between the sexes ($p > 0.05$).

This study concluded that STH infection remains a public health risk among children in the study area.

Keywords: School-aged children, Soil-transmitted helminthiasis (STH), Primary School.

Introduction

Soil-transmitted helminths (STHs) are included on the list of neglected tropical diseases worldwide.¹ The species of soil-transmitted helminths that infect humans are concentrated in the developing world, including the large round worm, *Ascaris lumbricoides*; *Trichuris trichiura*; and hookworm.² The disease burden is associated with different ecological conditions and local standards of living.³ Soil-transmitted helminths (STHs) are a group of parasitic

nematode worms that infect humans through ingestion of infective eggs or contact with larvae.^{4,5} Parasitic nematodes have widespread prevalence and distribution, resulting in hundreds of millions of human infections.² People become infected mainly through contamination, either by walking barefoot on soil contaminated with infective larvae or by ingestion of infective ova.⁶ Transmission can also occur through the act of eating soil.⁷

STHs are estimated to affect more than 1.5 billion people worldwide.⁸ Soil-transmitted helminthiasis (STH) is one of the most common chronic human infections in the developing world, occurring predominantly in areas of poverty, inadequate hygiene, and sanitation.⁹ All human soil-transmitted helminthes exhibit a highly dispersed distribution so that most individuals harbor only a few worms in their intestines, while a few hosts harbor a disproportionately large worm burden.² This over dispersion has many consequences, both with regard to the population biology of the helminths and public health consequences for the host, because heavily infected individuals are at risk of disease and are a major source of environmental contamination.²

Globally, the most prevalent STH is *Ascaris lumbricoides* infecting approximately 1.2 billion people, followed by *Trichuris trichiura*, infecting approximately 795 million people, and hookworm infect approximately 740 million people.¹⁰ Adult worms in the host feed on nutrients, proteins, and blood, especially hookworms, and *A. lumbricoides* can cause intestinal obstruction. STHs contribute to malnutrition and iron deficiency anemia and affect cognitive performance.¹¹ Morbidity is associated with the intensity of infection, which peaks in school-age children and is reduced by lower exposure and an increased immune response.¹²

The prevalence of soil transmitted helminthiasis in Nigeria has remained unchanged since the 1970s.¹³ Nigeria has the highest burden and endemicity of soil transmitted helminthiasis.^{14,15} School-aged children are particularly vulnerable to STH infections and are known to harbor the heaviest burden of infections and, therefore, suffer the most from associated morbidity. Most of these children live in rural and urban slums, and their ages range from 5 to 14 years.^{13,15,16} Children in this age group have been the target for chemotherapy and age-target strategies.^{17,18,19} Unhygienic and open defecation are common in Nigeria.^{15,20,21} Cultural, socioeconomic, and environmental factors are major contributing factors to the persistence of STH infections.^{13,15} Many rural communities

in Nigeria have no latrine. According to the 2018 National Demographic and Health Survey (NDHS), about 56% of Nigerian households use improved toilet facilities, 74% in urban areas and 39% in rural areas. About 27% of households in urban areas use flush toilets that flush to a septic tank, as compared with only 6% of households in rural areas.²²

In a study conducted in Southwest Nigeria, it was reported that the prevalence of *A. lumbricoides* reached a peak level among children between ages 11-14 years.¹⁸ A cross-sectional survey conducted to determine the prevalence and intensity of soil-transmitted helminths among preschool and school-aged children attending nursery and primary schools in Ile-Ife also revealed a high prevalence of soil-transmitted helminths.²³ Therefore, the present study aimed to assess the current prevalence and intensity of infection of soil-transmitted helminths among school-aged children in Ife Central and Ife East Local Government Areas, Osun State, Nigeria.

It is hoped that this will contribute useful baseline information to the planned national program for the control of parasitic infections in Nigeria.

Materials and Methods

Study Area

The study area is the Ife Central and Ife East Local Government Area, Nigeria. Children from public and private secondary school between March and June 2021 were used for the study. The study was carried out among six primary schools. Three of these schools are public (government) schools while three of them are private primary schools. These schools are located in Ife Central and Ife East Local Government Educational District.

Study Design

The study employed a school-based, cross-sectional study design.

Study Participants and study size

Each school in each Local Government Area sampled were selected randomly. The study

population consisted of both male and female aged 5-12 years who are resident in the selected communities. Sample size was estimated using the sample size estimation formula.²⁴

$$n = N/(1+Ne^2)$$

Where, n = sample size, N = total number of study population (based on 2006 census).

e = probability level (P = 0.05). The estimated sample size was 399. Though 310 people consented to the study.

Questionnaire Administration

A structured and pre-tested questionnaire was administered to the pupils to collect sociodemographic information on each pupil. The information contained in the questionnaire included pupils' biodata and parents' educational backgrounds.

Study Population

The study population consisted of school-aged children (aged 5-12 years) in the Ife Central and Ife East Local Government Areas, Osun State.

Ethical Consideration

This study was approved by the Institutional Review Board of Obafemi Awolowo University, Ile-Ife, Nigeria. Prior to the commencement of the study, verbal consent was obtained from the government's health authority. The headteacher and teachers of each school were contacted and informed of the purpose of the study. Written informed consent was obtained from the parents or guardians of the children. All information obtained from the participants was treated with confidentiality; only willing parents/guardians participated, but with the assistance of the teachers who were trusted, the unwilling were few in number.

Collection and Preparation of Stool Samples for Examination

The participants in the schools located in the community were randomly selected for the study. Stool samples were collected from all willing students in each school. The samples were collected between 10.00 am and 1.00 pm when

most pupils were attending school. All participating pupils were supplied with a clean labeled plastic universal bottle with a screw cap, clean sheet of paper, and wooden spatula. The children were instructed to pass their feces on the sheet of paper provided and to use the wooden spatula to transfer enough of the feces to fill half of the bottle and then to cover the bottle tightly with a screw cap (each child was assisted by the teacher and the researcher). Each collected fecal sample was fixed immediately by adding an adequate 10% aqueous formaldehyde solution and mixed thoroughly with a wooden applicator stick. Samples were coded and taken to the Department of Zoology, Obafemi Awolowo University Laboratory, where they were processed using the modified Kato-Katz technique and examined for helminth ova.²⁵

Laboratory Examination of Faecal Sample

In the laboratory, samples were examined for STHs using a modified Kato-Katz technique.²⁶ This involved passing a subsample of each specimen through a double-ply gauze to remove rough materials and washing with water, as necessary. The filtrate was then centrifuged at 2,500 rpm for 5 min. The supernatant was decanted, leaving behind the sediment. A plastic template with a central hole 6 mm in diameter was placed on a clean glass slide, and the hole was filled with stool sediment. The template was carefully withdrawn from the slide, leaving a fecal sample of about 14.7 mg on the glass slide. Two drops of malachite green solution were added to the sample on a slide and then mixed thoroughly. The mixture was covered with a coverslip and examined under a light microscope for helminth eggs. Each morphologically different egg was counted using a hand tally counter. The intensity of each helminth observed was determined by multiplying the number of eggs of the species counted by 24 to obtain the number of eggs per gram of feces (Epg).²⁷

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20. Statistical significance was set at $P \leq 0.05$.

Results

Socio-demographic Characteristic of the Study Population

Of the 324 students who participated in the study, 171 (52.8%) were from Ife East Local Government Area. School children aged 9-10 years had the highest participation 134 (41.4%), while 91 (28.1%) of the participants' mothers had primary school education as the highest educational level, and most of their mothers were traders 156 (48.1%) (Table 1).

Table 1. Socio-demographic Characteristics of the Study Population (where N=324)

Variables	Number Examined	Percentage (%) in the pool
LGA		
Ife Central	153	47.2
Ife East	171	52.8
Age group (in years)		
5-6	44	13.6
7-8	95	29.3
9-10	134	41.4
11-12	51	15.7
Sex		
Male	162	50
Female	162	50
Educational level of Subjects' mother		
Un-educated	80	24.7
Primary	91	28.1
Secondary	89	27.5
Tertiary	64	19.8
Occupation of Subjects' mother		
Trading	156	48.1
Artisan	77	23.8
Farming	37	11.4
Teaching	25	7.7
Housewives	16	4.9
Civil-servant	13	4.0

Table 2 shows the prevalence of STH infections in the selected schools. The overall prevalence of the infection was 24.4%. Islamic Government School had the highest prevalence of STH infection (34.6%), while Baptist Elementary School II had the lowest prevalence of infection (17.1%). The prevalence of infection in other schools varies between 19.4% and 27.9%. Private schools had a higher prevalence of STH infection (24.7%) than did government schools (24.1%). There was no significant difference in the prevalence of STH infection between the two schools. ($\chi^2=5.722$, $P=0.334$).

Table 2. Prevalence of Soil Transmitted Helminth Infection in Relation to the Selected School

Schools	No. Examined	No. Infected	Prevalence (%)
Private			
Private Primary School A	76	19	25.0
Private Primary School B	43	12	27.9
Private Primary School C	31	6	19.4
	150	37	24.7
Government / Public			
Public Primary School A	52	12	23.1
Public Primary School B	70	12	17.1
Public Primary School C	52	18	34.6
	174	42	24.1
Total	324	79	24.4

Table 3 shows the prevalence of STH infection in relation to LGAs, sex, and age groups. With reference to the LGAs, from the table, Ife East had a higher prevalence (28.7%) than Ife Central having a lower prevalence (19.6%). There was no significant difference in the prevalence of LGAs ($\chi^2=3.585$, $p=0.70$).

Table 3. Prevalence of Soil Transmitted Helminths infection in Relation to the LGAs, Sex and Age Groups

Variables	Number Examined	Number Infected	Percentage (%) in the pool
LGA			
Ife Central	153	30	19.6
Ife East	171	49	28.7
Total	324	79	24.4
Sex			
Male	162	42	25.9
Female	162	37	22.8
Total	324	79	24.4
Age groups			
5–6	44	19	43.2
7–8	95	24	25.3
9–10	134	30	22.4
11–12	51	6	11.8
Total	324	79	24.4

Males had a higher prevalence of STH (25.9%) than females (22.8 %). There was no significant difference in the prevalence of STH infection between sexes ($\chi^2=0.418$, $p=0.605$).

As shown in Table 3, the prevalence of STH infection decreased gradually from the highest value of 43.2% in children aged 5-6 years to the lowest value of 11.8% in children aged 11-12 years. There was a significant difference in the prevalence of infection among age groups ($\chi^2=3.167$, $p=0.04$).

Table 4 shows the intensity of STH eggs in children's fecal samples with sex, age groups, and LGAs. For *Ascaris lumbricoides* infection, males had a higher intensity (819.89 ± 930.06 epg) than females (595.20 ± 618.35 epg). School children aged 11-12 years had the highest intensity (1819.20 ± 2233.25 epg), while the lowest intensity was recorded in the age group 9-10 years (533.33 ± 382.92 epg). Participating schools in Ife Central LGA had higher intensity (719.04 ± 721.42 epg) than schools from Ife East LGA (706.21 ± 841.26 epg).

Table 4. Intensity of STH infection in Relation to Participating Schools

School	No. Examined	No. Infected	Mean egg intensity (epg \pm SEM)		
			A. lumbricoides eggs	No. Infected	Hookworm eggs
Private					
Private Primary School A	76	19	713.68 \pm 666.64	1	48.00 \pm 00.00
Private Primary School B	43	12	890.00 \pm 1388.78	0	00.00 \pm 00.00
Private Primary School C	31	4	468.00 \pm 361.60	2	60.00 \pm 16.97
Government / Public					
Public Primary School A	52	10	801.60 \pm 716.90	3	88.00 \pm 69.28
Public Primary School B	70	11	735.27 \pm 845.56	2	108.00 \pm 16.97
Public Primary School C	52	16	559.50 \pm 415.48	4	60.00 \pm 24.00
	324	72	710.67 \pm 796.55	12	74.00 \pm 38.91

Notes. epg: eggs per gram of faeces , SEM: Standard Error of Mean

Males had higher intensity (78.00 ± 43.97 epg) of hookworm infection than females (66.00 ± 30.20 epg). School children aged 11-12 years had highest intensity (108.00 ± 16.97 epg), while the lowest intensity (56.00 ± 13.86 epg) was recorded in age group 9-10 years.

Discussion

The present study was conducted to determine the prevalence and intensity of soil-transmitted helminth infection among school-aged children in Ife Central and Ife East Local Government Areas, Osun State, Nigeria. The overall prevalence of soil-transmitted helminthiasis (STH) among schoolchildren was 24.4%. Previous studies in Nigeria have reported a prevalence of 25.0 – 74.8%^{17,18,28,29}. The prevalence of STH obtained in this study was lower than the prevalence of 94.3% from Ibilo, Akoko-Eko L.G.A. Edo State.³⁰ Sequential studies in study area show decreased but not elimination of STH burden.²³

This study observed that *A. lumbricoides* was the most frequently encountered helminth with a prevalence of 24.4%. Previous studies in Nigeria and other parts of the world have reported that *A. lumbricoides* is the most common helminth among STHs.^{31,32} It has been established that the infective stages of *A. lumbricoides* can withstand extreme environmental conditions.² The high prevalence of *A. lumbricoides* observed in the present study may be attributable to the high environmental contamination resulting from the large number of infected people.³³

The intensity of *A. lumbricoides* and hookworm eggs, determined as mean egg counts per gram of faeces were 710.67 ± 796.55 and $74.00 \pm 38.91\%$, respectively. From the questionnaire survey, 269 (83%) participants had heard of intestinal worms, 172 (53.1%) participants had knowledge of how a worm could get into the body, 52 (16%) participants had knowledge of the signs and symptoms that can be seen in children with worm infection, and 103 (31.8%) participants knew how a worm could be expelled from the body.

Private schools had a slightly higher prevalence (24.7%) than did public schools (24.1%). This is due to the overall infrastructural difference between private and public schools in the study environment. Majority of the parents in the study area are traders. This contributes to a higher prevalence as there may be more travel to endemic areas, greater exposure to imported goods, or other factors that contribute to a higher risk of helminth infections.

This study concluded that soil-transmitted helminth infection remains a public health risk among children in the study area. Regular deworming exercises and sensitization programmes to teach the community on the route of infection will enhance control measures.

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Correspondence: Femi Awotokun, Nigeria, awotokun.femi@bouesti.edu.ng

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