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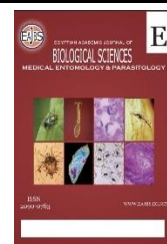
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Urinary Schistosomiasis and Its Determinants Among Elementary School Pupils in Osun State, Southwestern Nigeria

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ABSTRACT

Background and Objective: Nigeria still remains a major endemic area despite concerted efforts by the World Health Organization to reduce the burden of Schistosomiasis. This study aimed to determine the current prevalence of the infection and its associated risk factors among elementary school children in Osun State. **Materials and Methods:** The study purposively recruited 504 elementary students from eight schools across three senatorial districts of Osun State, Nigeria. A parasitological assessment of urine samples was done for the detection of *S. haematobium* eggs. A semi-structured questionnaire was administered to elicit information on the risk factors associated with urinary schistosomiasis. Bivariate and multivariate logistic regression was used to estimate the likelihood of infection among the various factors associated with urinary schistosomiasis. All statistics were performed at $p < 0.05$. **Results:** The mean (SD) age of respondents was 11 ± 1.93 years with a preponderance of age range between 11 and 16 years (54.0%). The overall prevalence of schistosomiasis was 4.4%. The highest prevalence (12.1%) was recorded in a school located in Osun West while the lowest (1.5%) was recorded in a school located in Osun East. The regression model showed that environmental activities such as fishing (aOR 7.0, 95% CI 1.59- 31.14), fetching water from river bodies (aOR 23.3, 95% CI 1.59-42.22) and open defecation (aOR 8.4, 95% CI 2.10-23.82) were independently associated with urinary schistosomiasis. **Conclusion:** This study revealed a low prevalence of urinary schistosomiasis and this is an indication of ongoing transmission.

INTRODUCTION

Sub-Saharan Africa especially Nigeria still remains a major endemic area despite efforts to reduce childhood morbidity and mortality from Schistosomiasis infection (WHO, 2013). An estimation of over 20 million people in Nigeria require annual treatment with Praziquantel (PZQ) which has been the major intervention approach for controlling schistosomiasis in the country (Hastings, 2016). *Schistosoma haematobium* and *Schistosoma mansoni* are the leading causative agents for urinary schistosomiasis and intestinal schistosomiasis respectively (Houmsou *et al.*, 2016; Mostafa *et al.*, 1999).

Bulinus species which is the intermediate host snail of *S. haematobium* has been found to be widely distributed across all geographic zones in Nigeria probably owing to the suitability of environmental factors favoring the survival of the snail (Oladejo & Ofoezie, 2006).

Schistosomiasis occurs during human contact with infected water. Activities prompting such contacts include water fetching, irrigation practices, fishing, swimming and other recreational activities where cercarial invasion through the skin occurs (Hassan *et al.*, 2015). The spread of schistosomiasis in Nigeria according to studies has been closely related to socio-demographic factors, unavailability of water, poor sanitation and hygiene conditions (Adenowo *et al.*, 2015; Hajissa *et al.*, 2018; Opara *et al.*, 2007). School-age children have been found to be largely affected by *S. haematobium* with prevalence ranging between 20 to 40 % and even as high as 50 to 70% in some endemic areas (Uneke and Egede, 2008). The endemicity of the infection has been closely linked to the availability of streams and the construction of artificial dams which serve as good habitats for the intermediate host of the schistosome parasite (Mafiana *et al.*, 2003; Okoli & Iwuala, 2004).

Osun, a State located in the western part of Nigeria has also witnessed several epidemiological studies on schistosomiasis though only in endemic regions of the state (Bolaji, 2014; Hassan *et al.*, 2015; Oladejo & Morenikeji, 2019; Oladejo & Ofoezie, 2006). These studies have largely been restricted to the communities around the dams that transverse Odo-Otin, Ifelodun and Olorunda LGAs leaving the remaining twenty-seven LGAs understudied, thus, causing a dearth of knowledge on the status of other LGAs in the state. Even in the areas where these studies have been carried out, the risk factors associated with Schistosomiasis in children have either been poorly reported or not in existence. This study therefore seeks to ascertain

factors that are associated with schistosomiasis in the State.

MATERIALS AND METHODS

Study Location:

The study was carried out within the three senatorial districts of Osun State namely Osun West, Osun East and Osun Central. The state has a total population of 3,416,959 according to the 2006 census report and is divided into three federal senatorial districts with each district having a total of ten LGAs. All the studied locations are densely populated with most children attending elementary schools provided by the State Government.

Study Population:

Using Leslie Fishers formula for sample size calculation, the study recruited five hundred and four elementary school pupils (504) within the age range of 5 to 16 years following convenience sampling. Convenience sampling was adopted due to consent issues. Subjects who have lived within the study communities for at least one year were included while pupils who have a history of being treated with praziquantel within the past 6 months and/or antimalarial drug(s) such as Artemether-Lumefantrine within the past 2 weeks before commencement of data collection were excluded.

School Selection / Characteristics:

The list of schools in each senatorial district was collected from the Osun State Ministry of Education. The researchers had interaction with the school supervisors and social mobilizers and the list of the schools close to rivers was drawn. Two consenting schools were randomly selected from each senatorial district. The school selection was in the order: 50 (9.9%) pupils were selected from school one; 81 (16.1%) from school two; 110 (21.8%) from school three; 67 (13.1%) from school four; 40 (7.9%) from school five; 19 (3.8%) from school six; 30 (5.9) from school seven; 107 (21.2) from school eight. All the schools selected have at least a river located within a 1 km radius of the school. Schools 6, 7 and 8 can be referred to as a single school as the

three schools are formed from a single mega building.

Parasitological Survey (Urine microscopy):

Midstream urine samples of pupils were collected between the hours of 8 am and 10 am daily using a wide-mouthed screwed capped plastic container. The plastic sample bottles were coated with black paints to prevent the hatching of the eggs and were quickly transported to the Department of Zoology, Osun State University laboratory using a project vehicle. 10 mls urine sample was examined microscopically using standard sedimentation by centrifugation method for the detection of *S. haematobium* eggs on a microscope (Chadeka *et al.*, 2017).

Questionnaire Survey:

A pre-tested interviewer-administered questionnaire was used to elicit information from the respondents on demographic characteristics, socioeconomic status, behavioral risks/lifestyle characteristics, and sanitation and hygiene factors. Parents' occupations were classified as high-risk and low-risk. High-risk occupations are those occupations that are directly related to water such as irrigation farming, fishing, car washing, etc while low-risk occupations do not require stream/river water contact.

Definition of Outcome Variable and Covariates:

The infection status (Schistosomiasis) of the pupils was defined by the microscopic detection of schistosome ova in the urine sample using urine filtration by centrifugation technique.

Statistical Analysis:

All results from the field were coded, compiled, and properly recorded in a prepared form. This was done daily to forestall the occurrence of missing data. Descriptive statistics (proportion, means, standard deviation and frequency tables) were used to summarize the data. Means with their standard deviations and percentages were used to summarize continuous and categorical variables, respectively. The chi-square test was used to assess the association between categorical variables. Variables that are statistically significant in bivariate analysis were included in the multivariate logistic regression model. Also, a multivariate logistic regression model was used to estimate the odds ratio (OR) and 95 % confidence intervals (CI) for factors associated with urinary Schistosomiasis among elementary pupils after adjusting for essential covariates at $p < 0.05$.

RESULTS

Sociodemographic Characteristics:

The results of sociodemographic variables of respondents are presented in Table 1. The mean \pm SD age recorded was 11 ± 1.93 years with the preponderance of those in the age range of 11 to 16 years (54.0%). The female pupils were lower (48.6%) than males. The majority of the pupils have both parents engaged in schistosomiasis low-risk occupations with only about a fifth (19.8%) of fathers engaging in schistosomiasis high-risk occupations and very few mothers (8.7%) engaging in the same respectively.

Table 1: Sociodemographic Characteristics of elementary school pupils (n=504).

Sociodemographic characteristics	Variable	frequency (%) N = 504
Age (years)	<i>Age (mean ± SD)</i>	11.0 ± 1.93
	<i>5-10</i>	232 (46.0%)
	<i>11-16</i>	272 (54.0%)
Sex	<i>Male</i>	259 (51.4%)
	<i>Female</i>	245 (48.6%)
Class	<i>2</i>	28 (5.6%)
	<i>3</i>	99 (19.6%)
	<i>4</i>	144 (28.6%)
	<i>5</i>	122 (24.2%)
	<i>6</i>	111 (22.0%)
Fathers' occupation	<i>High risk</i>	100 (19.8%)
	<i>Low risk</i>	404 (80.2%)
Mother's occupation	<i>High risk</i>	44 (8.7%)
	<i>Low risk</i>	460 (91.3%)

Child Activities Relating to Urinary Schistosomiasis:

Various activities of the pupils related to urinary schistosomiasis are documented in Table 2. A third (35.9%) of the pupils engage in swimming, about a fifth (22.6%) indulge in fishing, and very few (6.7%) use waterways for transportation. About a third (33.9%) do

laundry with river water while about half (43.5%) of them fetch water from streams for one domestic activity or the other. The majority (92.3%) of the pupils do not wear water-proof shoes while having contact with the streams and about a fifth (22.6%) of them reported defecating/urinating in nearby river bodies.

Table 2: Child activities related to urinary Schistosomiasis.

Activities	Variable	Frequency (%) N = 504
Swimming	<i>Yes</i>	181 (35.9%)
	<i>No</i>	323 (64.1%)
Irrigation farming	<i>Yes</i>	270 (53.6%)
	<i>No</i>	234 (46.4%)
Fishing	<i>Yes</i>	115 (22.8%)
	<i>No</i>	389 (77.2%)
Transportation by water	<i>Yes</i>	34 (6.7%)
	<i>No</i>	470 (93.3%)
Laundry/Dishwashing with river water	<i>Yes</i>	171 (33.9%)
	<i>No</i>	333 (66.1%)
Fetching water from stream/river	<i>Yes</i>	219 (43.5%)
	<i>No</i>	285 (56.5%)
Waterproof shoes	<i>Yes</i>	39 (7.7%)
	<i>No</i>	465 (92.3%)
Defecation/urination in/near river	<i>Yes</i>	114 (22.6%)
	<i>No</i>	390 (77.4%)

Sanitary Factors Relating to Schistosomiasis:

The sanitary/ environmental conditions of the selected schools are reported in Table 3. Only very few of the

respondents depend on stream water for drinking (4.0%) and domestic chores (5.6%). some of the pupils (7.5%) still practice open defecation, and only very few (10.1%) of those that have toilet facilities at

home use water, soap and disinfectant for cleaning their toilet. The majority (98.2%) reported having toilet facilities within the school premises and most (65.3%) of them

reported having their houses located within less than 60 minutes' walk distance from the river.

Table 3: Environmental/Sanitary Characteristics of Schools.

Environmental/Sanitary factors	Variable	frequency (%) N = 504
Drinking water	<i>Public tap water</i>	140 (27.8%)
	<i>Borehole</i>	189 (37.5%)
	<i>Well</i>	152 (30.2%)
	<i>River/Stream</i>	20 (4.0%)
	<i>Rain</i>	3 (0.6%)
Domestic water source	<i>Public tap water</i>	95 (18.8%)
	<i>Borehole</i>	161 (31.9%)
	<i>Well</i>	220 (43.7%)
	<i>River/Stream</i>	28 (5.6%)
Type of toilet in the house	<i>Water closet</i>	285 (56.5%)
	<i>Traditional latrine</i>	181 (35.9%)
	<i>Open defecation</i>	38 (7.5%)
Material used for cleaning	<i>Water only</i>	52 (10.3%)
	<i>Soap and water</i>	379 (75.2%)
	<i>Water, soap and disinfectant</i>	51 (10.1%)
	<i>None</i>	22 (4.4%)
Toilet facility within school premises	<i>Yes</i>	495 (98.2%)
	<i>No</i>	9 (1.8%)
Hand washing habit		
Before and after eating	<i>Yes</i>	404 (80.2%)
	<i>No</i>	100 (19.8%)
After leaving the toilet	<i>Yes</i>	298 (59.1%)
	<i>No</i>	206 (40.9%)
After returning from outing	<i>Yes</i>	72 (14.3%)
	<i>No</i>	432 (85.7%)
After touching feaces/urine	<i>Yes</i>	215 (42.7%)
	<i>No</i>	289 (57.3%)
River distance from home	<i><60 minutes</i>	329 (65.3%)
	<i>>60 minutes</i>	175 (34.7%)

Prevalence of Schistosomiasis:

Table 4, presents the prevalence of schistosomiasis by school and senatorial district with an overall prevalence of 4.4%. Assessing the prevalence by the school, the highest prevalence (12.1%) was recorded in

School 9 located in Osun West while the lowest (1.5%) was recorded in School 5 located in Osun East. Going by senatorial district, Osun West returned the highest prevalence (6.6%) while Osun East returned the lowest prevalence (0.6%).

Table 4: Prevalence of Schistosomiasis by School and Senatorial District.

School Code	Schistosomiasis Outcome	
	<i>No</i>	<i>Yes</i>
1	45 (90%)	5 (10%)
2	78 (96.3%)	3 (3.7%)
4	110 (100%)	0 (0%)
5	66 (98.5%)	1 (1.5%)
6	40 (100%)	0 (0%)
7	19 (100%)	0 (0%)
8	30 (100%)	0 (0%)
9	94 (87.9%)	13 (12.1%)
Senatorial District	<i>No</i>	<i>Yes</i>
Osun Central	123 (93.9%)	8 (6.1%)
Osun East	176 (99.4%)	1 (0.6%)
Osun West	183 (93.4%)	13 (6.6%)
Overall prevalence	4.4%	

Table 5, shows the unadjusted model for the determinants of urinary Schistosomiasis among elementary school pupils. Age (OR 4.0, 95% CI 1.34-12.11) and gender (OR 6.4, 95% CI 865-21.86) were among the factors observed to be associated with urinary Schistosomiasis. Others include swimming (OR 8.8, 95% CI 2.932-26.45); irrigation farming (OR 3.1,

95% CI 1.117-8.475); fishing (OR 17.9, 95% CI 5.909-53.983); laundry with stream water (OR 2.4, 95% CI 1.031-5.763); fetching water from the stream (OR 4.7, 95% CI 1.711-12.984); river water for domestic chores (OR 25.6, 95% CI 2.935-223.92) and being involved in open defecation (OR 10.7, 95% CI 3.850-29.989).

Table 5: Determinants of urogenital Schistosomiasis among elementary school pupils.

Factors	Schistosomiasis infection		Crude odd ratio (95% CI)
	Yes; N=22	No; N=482	
Sociodemographic			
<i>Age</i>			
<i>5-10 (ref)</i>	4 (1.7%)	228 (98.3%)	
<i>11-16</i>	18 (6.6%)	254(93.4%)	*4.0 (1.34-12.11)
Sex			
<i>Male</i>	19 (7.3%)	240 (92.7%)	*6.4 (1.86-21.86)
<i>Female</i>	3 (1.2%)	242 (98.8%)	
Father's Occupation			
<i>High risk</i>	7 (7%)	93 (93%)	2.0 (0.77-4.92)
<i>Low risk (ref)</i>	15 (3.7%)	389 (96.3%)	
Mother's occupation			
<i>High risk</i>	2 (4.5%)	42 (95.5%)	1.5 (0.24-4.64)
<i>Low risk (ref)</i>	20 (4.3%)	440 (95.7%)	
Child activities			
<i>Swimming</i>	18 (9.9%)	163 (90.1%)	*8.8 (2.93-26.46)
<i>Irrigation farming</i>	17 (6.3%)	253 (93.7%)	*3.1 (1.12-8.48)
<i>Fishing</i>	18 (15.7%)	97 (84.3%)	*17.9 (5.91-53.98)
<i>Laundry /dish washing</i>	12(7%)	159 (93%)	*2.4 (1.03-5.76)
<i>Fetching water from stream</i>	17 (7.8%)	202 (92.2%)	*4.7 (1.71-12.98)
<i>Defecation /urination in river</i>	8 (7%)	106 (93%)	2.0 (0.83-4.96)
Environmental/sanitary factors			
Drinking water			
<i>Public tap water (Ref)</i>	3 (2.1%)	137 (97.9%)	
<i>Borehole</i>	11 (5.8%)	178 (94.2%)	0.4 (0.09-1.29)
<i>Well</i>	6 (3.9%)	146 (96.1%)	0.7 (0.24-1.84)
<i>River/Stream</i>	2 (10%)	18 (90%)	1.8 (0.37-8.75)
<i>Rain</i>	0 (0%)	3 (100%)	-
Domestic water source			
<i>Tap water (Ref)</i>	1 (1.1%)	94 998.9%)	
<i>Borehole</i>	8 (5%)	153 (95%)	4.9 (0.60-39.92)
<i>Well</i>	7 (3.2%)	213 (96.8%)	3.1 (0.38-25.46)
<i>River/Stream</i>	6 (21.4%)	22 (78.6%)	*25.6 (2.94-23.92)
Type of toilet in the house			
<i>Water closet (Ref)</i>	8 (2.8%)	277(97.2%)	
<i>Traditional latrine</i>	3 (1.9%)	156 (98.1%)	0.7 (0.18-2.55)
<i>Public latrine</i>	2 (9.1%)	20 (90.9%)	3.4 (0.69-17.40)
<i>Open defecation</i>	9 (23.7%)	29 (76.3%)	*10.7 (3.85-29.99)
River/ stream distance from home			
<i><60 minutes</i>	17 (5.2%)	310 (94.8%)	1.9 (0.67-5.11)
<i>>60 minutes (ref)</i>	5 (2.9%)	169 (97.1%)	

Adjusted Multivariate Analysis of Determinants of Urogenital Schistosomiasis:

The result of adjusted multivariate analysis to determine the factors associated with urinary Schistosomiasis is reported in table figure 1.

Factors found to be associated with urinary Schistosomiasis include fishing (aOR 7.0, 95% CI 1.58- 31.14), river water for domestic chores (aOR 23.3, 95% CI 1.59-42.22) and open defecation (aOR 8.4, 95% CI 2.10-23.82).

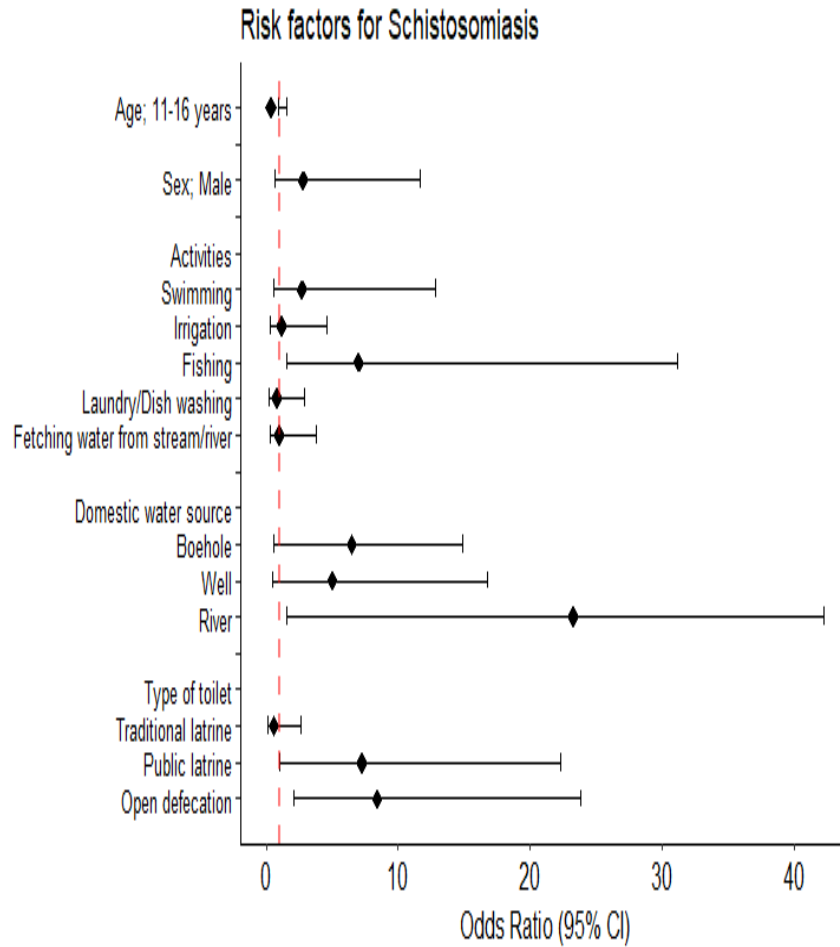


Fig. 1: Forest plot showing the risk factors of schistosomiasis.

DISCUSSION

Urinary schistosomiasis still remains a major challenge in Nigeria, especially in communities around the river system. As the global community is pushing to end NTDs by 2030, there must be concerted efforts to identify the hot spots and treat them accordingly in the concept of leaving no one behind. This concept necessitated extending surveillance to the three senatorial districts in Osun State. Our findings reported a prevalence of 4.4% for urinary schistosomiasis among school pupils in Osun State. This prevalence is by far lower than the 20% threshold recommended for endemicity by WHO (Oladejo & Ofoezie, 2006). This observation reinforced the earlier observation that the prevalence of the infection in Osun State is far below the threshold (Bolaji, 2014).

However, previous studies have reported a high prevalence of 31.7% (Hassan *et al.*, 2015) and 40% (Ojo *et al.*, 2021) in some localities around Erin Ile and Eko Ede dams. This perhaps, shows that the high endemicity of urinary schistosomiasis may be localized. The localization of this infection has been associated with the presence of the dams that support prolific breeding and survival of *Bulinus* intermediate host (Hassan *et al.*, 2015). Despite the low prevalence below the threshold, there is still a need for concerted efforts to sustain the ongoing school-based treatment of soil-transmitted helminthes and schistosomiasis in Osun State. This will ensure that the infection does not spread beyond the affected individuals while fast-tracking the process of elimination of the infection in the state.

Fishing and the use of stream water for domestic chores were major water-related activities found to be independently associated with schistosomiasis in this study. A previous study conducted in Erin-Ile in Osun State, Nigeria (Oladejo & Ofoezie, 2006) reported frequent water contact activities (swimming and fishing) among the males and fetching and washing among the females as major factors driving continued transmission of infection in the area. A similar study in the same area also confirmed the significance of water contact activities such as fishing, fetching and swimming in the transmission of the disease (Hassan *et al.*, 2015). The use of public latrines and open defecation in this study being associated with the infection status shows that the role of hygiene and sanitary environment cannot be overemphasized in infection prevention. The possibility of respondents who lack basic sanitary facilities at home using stream water as an alternative for defecating and urinating cannot be ruled out. Several studies have linked contact with river water to schistosomiasis infection with most reasons for such contacts being the result of poor sanitary conditions and unavailability of clean water in various neighborhoods. (Babatunde & Sowemimo, 2013; Echazú *et al.*, 2015; Noriode *et al.*, 2018; Odebunmi *et al.*, 2007). For instance, a study carried out among rural school children in Edo State, Nigeria found a strong association between schistosomiasis and water unavailability and poor sanitary conditions (Noriode *et al.*, 2018). Most of these factors showed a positive correlation with infection in the present study.

Conclusion

This study revealed a low prevalence of urinary schistosomiasis and this is an indication of ongoing transmission. Fishing, river water for domestic use and open defecation were the major factors that were independently implicated in the infection status of the respondents in this study. Public health enlightenment on this infection of public

health importance is therefore recommended for the vulnerable population within the State.

Declarations: None

Ethical Consideration: Permission and approval were sought from the Ethical Review Committee of Osun State Ministry of Health (OSHREC/PRS/569T/193) and the Planning, Research and Statistics department of Osun State Ministry of Education (MOE/PR&S/SS 2/vol.vi/43). Participants/caregivers were well-informed about the objectives of the study. Signed consent was obtained from the caregivers of the pupils and participation was on a voluntary basis with a view to respecting people's integrity.

Competing interests: The authors declare no conflict of interest.

Authors Contributions: I hereby verify that all authors mentioned on the title page have made substantial contributions to the conception and design of the study, have thoroughly reviewed the manuscript, confirm the accuracy and authenticity of the data and its interpretation, and consent to its submission.

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Availability of Data and Materials: All datasets analysed and described during the present study are available from the corresponding author upon reasonable request.

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