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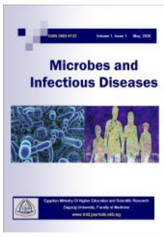

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Original article

Prevalence, intensity, and risk factors of urinary schistosomiasis among primary school children in Silame, Sokoto, Nigeria

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ABSTRACT

Background: Nigeria is the global hotspot for schistosomiasis despite several rounds of school-based preventive chemotherapy because reliable data regarding its geographical distribution are lacking and there is a need to know the current prevalence for the control plans. **Objective:** This study aimed to determine the current prevalence, intensity, and risk factors for urinary schistosomiasis among vulnerable primary school children in Silame, Sokoto, Nigeria. **Methods:** A cross-sectional laboratory-based study was carried out in April 2021 on 188 primary school children in Silame, Sokoto State, Nigeria. Urine samples were collected and examined using the sedimentation technique for the presence of *Schistosoma haematobium* eggs. Hematuria was tested using a urine dipstick. **Results:** Overall, 40 (21.3%) were positive for urinary *schistosomiasis* with a mean geometric count of 452 eggs/10 ml of urine. Gender was associated (p=0.0036) with *Schistosoma haematobium* infection and males 27 (14.4%) recorded higher prevalence than females 13 (6.9%). Hematuria was significantly associated with *Schistosoma haematobium* infection (p<0.001) and males (13.8%) recorded higher frequency than females (7.5%). Participants with light intensity of infections 26 (65%) were more than moderate 12 (30%), and heavy infections 2 (5%). Factors significantly associated with *Schistosoma haematobium* infection are gender (p=0.0036) and water source (p<0.001). **Conclusion:** The present study showed that a significant number of primary school children in Silame suffer from urinary schistosomiasis. Males are at higher risk of infections than females. Strengthening schistosomiasis surveillance systems to identify hotspots, sustainable chemotherapeutic intervention, and improving health education reduces schistosomiasis prevalence.

Introduction

Schistosomiasis caused by *Schistosoma haematobium (S.haematobium*) is a public health problem in several parts of the world, especially in tropical and sub-tropical countries characterized by poverty where there are inadequate supply of safe water, poor sanitation, and unhygienic practices such as open urination. Of the world's 250 million estimated schistosomiasis cases and estimated

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280,000 deaths reported annually, it is estimated that at least 93% of individuals affected and requiring treatment for schistosomiasis live in Africa [1-4]. In this region, Nigeria is the major contributor to the schistosomiasis burden with 25.8 million estimated cases and 101.3 million people at risk of the infection [5]. The endemicity of schistosomiasis is attributed to the lack of knowledge of the risks, deprived socio-economic status, inadequate sanitation, and open water activities in snail-infected rivers, streams, and ponds [6].

Schistosomiasis is essentially an infection in the rural and agricultural areas, transmitted by freshwater snails of the genus *Bulinus* where the people's lifestyle promotes the contamination of inland water with human excreta [7]. An individual becomes infected during contact with water containing the infective cercariae of the parasite that penetrate the skin and develops [8,9]. Adult male and female worms are paired together to form a copula within the pelvic venous plexus and the eggs produced are deposited in the bladder wall [10]. Children under 15 years of age remain the most vulnerable and represent the target group for most control interventions [11]. Early symptoms of the disease include haematuria, dysuria, anemia, retardation of growth, and development in children. At an advanced stage, schistosomiasis results in cancer of the bladder, hepatic, and renal malfunctions [12-14].

To date, concerted efforts to control schistosomiasis in Nigeria have failed woefully because reliable data regarding its geographical distribution are lacking due to the lack of political will and poor funding for the control programs [15]. It seems that eliminating schistosomiasis from the country by 2030 is a difficult task. In this context, addressing the underscored issues will escalate the journey towards the goal of schistosomiasis elimination [16]. Therefore, this study aimed to determine the current prevalence, intensity, and risk factors for urinary schistosomiasis among primary school children in Silame, Sokoto, Nigeria.

Materials and methods

Study area

This study was carried out in April 2021 in Silame, covering an area mass of 790 Km^2 along Sokoto River in Silame Local Government Area, Sokoto State, Nigeria. Sokoto River is located at latitude N13°2 ′20′′ and longitude E4°50′35′′ and provides water for domestic and agricultural uses. The river is the major source of water for irrigation farming, fish farming, and recreational activities even for the neighboring communities [17].

Study design and population

This is a cross-sectional laboratory-based study was carried out in April 2021 on 188 primary school children attending government primary school Silame, Sokoto State. Age ranged from 5-19 years. The study was conducted according to the international guidelines of Strengthening the Reporting for Observational Studies in Epidemiology (STROBE).

Ethical approval, recruitment, and enrollment

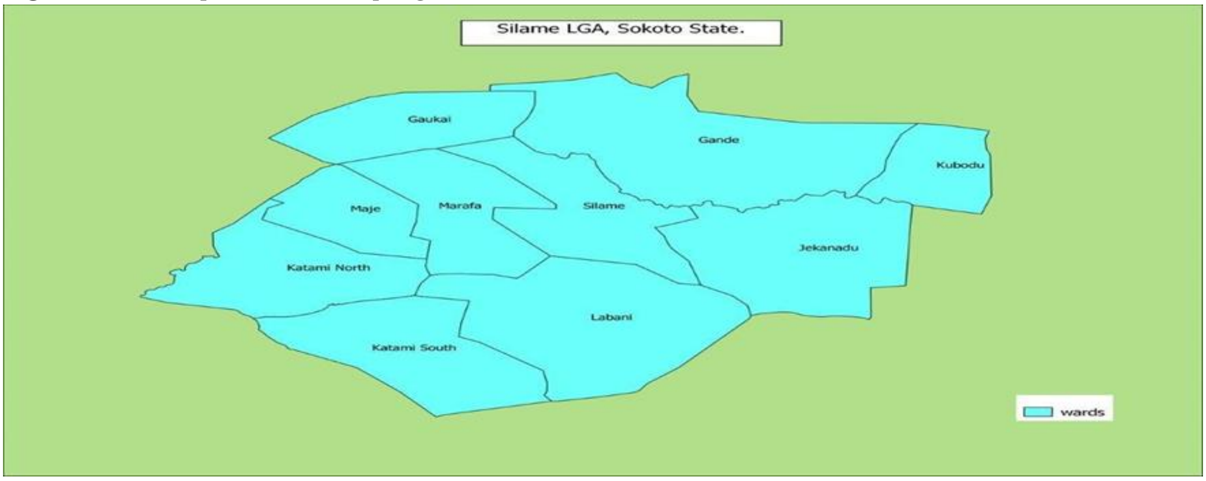
This study was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving human subjects. The protocol was approved by the Sokoto State Ministry of Health, Research Ethics Committee with Ref. No. SLM/PHC/VOL.1/039. The study objectives, procedures, and benefits were explained to the school authorities, parents/guardians, and participants to get their cooperation and consent to conduct the study. A total of 188 primary school children with parental consent were used in the study.

Participants received clean labeled urine containers and were taught how to collect urine samples. A structured questionnaire was administered to each participant to obtain socio-demographic information which was analyzed to determine the associated risk factors for Schistosoma infection in the study area [18]. School children who were found to be infected with *S. haematobium* were administered praziquantel drugs provided by the World Health Organization through The Sokoto State Ministry of Health. On the other hand, school children not willing to take part in the study were excluded.

Urine sample collection and processing

Individual-based questionnaires were used to collect information on name, age, sex, water sources, and parental occupation. Urinalysis form was used to record urine parameters while clean, screw-capped, and labeled plastic universal bottles (20 ml) were presented to the respondents who produced terminal urine samples between the hours of 10:00 AM and 2:00 PM [19, 20] which coincided with the circadian rhythm of the parasite egg excretion [21]. In the laboratory, 10ml of each urine sample was measured into a test tube and centrifuged at 5000 rpm for 5 min. The supernatant was decanted off while the sediment was examined under a light microscope using an x40 objective lens for the presence of terminal spine of *S. haematobium* eggs and expressed as the number of eggs/10ml of urine [22]. The intensity of infection was graded as light between 1-9 eggs/10ml urine, moderate (10-49 eggs/10 ml urine), and heavy excreting above 50 eggs/10 ml urine. A negative urine sample was indicated by the absence of parasite eggs [1].

Figure 1. GPS map of Silame sampling site.



Statistical analysis

Data obtained from the study were entered into Microsoft Excel 2010 and analyzed with SPSS version 25.0 (SPSS Inc., Chicago, IL, USA). Associations between variables were determined using the Chi-square test and a statistical significance was determined at $p < 0.05$.

Results

Table 1: Sociodemographic characteristics of study participants

Of the 188 urine samples analyzed for urinary *schistosomiasis*, 51.1% (96/188) were males and 48.9% (92/188) were females, giving a gender ratio of 1:1.044 (males: females). Study participants were primary school children and the majority (65.4%) were of age 5–11 years. Farming is the major occupation of their parents (63.3%). it was obvious that most of the participants depend on boreholes/rivers for daily activities such as bathing and washing.

Table 2: Prevalence of *S. haematobium* among the study participants

The overall prevalence of *S. haematobium* infection was 21.3% (40/188) with a mean egg intensity of 23.1 egg/10 ml of urine. The infections were more prevalent among males 27 (14.4%) than in females 13 (6.9%). The infections were significantly associated with participants' gender (p=0.036*).

Table 3: Age and gender distributions of *S. haematobium* among the study participants

Among the age groups, there was a positive association between the study population and *S. haematobium* infections. The highest frequency of *S. haematobium* infections 26 (13.8%) was recorded among those aged 5 to 11 years with a mean intensity of infections of 8.35 eggs/10 ml (20.9%), while participants aged 12 to 16 years had the least 14 (7.5%) prevalence with a mean intensity of 14.7eggs/10 ml (37.0%). However, the association was not significant. Males had the highest frequency 27 (14.4%) as compared to the females 13 (6.9 %). The association was statistically significant (p=0.036 *).

Table 4: Age and gender distribution of hematuria among study participants

The frequency of hematuria was higher among those aged 5 to 11 years (13.3%) than older aged 12 to 16 years (7.5%). Hematuria was most frequent among males (13.8%) than females (7.5%).

Table 5: Association between *S. haematobium* infections and hematuria among study participants

Schistosoma haematobium infections are significantly associated with hematuria (p<0.001*) with a mean parasite concentration of 3.0.

Table 6: Risk Factors of schistosomiasis among study participants

Schistosoma haematobium infections are significantly associated with participants' gender and sources of water (p<0.001*). There was no significant association between the father's occupation and the infection (p=0.75).

Table 7: Intensity of *S. haematobium* among study participants

Of the 188 samples examined, 40 (21.3%) were found to be positive for the presence of *S. haematobium* eggs. Of the 40 (21.3%) positive, 26 (65%) were excreting between 1-9eggs/10ml, 12 (30%) were excreting between 10-49 eggs/10ml urine, and 2 (5%) were excreting above 50 eggs/10 ml urine.

Table 1. Socio-demographic characteristics among study participants.

Variables	Frequency	Percentage (%)
Age (years)		
5 to 11	123	65.4%
12 to 16	65	34.6%
Gender		
Male	96	51.1%
Female	92	48.9%
Parents occupation		
Crop farmers	119	63.3%
Traders	52	27.7%
Herders	17	9.0%
Water source		
Well water	33	17.6%
River water	10	5.3%
Borehole water	145	77.1%
Education		
Primary school	188	100%

Table 2. Prevalence of *S. haematobium* among study participants.

Variable		Parasite Status – n (%)		Total	*P* – value
		Negative	Positive		
Gender of the Pupils					
	Male	69 (71.9)	27 (14.4%))	96 (100)	
	Female	79 (85.9)	13 (6.9%)	92 (100)	0.036 *
	Total	148 (78.7)	40 (21.3)	188 (100)	

Table 3. Age and gender distribution of *S. haematobium* among study participants.

Variable	Category	Number of negative *S. haematobium*	Number of positive *S. haematobium*	*p*-value
Age (years)	5 to 11 12 to 16	123 (65.4%) 65 (34.6%)	26 (13.8%) 14 (7.5%)	0.56
Gender	Male Female	69 (36.7%) 79 (42.0%)	27 (14.4%) 13 (6.9%)	0.036 *

Table 4. Age and gender distribution of hematuria among study participants.

Variable	Frequency hematuria	Percentage distribution
Age (years)		
5 to 11	25	13.3%
12 to 16	15	7.9%
Gender		
Male	26	13.8%
Female	14	7.5%

Table 5. Association between *S. haematobium* infection and hematuria among study participants

Variable	Mean parasite concentration	*p* – value
Hematuria		**<0.001***
S. haematobium	**3.0**	

* Significantly associated with parasite status at *p*<0.05.

Table 6. Risk Factors of schistosomiasis among study participants.

Variable	Category	Number of negative *S. haematobium*	Number of positive *S. haematobium*	*p*-value
Fathers' occupation	Farmers	119 (63.3%)	25 (13.3%)	0.753
	Traders	52 (27.7%)	11 (5.9%)	
	Civil servant	17 (9.0%)	4 (2.1%)	
Water sources	Well water	22 (11.7%)	2 (1.0%)	< 0.001*
	River water	36 (19.2%)	6 (3.2%)	
	Borehole water	130 (69.1%)	32 (17.0%)	
Level of Education	Primary	148 (78.7%)	40 (21.3%)	

Table 7. Intensity of schistosomiasis among study participants

Variable intensity	Age group		
	5-11 years	**12-16 years**	**Total**
Light (1-9eggs/10 ml)	18 (45%)	8 (20%)	26 (65%)
Moderate (10-49eggs/10 ml)	7 (17.5%)	5 (12.5%)	12 (30%)
Heavy (50eggs/10 ml)	1 (2.5%)	1 (2.5%)	2 (5%)
Mean Intensity (eggs/10ml)	8.35 (20.9%)	14.7 (37.0%)	23.1 (57.9%)

Discussion

The prevalence of *S. haematobium* infections among primary school children in Silame was 21.3%, a moderate risk prevalence which falls within the national prevalence range of 2 to 82.5% in Nigeria but higher than the national mean of 13% [23]. The finding of moderate risk prevalence was in tandem with previous studies in Sokoto, North-western Nigeria [24], Kaduna, North-central Nigeria [25], and Maiduguri, North-eastern Nigeria [26]. However, the present study recorded a lower figure of moderate risk prevalence. The decline in the prevalence of urinary schistosomiasis in the study areas could be attributed to the recent mass distribution of praziquantel drugs among school children [27].

The frequency of *S. haematobium* infection was higher among school age 5-11 years (13.8%) than 12-16 years (7.5%), supporting previous studies in Nigeria [8,28], Cameroon [29], Cote d'Ivoire [30], Swaziland [4], and Malawi [31]. However, the age difference in frequency was not significant. **Chu et al.** [4] and **Nwachukwu et al.** [32] reported the contrary at different locations. The high prevalence of schistosomiasis among younger children might be due to their unrestrained exposure to schistosome-infested water [33].

The frequency of *S. haematobium* infections was higher among males than females with a significant association (p=0.0036). This result is in tandem with other studies [19,30,33,34] but different from others that recorded higher prevalence among females [18,35]. Such differences could be traced to the different cultural and religious practices which grant male children unrestrained access to open waters.

Furthermore, the frequency of school children with a light intensity of infections was significantly higher than those with moderate and heavy infections. The high frequency of light intensity of infections in this study was in tandem with findings of **Uneke et al.** [36]; **Otuneme et al.** [18], an indication that most infected individuals harbor low schistosome. However, light-intensity of infections are lethal if not treated. Consistent with **Achanau et al.** [5] and **Degarege et al.** [27] reports, *S. haematobium* infection was associated with hematuria (p<0.001). Our findings also confirmed that the dipstick method could be used for rapid screening of *S. haematobium* infection in tandem with a previous report [37].

School children whose water sources for drinking, washing, bathing, and swimming are boreholes and rivers were significantly associated with schistosomiasis. Participants whose parental occupation is farming also showed a positive association with urinary schistosomiasis. This finding is supported by previous studies that associated schistosomiasis infections with cultural and traditional agricultural practices such as washing, fishing, and bathing influences schistosomiasis transmission in Nigeria [38].

Nonetheless, this study has some limitations and the results should be interpreted with care. We conceived that some light-intensity of infections were missed and the overall prevalence of *S. haematobium* might be higher than reported. We also speculate some reporting bias in the questionnaires administered to the participants, no specific information was collected on the hygiene behavior of the participants which are identified risk factors for schistosomiasis.

Conclusion

The present study showed that a significant number of primary school children in Silame suffer from urinary schistosomiasis. Males are at higher risk of infections than females in the study areas. Strengthening surveillance systems to identify schistosomiasis hotspots, sustainable chemotherapeutic intervention, and improving health education are recommended to reduce schistosomiasis prevalence.

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Availability of data and materials

Data are available on reasonable request from the corresponding author.

Conflict of interest : None

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Nothing to declare

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