

# URINARY SCHISTOSOMIASIS: RISK FACTORS AND SYMPTOMS AMONG SCHOOL ADOLESCENTS IN KADUNA STATE, NIGERIA

**Henry Gabriel Bishop**✉

Department of Microbiology<sup>1</sup>  
gabrielhenrybishop@gmail.com

**Helen Ileigo Inabo**

Department of Microbiology<sup>1</sup>

**Elijah Ekah Ella**

Department of Microbiology<sup>1</sup>

**Mohammed Bello**

Department of Public Health and Preventive Medicine<sup>1</sup>

Ahmadu Bello University

Sokoto Road-Samaru, Zaria, Nigeria, 810107

✉Corresponding author

## Abstract

Improper waste disposal, unsafe water and indiscriminate water-contact activities are major factors enhancing continuous spread of schistosomiasis in Nigeria. Many water bodies are prone to contamination with human wastes directly discharged into them or due to surface runoff, and are infested with parasites. Open defecation and discharge of household sewage into water channels is still practiced. Children conduct activities in these water bodies, thereby exposing themselves to infections with schistosomes among other pathogens. Urine samples (10 mL each) were collected from 600 consented school adolescents across six Local Government Areas of Kaduna State, Nigeria. Information on their water-contact activities were obtained by means of questionnaires. Urine sediment was examined for *Schistosoma haematobium* eggs by microscopy. No infection was recorded in adolescents who had awareness about the disease. Those who engaged in swimming (9.2 %, OR=2.2) and fishing (10.3 %, OR=2.1) were significantly more infected than those who did not ( $P \leq 0.05$ ). Adolescents who worked on irrigated farms (9.0 %, OR=1.4), washed clothes in rivers (9.0 %, OR=1.6), or fetch water from rivers for domestic purpose (10.0 %) were more infected than others who did not engage in those activities. Therefore, swimming and fishing are important factors enhancing the spread of schistosomiasis among school adolescents in Kaduna State. Irrigation farming, washing of clothes in rivers or fetching water from rivers exposed the adolescents to schistosome infections. Widespread awareness campaigns, provision safe water to communities, and standard water-based recreational centers are paramount.

**Keywords:** Urinary schistosomiasis, adolescents, infection, water-contact, Kaduna State, Nigeria, awareness, river, school.

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## 1. Introduction

Schistosomiasis (also known as bilharziasis or snail fever) is a chronic parasitic disease caused by blood flukes of the genus *Schistosoma* [1, 2]. In humans, urinary schistosomiasis is caused by *Schistosoma haematobium* [2], which induces chronic inflammation in organs and tissues of the urogenital tract, especially the bladder [3].

It is referred to as urinary or urogenital schistosomiasis, which is a neglected tropical disease [4] that thrives in communities that lack access to safe water and good sanitation [5]. Urinary schistosomiasis affects individuals involved in irrigation farming [6] and fishing as an occupation or for leisure [7]. School-aged children are more vulnerably affected by urinary schistosomiasis [8] and constitute a reservoir of the infection [9]. The disease is endemic in Africa [2, 10]. Considerable morbidity and mortality had been linked to the developing world like Africa [11, 12] due to prevailing ecology, behaviours and practices that encourage schistosomiasis transmission [13]. Due to children's indiscriminate play habits in unsafe bodies of water, they remain the most vulnerable group [6], more

often becoming infected and re-infected [3]. Low level of awareness about the disease, swimming or bathing in rivers, fishing, diving, wadding, fetching of water from rivers, conducting domestic chores with infested water, and undertaking agricultural activities on marshy or irrigated farms all put any participating individual (regardless of age or gender) at risk of schistosomiasis [14–16]. Only 50 % of eggs released by the parasite are extruded in urine, the remaining 50 % are trapped in bladder tissues and cause local tissue damage [17, 18], with consequent loss of blood and anaemia [16].

Objective of the study was to screen for urinary schistosomiasis and identify significant risk factors of the disease among school adolescents in Kaduna State, Nigeria.

## 2. Materials and methods

### 2.1. Study area and population

The study was conducted in Kaduna State Nigeria. Kaduna State has 23 Local Government Areas (LGAs) that are divided into three Senatorial Districts. Two LGAs were selected from each Senatorial District, namely Jaba and Kachia, Giwa and Kaduna South, Makarfi and Sabon-Gari LGAs. School-based schistosomiasis awareness was created across the selected LGAs, where 600 adolescents between the ages of 10–19 years old in secondary schools were enrolled.

### 2.2. Ethical clearance

Ethical clearance for this study was obtained from Kaduna State Ministry of Health with reference number MOH/ADM/744/VOL.1/539, and permission to conduct a school-based study from Kaduna State Ministry of Education, Science and Technology with reference number NCE/STAT.3/VOL.II.

### 2.3. Collection of urine samples and parasitological examination

Structured questionnaires were administered to gather some data on exposure to certain risk factors and symptoms of disease among school adolescents. From each consented subject, 10 mL urine sample was collected and examined at the Parasitology Laboratory in Department of Microbiology, Faculty of Life Sciences, Ahmadu Bello University, Zaria, Nigeria. Briefly, each urine sample was centrifuged at 3000 revolutions per minute for 5 minutes [3, 16], and then the sediment was examined using 10× and 40× objectives of the light microscope for characteristic terminal-spined eggs of *Schistosoma haematobium* [3].

### 2.4. Statistical analysis

Data obtained were subjected Chi-square ( $\chi^2$ ) and Odds ratio (OR) analysis using IBM SPSS version 23 at 95 % confidence interval. Final results were simplified in a chart and tables.

## 3. Results

Terminal-spined egg of *Schistosoma haematobium* observed in urine sediment is presented in **Fig. 1**. Out of the 600 urine samples examined, 41 were positive for urinary schistosomiasis, giving an overall prevalence of 6.8 % (**Fig. 2**).

In **Table 1**, there was no infection found in any of the study subjects who had awareness about urinary schistosomiasis ( $P=0.085$ ,  $OR=0.927$ ). Those school adolescents who engaged in irrigation farming were more infected (9.0 %) with the parasite than those who did not practice it (5.8 %), but it was not statistically significant ( $P=0.324$ ). Adolescents who engaged in indiscriminate swimming in water bodies had higher *Schistosoma haematobium* infections of 9.2 % than those who did not (4.4 %). Swimming in rivers/streams ( $P=0.024$ ,  $OR=2.177$ ) was a statistically significant factor in the transmission of *Schistosoma haematobium* among the school adolescents. In addition, study subjects who engaged in fishing activity had more infections (10.3 %) than those who did not (5.3 %). Fishing activity ( $P=0.024$ ,  $OR=2.062$ ) predisposed the subjects to the infection. Washing of clothes in rivers/streams or fetching of water from rivers by the adolescents led to increase in number of infections.

Symptoms of urinary schistosomiasis in this study are presented in **Table 2**. Adolescents who experienced painful urination were more infected with *Schistosoma haematobium* (10.8 %) than those who did not (5.8 %). The relationship between urinary schistosomiasis and painful urination was statistically significant ( $P=0.05$ ). Frequent urination (10.3 %) was more commonly found among infected

subjects than those who were not infected (OR=1.619). There was higher occurrence of urinary schistosomiasis (8.8 %) among adolescents with abdominal pains than 6.6 % among those without abdominal pains ( $P=0.490$ , OR=1.374). Terminal haematuria (also called visible haematuria) was a statistically significant sign of urinary schistosomiasis among the school adolescents (24.6 %,  $P=0.000$ , OR=6.661).



Fig. 1. An egg of *Schistosoma haematobium* in urine sediment of school adolescent in Kaduna State, Nigeria

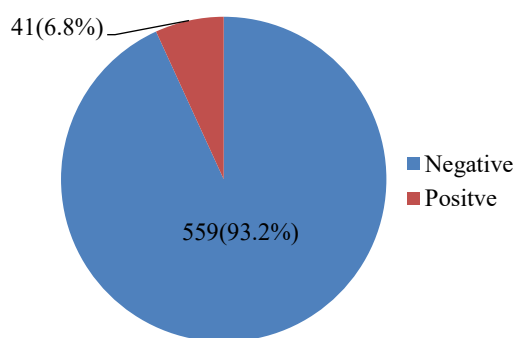


Fig. 2. Overall prevalence of urinary schistosomiasis among school adolescents in Kaduna State, Nigeria

Table 1

Risk factors of urinary schistosomiasis among school adolescents in Kaduna State

Risk factor	Category	Number examined	Number positive ( %)
Awareness <sup>a</sup>	No	562	41 (7.3)
	Yes	38	0 (0.0)
Irrigation <sup>b</sup>	No	308	18 (5.8)
	Yes	292	32 (9.0)
Swimming <sup>c</sup>	No	294	13 (4.4)
	Yes	306	28 (9.2)
Fishing <sup>d</sup>	No	416	22 (5.3)
	Yes	184	19 (10.3)
Washing of clothes <sup>x</sup>	At home	423	25 (5.9)
	River/stream	177	16 (9.0)
	Borehole	176	9 (5.1)
Source of water <sup>z</sup>	River/stream	10	1 (10.0)
	Well	414	31 (7.5)

Note: a –  $\chi^2=2.976$ ,  $df=1$ ,  $P=0.085$ , OR=0.927; b –  $\chi^2=0.973$ ,  $df=1$ ,  $P=0.324$ , OR=1.378; c –  $\chi^2=5.266$ ,  $df=1$ ,  $P=0.022$ , OR=2.177; d –  $\chi^2=5.085$ ,  $df=1$ ,  $P=0.024$ , OR=2.062; x –  $\chi^2=1.919$ ,  $df=1$ ,  $P=0.166$ , OR=1.582; z –  $\chi^2=1.254$ ,  $df=2$ ,  $P=0.534$

**Table 2**

Symptoms of urinary schistosomiasis among school adolescents in Kaduna State, Nigeria

Symptom/Sign	Category	Number examined	Number positive (%)
Painful urination <sup>x</sup>	No	480	28 (5.8)
	Yes	120	13 (10.8)
Frequent urination <sup>y</sup>	No	561	37 (6.6)
	Yes	39	4 (10.3)
Abdominal pains <sup>a</sup>	No	532	35 (6.6)
	Yes	68	6 (8.8)
Terminal haematuria <sup>β</sup>	No	535	25 (4.7)
	Yes	65	16 (24.6)

Note:  $x-\chi^2=3.770$ ,  $df=1$ ,  $P=0.05$ ,  $OR=1.961$ ;  $y-\chi^2=0.768$ ,  $df=1$ ,  $P=0.381$ ,  $OR=1.619$ ;  $a-\chi^2=0.477$ ,  $df=1$ ,  $P=0.490$ ,  $OR=1.374$ ;  $\beta-\chi^2=36.206$ ,  $df=1$ ,  $P=0.000$ ,  $OR=6.661$

#### 4. Discussion

Microscopic detection of terminal-spined eggs in urine samples of school adolescents in Kaduna State, Nigeria demonstrated evidence of urinary schistosomiasis in the area. This study is among the few that screened secondary school adolescents for urinary schistosomiasis in Nigeria. Most previous studies had been focused on primary schoolchildren.

Urinary schistosomiasis was detected among the school adolescents across all the six selected LGAs of Kaduna State, with an overall prevalence of 6.8 %. This prevalence compared to other studies within the state was relatively lower. A higher prevalence of 12.3 % had been reported by [19] in Lere LGA, and 12.3 % also by [16] in Jaba LGA of Kaduna State. A lower prevalence was found in this study because the study subjects were secondary school adolescents, who were relatively older with lesser tendency of indulging in indiscriminate activities in bodies of water. Some of them might have been privileged to be part of previous studies while they were still much younger in the primary school, which informed them of certain preventive measures.

However low the prevalence was in this study, the infected adolescents pose threat to other members of their communities if left untreated. They may discharge urine into or close to bodies of water when next they go to swim or fish. [2] had emphasized that lack of proper hygiene and certain play habits of school-aged children make them vulnerable to schistosomiasis.

Urinary schistosomiasis was not found among adolescents who were aware about the disease. They most likely did not expose themselves to cercariae-infested water bodies as done by the others. Therefore, awareness is important in the control of schistosomiasis [7, 20], because if adolescents are aware of the danger of infested stagnant or slow-flowing rivers, they won't bathe or swim in them. Unawareness promotes the spread of schistosomiasis among schoolchildren [7, 16, 21].

Irrigation farming is a common agricultural practice in Northern Nigeria. Shortage of rainfall and the need for an all-year-round supply of vegetables and fruits across the country necessitate the use of irrigation system. Many parents and youths have turned to agriculture (using irrigation system) to maintain steady source of income for themselves and family, as many of them do not have alternative means of income. Some of the adolescents assist their parents during the irrigation process. Majority of irrigated farms are located close to streams or large stagnant water bodies prone to snail infestation. Such water sources pose major threat to the health of these farmers and their children. In this study, many of the adolescents who engaged in irrigation farming had more *Schistosoma haematobium* infections than those who did not, and had higher risk of getting the infection due to the unsafe water used for irrigation. Routine agricultural, occupational, domestic and recreational activities exposed children, adolescents and adults to schistosomiasis [2, 3].

When water is infested with cercariae of *Schistosoma*, it becomes unfit for water-contact activities like swimming, wading or bathing. In this study, majority of the infected adolescents actively swam in streams/rivers within their communities. Sewage from homes (containing human wastes) is often discharged directly into streams/rivers in slums and unplanned local communities.

The surroundings of those water bodies are liable to open defecation. It is well reported that swimming in unsafe water poses great risk of *Schistosoma* infections among children [2, 7, 12, 22].

Fishing is also a water-contact activity and an occupation. There is usually a degree of body contact with the infested water during fishing. When the adolescents go fishing, they are lured to swim or bathe in the same stream/river. Fishing remains a risk factor for urinary schistosomiasis among the adolescents, as equally reported by [2, 23, 24].

Inadequate supply of potable water in many communities and poor sanitation system remain major challenges of the 21<sup>st</sup> Century. Cercariae-infested water is the bedrock of schistosomiasis transmission. In some communities, people often resort to any body of water for domestic use. In this study, adolescents whose sources of water at home were rivers and wells had more infections than those with boreholes. Hand-dug wells in homes cannot meet daily water need, especially during the dry season when the water table has dropped deep down. Most of the infected adolescents in this study washed their clothes in streams/ivers, aiding the transmission of schistosomiasis. According to [2], schistosomiasis is a disease that mostly affects people in poor and rural areas that lack access to safe water.

In this study, significant symptoms of urinary schistosomiasis among infected adolescents were painful urination and terminal haematuria ( $P<0.05$ ). In high intensity of the infection, more pains are felt during urination with increased tendency of terminal/visible haematuria. In some advanced (or untreated) cases of the infection, the entire urine passed out appears red and cloudy [23]. The association between urinary schistosomiasis and visible haematuria had been reported by [16, 20, 25]. In fact, terminal (or visible) haematuria is the main or classical sign of urinary schistosomiasis [2, 26]. Frequent urination and abdominal pains were more likely reported among the infected subjects ( $OR>1$ ). Other studies by [23, 27] had reported painful urination and abdominal pains as signs of the disease too.

Limitation of the study: some remote locations within the study area could not be accessed due to increased level of insecurity.

Prospects for further research will be targeted at evaluating health impacts of urinary schistosomiasis among infected individuals, especially the effects of the disease on children's physical growth and consequent development of bladder cancer and other urologic problems.

## 5. Conclusions

Results from this study revealed a prevalence of 6.8 % of urinary schistosomiasis among school adolescents in Kaduna State, Nigeria.

Important factors aiding the continued spread of the disease among school adolescents in the study area included lack of awareness, swimming and fishing in infested rivers. Practices such as irrigation farming (using unsafe water), washing of clothes in rivers and fetching of water from rivers for domestic purpose increased the predisposition to urinary schistosomiasis.

The results indicated that significant symptoms of the disease among the school adolescents included painful urination and terminal haematuria. However, frequent urination and abdominal pains were more likely encountered during the infection. There is need to expand the horizon of awareness campaigns via mass media and social media. Provision of safe water will help to control urinary schistosomiasis in Kaduna State, Nigeria.

## Conflict of Interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

## Financing

This study was conducted without any financial support.

## Data availability

Data will be made available if a written reasonable request is presented.

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