



Prevalence of Urinary Schistosomiasis among Primary School Pupils in Jos, Northcentral Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Authors ASD and RJJ conceptualized the study, wrote the protocol and the first draft of the manuscript. Authors TE, GS and MCN performed the statistical analysis and managed the literature searches. Authors ASL and EDJ supervised and monitored the entire work. All the authors reviewed and gave their approval for this article to be submitted for publication. All authors read and approved the final manuscript.

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ABSTRACT

Background: Urinary schistosomiasis is a parasitic disease caused by *Schistosoma haematobium*. It is a neglected tropical disease with Africa responsible for an estimated 90% of all cases requiring treatment. Nigeria is known to be endemic for urinary schistosomiasis with more than 100 million people at risk and about a 25million already infected.

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Aim: This study aimed to determine the prevalence and associated risk factors of urinary schistosomiasis among primary school pupils in Jos, Northcentral Nigeria.

Study Design: A cross-sectional school-based study of 264 primary school pupils in Jos, Northcentral Nigeria.

Place and Duration of Study: This study was carried out in Jos, Northcentral Nigeria between September 2021 and February 2022.

Methodology: About 50ml of terminal urine samples were collected from each pupil in a sterile, wide-mouth universal container after obtaining consent from their parents and filling out a structured questionnaire. Urinalysis was done on-site using Swe-Care Uric 9V Urinalysis Reagent Strip. The ova of *Schistosoma haematobium* were identified using microscopy. DNA extraction was done on the positive sample and stored for subsequent sequencing. Statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 22.

Results: The eggs of *Schistosoma haematobium* were observed in 43(16.3%) of 264 urine samples examined. School B had the highest prevalence of 30.8% followed by School A, while School C with the highest number of recruited pupils was responsible for the lowest prevalence rate at 5(7.1%). Males were more infected than females with the age group 11-13 years old accounting for the highest prevalence rate of 15(25.9%). Haematuria and dysuria were found to have a positive correlation with urinary schistosomiasis among the participants.

Conclusion: The findings of this research revealed that urinary schistosomiasis is still a major concern among primary school pupils in Jos, Northcentral Nigeria. Preventive chemotherapy using praziquantel should be combined with health education and communication strategies to treat and change risky behaviours among infected pupils such as swimming in snail-infested freshwater.

Keywords: Cercariae; microscopy; praziquantel; *Schistosoma haematobium*; terminal haematuria.

1. INTRODUCTION

Urinary schistosomiasis is a parasitic disease caused by the blood fluke *Schistosoma haematobium*. This parasite lives in the vesical plexus of the infected individuals and releases eggs that penetrate the bladder mucosa using proteolytic enzymes, aided by their terminal spines to gain access into the bladder lumen [1]. Although a preventable disease, urinary schistosomiasis ranks second only to malaria in terms of the prevalence and socio-economic impact of parasitic diseases in tropical and subtropical countries where it is endemic. The distribution of the disease is focal and its effects are more common in rural areas where the population uses natural fresh water for their domestic water supply, recreational activities, and agricultural production. Hence, disease transmission is contingent on the presence of freshwater infested with the infected freshwater snail *Bulinus*; the intermediate host [2,3].

The high prevalence of urinary schistosomiasis has been attributed to the wide distribution of the intermediate host; freshwater snails. Indiscriminate micturition, poor sanitation, poverty, ignorance, and limited access, and availability of health facilities are factors that sustain the persistence of urinary schistosomiasis in developing countries [4]. The report for 2021 indicated that 29.9% of people

requiring treatment were reached globally, with a proportion of 43.3% of school-aged children requiring preventive chemotherapy for schistosomiasis being treated. A drop of 38% compared to 2019, was due to the COVID-19 pandemic which caused the suspension of treatment campaigns in many endemic areas [5]. Urinary schistosomiasis is a serious health problem in Nigeria, with about 29 million infected cases and 101 million people at risk of infection [6].

Patients with urinary schistosomiasis often present with haematuria or blood in urine with progressive damage to the bladder, ureters, and kidneys [7,8]. School children, adolescents, and young adults have been found to have the highest prevalence and morbidity rate due to Schistosomiasis. The negative impacts caused by untreated infections demoralize both the social and economic development of school performance among infected children in endemic areas [9]. It causes growth retardation, anaemia, vitamin-A deficiency as well as possible cognitive and memory impairment, which limits their learning potential [10].

The negative impact of this infection has warranted the need for continuous surveillance and treatment to curtail the health implications. The WHO strategy for schistosomiasis control focuses on reducing disease through periodic,

large-scale treatment of at-risk populations with praziquantel [5]. However, this has suffered serious neglect in most developing countries due to financial constraints. This necessitated the need for this study to draw the attention of policymakers to the challenges faced by sufferers of this infection.

2. MATERIALS AND METHODS

2.1 Study Area

A cross-sectional school-based study was conducted among primary school pupils in Jos South Local Government Area of Plateau State. Most of the children attending these schools live with their parents and guardians within the surrounding communities of the study area. The people living in this community are mainly civil servants, farmers, traders, and artisans. There are many abandoned mining ponds in the study area that the residents use for irrigation farming, washing clothes, swimming and as sources of water for domestic use.

The study area was selected purposely, while the five schools were selected by ballot without replacement out of the total of ten schools in the area. All the selected schools are government-owned day schools. The sample size was distributed to the five selected schools proportionately taking into consideration the total number of students in each school. The students were finally recruited by using a simple paper balloting containing "YES" or "NO," and those who picked YES were recruited into the study.

Terminal urine samples were collected from 264 primary school pupils (comprising 164 males and 100 females), using well-labelled 50ml sterile, wide-mouth, screw-capped plastic containers after giving them instructions on how to collect the terminal urine, and filling out a self-administered, structured questionnaire. The samples were transported in the cold box containing ice blocks and transported to the laboratory within 10 minutes of collection and analyzed immediately. The samples were divided into two portions, the first portion was stored at -20°C for polymerase chain reaction (PCR) while the second portion was used for Urinalysis and microscopy.

2.2 Urinalysis

Urinalysis of the urine samples was done for microhaematuria using Swe-Care Urinalysis

Reagent strips following the manufacturer's procedure. The reagent strip was dipped into the urine sample for 2 seconds, taken out, and left over the bench for about one minute. Finally, the reagent strip colour was compared with the chromatic scale provided by the manufacturer. The result was recorded and graded as negative (0), trace (\pm), small (1+), moderate (2++), and large (3+++ according to the manufacturer's instructions [11].

2.3 Urine Filtration and Microscopy

Urine filtration technique was performed using a polycarbonate membrane filter with 12 μ m pore size (SterliTech corporation, USA), Swinnex polypropylene filter holder (SterliTech corporation, USA), and 10 ml plastic syringe. After thorough mixing, 10 ml urine was taken by syringe and filtered through the polycarbonate membrane filter. The filter was then removed with sterile forceps placed on a clean glass microscope slide and examined under a 10X objective lens of a light microscope for *Schistosoma haematobium* eggs. The number of eggs obtained per 10 ml of urine specimen was counted and recorded. The intensity of infection was expressed as egg count per 10ml of urine. The intensity of infection was classified as light (< 50 eggs/ 10 ml of urine) or heavy (\geq 50 eggs/10 ml of urine) [12].

2.4 Statistical Analysis

The results obtained were analyzed using Statistical Package for Social Sciences (SPSS) version 26 (IBM SPSS Inc, Chicago, IL, USA).

3. RESULTS

The study revealed that 43(16.3%) out of the 264 pupils examined had urinary schistosomiasis with School B having the highest prevalence rate (30.8%), followed by School-A (27.3%). School D and School E had a prevalence of 15(12.0%) and 5(10.0%) respectively. Although School C had the highest number of respondents, it had the least prevalence of 5(7.1%) [Table 1]. This was statistically significant ($P = 0.002$, $\chi^2 = 17.283$).

The infection was more among males than females with a prevalence of 29(17.7%) and 14(14.0%) respectively. For the male patients, the infection was higher among the age group 11-13 years (25.9%) compared to the age group 8-10 years (22.2%) among the female patients. Generally, the age group 11-13 years were the

most infected among the studied population followed by the age group ≥ 14 years. The age groups 5-7 years and 8-10 years had the least prevalence rate of 14.0% each. This was not statistically significant [Table 2] ($P = 0.23$, $\chi^2 = 4.329$).

Table 1. Prevalence of urinary schistosomiasis among primary school pupils in the study area

Schools	No. Examined	No. Positive (%)
A	55	15(27.3)
B	39	12(30.8)
C	70	5(7.1)
D	50	6(12.0)
E	50	5(10.0)
Total	264	43(16.3)

$$\chi^2 = 17.283, P = 0.002, df = 4$$

Swimming in Rivers/Ponds was found to be significantly associated with urinary schistosomiasis at $P < 0.001$. Sixty of the respondents confirmed swimming in rivers or ponds of which 41(68.3%) had urinary schistosomiasis. Washing of clothes in rivers or ponds also recorded a significant association with urinary schistosomiasis. Twenty-two (26.8%) out of 88 respondents who go to the rivers or ponds to wash their clothes, were positive for urinary schistosomiasis. Other risk factors that were evaluated and not found to be significant were awareness of urinary schistosomiasis, sources of water for domestic uses, and type of toilets used at home [Table 3]. The use of prophylactic praziquantel had no significant correlation with urinary schistosomiasis in this study. Only 14 of the respondents had taken praziquantel within the last two weeks before the sample collection and 1(7.1%) was positive for the eggs of *Schistosoma haematobium*. This was not statistically significant as compared to those who have not taken the medication

Table 4 shows symptoms associated with Urinary Schistosomiasis among the study population. The commonest symptom among the pupils was terminal haematuria. Out of 78 respondents who complained of terminal haematuria, 28(35.9%) had urinary schistosomiasis. This was statistically significant at $P < 0.001$ (Table 4). Fifty-six respondents had dysuria with 17(30.4%) testing positive for *Schistosoma haematobium* [Table 4] ($P = 0.001$, $\chi^2 = 10.319$). Lower abdominal pain was recorded among 125 respondents of which 22(17.6%) had urinary schistosomiasis this as

well as urinary frequency was not significantly associated with urinary schistosomiasis [Table 4].

4. DISCUSSION

The prevalence of urinary schistosomiasis was found to be 16.3% among the study population. Comparatively, this prevalence is slightly lower than the prevalence rate of 18.7%, previously reported in the same province among irrigation farmers in 2018 [13]. The difference in the prevalence rate may be due to the difference in the occupations of the study population. While this research was conducted among primary school pupils regardless of their parents' occupations, the previous research was carried out among irrigation farmers which placed them more at risk of urinary schistosomiasis. Reports of higher prevalence from other parts of Nigeria have clearly shown that urinary schistosomiasis is still a serious problem in this part of the world and this may not be unconnected with little or absence of government intervention. A high prevalence of 40.0% and 58.5% were reported in Southwest and Northeast Nigeria respectively [14,15]. These differences in prevalence rates may probably be due to differences in the study population, and the availability of bodies of freshwater infested by the intermediate host, the *Bulinus* snails. One could have attributed the low prevalence in this study to government interventions by regularly deworming with praziquantel 40mg/kg as advocated by the World Health Organisation (WHO), but such intervention has been non-existent for many years, and school pupils depend on their parents and occasional Free Medical Outreach in their communities to get dewormed.

Based on the school, pupils recruited from school B had a relatively higher infection rate compared to the other schools. A survey of the town where the school is located revealed many abandoned mining ponds that inhabitants of the area use for washing clothes, irrigation farming, and swimming. This could be a strong reason for the high prevalence in school B, and this underscored the importance of mollusc control in areas surrounded by these mining ponds as part of the preventive measures against urinary schistosomiasis. The schools with low prevalence had good sources of water supply and toilet facilities with no abandoned ponds within the vicinity of the schools. Provision of good and adequate water supply, good toilets, and molluscs control, as well as routine

Table 2. Age and sex distribution of urinary schistosomiasis among primary school pupils in Jos, Northcentral Nigeria

Age group	Males		Females		Total No. Positive (%)
	No. Tested	No. Positive (%)	No. Tested	No. Positive (%)	
5-7	29	4(13.8)	20	2(10.0)	6(14.0)
8-10	24	2(8.3)	18	4(22.2)	6(14.0)
11-13	58	15(25.9)	28	4(14.3)	19(44.1)
≥14	53	8(15.1)	34	4(11.8)	12(27.9)
Total	164	29(17.7)	100	14(14.0)	43(16.3)

$P = 0.23, \chi^2 = 4.329, df = 3$

Table 3. Prevalence of urinary schistosomiasis and associated risk factors among the study population

Risk Factors	No. of Respondents	No. Positive (%)	χ^2	P-value
Awareness about Schistosomiasis				
Yes	23	3(13.0)	0.195	0.66
No	241	40(16.6)		
Swimming in River/Pond				
Yes	60	41(68.3)	154.254	<0.001
No	204	2(1.0)		
Washing in River/Pond				
Yes	82	22(26.8)	9.694	0.002
No	182	21(11.5)		
Sources of Water				
Well	139	19(13.7)	4.042	0.13
Stream	77	18(23.4)		
Borehole/Tap	48	6(12.5)		
Type of Toilet				
Modern Toilet	148	23(15.5)	2.601	0.46
Pit Toilet	97	19(19.6)		
Open defecation	19	1(5.3)		
Prophylactic Praziquantel				
Yes	14	1(7.1)	0.907	0.34
No	250	42(16.8)		

praziquantel administration to vulnerable populations, are critical in tackling parasitic infections including urinary schistosomiasis [16]. Where this is lacking, the prevalence of urinary schistosomiasis will continue to increase due to poverty, poor public health infrastructures, and low literacy levels.

The pattern of urinary schistosomiasis among the participants revealed a typical gender-based preponderance where males were infected more than females. Though not statistically significant, the male participants were responsible for 17.7% while 14.0% of the females were infected. This is possible because males are more involved in outdoor activities such as swimming, fishing, and irrigation farming while females participate less in

such activities. This finding is corroborated by many researchers [17,18,19]. Among the male participants, the age group 11-13 years was the most infected while the age group 8-10 years accounted for most of the infections among the female counterparts. This is consistent with research conducted in North-western Nigeria and central Zambia [17,20]. This age group among the males is known for being adventurous and engaging in exploring their environment which could predispose them to getting urinary schistosomiasis than the females who are usually more engaged in domestic activities [16]. However, the female age group 11-13 years are known to always help their mothers at the stream in washing clothes and plates thereby predisposing them to urinary

Table 4. Relationship between symptoms and prevalence of urinary schistosomiasis among the study population

Symptoms	No. Respondents	Positive (%)	χ^2	P-value
Dysuria				
Yes	56	17(30.4)	10.319	0.001
No	208	26(12.5)		
Urinary Frequency				
Yes	66	11(16.7)	0.213	0.64
No	166	32(16.2)		
Terminal Haematuria				
Yes	78	28(35.9)	31.223	<0.001
No	186	15(8.1)		
Lower Abdominal Pain				
Yes	125	22(17.6)	0.300	0.58
No	139	21(15.1)		

schistosomiasis. While this has been supported by previous research [21,22,23], a contrary report from another location indicated the highest prevalence in the age group 6-10 years old [4]. The variation in the prevalence rates in different age groups from various centres may be attributed to natural environmental conditions, water contact patterns of the studied population, and the presence of the intermediate host in locally available water bodies.

The prevalence of urinary schistosomiasis is influenced by key epidemiological determinants such as living near freshwater bodies, irrigation farming, snail species, and indiscriminate defecation [24]. This study analyzed the risk factors among the studied population and discovered that swimming and washing in rivers and ponds had a significant association with urinary schistosomiasis [Table 3]. This implies that open defecation or the use of untreated sewage as fertilizer may still be a practice in the areas. These findings are in concordance with studies conducted in other places [25,26]. The awareness of urinary schistosomiasis was found to be limited among the study population. Only a few responders knew about the infection before the study and 13.0% of them had the infection. This was not statistically significant as well as the sources of water for domestic use and types of toilet facilities. In this context, the type of toilet is not important as long as it fulfils its function of containing human waste and thereby preventing the contamination of water bodies. The majority of the studied population used modern toilets but quite a number still engaged in open defecation which has been reported to be a significant risk factor for urinary schistosomiasis [27]. This habit of open defecation soiled the environment with eggs of parasites which are washed during the

rainy season into water bodies used by these communities posing a serious risk for schistosomiasis and other parasitic infections.

This study revealed the common symptoms among the participants as terminal haematuria, dysuria, lower abdominal pain, and urinary frequency. Among these symptoms, terminal haematuria and dysuria had a significant correlation with urinary schistosomiasis. This is in agreement with a report by Bishop and his colleague in Northwestern Nigeria [28]. However, painful urination (dysuria), frequent urination, and abdominal pain were equally significant in their study which were not in this study. Terminal haematuria has always been used as the major symptom to differentiate urinary schistosomiasis from schistosomiasis caused by *Schistosoma haematobium* from schistosomiasis caused by *Schistosoma mansoni* and *Schistosoma japonicum* [29]. Other late complications of urinary schistosomiasis are ulceration, granulomatous inflammation, fibrosis, and as well as bladder cancer [30].

5. CONCLUSION

Urinary schistosomiasis is still an endemic disease in Northcentral Nigeria and a recognized cause of terminal haematuria. Efforts must be made through health education and prophylactic praziquantel, as well as control of molluscan species to eradicate and effectively prevent the devastating consequences of this parasitic infection such as bladder cancer.

6. LIMITATIONS OF THE STUDY

Despite the DNA extraction of positive cases, sequencing could not be done due to a lack of

funds. Also, this study may have been influenced by the inability to examine the freshwater sources for the snail host and quantify the respondents' freshwater contact activities.

CONSENT AND ETHICAL APPROVAL

Approval for this study was obtained from the Institutional Ethics Committee of the Plateau State Specialist Hospital and Universal Basic Education Board. A written informed consent was obtained from the schools' authorities, the parents and guardians of the pupils recruited for this research. The pupils were also educated on the health implications of urinary schistosomiasis and their assent was obtained before sampling.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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