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Research Article

Prevalence of Urinary Schistosomiasis among Primary School Pupils in Bindawa Local Government Area of Katsina State, Nigeria

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ABSTRACT
This study investigated the prevalence of urinary schistosomiasis among primary school pupils in Bindawa Local Government Area (LGA), Katsina State, Nigeria. A total of 500 pupils from 12 randomly selected schools participated in the study conducted between October and December 2023. Urine samples were collected and microscopically examined for *Schistosoma haematobium*. Prevalence rates were statistically analysed with significance set at $p \leq 0.05$. The overall prevalence of urinary schistosomiasis was higher among males (38.2%) compared to females (24.3%). Age-specific prevalence was highest among pupils aged 11–15 years (36.5%), followed by those aged 6–10 years (33.6%) and 1–5 years (30.7%). The primary risk factors for infection included contact with streams (47.7%) and wells (27.8%), with activities like irrigation (46.6%) and catching fish (36.2%) posing significant exposure risks. Frequency of water body visits, history of travel, and lack of awareness about schistosomiasis were also associated with increased infection rates. Structured questionnaires revealed limited knowledge of the disease's curability and preventive measures. History of haematuria (33.8%) and Praziquantel administration (33.9%) highlighted the ongoing challenges in disease control. The findings underscore the persistent burden of urinary schistosomiasis in the study area and the need for improved hygiene practices, provision of safe drinking water, effective sanitation, and health education. Targeted interventions such as regular deworming with Praziquantel and public awareness campaigns are crucial to mitigating the risk of infection among school-aged children.

Keywords: Dysuria; Haematuria; Praziquantel; Prevalence; Public Health

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INTRODUCTION

Schistosomiasis is an important neglected tropical disease (NTDs) and is second to malaria in terms of parasite-induced morbidity and mortality (Golan *et al.,* 2014). It is an acute and chronic parasitic disease caused by blood flukes (trematode worms) of the genus *Schistosoma*. It occurs in many developing countries in tropical and sub-tropical Africa, Middle East, Asia and Latin America. The disease accounts for up to 90% of cases in Sub-Saharan Africa in a population that accounts for 13% of the world's population (Auta *et al.,* 2021).Schistosomiasis is an infectious disease of poverty that is endemic in resources-constrained settings which include Sub-saharan Africa, the Middle East, Brazil and the Caribbean. The agents of Schistosomiasis are digenetic trematodes in the genus *Schistosoma* (WHO, 2020). The urogenital form of schistosomiasis is caused by the infective stage (cercariae) of *S. haematobium* (Afukwa *et al*., 2019). Humans become infected in wholesome water bodies (river, ponds, streams etc) when they into contact with the microscopic cercariae shed by some gastropod snails in the genus *Bulinus* (Ridi and Talima, 2013).

The three main species that cause human schistosomiasis are *Schistosoma haematobium* which causes urinary schistosomiasis, *S. Mansonii* and *S. Japonicum*, which causes intestinal schistosomiasis. Others such as *S. guineensis* and *S. intercalatum* cause intestinal schistosomiasis but are less prevalent. Infections occur when people come in close contact with fresh water bodies infested with cercariae released by specific intermediate host snails which have been infected by miracidia released from egg of adult worms. The disease caused by *S. haematobium* is characterized by bloody urine, lesion of the bladder, kidney failure and bladder cancer in children (Butterworth, 2007). Because of these, the study determined the prevalence of urinary schistosomiasis among school children in Bindawa Local Government Area, Katsina State, Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in Bindawa Local Government Area Katsina State's Nigeria's. The land area of Bindawa is 398 square kilometers. It is situated at longitude 12°40'1''N and latitude 7°48'19''E, respectively. According to 2006 census data, the LGA had a population of 152,356 individuals. The mean annual temperature around the LGA ranges from 35°C to 39°C. Trees, shrubs, and grasses are the primary plant species. The majority of natives work as farmers, government employees, fisherman, or perform other business.

Study Design

The study design is cross sectional in approach which involves sample collection from primary pupils in 12 selected schools in Bindawa local government area of Katsina state. The study was carried out between Octobers to December, 2023. This period was better as the primary pupils are nearly all present, thereby making the research easy.

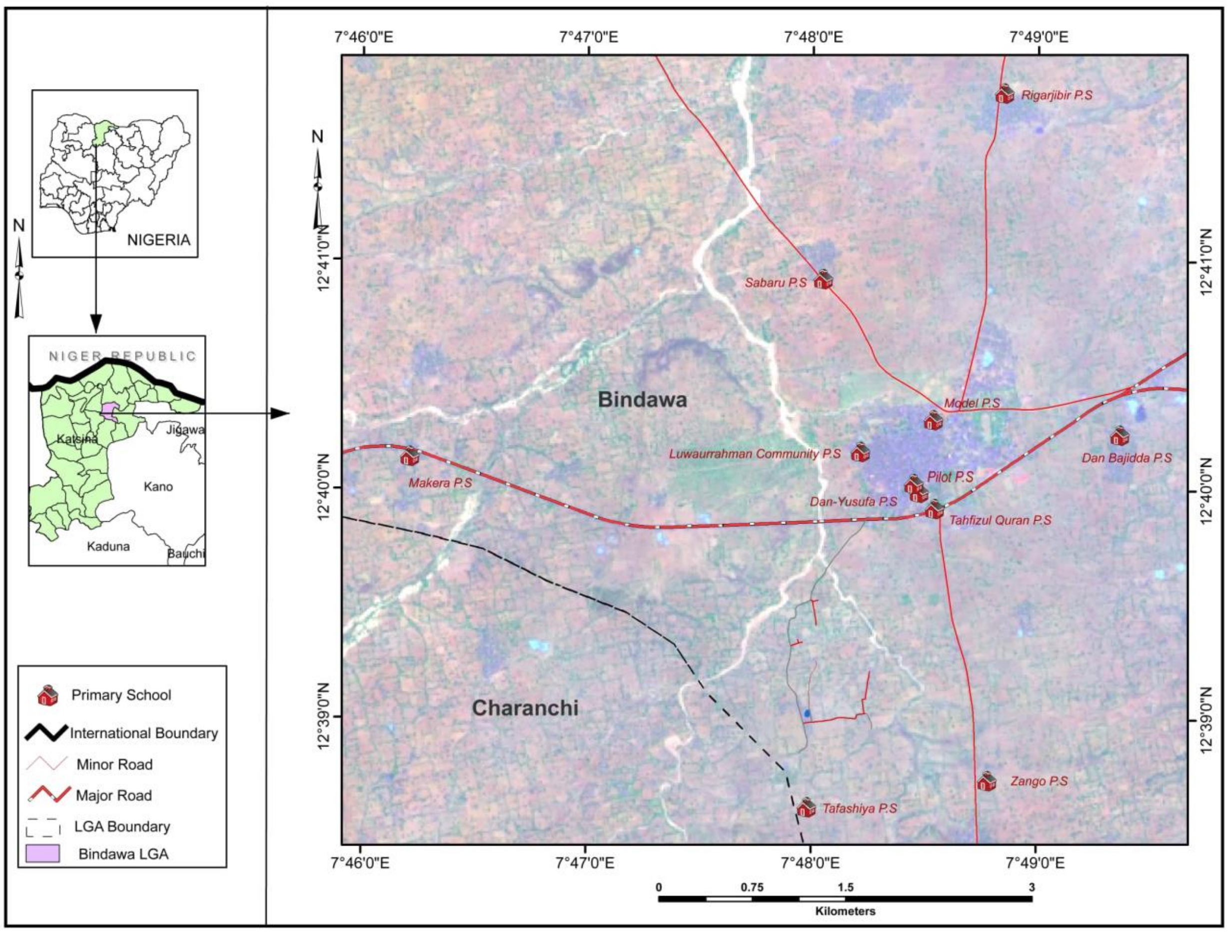

Fig 3.1 Map of Bindawa Local Government Area Showing the sampled schools.(GIS LAB FUDUMA, 2024)

Sample Size Determination

The sample size for this study was calculated in accordance with WHO guidelines (Nmorsi *et al*., 2005). The formula used for the calculation of sample size is as follows:

$$N = \frac{Z^2 P(1-P)}{d^2}$$

Where:-

- N = sample size =?
- Z = standard normal variance at 95% type 1 error P<0.05 = 1.96
- P = expected proportion in the population base on previous research (20%) = 0.2 (Auta *et al;* 2020).
- d = absolute error 5% (to convert it into decimal) = 0.05

$$N = \frac{1.96^2 \times 0.2(1-0.2)}{0.05^2} = 245$$

Therefore, N = 245

The minimum sample size required for this study is 245. This sample size was increased by 50% to maximize samples, hence a total of 500 samples were considered for this research.

Sample Population

A total of five hundred (500) students was selected by random sampling technique for this study.

Ethical Clearance

Before the study began, permission was obtained from Local Government Education Secretary (ES)

Questionnaire Survey

Questionnaires were administered to the students, where certain question was asked. Question including name, age, state of origin, behavioural risk (water body contact), health condition, educational status, knowledge about Schistosomiasis and parent's occupation.

Urine Sample Collection

After filling out the questionnaire, each students was given a sample bottle and was told to fill it with his urine, the time of collection was from 10:00am to 2:00pm (Cheesebrough, 2005). Each sample bottle was labelled with participants name and a serial number given to each written on the bottle. The samples collected from the students was placed in a suitable cool container and were then transported to the laboratory of Comprehensive Health Centre Bindawa Local Government.

Sampling Techniques

Analysis of Urine Sample

Laboratory analysis of urine sample was carried out to determine the presence of schistosomiasis eggs using sedimentation technique as explained by Cheese brough (2009). Each urine sample was mixed thorough with a glass red and 10ml was transferred into a 10ml centrifuge tube using 10ml syringe and centrifuge at 2000rpm for 5 minutes at a room temperature. The supernatant was discharged and sediments transferred to a microscope glass slide and covered with cover slip. Examination of the sediments was done microscopically using the x10 and x40 objectives. A drop of Lugol's iodine was added to the slides of cover slips prior to examination. Eggs with terminal spine is a characteristic of *Schistosoma haematobium* were counted for each positive sample and the result was recorded as the number of eggs/10ml of urine (Cheese brough, 2009).

Data Analysis

Data obtained was summarized using descriptive statistics. Chi-square analysis was used to test for statistical differences between distributions of schistosomiasis infection

RESULTS

Among the 500 school children recruited in this study who voluntarily provided urine samples, and were diagnosed for the presence of *Schistosoma haematobium* ova, 170 of the urine samples tested positive, giving a prevalence of 34.0% (Table 1). The study finds significant association of urinary schistosomiasis infection with the school pupils (χ^2 = 60.384, p = 0.000), Tafashiya Primary School recorded the highest prevalence of 61.0% and Pilot Primary School recorded the lowest prevalence of 7.1% (Table 1).

Prevalence of Urinary Schistosomiasis Infection with respect to Sex and Age group school pupils in Bindawa Local Government Area

The prevalence of urinary schistosomiasis infection to the sex, and age group of the school children in Bindawa Local Government Area are as presented in Table 2. With the sex of the children, males had a higher prevalence of 38.2% than females, who had 24.3%. Chi-square analysis revealed a significant association of the prevalence of urinary schistosomiasis with sex (χ^2 = 9.078, p = 0.003), with the males more at risk of infection than the females (OR = 1.9227, 95% CI = 1.251 – 2.9525).study indicated highest Prevalence of urinary schistosomiasis infection among the age groups of the subjects in this prevalence among school children aged 6 – 10 years (36.5%), while 11-15 years had the lowest prevalence (30.7%). Age group recorded a statistically non-significant association with the infection of urinary schistosomiasis (χ^2 = 1.377, p = 0.502).

Table 1. Prevalence of Urinary Schistosomiasis Infection among School pupils in Bindawa Local Government Area of Katsina State, Nigeria

School	Number Examined (n)	Number Positive	Prevalence (%)	Statistical Values (95% CI)
Model PS	42	7	16.7	$\chi^2 = 60.384$, $p = 0.000$
Danyusufa PS	42	7	16.7	
Pilot PS	42	3	7.1	
Lu. Comm. PS	42	9	21.4	
TFQ Comm. PS	42	11	26.2	
Sabaru PS	42	15	35.7	
Dan Bajidda PS	42	19	45.2	
Zango PS	41	16	39.0	
Makera PS	42	20	47.6	
Jibawa PS	43	15	34.9	
Tafashiya PS	41	25	61.0	
Rugar Jibir PS	39	23	59.0	
Total	**500**	**170**	**34.0**	

Table 2. Prevalence of Urinary Schistosomiasis Infection with respect to Sex and Age Group among School pupils in Bindawa Local Government Area of Katsina State, Nigeria

Factors	Number Examined (n)	Number Positive	Prevalence (%)	Statistical Values (95% CI)
Sex				
Male	348	133	38.2	$\chi^2 = 9.078$, $p = 0.003$, OR = 1.9227, 95% CI = 1.251–2.9525
Female	152	37	24.3	
Age (years)				
1 – 5	131	44	33.6	$\chi^2 = 1.377$, $p = 0.502$
6 – 10	219	80	36.5	
11 – 15	150	46	30.7	

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Prevalence of Urinary Schistosomiasis Infection in Relation Associated Risk Factors among School Children in Bindawa Local Government Area of Katsina State

Results of the study of urinary schistosomiasis infection among the school children in Bindawa Local Government Area about their sources of water, water body contact activities, and history of travel are presented in Table 3.

Four sources of water for the children, well, river, tap, and stream were reported during this study. The prevalence was highest among the school children who sourced their water from streams, with a 47.7% infection rate, with a statistically significant association of urinary schistosomiasis infection with the source of water in this study area ($\chi^2 = 14.521$, $p = 0.002$).

With contact with water bodies, children who responded yes to having contact with water bodies had the highest prevalence of infection (34.1%), with no significant association with infection ($\chi^2=0.146$, $p = 0.70$).

On the activity these school children carry out when at water bodies, children who use the water body for farming (irrigation) purposes recorded a higher prevalence of 46.6%, while the lowest prevalence of 25.0% was among children who used the water body for other purposes. There was no significant statistical relationship of urinary schistosomiasis infection with activity at water body in this study ($\chi^2 = 7.036$, $p = 0.134$) (Table 3).

Frequency of visit to water body had no statistically significant association with urinary schistosomiasis infection (χ^2 = 6.874, p = 0.076), with children who visit water body other time having the highest prevalence of 66.7% and tho3e who visit daily having the lowest prevalence of 29.1%. School children who had history of travel in the last 1 week had the highest prevalence of 37.7%, while those who travelled in the last 1 month had lowest prevalence of 30.8%, with no significant association of infection with history of travel (χ^2=1.085, p = 0.781) (Table 3).

Results on the prevalence of urinary schistosomiasis infection about school children's knowledge and experience of symptoms in Bindawa Local Government Area of Katsina State, Nigeria, as obtained in this study are presented in Table 4.3. Children who answered yes to knowing about urinary schistosomiasis had the same prevalence of 34.0% as those who answered no, which implied that knowledge of schistosomiasis has no direct relationship or association with its infection (χ^2=0.000, p = 0.995). On the other hand, believe whether its existence is true or not had a significant association with infection (χ^2=11.491, p = 0.001), with those who do not believe it exists having the highest prevalence of 43.5%, compared to 28.6% prevalence among those who believe it exists (Table 3). Knowledge on the curability of urinary schistosomiasis, history of haematuria, and dysuria all did not show significant association with the infection of urinary schistosomiasis in this study (p > 0.05) (Table 3).

The findings of this study revealed school children who had no history of Praziquantel administration to have a higher prevalence of 34.0%, though not significantly associated with infection (χ^2= 0.001, p= 0.981), as shown in Table 3. As shown on same Table 5, school children who had the last administration of Praziquantel over 6 months ago recorded the highest prevalence of 50.0%.

Table 3. Prevalence Rate of *Schistosoma haematobium* Infection According to Associated Risk Factors among Children in Bindawa Local Government Area of Katsina State, Nigeria

Variables	Number Examined (n)	Number Positive	Prevalence (%)	Statistical Values
Source of Water				
Well	108	30	27.8	χ^2=14.521,
River	139	35	25.2	p=0.002
Tap	188	74	39.4	
Stream	65	31	47.7	
Contact with Water Body				
Yes	496	169	34.1	
No	4	1	25.0	
Activity at Water Body				
Bath and Games	74	26	35.1	χ^2=7.036, p=0.134
Fetching Water Catching Fish	224	73	32.6	
Irrigation	73	34	46.6	
Others	4	1	25.0	
	179	52	29.1	χ^2=6.874, p=0.076
Weekly	271	94	34.7	
Monthly	47	22	46.8	
Other time	3	2	66.7	
1 Week ago	53	20	37.7	χ^2=1.085, p =
1 Month ago	104	32	30.8	0.781
4 Month ago	295	103	34.9	
6 Month ago	48	15	31.2	
Knowledge of schistosomiasis				
Yes	447	152	34.0	χ^2=0.000,
No	53	18	339	p = 0.995
Believe in Existence of Schistosomiasis				

Yes	315	90	28.6	χ^2=11.491,
No	184	80	43.5	p = 0.001
Knowledge on curability of schistosomiasis				
Yes	400	136	34.0	χ^2=0.000, p=1.000
No	100	23	34.0	
History of Haematuria				
Yes	290	98	33.8	χ^2=0.013,
No	210	72	34.3	p=0.0.909
History of Dysuria				
Yes	247	81	32.8	χ^2=0.317,
No	253	89	35.2	p = 0.574
History of Praziquantel				
Yes	168	57	33.9	χ^2= 0.001,
No	215	113	34.0	p= 0.981
Last Administration of Praziquantel				
1 Month Ago	34	14	41.2	χ^2=3.629,
2 Months Ago	24	5	20.8	p = 0.459
4 Months Ago	39	14	35.9	
6 Months Ago	8	4	50.0	
Can't Remember	395	133	33.7	

DISCUSSION

This study found an overall prevalence of 34.0% for urinary schistosomiasis infection, which classified our study settings as a moderately prevalence area for urinary schistosomiasis according to WHO guidelines (WHO, 2006). This is consistent with the moderate infections reported for Bindawa Local Government Area in the report on epidemiological mapping of schistosomiasis and soil-transmitted helminthiasis in 19 States and the FCT of Nigeria in 2015. This recorded prevalence is above the existing national average of 9.5% recorded in 2015 (Nduka *et al.*, 2019). In an earlier report on the prevalence of *S. haematobium* in Danbatta by Abdullahi *et al.* (2009), a higher prevalence of 54% was reported, while a higher prevalence of 65% was reported for Kura LGA. The relatively lower prevalence earlier reported for Danbatta by Abdullahi *et al.* (2009) could be due to urinalysis reagent strip method (Medi-Test Combi-9) deployed in their study, which is less accurate than the urine sedimentation microscopy technique used in the current study. Awosolu *et al.* (2019) reported higher prevalence of *S. haematobium* infection using microscopy than using reagent strip, on the same urine samples in Ikota, Ifedore Local Government Area, Ondo State. Balogun *et al.* (2022) reported higher prevalence of 65.7% and 69.0% in the Jidawa and Zobiya communities of Jigawa State.

The high prevalence reported in this study is quite higher than the 30.0% prevalence reported in Zamfara (Mudassiru *et al.,* 2018), 21.3% prevalence reported among vulnerable children in security challenged district of Safana (Auta *et al.*, 2020), the 3.71% reported among Secondary School children in Dutsin-Ma (Ahmed *et al.,* 2021) and also lower than the 37% prevalence reported by Iduh and Bwari (2021) in Sokoto. The findings in this study indicate that Bindawa Local Government is still moderately prevalence for urinary schistosomiasis and appears to be among the hotspots for transmission of urinary schistosomiasis in Nigeria despite several interventions.

The gender-biased infection prevalence, in favors of males recorded in this study is similar to the reports of Abdullahi *et al.* (2010), Ali *et al.* (2016), Auta *et al.* (2020), Ahmed *et al.* (2021), Iduh and Bwari (2021), Agada *et al.* (2022), Balogun *et al.* (2022) who all reported higher prevalence in males than females, with statistical significance in association. The higher prevalence among the males may not be unconnected to their activities and mobility, which bring them in contact with water bodies more than the females. This finding differs with the report of Awosolu *et al.* (2019), who reported higher prevalence of 27.03% among the female students than their male counterparts, who had 21.05% in Ondo State.

The higher prevalence recorded in this study among children 6-10 years, compared to lower prevalence among children 11-15 years is similar to the reports of Awosolu*et al.* (2019) and Auta *et al.* (2023) who also reported higher prevalence among students 10 years and below. Other previous reports by Auta *et al.* (2020), Ahmed *et al.* (2021), Iduh and Bwari (2021) recorded higher prevalence of urinary schistosomiasis among children above 10 years, which differ with the current study. Although the association between age group and urinary schistosomiasis infection was not statistically significant in this study, the observed trends warrant further investigation. Understanding why younger children are more affected could lead to targeted interventions such as early education programs and preventive measures tailored to this age group.

The highest prevalence of urinary schistosomiasis recorded among the school children who attend Tafashiya Primary School could be associated with the presence of water bodies around the school community. Furthermore, the significant association of urinary schistosomiasis infection with the school attended by the children underscores the importance of environmental factors in disease transmission. The variation in prevalence rates among different schools highlights the need for school-specific interventions and emphasizes the role of sanitation and hygiene practices in preventing schistosomiasis transmission within school environments.

The disparity in prevalence rates among different classes of children within the same school is another interesting finding. While Primary 4 recorded the highest prevalence, Primary 3 had the lowest. Although this association was not statistically significant, it raises questions about potential factors contributing to differential exposure or susceptibility within the school setting. Further research could explore factors such as classroom hygiene, water sources, and recreational activities to elucidate these differences.

Regarding water sources, the study identified four primary sources of water for the children: well, river, tap, and stream. The highest prevalence of infection was observed among children who sourced their water from streams, with a statistically significant association between the source of water and schistosomiasis infection. This finding aligns with previous studies conducted in Nigeria. For instance, studies by Ekpo *et al*. (2010) and Nkengazong *et al*. (2015) found that communities relying on stream water were at increased risk of schistosomiasis transmission compared to those with access to treated tap water or boreholes. This underscores the importance of improving access to safe water sources as a primary preventive measure against schistosomiasis.

In terms of water contact activities, the study found no significant association between schistosomiasis infection and engaging in activities such as swimming or bathing in water bodies. This contrasts with findings from studies in other regions of Nigeria. For example, Ugbomoiko *et al*. (2023) reported a significant association between water contact activities and schistosomiasis infection among school children in a rural community in southwestern Nigeria. The disparity in findings may reflect variations in local environmental conditions, water contamination levels, and behavioural patterns among the study populations.

However, the finding of the study In relation to the Children's knowledge about urinary schistosomiasis did not exhibit a significant association with infection prevalence. This result contradicts some previous studies in Nigeria and Africa. For example, Olorunfemi *et al*. (2017) conducted research in southwestern Nigeria and found that children with better knowledge about schistosomiasis transmission and prevention practices had lower infection rates. Similarly, Nalugwa *et al*. (2016) reported a positive correlation between knowledge levels and reduced schistosomiasis prevalence among school children in Uganda. The discrepancy in findings underscores the need for further exploration into the specific factors influencing the relationship between knowledge and infection in diverse contexts.

Conversely, the belief in the existence of urinary schistosomiasis demonstrated a significant association with infection prevalence in the current study. Children who did not believe in the existence of the disease exhibited a higher prevalence of infection compared to those who believed in its existence. This finding underscores the importance of addressing misconceptions and cultural beliefs surrounding schistosomiasis in health education and awareness campaigns. Similar findings have been reported in studies from other African countries, such as Ghana and Tanzania, where beliefs and perceptions about schistosomiasis influenced preventive behaviours and infection rates (Appiah *et al*., 2019; Kajeguka *et al*., 2021).

CONCLUSIONS

In conclusion, this study aimed to determine the prevalence of urinary schistosomiasis and associated risk factors among primary pupils in Bindawa Local Government Area of Katsina State, Nigeria. The study found an overall prevalence of 34.0% for urinary schistosomiasis infection, classifying the study area as moderately endemic according to WHO guidelines. This prevalence is consistent with previous reports for the same area and exceeds the national average recorded in 2015. While some previous studies reported higher prevalence rates in nearby communities, variations in prevalence may be attributed to differences in diagnostic methods and study populations.

The study identified several risk factors associated with urinary schistosomiasis infection, including gender, age, school attended, and proximity to water bodies. Males were found to have a higher prevalence of infection, possibly due to increased water contact activities. Younger children (6-10 years) also exhibited a higher prevalence compared to older children (11-15 years), highlighting the vulnerability of this age group to schistosomiasis infection. Furthermore, the prevalence of infection varied among different schools and classes, suggesting the influence of environmental and behavioral factors within school settings.

Regarding water sources and activities, children who sourced water from streams and engaged in water contact activities, such as bathing and swimming, were more likely to be infected. This underscores the importance of improving access to safe water sources and promoting hygiene practices to prevent schistosomiasis transmission. Additionally, the study found that knowledge about schistosomiasis and beliefs about its existence were not significantly associated with infection prevalence, highlighting the need for targeted health education interventions to address misconceptions and promote preventive behaviours.

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Credit Authorship Contribution Statement

Muhammad Surajo conducted laboratory analyses and wrote the initial draft of the manuscript. James Benshina Orpin contributed to writing the draft manuscript. Surajo Yahaya Shinkafi contributed to the manuscript's data retrieval, writing, review, and editing. The final version of the manuscript was reviewed and approved by all authors.

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