

## Post-COVID-19 Schistosomiasis Burden in School Pupils: Evidence from Thomas Dam, Kano State, Nigeria.

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### ABSTRACT

Schistosomiasis remains a major global public health problem, affecting approximately 250 million people worldwide, with about 90% of cases occurring in sub-Saharan Africa. Nigeria bears the highest burden globally, and recent evidence indicates that primary school children in resource-poor communities are disproportionately affected. In line with World Health Organization recommendations for integrated control including improved access to safe water, sanitation, health education, and mass drug administration. This study investigated the post-COVID-19 prevalence and socio-demographic factors of schistosomiasis among primary school pupils (PSP) in communities surrounding Thomas Dam, Dambatta Local Government Area, Kano State, Nigeria. A cross-sectional study was conducted among 864 PSP aged 5–15 years across eight primary schools. *Schistosoma mansoni* eggs were detected by formol-ether concentration technique from stool samples, *Schistosoma haematobium* eggs were detected by sedimentation technique from urine samples. Socio-demographic and risk factor data were obtained through pre-tested questionnaires, and descriptive statistics alongside Pearson's chi-square tests were used to assess associations between variables and infection status. The findings revealed a predominance of males (66.7%), with older pupils aged 10–15 years forming the majority. Frequent water contact activities such as swimming, bathing, and washing at the dam indicated substantial exposure to potential sources of infection, while awareness and knowledge of the disease remained low among the pupils. These results highlight significant behavioral risk factors and poor health education, underscoring the need for targeted school-based interventions and improved awareness programs. The overall prevalence of schistosomiasis among PSP was 14.6%, comprising 9.0% *S. haematobium* and 5.6% *S. mansoni*. Males had a higher prevalence (15.9%) than females (12.2%), although the difference was not statistically significant ( $p = 0.164$ ). Infection was significantly associated with age ( $p = 0.002$ ), with the highest prevalence observed among children aged 10–15 years. The findings indicate persistent transmission and low awareness in the study area, emphasizing the need for strengthened integrated control strategies to reduce morbidity and achieve elimination.

**Keywords:** Schistosomiasis, Burden, Post-Covid-19, Primary School Children and Neglected Tropical Disease

## 1.0 INTRODUCTION

### 1.1 Background

Schistosomiasis is a Neglected Tropical Disease (NTD) that continues to pose a significant public health challenge, particularly in low- and middle-income countries. The disease is endemic in approximately 78 tropical and subtropical countries and affects about 250 million people worldwide, with more than 90% of infections occurring in sub-Saharan Africa (Donohue et al., 2017). Globally, schistosomiasis is responsible for substantial morbidity and mortality, with estimates

suggesting between 20,000 and 200,000 deaths annually (Gabaake et al., 2022). In addition to mortality, the disease contributes significantly to disability and has been ranked among the leading causes of disability in several African countries (Chitsulo et al., 2000).

Recent estimates indicate that approximately 249 million people are infected with schistosomiasis globally, while about 779 million people remain at risk of infection (Aula et al., 2021). Within Africa, Nigeria has the highest number of infected people, with about 29 million infected individuals, followed by Tanzania with about 19 million cases, while Ghana and the Democratic Republic of

Congo each report approximately 15 million infections (King and Galvani, 2018). Despite ongoing control strategies, schistosomiasis remains endemic in many African communities, particularly those with poor sanitation and limited access to safe water.

School-aged children (SAC) are the most affected group and bear the greatest burden of schistosomiasis infection in endemic regions (Adenowo et al., 2015). Children aged 5–17 years are particularly vulnerable due to their frequent contact with contaminated freshwater during recreational, domestic, or livelihood activities. Consequently, this group is the primary target for preventive chemotherapy through mass drug administration programmes (Kokaliaris et al., 2022). In sub-Saharan Africa, schistosomiasis is mainly caused by *Schistosoma haematobium* and *Schistosoma mansoni*, which are transmitted through contact with water containing cercariae released from infected freshwater snails.

The clinical manifestations of schistosomiasis range from haematuria and abdominal pain to chronic intestinal, hepatic, or urogenital complications that may lead to long-term disability if untreated. Evidence suggests that repeated infections can negatively affect children's growth, cognitive development, and school performance (Kokaliaris et al., 2022). Several socio-demographic factors have been associated with increased risk of infection, including younger age, male gender due to greater water-contact activities, low socio-economic status, poor sanitation, and limited access to safe drinking water (Saidu et al., 2023).

Recent epidemiological studies continue to demonstrate a significant burden of schistosomiasis among school children in endemic regions. For example, studies in Nigeria and other African countries have reported persistent infections among school-aged children despite ongoing control programmes, highlighting the continued public health importance of the disease (Alade, et al., 2023).

The emergence of the COVID-19 pandemic in 2020 disrupted many global health programmes, including those targeting neglected tropical diseases. The World Health Organization initially recommended the temporary suspension of community-based mass drug administration activities to minimize viral transmission. Interruptions in preventive chemotherapy programmes may increase the risk of transmission and the prevalence of infection, particularly among school-aged children

who are the main beneficiaries of school-based treatment programmes.

Despite ongoing control efforts, there is limited recent data on the prevalence and socio-demographic determinants of schistosomiasis in the post-COVID-19 era, when health systems experienced disruptions and shifting priorities. Teachers also play a critical role in school-based health education and can influence students' knowledge and preventive behaviors. However, their level of awareness and perception of schistosomiasis remains insufficiently documented. Therefore, this study aims to investigate the prevalence of schistosomiasis and associated socio-demographic risk factors in the post-COVID-19 period.

## 2.0 MATERIALS AND METHODS

### 2.1 Ethical Approval

The study was approved by the research ethics committee of Department of Biological sciences, Federal University, Dutse, Jigawa State, Kano State Ministry for Health (NHREC Approval number; NHREC/17/03//2018) and the Local Education Authority, Makoda local government.

The head master consent was sought on behalf of the participants (school pupils) the procedure and objectives of the research was explained to the school pupils. Also, participants can be withdrawn from study without any consequences.

### 2.2 Study area and population

The study was conducted among 864 primary school pupils (PSP) aged 5–15 years attending primary schools located around Thomas Dam in Dambatta Local Government Area, Kano State, Nigeria.

The communities surrounding the dam are predominantly rural, with the majority of residents engaged in farming activities, particularly year-round irrigation farming, while a smaller proportion of the population practices fishing. The main languages spoken in the area are Fulfulde and Hausa.

Thomas Dam is located along the Daura–Kazaure–Dambatta Kano road within Dambatta Local Government Area. Dambatta has an estimated population of 222,399 people and covers a total land area of approximately 441 km<sup>2</sup> (170 sq mi). The area is geographically located at latitude 12°25'07" N and longitude 8°25'57" E, with a population density of about 504 persons per km<sup>2</sup> (1,306 per sq mi) (Butu et al., 2019) (Fig.1).

The climate of the study area is characterized by a tropical wet-and-dry climate typical of the West African savannah. The rainy season usually occurs from May to October, while the dry season extends from October to April. The area receives an average annual rainfall of approximately 800–900 mm. Temperatures are generally high throughout the year, with maximum temperatures reaching up to 43 °C and a mean annual temperature of about 26 °C (Olofin, 2008).

### 2.3 Study design

A school-based cross-sectional study was conducted between May and June 2021–2022 among primary school pupils and teachers in primary schools located around Thomas Dam in Dambatta Local Government Area, Kano State, Nigeria. A total of 864 primary school children aged 5–15 years participated in the study. The children were drawn from classes Primary 1 to Primary 6.

This age group was selected because children aged 5–15 years are known to bear the highest burden of

schistosomiasis infection in endemic areas (Mazani et al., 2020).

Eight rural primary schools were randomly selected from the Makoda Local Education Authority (LEA) school list across four wards surrounding the dam: Babbar Ruga, Wailare, and Tangaji. The selected schools included Danmarke II Primary School, Babbar Ruga Nomadic Primary School, Tsamiya Walawa Nomadic Primary School, Wailare Child-Friendly Primary School, Tangaji Primary School, Bakarari Nomadic Primary School, and Dawan Kaya Primary School and Tangajiyo Nomadic Primary School (Figure 1).

These schools were chosen because of their close proximity to Thomas Dam, where community members, particularly children, frequently engage in water-related activities that may expose them to schistosomiasis infection.

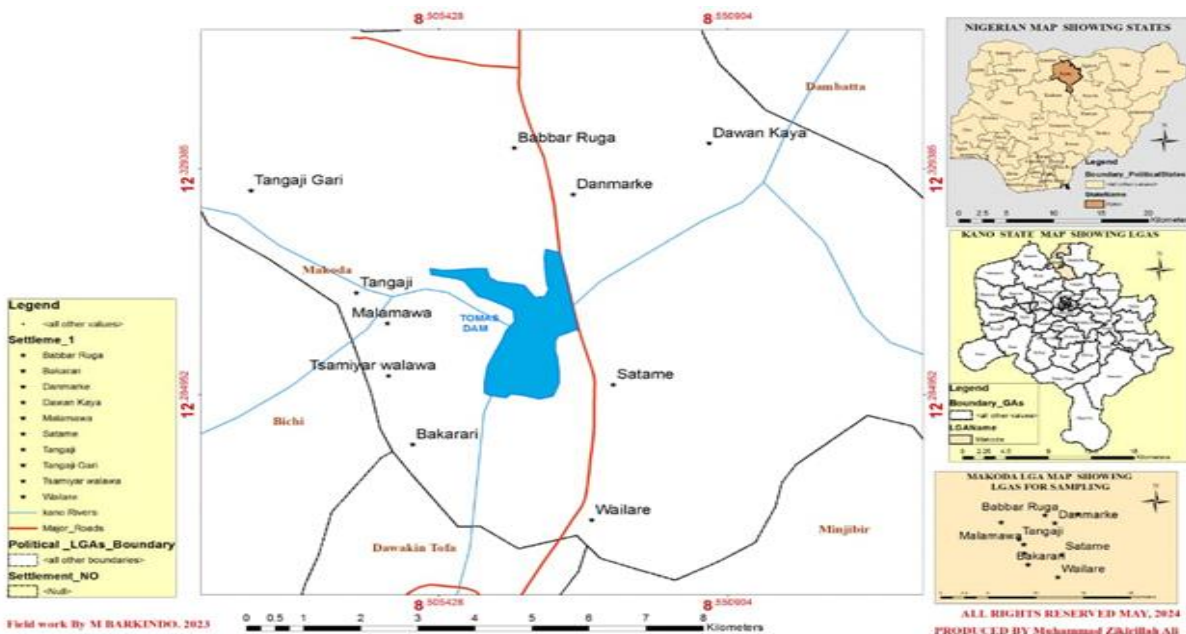


Figure 1: Map of Dambatta Showing the Eight Sample Collection Sites

### 2.4 Determination of Sample Size

The sample size for this study was calculated using the standard formula commonly applied in prevalence studies:

$$N = \frac{Z^2 p q}{d^2} \quad (\text{Sarmah, \& Hazarika, 2012}).$$

In which:

- N = the minimum required sample size
- Z = the standard normal value at a 95% confidence interval (1.96)
- p = the estimated prevalence of schistosomiasis obtained from a prior study (65.7% = 0.657) (Noriode et al., 2018)

- $q = 1 - p = 1 - 0.657 = 0.343$
- $d = \text{margin of error} (5\% = 0.05)$   
Substituting the values into the formula:

$$N = \frac{0.657 \times 0.343 \times 3.841}{0.003}$$

To improve the representativeness of the study population and account for cluster sampling across different schools, the calculated sample size was multiplied by a design effect of three (3).

$$N = 288 \times 3 \text{ Clusters} \\ = 864 \text{ Samples.}$$

Accordingly, the final sample size for the study was 864 participants. Extra participants were included to compensate for possible non-response and to reduce the impact of intra-class correlation among schools. This approach ensured that an adequate number of participants was available for reliable statistical analysis.

### 2.5 Sampling & Sampling Techniques

Participants were selected using a simple random sampling technique based on the class registers of the selected schools. Each participant selected for the study was provided with two wide-mouthed, 100 mL containers with screw caps were pre-tagged with the participant's identification code, name, and sex for the collection of urine and stool samples and questionnaire were administered to collect socio-demographic characteristics.

After collection, the urine and stool samples were placed in a suitable cool box and transported to the Medical Laboratory of the General Hospital, Dambatta, Kano State, for laboratory analysis.

### 2.6 Questionnaire Survey

Socio-Demographic information (age, gender, school location, educational level of (PSP), behavioral or associated risk factors like water contact activities, (swimming, washing clothes, washing machine, fishing and irrigation) were collected by administering an adopted questionnaire.

Data from primary school teachers and primary school children were obtained using questionnaires. Data from PSC were obtained by interview with the help of their teachers.

Participants (PSC) were interviewed face-to-face by trained research assistants.

### 2.7 Urine Sample Analysis

Urine samples were tested for hematuria using dipstick strips (chuncheon, Korea) as described previously. (Rabiu, *et al.*, 2025), and subsequently analyzed for the presence of *S. haematobium* eggs using a sedimentation technique described by (Iliyasu, *et al.*, 2022). Briefly, each sample was mixed very well, by turning the container gently up and down several times for about 30 seconds. The content pours in to a centrifuge tube, and centrifuge at 3000 revolutions per minutes for 3 minutes. The supernatants were discarded gently without disturbing the sediments. The sediment were pipetted on to a clean glass slide, covered with a clean cover slip and examine under X10 and then X40 objectives of microscope for *S. haematobium* eggs.

### 2.8 Stool Sample Analysis

The Formol-Ether Concentration Technique was used to examine stool samples collected from primary school children, following the method described by Chinenye *et al.* (2018). A 10% formol water solution was prepared by mixing 50 ml of formaldehyde with 450 ml of distilled water. Diethyl ether was handled carefully because of its highly flammable and volatile nature, while caution was also required when using ethyl acetate to avoid remixing the fecal debris with the sediment. A nylon tea or coffee strainer with pore sizes of 400–450  $\mu\text{m}$  was used to filter the stool suspension.

For examination, 1 g of stool was emulsified in 10 ml of 10% formol solution and strained to remove large fecal particles. Approximately 3–5 ml of diethyl ether was added to the filtrate, and the mixture was shaken for 1 minute before centrifugation at 2000 rpm for 5 minutes. This process separated the fecal debris from the sediment containing parasite eggs. After discarding the supernatant, the sediment was re-suspended, a drop was placed on a clean glass slide, covered with a cover slip, and examined microscopically for parasite detection (Chinenye *et al.*, 2018).

## 3.0 RESULTS

### 3.1 Overall Features of the Participants

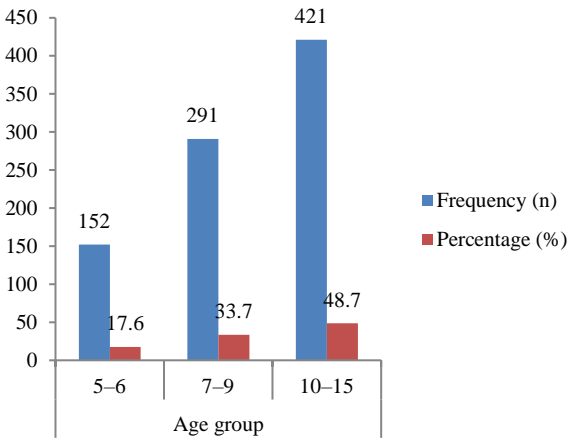
#### 3.1.1 Socio-demographic Features of Primary School Pupils

The socio-demographic features of the primary school children are presented in (Figure 2, 3, 4 & 5). A total of 864 pupils participated in the study, comprising 576 (66.7%) males and 288 (33.3%) females. Regarding age distribution, most of the children were aged 10 - 15 years 421 (48.7%), followed by those aged 7–9 years 291

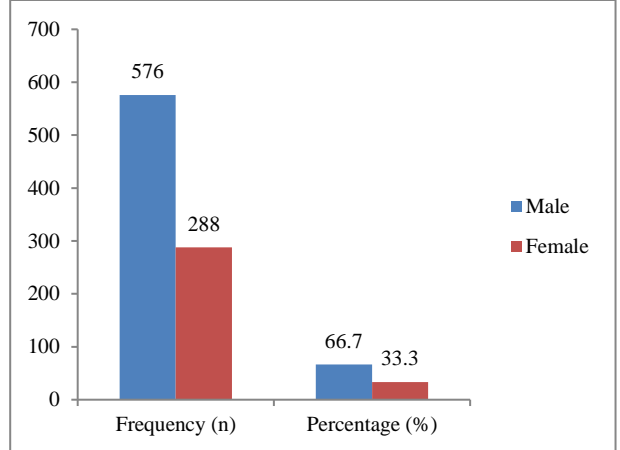
(33.7%), while the least proportion were aged 5–6 years 152 (17.6%).

In terms of educational level, pupils in Primary 6 constituted the highest proportion of respondents 350 (40.5%), followed by Primary 5, 200 (23.1%) and Primary 4, 117 (13.5%). Primary 1 pupil accounted for the smallest proportion 30 (3.5%).

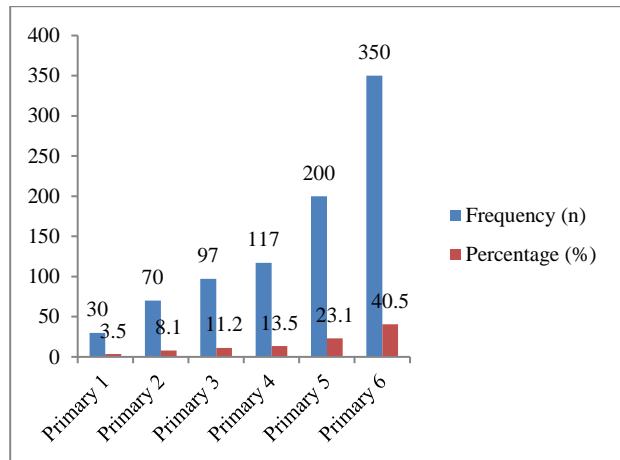
Distribution by school showed that Danmarke II 161 (18.6%) and Babbar ruga Nomadic 157 (18.2%) had the highest enrolment of pupils, while Dawankaya Nomadic recorded the lowest number 55 (6.4%). The remaining schools Wailare C.F, Tsamiya Walawa ND, Tangaji Nomadic, Tangajiyo Nomadic, and Bakarari Nomadic contributed varying proportions of the study population.



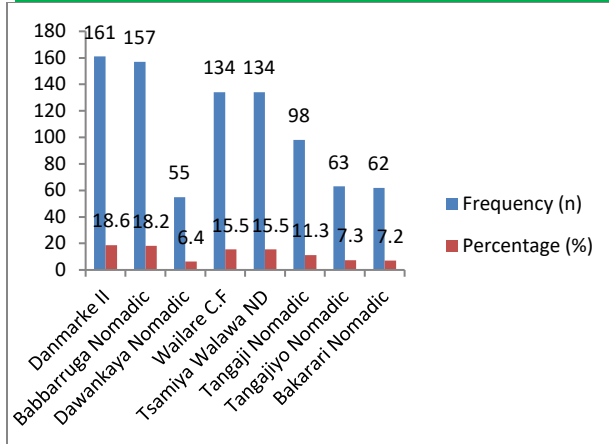
**Figure 2: Age group distribution of primary school pupils in the study area (n = 864).**  
Source: Questionnaire administered in the study area, 2022



**Figure 3: Gender distribution of primary school pupils participating in the study area (n = 864).**  
Source: Questionnaire administered in the study area, 2022.



**Figure 4: Distribution of participating primary school pupils their education level in the study area (n = 864).**Source: Questionnaire administered in the study area, 2022



**Figure 5: Distribution of participating primary school pupils across the selected schools in study area (n = 864).**  
Source: Questionnaire administered in the study area, 2022.

### 3.2 Risk Factors Associated With Schistosomiasis Infection and Socio-demographic Characteristics

The risk factors and socio-demographic characteristics of the respondents are shown in (Table 1). The respondents were Primary School Pupils.

### 3.3 Risk factors associated with primary School Pupils

Among the 864 pupils surveyed 576 (66.7%) were males and 288 (33.3%) were females, indicating male predominance. Most respondents were aged 10–15 years (48.7%), followed by 7–9 years (33.7%) and 5–6 years (17.6%), showing that older children constituted the majority of the study population.

Water-contact activities associated with schistosomiasis transmission were common. Swimming and bathing at the dam side were the most frequently reported activities, each involving 37 (29.1%) children, followed by washing clothes 28 (22.0%), fishing 14 (11.0%), and irrigation farming 11 (8.7%). These findings indicate considerable exposure to potentially contaminated water sources.

Exposure to schistosomiasis education was highest among pupils in upper primary classes, particularly Primary 6 (125; 43.4%), Primary 5 (100; 34.7%), and Primary 4 (55; 19.1%), while very few pupils in lower classes had received such education and none in Primary 1 had been exposed.

Knowledge of schistosomiasis was generally poor. Only 67 (28.9%) pupils had heard of the disease, 48 (20.7%) could describe it, 67 (28.9%) knew its mode of transmission, and 50 (21.6%) were aware of its symptoms. Overall, the results suggest that older children were more represented in the study, many engaged in water-contact activities that increase infection risk, and awareness of schistosomiasis was low, highlighting the need for strengthened school-based health education and preventive interventions (Table 1).

Table 1: Risk factors and socio-demographic characteristics of Primary School Pupils.

Variable	No.examined	Percentage %
Gender		
Male	576	66.7
Female	288	33.3
Total	864	100
Age group		
5 – 6	152	17.6
7 – 9	291	33.7
10 – 15	421	48.7
Total	864	100
Water contact activities		
Swimming in Dam	37	29.1
Bathing at Dam side	37	29.1
Fishing in Dam	14	11.0
Irrigation Farming	11	8.7
Washing Clothes	28	22.0
Washing Machine	0	0
Total	127	100
Educational Level of Pupils		
Primary 1	0	0
Primary 2	2	0.79
Primary 3	6	2.1
Primary 4	55	19.1
Primary 5	100	34.7
Primary 6	125	43.4
Total	288	100
Knowledge on Schistosomiasis		
Heard of schistosomiasis	67	28.9
Described Schistosomiasis	48	20.7

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knew mode of transmission	67	28.9	accounted for 9.0% of infections, while <i>Schistosoma mansoni</i> accounted for 5.7%. Although infection was higher among males (15.9%) than females (12.2%), the difference was not statistically significant ( $\chi^2= 1.94$ , df= 1, p = 0.164). Prevalence increase significantly with age, ranging from 6.6% among pupils aged 5 – 6 years to 18.3% among those aged 10 – 15 years, and the association between age and schistosomiasis was statistically significant ( $\chi^2= 12.53$ , df = 2, p= 0.002).		
Knew symptoms	50	21.6			
Total	232	100			
Source: Questionnaire administered in the study area, 2022			There was a statistically significant association between primary school location and schistosomiasis infection among the pupils ( $\chi^2 = 16.93$ , df = 7, p = 0.018). The highest prevalence of infection was recorded among pupils from Tangajiyo Primary School (30.2%), followed by Bakarari (25.8%) and Dawankaya (23.6%), while the lowest prevalence was observed in Danmarke Primary School (11.8%), (Table 2).		
<b>3.4 Prevalence and Pattern of Schistosomiasis</b> In this study, participants (PSP) were enrolled. The primary school children (PSP) were 864 in number from eight (8) different primary schools in the study.					
<b>3.4.1 Prevalence of Infection among the Primary School Pupils</b> A total of 864 primary school pupils were examined, of which 127 were positive for schistosomiasis, giving an overall prevalence of 14.7%. <i>Schistosoma haematobium</i>					

Table 2: Prevalence and pattern of Schistosomiasis among Primary School Children based on Socio-demographic factors.

Factors	No Examined	No Positive	%	$\chi^2$	Df	P-Value
Overall Schistosomiasis	864	127	14.7			
<i>S.haematobium</i>	864	78	9.0			
<i>S.mansoni</i>	864	49	5.7			
Gender						
Male	576	92	15.9	1.94	1	0.164
Female	288	35	12.2			
Age groups (years)						
5 – 6	152	10	6.6	12.53	2	0.002
7 – 9	291	40	13.7			
10 – 15	421	77	18.3			
Location (Pri.Schs.)						
Danmarke p.s	161	19	10.6	16.93	7	0.18
Babbarruga p.s	157	26	14.8			
Dawankaya	55	13	20.9			
Wailare	134	21	14.0			
Tsamiya Walawa	134	29	19.3			
Tangaji	98	14	12.7			
Tangajiyo	63	19	27.1			
Bakarari	62	16	22.9			
Total	864	157	18.2			

Source: Questionnaire and Laboratory analysis, 2022.  $\chi^2$ = Chi-square, Df= Degree of freedom



**Figure 6: Showing egg of *schistosoma haematobium* with a terminal spine viewed under microscope.**

#### 4.0 DISCUSSION

The socio-demographic characteristics observed in this study were generally consistent with findings reported globally, across Africa, and within Nigeria. Male pupils constituted the majority of participants, reflecting patterns reported in endemic regions where boys are more involved in water-related activities that increase exposure to schistosomiasis transmission sites (Hotez et al., 2014; WHO, 2022; Mazigo et al., 2012). Similar gender distributions have been reported in Nigeria and Kano State (Adenowo et al., 2015; Dawaki et al., 2015). Children aged 10–15 years formed the largest age group, consistent with global and national evidence showing that older school-aged children have greater mobility and more frequent contact with contaminated water sources (Colley et al., 2014; WHO, 2022; Mazigo et al., 2012; Adenowo et al., 2015; Dawaki et al., 2015). Higher participation among pupils in upper primary classes also agrees with previous school-based studies where older pupils were more accessible and cooperative during surveys (WHO, 2022; Dawaki et al., 2015).

Water-contact activities such as swimming, bathing, fishing, irrigation farming, and washing clothes were common among respondents, with swimming and bathing being the most frequent. These activities are recognized risk factors for schistosomiasis transmission worldwide and have been similarly reported in African and Nigerian studies (WHO, 2022; Stothard et al., 2017; Dawaki et al., 2016). Knowledge of schistosomiasis among pupils was generally poor, as only a small proportion had heard of the disease or understood its transmission and symptoms. This finding is consistent with reports from endemic communities where awareness remains low, although knowledge tends to improve with increasing educational level and school-

based health education (Mazigo et al., 2012; Dawaki et al., 2016; Colley et al., 2014).

The overall prevalence of schistosomiasis was 14.7%, indicating moderate endemicity according to World Health Organization classifications (WHO, 2022). This prevalence is comparable to findings from other endemic regions in Nigeria, including Osun State and Kano State (Adenowo et al., 2023; Abdullahi et al., 2016), although it is lower than rates reported in some northern Nigerian states and highly endemic riverine communities (Suleiman et al., 2022; Bila et al., 2025; Ahmad & Bagwai, 2024). Differences may be attributed to variations in environmental conditions, access to safe water, health education, and previous mass drug administration programmes.

*Schistosoma haematobium* was more prevalent than *Schistosoma mansoni*, confirming urinary schistosomiasis as the dominant form of infection in the study area, a pattern widely reported in Nigeria and other African countries (Adenowo et al., 2023; Hotez et al., 2019). Although males recorded a higher prevalence than females, the difference was not statistically significant, suggesting that both sexes may be similarly exposed to contaminated water sources (Suleiman et al., 2022; Adenowo et al., 2023). Infection prevalence increased significantly with age, with the highest rates occurring among children aged 10–15 years, while marked variations among schools likely reflected differences in environmental conditions, proximity to water bodies, sanitation facilities, and behavioural practices (Ahmad & Bagwai, 2024; Adenowo et al., 2023; Bila et al., 2025).

Overall, the findings confirm that schistosomiasis remains endemic in the study area and highlight the need for integrated control measures, including health education, improved water supply and sanitation, snail control, and regular mass drug administration targeting school-aged children (WHO, 2022; Colley et al., 2014).

#### 5.0 CONCLUSION

This study provides important insights into the epidemiology of schistosomiasis among primary school children and teachers in the study area. The findings demonstrate that schistosomiasis remains a significant public health concern, with an overall prevalence of 14.7% among school children, indicating moderate endemicity in line with the classification of the World Health Organization. The predominance of *Schistosoma haematobium* over *Schistosoma mansoni* further confirms that urinary schistosomiasis is the most

common form of infection in the area. The socio-demographic characteristics observed particularly the higher proportion of male pupils and the dominance of children aged 10–15 years are consistent with established epidemiological patterns reported globally, across Africa, and within Nigeria. These groups are more actively involved in water-contact activities such as swimming, bathing, fishing, and irrigation farming, which were identified as major risk factors for infection in this study. Despite the moderate prevalence, the study revealed poor knowledge and awareness of schistosomiasis among pupils, highlighting a critical gap in health education. The variation in infection rates across schools also underscores the influence of environmental and behavioural factors, including proximity to contaminated water sources and differences in sanitation and water infrastructure.

The study confirms that schistosomiasis transmission in the study area is sustained by a combination of socio-demographic, environmental, and behavioural factors. These findings reinforce the need for integrated and sustained control strategies targeting school-aged children, who remain the most vulnerable group.

## 6.0 RECOMMENDATIONS

- i. Schistosomiasis education should be incorporated into primary school curricula, while community awareness programmes should promote preventive practices and discourage risky water-contact activities.
- ii. Regular mass drug administration with praziquantel should be sustained, with priority given to high-risk children and schools with higher prevalence rates.
- iii. Safe water supplies, improved sanitation facilities, and appropriate environmental and snail control measures should be provided to reduce transmission.
- iv. Teachers and health workers should be trained to support health education and case detection, while continuous surveillance and further research should be encouraged to strengthen control programs.

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