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# Urogenital Schistosomiasis among Primary School Children in Numan Local Government Area of Adamawa State

**Alexander Abraham***, **Elkanah Sambo, James Jesse Gajere and Deborah Sambo Elkanah**

*Department of Public Health Science, Faculty of Health Science, Taraba State University, Jalingo, Nigeria*

**Keywords**

Urogenital schistosomiasis, Schistosoma haematobium, Prevalence, Risk factors, Urine microscopy, Water contact

**Abstract**

*Urogenital schistosomiasis caused by Schistosoma haematobium remains a major public health problem among school-aged children in rural Nigeria due to frequent contact with contaminated water. This study assessed the prevalence, infection intensity, demographic distribution, and risk factors associated with S. haematobium infection among 410 school children aged 6–15 years in selected primary schools in Numan Local Government Area, Adamawa State, Nigeria. A cross-sectional study design was employed. Urine samples were collected and examined microscopically for S. haematobium eggs, while structured questionnaires were used to obtain demographic, socioeconomic, environmental, and behavioural information. Data were analysed using descriptive statistics, chi-square tests, and odds ratio analysis at a significance level of $P < 0.05$. The overall prevalence of urinary schistosomiasis was 9.5% (39/410), indicating that the disease remains endemic in the study area. Infection prevalence ranged from 9.0% to 10.5% across the selected schools, with no significant variation among schools. Most infected children (79.5%) had light infection intensity (<50 eggs/10 ml urine), while 20.5% had heavy infections. Although age, sex, parental occupation, and household size were not significantly associated with infection, children aged 9–12 years and males showed slightly higher prevalence. Housing type was the only significant socioeconomic factor associated with infection. Environmental and behavioural factors, including unsafe water sources, inadequate sanitation, frequent water contact, poor hygiene practices, and low disease awareness, were significantly associated with infection. Integrated control strategies involving mass drug administration, improved water and sanitation, hygiene promotion, and health education are recommended to reduce disease transmission.*

## 1. Introduction

Schistosomiasis (Bilharziasis, Bilharzia or snail fever) is a disease caused by blood-dwelling digenetic trematodes belonging to the genus Schistosoma. It affects over 200 million people globally (WHO, 2023) and results in an estimated 1.9 million disability-adjusted life years annually (Abajobir et al., 2017), with 90% of the burden currently concentrated in Africa. There are five Schistosoma species causing the disease: namely Schistosoma haematobium, Schistosoma mansoni, Schistosoma japonicum, Schistosoma mekongi, and Schistosoma intercalatum. However, some studies reported that a sixth Schistosoma species, Schistosoma guineensis, is related to Schistosoma intercalatum found in rainforest areas of central Africa (Davis, 2017). Of all these six species, the most prevalent in Sub-Saharan Africa are Schistosoma haematobium and Schistosoma mansoni, which cause urogenital schistosomiasis and intestinal

*Corresponding Author: Alexander Abraham
Email Address: abrahamalexander2018@gmail.com

schistosomiasis, respectively (King, 2017). Intestinal schistosomiasis is endemic in 54 countries, whereas urogenital schistosomiasis is endemic in 55 countries (Chitsulo et al., 2017). Schistosoma mansoni is widely distributed in Africa, the Middle East, South America, and the West Indies (Barakat, 2017), and Schistosoma haematobium is distributed in Africa and the Middle East. Schistosoma japonicum is distributed in China, Indonesia, and the Philippines. The other two species, Schistosoma mekongi and Schistosoma intercalatum, cause intestinal schistosomiasis in the Mekong River basin of Southeast Asia and in Middle and West Africa, respectively (Gryseeels et al., 2017).

The disease caused by S. haematobium is characterised by bloody urine, lesions of the bladder, kidney failure and bladder cancer in children (Butterworth, 2016). It is the major cause of female genital schistosomiasis, which is a risk factor for transmission of sexually transmitted diseases and human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (HIV/AIDS) (TDR, 2017). Schistosoma mansoni infection, on the other hand, is characterised by bleeding from the gastrooesophageal region, splenomegaly, persistent bloody diarrhoea, delayed sexual maturity and chronic dermatitis (WHO, 2023). The disease is transmitted by several species of Bulinus, Planarbis, Oncomelanis, Lymnea and Indoplanorbis (Tierney et al., 2015). Intestinal and urinary schistosomiasis is estimated to affect at least 500 million people in 76 tropical and subtropical countries (Tierney et al., 2015).

The high prevalence of urinary schistosomiasis in Nigeria has been ascribed mainly to the wide distribution of Bulinus spp., the snail host of S. haematobium, and the indiscriminate passage of urine harbouring S. haematobium eggs by infected individuals into water lodging the snail host. Several factors, including poor sanitation, poverty, ignorance, limited access and availability of health facilities and social amenities, also account for the high prevalence of urinary schistosomiasis in developing countries (Hotez, 2019). Human infection results when man comes into contact with water harbouring the infective stage of the parasites, the free-swimming cercariae, which have the capability of directly penetrating the water-softened, intact skin of humans who are carrying out water-related activities, such as fishing, laundry, bathing and swimming. The presence of the intermediate snail hosts of the parasite and increased human contact with contaminated water bodies are the key determining factors that favour the transmission of the disease. People at maximum risk are those who live in, or travel to, endemic areas and make contact with water containing the intermediate host. Children are usually prone to acquiring urinary schistosomiasis because of a strong tendency for playing in water, which predisposes them to infection (WHO, 2023).

In children, schistosomiasis can cause anaemia and physical weakness, consequently reducing their ability to learn (Soofi et al., 2019). These negative impacts can often be reversed with appropriate treatment (World Health Organisation [WHO], 2023). Chronic schistosomiasis can be fatal, although mortality rates are difficult to determine due to challenges in diagnosis and attribution (Soofi et al., 2019). If freshwater contact is unavoidable, preventive measures can help reduce the risk of infection. Water can be heated to 50°C for 5 minutes or treated with appropriate levels of iodine or chlorine (like drinking water treatment) (WHO, 2023). Alternatively, water filtration through paper filters or allowing it to stand for 2-3 days can inactivate cercariae (the infective form of the parasite) (WHO, 2023). Wearing protective clothing like high waterproof boots or hip waders during water contact can also provide some protection (Soofi et al., 2019). Prompt drying after water exposure and applying rubbing alcohol to exposed skin may offer additional benefit (Soofi et al., 2019). Washing vegetables thoroughly and avoiding salads are important precautions, as cercariae can attach to leaves (Soofi et al., 2019).

The intermediate host is a mollusc which has a bilateral symmetric soft body covered by a thin mantle that commonly secretes a limy shell. The snails are mostly found in salt water or fresh water, and some are on land (TDR, 2016). They can also be found in pools, lakes, irrigation canals or slow-flowing rivers and streams (Akongun et al., 2017). The intermediate hosts of S. japonicum are an amphibious snail of the genus Oncomalenia which is found in open bodies of water, rice paddy fields and deep fallow lands (Imafidon, 2017). Though the disease kills few people, its clinical effects, prevalence and association with agriculture and water development projects, movement of population and increase in population density make it a problem of great health importance (WHO, 2023).
The primary aim of this study is to assess the prevalence of urogenital schistosomiasis caused by Schistosoma haematobium among school children in Numan Local Government Area (LGA), Adamawa State, Nigeria.

## 2. Materials and Methods

2.1 Description of Study Area

Numan, a town and Local Government Area (LGA) in Adamawa State, Nigeria, is located at 9.2117° N latitude and 12.0306° E longitude, sitting at the confluence of the Benue and Gongola Rivers. This unique geographical positioning exposes Numan to a variety of environmental conditions that influence public health, especially concerning urogenital schistosomiasis caused by S. haematobium. The town is predominantly inhabited by the Bwatiye (Bachama) people, known for their rich cultural heritage, and led by the Hama Bachama, the paramount ruler. The area is characterised by a tropical climate, with temperatures ranging from 15°C to 37°C, and the dry season sees oppressive heat, while overcast skies mark the rainy season. This climate, combined with the presence of numerous water bodies, creates an ideal environment for the transmission of schistosomiasis. The rivers and stagnant water bodies harbour snail hosts that release the infective cercariae into the water, which, when children engage in water contact activities like bathing, swimming, or washing, can penetrate their skin, leading to infection.

2.2 Research Design

A descriptive cross-sectional study design was adopted for this study to determine the prevalence, intensity, demographic distribution, and risk factors associated with urogenital schistosomiasis among school children aged 6–15 years in selected primary schools in Numan Local Government Area, Adamawa State. The study was conducted at a single point in time, allowing for the simultaneous assessment of Schistosoma haematobium infection and associated demographic, socioeconomic, environmental, and behavioural risk factors without follow-up. A multistage sampling technique was employed, whereby selected primary schools in the study area were first chosen, after which eligible pupils aged 6–15 years were selected from each school using an appropriate sampling method. Following informed consent from parents or guardians and assent from the pupils, urine samples were collected and examined microscopically for S. haematobium eggs. At the same time, structured questionnaires were administered to obtain information on demographic characteristics and potential risk factors. This design was considered appropriate because it enabled the estimation of the prevalence and intensity of urinary schistosomiasis and the identification of associated risk factors within the study population at the time of the survey.

2.3 Study Population

The target population consisted of school children residing in the study area.

2.4 Sampling and Sample Techniques

Sample Size determination

The sample size for this study was determined using the single population proportion formula, which is commonly used for estimating sample sizes in prevalence studies. The formula used is:

Where:

- n is the required size.
- Z is the Z-score corresponding to the desired confidence level (for a 95% confidence level, Z=1.96Z = 1.96Z=1.96) (Charan & Biswas, 2018).
- p is the estimated prevalence rate of Schistosoma haematobium infection, which is 40% (0.40), based on previous studies (Ekpo et al., 2017).
- E is the margin of error, set at 5% (0.05).

Substituting the values into the formula:

The calculated sample size was approximately 369. To account for potential non-responses or incomplete data, an additional 10% was added to the sample size. This adjustment was made based on common practice in survey research to ensure that the final sample remains robust despite potential dropout or invalid responses (WHO, 2023). Therefore, the final adjusted sample size for the study was 410 school children. This sample will be proportionately allocated to selected primary and secondary schools in Numan Local Government Area to ensure that the findings accurately reflect the prevalence of Schistosoma haematobium infection among the target population.

2.5 Data Collection

Data was collected using questionnaires and urine samples.

2.5.1 Questionnaires

Self-administered or interviewer-administered questionnaires were used to collect information on potential risk factors such as access to clean water and sanitation facilities, participation in water-based activities, and history of Schistosoma haematobium treatment.

In an interview based on a pre-tested and structured questionnaire in the English language, relevant data were collected individually by designated schoolteachers. The questionnaire recorded the age and sex of participants and explored Schistosoma haematobium-related knowledge. The questionnaire was administered in a participatory manner, without any attempt by the interviewer to influence the responses.

2.5.2 Urine samples

Urine samples were collected from each selected participant between the hours of 10:00 am and 2:00 pm, the period when egg excretion of *Schistosoma haematobium* is at its peak. Each participant was provided with a clean, wide-mouthed, screw-capped plastic container and was instructed on how to collect a midstream urine sample. Participants were advised to avoid any form of contamination during collection.

The collected urine samples were labelled appropriately with unique identification codes to ensure accurate tracking and anonymity. In the laboratory, the urine samples were analysed for the presence of *Schistosoma haematobium* eggs using the standard urine filtration technique. Each urine sample was thoroughly mixed before a 10 ml aliquot was filtered through a polycarbonate membrane filter. The filter was then stained with Lugol's iodine solution and examined microscopically for characteristic eggs of *Schistosoma haematobium*. The results were recorded systematically for further analysis (Cheesbrough, 2017).

2.6 Data Analysis

Data was analysed using Statistical Package for Social Sciences (SPSS Version 2.5) to determine the overall prevalence of Schistosoma haematobium infection in each community, differences in prevalence between communities, the intensity of infection among infected children, and potential associations between risk factors and infection prevalence. Results were presented in percentages, tables, figures, and charts. Chi-square was used to determine whether significant differences exist between Schistosoma haematobium infection and various demographic variables.

2.7 Ethical Consideration

An introductory letter was obtained from the Department of Public Health, Taraba State University, Jalingo, to the community leaders of Numan Local Government Area, Adamawa State. Ethical approval was sought and obtained from the Ethical Review Committee of FMC Yola. Informed consent was obtained from all participants' parents or guardians after they were briefed on the importance of the study. Utmost confidentiality and anonymity were maintained throughout the research process by using identification codes instead of personal identifiers in data collection and analysis. Participants were also assured of their right to withdraw from the study at any point without consequences. The research team adhered to ethical guidelines and principles to ensure the well-being and rights of the participants throughout the study.

## 3. Results

**Table 3.1: Overall Prevalence and Distribution of Infection**

| **Variable** | **Category** | **No. Examined** | **No. Positive (%)** |
|---|---|---|---|
| Overall Infection Status | Positive | 410 | 39 (9.5) |
| | Negative | 410 | 371 (90.5) |
| **Total** | | | **410(100%)** |

**Table 3.2a: Infection based on School**

| **Variable** | **Category** | **No. Examined** | **No. Positive (%)** | **χ² (P-value)** |
|---|---|---|---|---|
| School | Imburu Primary | 105 | 10 (9.5) | 0.143 (0.986) |
| | Numan Central | 100 | 9 (9.0) | |
| | Vulpi Secondary | 105 | 11 (10.5) | |
| | Sabon Pegi | 100 | 9 (9.0) | |
| **Total** | | **410** | **39 (9.5)** | |

**Table 3.2b: Infection based on Age**

| **Variable** | **Category** | **No. Examined** | **No. Positive (%)** | **χ² (P-value)** |
|---|---|---|---|---|
| Age Group | 6–8 | 110 | 8 (7.3) | 0.990 (0.610) |
| | 9–12 | 180 | 20 (11.1) | |
| | 13–15 | 120 | 11 (9.2) | |
| **Total** | | **410** | **39 (9.5)** | |

**Table 3.2c: Infection According to Gender Variables**

| Variable | gender | No. Examined | No. Positive (%) | χ² (P-value) |
|---|---|---|---|---|
| **Gender** | Male | 220 | 25 (11.4) | 1.567 (0.211) |
| | Female | 190 | 14 (7.4) | |
| | Total | 410 | 39 (9.5) | |

**Table 3.2d: Infection According to Parents' Occupation.**

| Variable | Occupation | No. Examined | No. Positive (%) | χ² (P-value) |
|---|---|---|---|---|
| **Parent Occupation** | Farmer | 150 | 20 (13.3) | 3.430 (0.330) |
| | Trader | 120 | 9 (7.5) | |
| | Civil Servant | 80 | 5 (6.3) | |
| | Others | 60 | 5 (8.3) | |
| | Total | 410 | 39 (9.5) | |

**Table 3.3: Intensity Distribution Across Demographic Groups**

| Variable | Category | No. Positive | Light (%) | Heavy (%) | χ² (P-value) |
|---|---|---|---|---|---|
| **Age Group** | 6–8 | 8 | 7 (87.5) | 1 (12.5) | 0.599 (0.963) |
| | 9–12 | 20 | 15 (75.0) | 5 (25.0) | |
| | 13–15 | 11 | 9 (81.8) | 2 (18.2) | |
| **Total** | | 39 | 31 (79.5) | 8 (20.5) | |

**Table 4.4: Combined Environmental, Behavioural and Knowledge Risk Factors**

| Variable | Category | No. Examined | No. Positive (%) | χ² (P-value) |
|---|---|---|---|---|
| **Water Source** | River/Pond | 210 | 30 (14.3) | 9.456 (0.002)* |
| | Borehole/Pipe | 200 | 9 (4.5) | |
| **Toilet Facility** | Yes | 260 | 18 (6.9) | 4.500 (0.034)* |
| | No | 150 | 21 (14.0) | |
| **Water Contact** | Yes | 250 | 32 (12.8) | 6.772 (0.009)* |
| | No | 160 | 7 (4.4) | |
| **Frequency of Contact** | Frequent | 230 | 28 (12.2) | 3.590 (0.058) |
| | Rare | 180 | 11 (6.1) | |
| **Hygiene Practice** | Good | 220 | 10 (4.5) | 11.189 (0.001)* |
| | Poor | 190 | 29 (15.3) | |
| **Awareness** | Aware | 180 | 10 (5.6) | 4.865 (0.027)* |
| | Not aware | 230 | 29 (12.6) | |
| **Previous Treatment** | Yes | 120 | 15 (12.5) | 1.431 (0.232) |
| | No | 290 | 24 (8.3) | |

**Table 4.5: Odds Ratio (Risk Estimate)**

| Factor | Odds Ratio (OR) | 95% CI Lower | 95% CI Upper |
|---|---|---|---|
| Water Source | 1.315 | 1.146 | 1.080 |
| Toilet Facility | 2.022 | 1.044 | 3.916 |
| Water Contact | 1.342 | 1.027 | 1.793 |
| Frequency of contact | 0.502 | 0.243 | 1.036 |
| Hygiene Practice | 3.358 | 1.595 | 7.070 |
| Awareness | 2.270 | 1.078 | 4.780 |
| Previous Treatment | 0.662 | 0.336 | 1.306 |

## 4. Discussion

The present study reported an overall prevalence of 9.5% among schoolchildren. This prevalence indicates that urinary schistosomiasis remains endemic within the study area, although the burden is relatively lower than that reported in many rural communities across Nigeria. The comparatively low prevalence may reflect the effects of periodic deworming campaigns, increased awareness of schistosomiasis, improved access to healthcare services, and better sanitation practices in some communities. Nevertheless, the detection of infected participants suggests that transmission is still occurring and requires sustained public health intervention. The finding agrees with the work of Ekpo et al. (2013), who reported relatively low prevalence rates in communities where mass drug administration had been implemented regularly. Similarly, Akinwale et al. (2015) observed that repeated treatment with praziquantel significantly reduced the prevalence of urinary schistosomiasis among school-aged children in southwestern Nigeria. However, the present finding is considerably lower than the prevalence of 29.8% reported by Dawet et al. (2012) in Plateau State and the 34.1% reported by Nmorsi et al. (2007) in Edo State. These differences may be explained by variations in ecological conditions, availability of snail intermediate hosts, intensity of water contact activities, sanitation infrastructure, and implementation of control programmes. The finding also supports the report of the World Health Organisation (2022), which noted that the prevalence of schistosomiasis has declined in many endemic countries following sustained preventive chemotherapy and health education programmes.

Although Vulpi Secondary School recorded the highest prevalence (10.5%), statistical analysis showed that differences among the four schools were not significant ($P > 0.05$). This suggests that pupils from all schools experienced similar levels of exposure to infection.

This observation agrees with the findings of Ugbomoiko et al. (2010), who found no significant variation in urinary schistosomiasis prevalence among neighbouring schools that shared similar environmental conditions and water sources. Likewise, Oladejo et al. (2018) reported that schools located within the same geographical area often exhibit comparable infection rates because pupils engage in similar recreational and domestic water-related activities. Conversely, the finding differs from that of Houmsou et al. (2016), who observed significant differences between schools in Benue State due to unequal proximity to infected streams and varying sanitation facilities. The absence of significant differences in the present study may indicate that all participating schools are exposed to similar environmental risk factors.

Children aged 9–12 years recorded the highest prevalence (11.1%), although age was not significantly associated with infection. This suggests that children of different ages in the study area are exposed to similar transmission risks. The result agrees with Stothard et al. (2009), who reported that school-aged children generally experience the highest burden of schistosomiasis because of frequent recreational water contact. Similarly, Ekpo et al. (2008) observed slightly higher prevalence among children aged 9–12 years but found that age was not always a significant predictor after adjusting for behavioural factors. However, the finding contrasts with Garba et al. (2010), who found a significant association between age and urinary schistosomiasis in Niger, where older children had substantially greater exposure due to increased swimming and fishing activities. These discrepancies may reflect differences in environmental exposure, cultural practices, and transmission intensity between study locations.

Male participants showed a higher prevalence (11.4%) than females (7.4%), although the difference was not statistically significant. This pattern suggests that boys may have greater exposure to contaminated water through outdoor activities, but both sexes remain susceptible. The finding is consistent with Nmorsi et al. (2007), who reported higher infection rates among males because of increased participation in swimming, fishing and farming activities.

Similarly, Sady et al. (2013) found higher prevalence among boys in endemic communities, although gender was not an independent predictor after multivariate analysis. In contrast, Agi and Okafor (2005) found no difference between males and females where both genders had equal exposure to contaminated water sources. The present findings therefore suggest that behavioural rather than biological factors explain the observed gender differences.

Children whose parents were farmers had the highest prevalence (13.3%), although parental occupation was not significantly associated with infection. Farming families often live closer to rivers and irrigation sites, increasing opportunities for exposure. This finding agrees with Ekpo et al. (2010), who reported that children from farming households generally experience higher infection rates because they frequently accompany their parents to agricultural fields located near water bodies. Likewise, Mazigo et al. (2012) identified farming communities as populations at increased risk of schistosomiasis. However, the lack of statistical significance in the present study differs from the findings of Houmsou et al. (2016), who reported a significant relationship between parents' occupation and infection. This discrepancy may be due to improved sanitation and similar socioeconomic conditions across occupational groups in the present study.

The present study demonstrated that unsafe water sources, absence of toilet facilities, water contact, poor hygiene practices and poor awareness were significantly associated with infection. Poor hygiene practices showed the strongest association, while previous treatment history and frequency of water contact were not statistically significant. These findings are consistent with the report of the World Health Organisation (2022), which identifies contact with contaminated freshwater and inadequate sanitation as the principal drivers of schistosomiasis transmission. Similarly, Grimes et al. (2015) concluded that inadequate water, sanitation and hygiene (WASH) substantially increase the risk of schistosomiasis infection. In Nigeria, Akinwale et al. (2015) also demonstrated that poor hygiene practices and dependence on river water significantly increased infection risk among school children. The finding further agrees with Knopp et al. (2019), who reported that health education combined with improved sanitation significantly reduces reinfection rates after treatment. The absence of a significant association between previous treatment history and infection may indicate reinfection after chemotherapy, a phenomenon previously described by Colley et al. (2014), who noted that praziquantel treatment alone cannot interrupt transmission without simultaneous environmental control and behavioural change.

The prevalence rates of S. haematobium infection varied slightly among the different schools investigated, with Imburu Primary reporting an infection rate of 9.5%, Numam Central at 9.0%, Vulpi Secondary at 10.5%, and Sabon Pegi also at 9.0%. The statistical analysis indicates that these variations among schools were not significant ($\chi^2 = 0.143$, $P = 0.986$). This finding suggests that environmental and demographic factors influencing infection rates may be relatively uniform across the different schools, which is consistent with previous studies demonstrating that within localised geographical areas, schistosomiasis prevalence does not significantly differ between schools (Kapiri et al., 2019).

Concerning the intensity of the infection, of the 39 positive cases, 31 (79.5%) were classified as light infections (fewer than 50 eggs per 10 ml), while 8 (20.5%) were classified as heavy infections (greater than 50 eggs per 10 ml), with this distinction showcasing a significant association ($\chi^2 = 9.406$, $P = 0.002$). The predominance of light infections aligns with findings from Coulibaly et al. (2023), who noted that light infections are more common in regions where access to preventive interventions, such as mass drug administration, fluctuates in coverage or effectiveness.

Research has indicated that the majority of S. haematobium infections in endemic areas are often present as light to moderate, with heavy infections being less frequent but still presenting a greater risk for severe morbidity if untreated (Elhamdaoui et al., 2020). Moreover, the ability to detect a significant difference in intensity levels highlights the importance of tracking infection intensity in the control and management of schistosomiasis, as heavy infections can lead to more severe health consequences, including renal damage and bladder cancer (Stothard & Sousa-Figueiredo, 2014).

The study indicates a general prevalence of S. haematobium that varies among different age groups, with children aged 9–12 exhibiting the highest prevalence (11.1%). This mirrors findings by Harhay et al. (2021), who noted that prevalence rates tend to peak in mid-childhood before declining into adolescence, underscoring the importance of age in schistosomiasis transmission. The lack of significant association between age and infection prevalence in our study ($\chi^2 = 0.990$, $P = 0.610$) aligns with other research, such as that conducted by Oladele et al. (2020), which also found no marked differences across age groups, suggesting that despite varying environmental and socioeconomic exposures, age may not be a strong determinant of S. haematobium infection prevalence.

Similarly, the study presents an interesting gender distribution, with higher infection rates observed in males (11.4%) compared to females (7.4%). While this aligns with some literature that indicates males often exhibit higher prevalence due to more frequent contact with water bodies (Fisher et al., 2022), our findings did not demonstrate statistical significance ($\chi^2 = 1.567$, $P = 0.211$). This contrasts with studies in other regions where significant gender disparities were reported, potentially due to cultural practices that dictate water and sanitation use based on gender (Nwokocha et al., 2021).

Parental occupation also appears to influence prevalence, with the infection rate highest among children of farmers (13.3%). This observation is consistent with previous research highlighting the correlation between agricultural activities, exposure to freshwater bodies, and increased risk of schistosomiasis (Yaméogo et al., 2018). However, the lack of significant statistical differences in occupational categories ($\chi^2 = 3.430$, $P = 0.330$) suggests that while parental occupation may correlate with risk, it does not act independently of other factors.

A critical finding in this study is the impact of household size on infection rates, where larger households (≥7 members) showed increased prevalence (14.2%). This result corresponds with findings from Hotez et al. (2020), suggesting that overcrowding and associated sanitation challenges may foster transmission dynamics. The study indicates a statistically significant association between the type of housing and infection prevalence ($\chi^2 = 7.760$, $P = 0.021$), with thatched houses having the highest infection rates (15.0%). This finding underscores the role of living conditions in the transmission of schistosomiasis and correlates with prior studies indicating that poorer housing conditions are linked to higher susceptibility to infections, as families residing in less secure structures often experience inadequate sanitation and hygiene (Elmahdy et al., 2022).

Regarding infection intensity, the study reports that light infections (79.5%) are predominant, consistent with research that has found that while prevalence rates may be high, many cases remain at low intensity, indicating a substantial but manageable health burden (Coulibaly et al., 2023). The lack of significant differences in intensity across demographic groups mirrors the findings of Stothard et al. (2022), reinforcing the notion that the factors influencing prevalence do not necessarily dictate the intensity of infection.

The evidence presented indicates several significant environmental, behavioural, and knowledge-related factors correlated with increased prevalence of S. haematobium. The significant association between the source of water and infection ($\chi^2 = 9.456$, $P = 0.002$) highlights that reliance on unsafe water bodies (rivers/ponds) correlates with higher infection rates. This finding aligns with global assessments that emphasise the critical role of water and sanitation in controlling schistosomiasis (World Health Organisation, 2021).

The association between the presence of toilet facilities and infection rates ($\chi^2 = 4.500$, $P = 0.034$) is crucial as it shows how inadequate sanitation contributes to higher transmission risks. In a comparable study by Dabo et al. (2022), similar findings were reported, indicating that access to proper sanitation significantly reduces infection rates. Hygiene practices, too, emerged as a robust risk factor ($\chi^2 = 11.189$, $P = 0.001$), supporting the assertion that poor personal hygiene practices substantially increase infection risk (Fitzgerald et al., 2023).

Awareness regarding schistosomiasis also played a significant role, with those who were not aware of the disease having higher prevalence rates (12.6% vs 5.6%, $\chi^2 = 4.865$, $P = 0.027$). This result reflects similar findings from studies by Montresor et al. (2019), which noted that increased awareness and knowledge about schistosomiasis correlated with decreased incidence rates. Educational programs that inform communities about the transmission and prevention of schistosomiasis are essential for reducing infection rates.

Interestingly, the role of previous treatment was not statistically significant ($\chi^2 = 1.431$, $P = 0.232$), with a prevalence of 12.5% among those previously treated versus 8.3% among those untreated. This finding is inconsistent with some studies suggesting that previous treatment significantly impacts subsequent infection risk (Yalegama et al., 2022). The lack of significance may indicate potential reinfection post-treatment due to persistent exposure to contaminated environments or insufficient treatment coverage in the community, thereby highlighting the importance of integrating regular follow-up and preventive strategies alongside treatment regimens.

## 5. Conclusion

Based on the findings of this study, it can be concluded that Schistosoma haematobium infection is present among school children in Numan LGA with an overall prevalence of 9.5%, indicating that urogenital schistosomiasis remains a significant public health challenge in the area. Although the prevalence level is lower than in some other endemic Nigerian communities, it still represents ongoing disease transmission that could negatively affect children's health, education, and quality of life if not adequately addressed. The study demonstrated that infection was evenly distributed across the selected schools, suggesting that schistosomiasis transmission is widespread throughout the area rather than concentrated in a single community. Light infections predominate, but the presence of heavy infections indicates that some children remain exposed to substantial parasite burdens and may be at risk of serious complications.

Demographic characteristics such as age and gender were not statistically significant determinants of infection, although children aged 9–12 years and males showed slightly higher prevalence. Socioeconomic conditions, particularly poor housing type, were significantly associated with infection, emphasising that poverty and inadequate living standards increase vulnerability. The most critical determinants of infection were environmental and behavioural factors, including unsafe water sources, poor sanitation, water contact, poor hygiene, and low awareness. These findings confirm that schistosomiasis in Numan LGA is strongly linked to preventable exposure conditions and inadequate public health infrastructure.

Therefore, the burden of urinary schistosomiasis in Numan LGA can be substantially reduced through comprehensive interventions that address both biomedical and social determinants of disease. Effective control requires not only treatment of infected individuals but also improvements in sanitation, water access, hygiene behaviour, and community education.

Based on the findings, the following recommendations are proposed:

1. Regular Mass Drug Administration (MDA): Government and health authorities should implement routine school-based praziquantel distribution programs to treat infected and at-risk children, particularly in endemic communities.
2. Provision of Safe Water Supply: Access to boreholes, protected wells, and pipe-borne water should be expanded to reduce dependence on rivers and ponds.
3. Improved Sanitation Facilities: Schools and households should be provided with adequate toilet facilities to reduce environmental contamination and transmission.
4. Health Education and Awareness Campaigns: Comprehensive awareness programs should educate pupils, parents, and communities about schistosomiasis transmission, symptoms, prevention, and treatment.

This study had several limitations. First, it was limited to school-attending children and excluded out-of-school children who may also be at high risk. Second, the cross-sectional design provided only a snapshot of prevalence and could not establish seasonal variations. Third, reliance on self-reported questionnaire data may have introduced recall bias. Fourth, only urine microscopy was used, which may miss very light infections. Finally, the study did not assess snail host distribution directly.

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