

# Prevalence and Age–Sex Variation of Urogenital Schistosomiasis Among School-Aged Children around Ajiwa Reservoir, Katsina State, Nigeria

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## ABSTRACT

Urogenital schistosomiasis is a freshwater-associated parasitic disease strongly influenced by human–water interactions and environmental conditions that support transmission. This study assessed the prevalence of urogenital schistosomiasis caused by *Schistosoma haematobium* and described its variation by age and sex among school-aged children living in communities around Ajiwa Reservoir, Katsina State, Nigeria. A cross-sectional survey was conducted between August and September 2023 among 105 pupils aged 8–15 years. Urine samples were screened using reagent strips and examined microscopically following centrifugation–sedimentation. The overall prevalence was 42.9% (95% CI: 33.8–52.4%). Infection was descriptively more frequent among males (46.9%) than females (36.6%; OR 1.53, 95% CI: 0.69–3.41;  $p = 0.299$ ) and among younger age groups (50.0% at age 8–10 years declining to 31.3% at age 15;  $\chi^2 = 1.558$ ,  $df = 3$ ,  $p = 0.669$ ); however, neither difference was statistically significant. The findings indicate that urogenital schistosomiasis remains an important public health concern among school-aged children in communities around Ajiwa Reservoir and underscore the importance of preventive chemotherapy, health education, improved water, sanitation and hygiene practices, and reduction of risky freshwater contact.

**Keywords:** Urogenital schistosomiasis; Prevalence; Age–sex variation; School-aged children; Ajiwa Reservoir

## 1.0 INTRODUCTION

Globally, urinary schistosomiasis remains a significant public health burden. Current estimates show that at least 253.7 million people required preventive chemotherapy for schistosomiasis in 2024, with the great majority in Africa, where *Schistosoma haematobium* is an important cause of human infection (World Health Organization [WHO], 2026). It is closely associated with rural populations in tropical and subtropical regions (Amuta & Houmsou, 2014).

Various species of freshwater snail belonging to the genus *Bulinus* act as intermediate hosts of *S. haematobium*. Disease transmission is further aided by human water-contact activities for recreational, domestic and occupational purposes. School-aged children are particularly vulnerable where swimming, fishing, bathing, washing and other activities bring them into contact with infested freshwater (Deribew et al., 2022; WHO, 2026).

Early manifestations of urogenital schistosomiasis include haematuria and other urinary symptoms, while chronic infection may result in serious urinary and reproductive complications (WHO, 2026). In Nigeria, schistosomiasis remains an important neglected tropical disease, with substantial populations at risk and persistent

transmission reported in different parts of the country (Balogun et al., 2022; Odaibo et al., 2024). Recent surveys confirm that transmission remains active across northern states, including Katsina, Jigawa, Zamfara and Bauchi (Abubakar et al., 2022; Auta et al., 2020; Bala et al., 2020; Balogun et al., 2022; Bello et al., 2024).

Schistosomiasis is a freshwater-associated parasitic disease whose transmission is strongly influenced by ecological conditions and human interaction with aquatic environments. The development of reservoirs and irrigation systems can alter natural hydrological regimes and create habitats suitable for intermediate snail hosts, while frequent human contact with contaminated water provides opportunities for infection (Deribew et al., 2022). Ajiwa Reservoir in Batagarawa Local Government Area of Katsina State serves as an important freshwater resource for surrounding communities. The reservoir and associated water-contact activities therefore provide a relevant setting for investigating the occurrence of urogenital schistosomiasis among school-aged children.

However, although schistosomiasis has been documented in different parts of northern Nigeria, the evidence cited above does not specifically establish the epidemiological situation among school-aged children

living in communities surrounding Ajiwa Reservoir. In particular, location-specific information on the prevalence of *Schistosoma haematobium* infection in this reservoir-associated population and its variation by age and sex remains limited. This represents an important local evidence gap because the epidemiology of urogenital schistosomiasis can vary between communities according to environmental conditions and patterns of human–water interaction. Addressing this gap provides relevant baseline evidence for surveillance and locally appropriate schistosomiasis control measures around Ajiwa Reservoir.

This study therefore assessed the prevalence of urogenital schistosomiasis among primary school children living around Ajiwa Reservoir, with particular attention to variation by age and sex.

## 2.0 MATERIALS AND METHODS

### 2.1 Study Area

The survey was conducted in selected communities surrounding Ajiwa Reservoir, in Batagarawa Local Government Area of Katsina State, North-western Nigeria, located at latitude and longitude 12°54'69"–12°57'58" N and 7°42'53"–7°47'50" E, in the Sudan savannah zone of Nigeria with two distinct seasons (wet and dry). The rainy season on average lasts from May to October and the dry season from November to April, with a temperature range around 29.31 °C. The ethnic groups comprise the Hausa and Fulani who are predominantly cereal crop farmers, animal rearers, including fishing, and traders. The main purpose of the reservoir is irrigation and water supply for the people of Katsina, Batagarawa, Mashu and Mani local government areas.

### 2.2 Study Design, Duration and Respondents

This cross-sectional epidemiological survey was carried out between August and September 2023 among 105 primary school children aged 8–15 years. The study targeted pupils from Gajerar Giwa, Masabo and Ajiwa primary schools. Pupils in the age group 8–15 years were enrolled voluntarily in the study, while pupils who were severely ill, unwilling, or who supplied invalid or artificial urine samples were excluded. A total of three primary schools were selected around the area: P.S. Gajerar Giwa, P.S. Masabo and P.S. Ajiwa. Sample size was allotted to each school and, by extension, to each class of participating pupils. Simple random sampling technique was employed to enroll 105 pupils.

The original study plan targeted 150 pupils; however, 105 pupils provided samples that were available for analysis and constituted the final study sample, with the remaining 45 pupils not returning samples, giving a response rate of 70.0% (105/150).

### 2.3 Sample Collection and Processing

Ethical approval for conducting the study was sought from the communities' leaders, followed by mobilisation of the school children by the Schools Head. Forms A, B and C, representing school-based, individual-based and urine analysis forms respectively, were used to collect data during the survey. The school-based questionnaire was administered to each Head Teacher and was used, among other things, to collect data on student population, reports of haematuria and local names for haematuria and *Bulinus* species. The urinalysis form was designed to record urine sample parameters.

Clean, screw-capped, labelled plastic universal bottles (20 ml) were offered to the respondents, who produced terminal urine samples between the hours of 8:00 am and 12:00 pm, as described in similar recent surveys (Odaibo et al., 2024; Vaillant et al., 2024). Haematuria and proteinuria were tested chemically and documented; in the presence of protein, the Combi-2 indicator changed colour from light yellow to green-blue, the intensity depending on the amount of protein present, while intact red cells in urine were detected by green spotting of the yellow test area of the Combi-10 strip (Cheesbrough, 2005).

About 5 ml of each urine sample was measured into a test tube and centrifuged at 3000 rpm for 5 minutes using a Centurion Scientific Centrifuge (C2 series). The supernatant fluid was decanted while the sediment was examined under a light microscope. An adjustable micropipette (10–100 µl) was used to introduce 10 µl of each sediment sample onto a clean, grease-free glass slide, which was covered at an angle with a glass slip to avoid bubble formation. Microscopic examination of wet preparations for the eggs of *S. haematobium* was carried out using the 10× objective of a binocular compound light microscope, following standard sedimentation protocols (Cheesbrough, 2005; Esier et al., 2022; Umoh et al., 2020).

All urine samples, whether reagent-strip positive or negative, were processed by centrifugation–sedimentation and examined microscopically. Samples with eggs were recorded as positive while those without eggs were taken to be negative. For positive samples, egg counts were carried out and each average count was recorded as the number of eggs per 10 ml of urine sample (Odaibo et al., 2024); counts obtained from the 10 µl of sediment examined were converted to the 10 ml urine equivalent by multiplying by 1,000 (10 ml ÷ 10 µl = 1,000). Intensity of infection was categorized into light

(<50 eggs/10 ml of urine) and heavy ( $\geq 50$  eggs/10 ml of urine) infections (WHO, 2002).

## 2.4 Quality Assurance

Each universal bottle was assigned a serial number which corresponded to the number on each individual-based questionnaire. Where immediate examination was impossible, samples were quickly transported to the Biology Laboratory of the Federal University Dutsin-Ma. Because accuracy and thoroughness might be compromised by the stress of examining all samples under the microscope, reagent strips were first used as a preliminary screening aid; strip-positive and strip-negative samples were subsequently processed by centrifugation–sedimentation and examined microscopically to confirm positivity and negativity, respectively. The performance of reagent strips for this purpose is documented (Vaillant et al., 2024). Average counts of *S. haematobium* eggs were recorded; on a few occasions where intensities were extremely light, averages of six or seven counts were recorded.

## 2.5 Ethical Considerations

This study was conducted in accordance with the ethical principles for research involving human participants. Institutional (traditional) verbal ethical approval was obtained from the ward heads. Verbal informed consent was obtained from participating pupils under the

supervision of their various head teachers and verbal assent was obtained from the children before enrolment. Participation was voluntary, and confidentiality of participants' data was maintained throughout the study.

## 2.6 Data Analysis

Data obtained from the survey were entered into Microsoft Excel 2010 and analysed with SPSS version 15.0. Data summary was carried out using the frequency and crosstabs sections of descriptive statistics. Prevalence is reported with 95% Wilson score confidence intervals. Associations between age group, sex and *S. haematobium* infection were assessed using the chi-square test; because some expected cell counts were small, Fisher's exact test was used as a check for the sex comparison and exact/Monte Carlo methods are recommended where expected counts fall below five. The sex-specific odds ratio with 95% confidence interval is also reported. Statistical significance was considered at the 95% confidence level with a p-value of less than 0.05.

## 3.0 RESULTS

### 3.1 Overall Prevalence

The results obtained from the analysis of samples collected from Ajiwa, Masabo and Gajerar Giwa primary school children showed that 45 (42.9%) out of 105 samples collected were positive for *Schistosoma haematobium* (Table 1).

**Table 1. Overall prevalence of *Schistosoma haematobium* infection among school-aged children around Ajiwa Reservoir**

| Parameter | Number Examined | Number Positive | Prevalence, % (95% CI) |
|-----------|-----------------|-----------------|------------------------|
| Overall   | 105             | 45              | 42.9 (33.8–52.4)       |

### 3.2 Age-Related Variation in Prevalence

Age-related variation was descriptive rather than statistically significant (Table 2): 15 of 30 pupils aged 8–10 years were positive (50.0%), 14 of 34 aged 10–12

years (41.2%), 11 of 25 aged 12–14 years (44.0%), and 5 of 16 aged 15 years (31.3%) ( $\chi^2 = 1.558$ , df = 3,  $p = 0.669$ ). Prevalence was thus descriptively highest in the youngest group and lowest at age 15 years.

**Table 2. Age-related variation in the prevalence of *Schistosoma haematobium* infection among school-aged children around Ajiwa Reservoir ( $\chi^2 = 1.558$ , df = 3,  $p = 0.669$ )**

| Age Group (Years) | Number Examined | Number Positive | Prevalence, % (95% CI) |
|-------------------|-----------------|-----------------|------------------------|
| 8–10              | 30              | 15              | 50.0 (33.2–66.8)       |
| 10–12             | 34              | 14              | 41.2 (26.4–57.8)       |
| 12–14             | 25              | 11              | 44.0 (26.7–62.9)       |
| 15                | 16              | 5               | 31.3 (14.2–55.6)       |

### 3.3 Sex-Based Variation in Prevalence

By sex, 30 of 64 male pupils (46.9%) were infected compared with 15 of 41 female pupils (36.6%) (Table 3). The male-to-female odds ratio was 1.53 (95% CI: 0.69–

3.41). Although descriptively higher in males, the difference was not statistically significant ( $\chi^2 = 1.080$ , df = 1,  $p = 0.299$ ; Fisher's exact  $p = 0.320$ ).

**Table 3. Sex-based variation in the prevalence of *Schistosoma haematobium* infection in peri-reservoir communities of Ajiwa Reservoir (OR = 1.53, 95% CI: 0.69–3.41;  $p = 0.299$ )**

| Sex    | Number Examined | Number Positive | Prevalence, % (95% CI) |
|--------|-----------------|-----------------|------------------------|
| Male   | 64              | 30              | 46.9 (35.2–58.9)       |
| Female | 41              | 15              | 36.6 (23.6–51.9)       |

### 3.4 Summary of Findings

In summary, of the 105 school-aged children examined, 45 tested positive for *S. haematobium* infection, giving an overall prevalence of 42.9% (95% CI: 33.8–52.4%). Observed variation by age and sex was not statistically significant at the 5% level.

### 4.0 DISCUSSION

The prevalence of *S. haematobium* infection, also called urogenital schistosomiasis, was studied among selected primary school children of Ajiwa, Masabo and Gajerar Giwa primary schools in communities around Ajiwa Reservoir, Batagarawa Local Government Area of Katsina State. The overall prevalence of 42.9% indicates that urogenital schistosomiasis remains an important public health concern among the school-aged children examined.

The occurrence of infection around Ajiwa Reservoir is consistent with the established relationship between freshwater environments, human water-contact activities and schistosomiasis transmission. Reservoirs and other permanent freshwater habitats can provide suitable conditions for intermediate snail hosts, while frequent contact with infested water provides opportunities for cercarial penetration (Deribew et al., 2022; WHO, 2026). However, the present study did not directly assess snail abundance or infection status and therefore cannot independently establish the contribution of specific reservoir ecological characteristics to transmission.

The overall prevalence of 42.9% is higher than the 32.2% reported in Faskari and Funtua Local Government Areas of Katsina State (Bello et al., 2024), but lower than the 67.3% reported among primary school pupils in Jigawa State (Balogun et al., 2022) and the 73.1% reported among school-aged children in a rural farming community in Oyo State (Odaibo et al., 2024). Differences between studies may reflect variations in location, timing, environmental conditions, water-contact practices, preventive chemotherapy coverage and diagnostic approaches.

The present study supports reports showing that *S. haematobium* infection remains endemic in Nigeria and that school-aged children are an important population at risk (Onyekwere et al., 2022; Opara et al., 2021). Exposure can occur through washing, bathing, irrigation, fishing and recreational contact with freshwater. The survey was conducted during August and September, a period within the rainy season in the study area, and the cross-sectional design does not permit assessment of seasonal transmission patterns.

Infection was descriptively more frequent in males (46.9%) than in females (36.6%), a pattern also reported by Balogun et al. (2022), who recorded 74.4% in males versus 58.0% in females in Jigawa State; by Umoh et al. (2020), who recorded 10.3% in males versus 4.4% in females in Ebonyi State; and by Onwe et al. (2025), who recorded 17.9% in males versus 11.8% in females in Ohaukwu, Ebonyi State. Studies in comparable settings have attributed higher male prevalence to greater participation in water-contact activities such as swimming, washing, paddling of canoes and irrigation practice (Deribew et al., 2022; Umoh et al., 2020). In the present study, however, the sex difference was not statistically significant ( $p > 0.05$ ), and the confidence interval for the odds ratio (0.69–3.41) includes values consistent with no association as well as a moderate male predominance; the observed difference should therefore be interpreted cautiously.

With respect to age, 15, 14, 11 and 5 cases were found in the age groups 8–10, 10–12, 12–14 and 15 years respectively, corresponding to prevalences of 50.0%, 41.2%, 44.0% and 31.3%. Prevalence was descriptively highest in the youngest group, but the age association was not statistically significant ( $p = 0.669$ ). Development of acquired immunity has been proposed as one possible explanation for age-related differences in schistosomiasis infection (Woolhouse et al., 1991); however, no immunological measure was obtained in the present study, and this explanation should be regarded as speculative rather than demonstrated.

This study has several limitations. It was cross-sectional and restricted to the rainy-season months of August and September, so temporal and seasonal inferences are not possible. The sample size was modest ( $n = 105$ ) following non-return of samples by 45 of the 150 pupils originally targeted (a response rate of 70.0%), and non-response may have introduced bias if non-return was related to infection status or symptoms; the age and sex distribution of respondents and non-respondents was not compared. Reagent strips were used as a preliminary screening aid and all samples, strip-positive and strip-negative, were examined microscopically; however, microscopy of a small sediment volume (10  $\mu$ l) may still miss very light infections, potentially leading to underestimation of prevalence. Age bands as field-coded overlapped at their boundaries. Finally, snail populations, reservoir ecology and water-contact behaviour were not analysed, so the ecological and behavioural mechanisms underlying the observed prevalence pattern remain to be clarified.

The findings underscore the importance of continued surveillance, health education, access to safe water and sanitation, reduction of risky freshwater contact, and preventive chemotherapy in communities where schistosomiasis transmission persists. WHO recommends periodic preventive treatment with praziquantel for at-risk populations, together with complementary water, sanitation, hygiene, behaviour-change and snail-control measures where appropriate (WHO, 2026).

## 5.0 CONCLUSION

Urogenital schistosomiasis remains an important public health concern among school-aged children in communities around Ajiwa Reservoir, with an overall prevalence of 42.9%. Prevalence was descriptively higher among males and younger children, but observed variation by age and sex was not statistically significant.

## REFERENCES

- Abubakar, B. M., Abubakar, A., Moi, I. M., Gagman, H. A., Mohammed, U. A., Katagum, Y. M., & Musa, S. I. (2022). Urinary schistosomiasis and associated risk factors among primary school students in the Zaki Local Government Area, Bauchi State, Nigeria. *Dr. Sulaiman Al Habib Medical Journal*, 4(4), 196–204. <https://doi.org/10.1007/s44229-022-00021-y>
- Amuta, E. U., & Houmsou, R. S. (2014). Prevalence, intensity of infection and risk factors of urinary schistosomiasis in pre-school and school aged children in Guma Local Government Area, Nigeria. *Asian Pacific Journal of Tropical Medicine*, 7(1), 34–39. [https://doi.org/10.1016/S1995-7645\(13\)60188-1](https://doi.org/10.1016/S1995-7645(13)60188-1)
- Auta, T., Ezra, J. J., Rufai, H. S., Alabi, E. D., & Anthony, E. (2020). Urinary schistosomiasis among vulnerable children in security challenged district of Safana, Katsina State, Nigeria. *International Journal of Tropical Disease & Health*, 41(23), 73–81. <https://doi.org/10.9734/IJTDH/2020/v41i2330419>
- Bala, A. Y., Salau, S. A., Bandiya, H. M., Aliyu, M., & Suleiman, J. (2020). Prevalence and intensity of urinary schistosomiasis among the primary school children of some selected villages of Shinkafi Local Government Area, Zamfara State, Nigeria. *South Asian Journal of Parasitology*, 4(4), 28–35.
- Balogun, J. B., Adewale, B., Balogun, S. U., Lawan, A., Haladu, I. S., Dogara, M. M., Aminu, A. U., Caffrey, C. R., De Koning, H. P., Watanabe, Y., & Balogun, E. O. (2022). Prevalence and associated risk factors of urinary schistosomiasis among primary school pupils in the Jidawa and Zobiya communities of Jigawa State, Nigeria. *Annals of Global Health*, 88(1), Article 71. <https://doi.org/10.5334/aogh.3704>

The findings highlight the need for continued surveillance and integrated control measures, including preventive chemotherapy, health education, improved water, sanitation and hygiene practices, and reduction of risky contact with potentially infested freshwater. Further studies incorporating direct assessment of *Bulinus* snail populations, environmental characteristics of the reservoir and detailed water-contact behaviour would help to clarify the ecological and behavioural factors associated with transmission in the study area.

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- Bello, S., Eberemu, E. C., Orpin, J. B., & Ya'u, S. (2024). Prevalence of *Schistosoma haematobium* infection among primary school children in Faskari and Funtua Local Government Areas of Katsina State, Nigeria. *FUDMA Journal of Sciences*, 8(3), 311–315. <https://doi.org/10.33003/fjs-2024-0803-2516>
- Cheesbrough, M. (2005). *District laboratory practice in tropical countries: Part 1* (2nd ed.). Cambridge University Press.
- Deribew, K., Erko, B., Mereta, S. T., Yewhalaw, D., & Mekonnen, Z. (2022). Assessing potential intermediate host snails of urogenital schistosomiasis, human water contact behavior and water physico-chemical characteristics in Alwero Dam Reservoir, Ethiopia. *Environmental Health Insights*, 16, Article 11786302221123576. <https://doi.org/10.1177/11786302221123576>
- Esiere, R. K., Ibeneme, E. O., Effanga, E. O., Imalele, E. E., Esiere, M. K., Inyang-Etoh, P. C., & Alaribe, A. A. (2022). Detecting *Schistosoma haematobium* infection by microscopy and polymerase chain reaction (PCR) in school children in three senatorial districts of Cross River State, Nigeria. *Journal of Parasitic Diseases*, 46(1), 272–279. <https://doi.org/10.1007/s12639-021-01446-2>
- Odaibo, A. B., Komolafe, A. K., Olajumoke, T. O., Diyan, K. D., Aluko, D. A., Alagbe, O. A., Ajagbe, O. A., & Olarinloye, D. B. (2024). Endemic status of urogenital schistosomiasis and the efficacy of a single-dose praziquantel treatment in unmapped rural farming communities in Oyo East Local Government Area, Oyo State, Nigeria. *PLOS Neglected Tropical Diseases*, 18(4), Article e0012101. <https://doi.org/10.1371/journal.pntd.0012101>
- Onwe, S. O., Ani, O. C., Elom, M. O., Eze, E., Okwe, H. E., & Ede, J. U. (2025). Prevalence of *Schistosoma*

- haematobium infection among school aged children in Ohaukwu Local Government Area, Ebonyi State, Nigeria. *International Journal of Community Medicine and Public Health*, 12(11), 4956–4963. <https://doi.org/10.18203/2394-6040.ijcmph20253669>
- Onyekwere, A. M., Rey, O., Nwanchor, M. C., Alo, M., Angora, E. K., Allienne, J. F., & Boissier, J. (2022). Prevalence and risk factors associated with urogenital schistosomiasis among primary school pupils in Nigeria. *Parasite Epidemiology and Control*, 18, Article e00255. <https://doi.org/10.1016/j.parepi.2022.e00255>
- Opara, K. N., Wilson, E. U., Yaro, C. A., Alkazmi, L., Udoidung, N. I., Chikezie, F. M., Bassey, B. E., & Batiha, G. E.-S. (2021). Prevalence, risk factors, and coinfection of urogenital schistosomiasis and soil-transmitted helminthiasis among primary school children in Biase, Southern Nigeria. *Journal of Parasitology Research*, 2021, Article 6618394. <https://doi.org/10.1155/2021/6618394>
- Umoh, N. O., Nwamini, C. F., Inyang, N. J., Umo, A. N., Usanga, V. U., Nworie, A., Elom, M. O., & Ukwah, B. N. (2020). Prevalence of urinary schistosomiasis amongst primary school children in Ikwo and Ohaukwu communities of Ebonyi State, Nigeria. *African Journal of Laboratory Medicine*, 9(1), Article a812. <https://doi.org/10.4102/ajlm.v9i1.812>
- Vaillant, M. T., Philippy, F., Neven, A., Barré, J., Bulaev, D., Oliaro, P. L., Utzinger, J., Keiser, J., & Garba, A. T. (2024). Diagnostic tests for human *Schistosoma mansoni* and *Schistosoma haematobium* infection: A systematic review and meta-analysis. *The Lancet Microbe*, 5(4), e366–e378. [https://doi.org/10.1016/S2666-5247\(23\)00377-4](https://doi.org/10.1016/S2666-5247(23)00377-4)
- Woolhouse, M. E. J., Taylor, P., Matanhire, D., & Chandiwana, S. K. (1991). Acquired immunity and epidemiology of *Schistosoma haematobium*. *Nature*, 351(6329), 757–759. <https://doi.org/10.1038/351757a0>
- World Health Organization. (2002). Prevention and control of schistosomiasis and soil-transmitted helminthiasis: Report of a WHO expert committee (WHO Technical Report Series No. 912).
- World Health Organization. (2026, February 23). Schistosomiasis [Fact sheet]. <https://www.who.int/news-room/fact-sheets/detail/schistosomiasis>