Prevalence of *Schistosomiasis* among Almajiri School Children in Kaura Namoda Metropolis, Zamfara State, Nigeria

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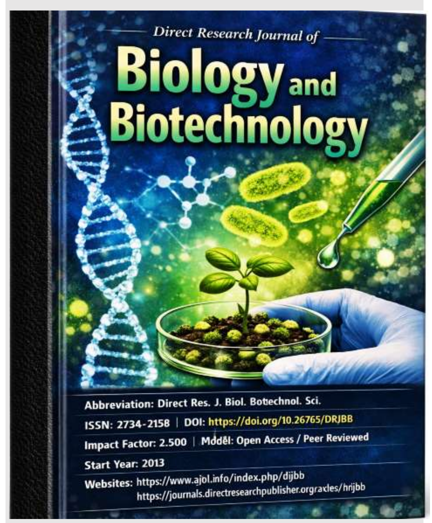
ABSTRACT

Background: *Urinary schistosomiasis remains one of the most prevalent neglected tropical diseases affecting school-aged children in sub-Saharan Africa. Almajiri school pupils constitute a particularly vulnerable population because of frequent exposure to contaminated freshwater sources, poor sanitation, and limited access to healthcare services. This study determined the prevalence of urinary schistosomiasis among Almajiri school children in Kaura Namoda Metropolis, Zamfara State, Nigeria.* ***Materials and Methods:*** *A cross-sectional descriptive study was conducted among 160 Almajiri school pupils aged 5–16 years selected using a multistage sampling technique. Sociodemographic and epidemiological information was collected using structured questionnaires. Midday terminal urine samples were examined for Schistosoma haematobium eggs using the standard World Health Organization urine filtration technique, while biochemical abnormalities were assessed using urine reagent strips. Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 26.0. Descriptive statistics were computed, and associations between variables were evaluated using Pearson's Chi-square test at a significance level of $p < 0.05$.* ***Results:*** *Of the 160 pupils examined, 63 were positive for urinary schistosomiasis, giving an overall prevalence of 39.4%. The highest prevalence occurred among children aged 11–13 years (50.0%), followed by those aged 8–10 years (40.0%), whereas the lowest prevalence was observed among children aged 5–7 years (26.7%). Male pupils recorded a higher prevalence (41.7%) than females (32.5%). Haematuria was the most common biochemical abnormality, occurring in 57.1% of infected participants, followed by proteinuria (40.0%), while glucosuria was detected in 15.0% of cases.* ***Conclusion:*** *Urinary schistosomiasis remains highly prevalent among Almajiri School children in Kaura Namoda Metropolis, with older children and males disproportionately affected. The high occurrence of haematuria among infected pupils highlights its usefulness as a rapid screening indicator in endemic settings. Strengthening school-based praziquantel mass drug administration, improving water, sanitation and hygiene (WASH) facilities, promoting health education, and implementing routine surveillance are recommended to reduce disease transmission and associated morbidity among this vulnerable population.*

Keywords: *Urinary schistosomiasis; Schistosoma haematobium; Almajiri school children; prevalence; haematuria; Zamfara State; Nigeria*



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INTRODUCTION

Schistosomiasis remains one of the most important neglected tropical diseases (NTDs) affecting human populations in tropical and subtropical regions, particularly in sub-Saharan Africa. The disease is caused by blood flukes of the genus Schistosoma, with Schistosoma haematobium responsible for urogenital *schistosomiasis* and Schistosoma mansoni responsible for the intestinal form. Transmission occurs when individuals come into contact with freshwater contaminated by cercariae released from infected freshwater snails that serve as intermediate hosts. The disease remains closely associated with poverty, inadequate access to safe water, poor sanitation, and frequent human contact with natural freshwater bodies, making it a persistent public health challenge despite decades of global control efforts (Atalabi et al., 2016; Balogun et al., 2022).

Globally, *schistosomiasis* continues to impose substantial health, social, and economic burdens, particularly among school-aged children (SAC), typically between 5 and 16 years, who constitute the most vulnerable population because of their frequent recreational and domestic water-contact activities and who have consistently been identified as the group contributing most significantly to disease transmission and morbidity (Atalabi et al., 2016). Chronic infection contributes to anaemia, malnutrition, impaired physical growth, poor cognitive development, reduced educational performance, chronic urinary tract pathology, and diminished productivity later in life. Beyond these physical complications, recent evidence indicates that advanced *schistosomiasis* is also associated with considerable psychological morbidity; a systematic review and meta-analysis conducted in China demonstrated that depressive symptoms are common among patients with advanced *schistosomiasis*, underscoring that the disease extends beyond physical morbidity to significantly affect mental health and quality of life (Qi et al., 2024). These findings reinforce the need for comprehensive control strategies that address both the biomedical and psychosocial consequences of infection.

The epidemiology of *schistosomiasis* is strongly shaped by ecological, environmental, and behavioural factors that facilitate the survival of intermediate host snails and increase opportunities for human-water contact. Environmental modifications such as irrigation schemes, dam construction, and expansion of freshwater bodies frequently create favourable habitats for snail vectors, thereby increasing transmission intensity; evidence from Côte d'Ivoire demonstrated dramatic increases in S. haematobium prevalence following the construction of large hydroelectric dams, highlighting the relationship between environmental change and disease transmission (N'Goran et al., 1997). Age-related exposure also drives transmission dynamics: studies in Côte d'Ivoire have shown that prevalence of S. mansoni rises sharply from the pre-school years into school age, with school-aged children recording several-fold higher infection rates than younger children, reflecting increased independent water contact as children grow older (Coulibaly et al., 2013). Similarly, in the Greater Accra region of Ghana, community-based screening demonstrated that both S. haematobium and S. mansoni were highly prevalent among school-age populations, with males significantly more likely than females to harbour high-intensity infections, and low socioeconomic status independently associated with higher infection risk (Cunningham et al., 2020). These findings align with the broader literature indicating that male sex, use of unprotected water sources such as wells, ponds, and rivers, and poor sanitation practices are recurrent risk factors for *schistosomiasis* across endemic settings (Atalabi et al., 2016).

Reliable epidemiological surveillance remains essential for monitoring transmission dynamics and evaluating intervention effectiveness. Recent investigations have demonstrated that *schistosomiasis* distribution is highly heterogeneous even within endemic regions, emphasizing the value of localized, precision-based surveillance over broad regional estimates. Precision mapping conducted among school-aged children in north-western Tanzania showed considerable geographical variation in prevalence between neighbouring districts and schools, indicating that interventions should be targeted at smaller administrative units (Mazigo et al., 2022), while similar precision mapping in western Kenya confirmed that identifying localized transmission hotspots enables more efficient allocation of limited public health resources and improves implementation of mass drug administration programmes (Kepha et al., 2025). Complementary methodological innovations, such as multiple category-lot quality assurance sampling, have further improved the efficiency and cost-effectiveness of classifying *schistosomiasis* prevalence in endemic communities (Olives et al., 2012). Advances in molecular epidemiology have also enhanced understanding of transmission dynamics; work among school-aged children living along the southern shoreline of Lake Malawi revealed persistent transmission of both intestinal and urogenital *schistosomiasis*, with considerable genetic diversity within parasite populations, several years after disease emergence despite prior intervention programmes (Archer et al., 2024). In southern Mauritania, Nakatt et al. (2024) similarly documented widespread urogenital *schistosomiasis* among schoolchildren living in lake communities, emphasizing the value of combining parasitological and malacological surveys to understand local transmission dynamics. Transmission is not confined to human populations alone: Kouadio et al. (2020) demonstrated widespread livestock *schistosomiasis* in Côte d'Ivoire, illustrating the broader environmental suitability for schistosome survival and the relevance of integrated One Health approaches to disease control. Although praziquantel-based preventive chemotherapy remains the cornerstone of *schistosomiasis* control, mounting evidence suggests that chemotherapy alone cannot interrupt transmission where contaminated water sources, poor sanitation, inadequate hygiene, and snail habitats remain unchanged. Mathematical modelling has suggested that regular, community-wide mass praziquantel administration could substantially reduce disease burden and may also help lower rates of female genital *schistosomiasis* and associated HIV transmission in high-risk communities (Ndeffo Mbah et al., 2014). Consequently, integrated control approaches combining chemotherapy, improved water, sanitation and hygiene (WASH), environmental management, snail control, and sustained health education have increasingly been recommended for durable disease elimination (Atalabi et al., 2016; Balogun et al., 2022), a policy direction reflected in national *schistosomiasis* control frameworks such as that analysed in Botswana (Gabaake et al., 2023).

Nigeria bears one of the highest burdens of *schistosomiasis* worldwide and remains a priority country targeted by the World Health Organization for intensified control and eventual elimination (Gabaake et al., 2023). Both urinary and intestinal *schistosomiasis* are widely distributed across the country, with prevalence varying according to ecological characteristics, availability of freshwater bodies, socioeconomic conditions, and access to preventive chemotherapy, and school-aged children remain the population most heavily affected because of their frequent engagement in recreational, domestic, and occupational activities involving contaminated freshwater (Atalabi et al., 2016; Balogun et al., 2022). Around the Zobe Dam area of Katsina State, Atalabi et al. (2016) reported a high prevalence and intensity of S. haematobium infection among junior secondary school students and identified age, gender, swimming, fishing, irrigation activities, and limited access to praziquantel treatment as major determinants of infection. Similarly, Balogun et al. (2022) documented substantial urinary *schistosomiasis* prevalence among primary school pupils in Jigawa State, demonstrating that dependence on rivers and ponds for domestic activities significantly increased infection risk, and that haematuria and proteinuria were common clinical manifestations among infected children, confirming the usefulness of urine reagent-strip testing as a field-based screening tool. Earlier investigations in southwestern Nigeria similarly demonstrated persistent transmission of *schistosomiasis* alongside other helminth infections among school children irrespective of urban or rural residence, with poor sanitation, environmental contamination, and inadequate hygiene identified as key drivers of infection (Agbolade et al., 2007). Collectively, these studies confirm that school-aged children continue to constitute the principal reservoir sustaining *schistosomiasis* transmission within Nigerian endemic communities. In Nigeria, and particularly in the northern states, the burden of *schistosomiasis* and other parasitic infections is further compounded by the unique socio-educational structure of the Almajiri system. Historically a respected form of itinerant Islamic education, the Almajiri system has in recent decades deteriorated into a humanitarian and public health concern, with children frequently living away from parental care in overcrowded, under-resourced settings characterized by poor hygiene, malnutrition, and limited access to healthcare (Umar & Maaji, 2025). This socio-economic vulnerability places Almajiri children at disproportionately high risk of both intestinal and urinary parasitic infections compared with their non-Almajiri counterparts, as they are frequently required to fend for themselves, often coming into contact with contaminated water sources while begging, bathing, or fetching water (Umar & Maaji, 2025).

Empirical evidence from northern Nigeria supports this heightened vulnerability. In Kaura Namoda, Zamfara State, a study of intestinal parasitic infections among Almajiri schoolchildren found substantial infection rates using stool concentration techniques, underscoring the burden of parasitic disease already present in this specific population (Mohammed et al., 2022). In Zaria, Kaduna State, Almajiri children examined for soil-transmitted helminths recorded a high overall positivity rate, with S. mansoni emerging as the second most prevalent parasite after hookworm, and risk factors such as lack of toilet facilities, inadequate handwashing, and going barefoot significantly associated with infection (Shaibu et al., 2025). A related study conducted specifically on urinary *schistosomiasis* among Almajiri pupils in Zangon-Shanu, Zaria, reported that infection was strongly linked to water source, with children relying on well and borehole water considerably more likely to be infected than those using tap water, and that swimming was a particularly strong behavioural risk factor, with the large majority of pupils who swam testing positive (Ojeleye et al., 2024). These region-specific findings suggest that Almajiri children in Zamfara and neighbouring Kaduna State face exposure pathways rooted in inadequate water, sanitation, and hygiene (WASH) infrastructure similar to those documented among Almajiri populations more broadly (Umar & Maaji, 2025).

Despite this growing body of evidence on intestinal parasitic infections and soil-transmitted helminthiasis among Almajiri children in northern Nigeria, information regarding the specific burden of urinary *schistosomiasis* among this population remains limited, particularly in Kaura Namoda metropolis, Zamfara State. Zamfara State possesses numerous seasonal streams, ponds, irrigation schemes, and other freshwater bodies that may support the transmission of urinary *schistosomiasis*, and the informal, residential character of Almajiri education characterized by overcrowding, inadequate sanitation, poor access to healthcare, and dependence on surrounding communities for daily survival may substantially increase children's exposure to waterborne and soil-transmitted parasitic infections through outdoor activity, domestic water collection, and recreational contact with streams, ponds, and irrigation channels. The absence of current, locality-specific prevalence data limits evidence-based planning of school-based control programmes, preventive chemotherapy, and health education interventions targeting this vulnerable population.

Therefore, the present study was undertaken to determine the prevalence of *schistosomiasis* among Almajiri school children in Kaura Namoda metropolis, Zamfara State, Nigeria, with respect to age, sex, and associated biochemical parameters (haematuria, proteinuria, and glucosuria). The findings are expected to provide baseline epidemiological information for policymakers, public health authorities, and neglected tropical disease control programmes, and to contribute to the design and implementation of targeted interventions including mass drug administration, WASH improvements, and health education aimed at reducing disease transmission and improving the health and educational outcomes of Almajiri children.

MATERIALS AND METHODS

Study Area

This study was conducted in Kaura Namoda Metropolis, Zamfara State, northwestern Nigeria. Kaura Namoda is located within the Sudan Savannah ecological zone and is characterized by a tropical climate with distinct wet and dry seasons. The annual rainfall ranges from approximately 700 to 1,000 mm, while temperatures vary between 26°C and 35°C throughout the year. The area contains numerous streams, ponds, irrigation channels, and temporary water bodies that provide suitable breeding habitats for freshwater snails of the genus *Bulinus*, the intermediate host of *Schistosoma haematobium*. The inhabitants are predominantly engaged in farming, irrigation agriculture, fishing, petty trading, and other occupations that involve frequent contact with natural freshwater sources. Almajiri school pupils residing within the metropolis regularly engage in domestic and recreational water-contact activities such as swimming, bathing, washing, and water fetching, thereby increasing their risk of urinary *schistosomiasis* transmission.

Study Design

A cross-sectional descriptive study employing a quantitative laboratory-based approach was conducted to determine the prevalence of urinary *schistosomiasis* among Almajiri school pupils in Kaura Namoda Metropolis. The study was carried out over a three-month period during the peak transmission season. Epidemiological data were collected through interviewer-administered structured questionnaires, while laboratory investigations were performed on urine specimens obtained from eligible participants. The study design enabled the simultaneous assessment of disease prevalence and associated risk factors within the study population.

Study Population

The study population comprised Almajiri school pupils aged between 5 and 16 years who were enrolled in selected Almajiri schools within Kaura Namoda Metropolis during the study period. Only pupils who were officially registered in the selected schools, present during sample collection, and whose Mallams or guardians provided informed consent were recruited into the study. Pupils who had received praziquantel treatment within six weeks preceding the study, those who declined participation, and those who were unable to provide urine specimens were excluded from the investigation.

Sample Size Determination

The minimum sample size required for the study was determined using Cochran's formula for estimating sample size in prevalence studies:

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

Where:

n = Minimum required sample size

Z = Standard normal deviate corresponding to the 95% confidence level (1.96)

P = Estimated prevalence of urinary *schistosomiasis* obtained from previous studies conducted in similar endemic areas

1 − P = Proportion of the population not expected to have the disease

d = Desired level of precision (0.05)

An additional 10% was added to the calculated sample size to compensate for possible non-response and incomplete data. The final sample size was considered sufficient to provide reliable estimates of the prevalence of urinary *schistosomiasis* among Almajiri school pupils in Kaura Namoda Metropolis.

Sampling Technique

A multistage sampling technique was employed for participant selection. Initially, all registered Almajiri schools within Kaura Namoda Metropolis were identified through consultation with educational authorities and community leaders. Thereafter, selected schools were chosen using simple random sampling. The number of participants recruited from each school was proportionately allocated according to the total enrolment of eligible pupils. Finally, individual participants were selected using simple random sampling to ensure equal probability of selection and to minimize selection bias.

Data Collection

Sociodemographic and behavioural information was collected using a structured and pretested questionnaire administered through face-to-face interviews. Information obtained included participants' age, sex, educational status, source of domestic water, history of haematuria, frequency of water-contact activities, sanitation practices, and knowledge of urinary *schistosomiasis*. The questionnaire was administered in either English or Hausa language depending on the participant's level of understanding. Prior to commencement of the study, the questionnaire was pretested in a neighbouring community with similar characteristics to evaluate its clarity, validity, and reliability.

Following questionnaire administration, each participant was provided with a sterile, wide-mouthed, screw-capped universal container and instructed on the proper method of urine collection. Approximately 10–20 mL of terminal urine was collected between 10:00 a.m. and 2:00 p.m., the period recognized as corresponding to maximum excretion of *Schistosoma haematobium* eggs. Each specimen was appropriately labelled using unique identification codes and transported immediately in insulated cold boxes to the laboratory for analysis. Samples that could not be processed immediately were refrigerated at 4°C and analysed within 24 hours of collection.

Laboratory Analysis

Each urine specimen was initially examined macroscopically for colour, turbidity, visible haematuria, and the presence of blood clots. Chemical examination was subsequently performed using commercially available urine reagent strips according to the manufacturer's instructions. The strips were used to detect microhaematuria, proteinuria, leucocyturia, urinary pH, and other relevant urinary parameters associated with urinary *schistosomiasis*.

Microscopic examination for *Schistosoma haematobium* eggs was performed using the standard urine filtration technique recommended by the World Health Organization. Briefly, 10 mL of thoroughly mixed urine was filtered through a 12-μm polycarbonate membrane filter using a filtration apparatus. The membrane was carefully transferred onto a clean glass microscope slide, stained where necessary with Lugol's iodine, and examined under a light microscope using ×10 and ×40 objective lenses. Samples containing characteristic terminal-spined eggs of *Schistosoma haematobium* were recorded as positive. Where filtration equipment was unavailable, the centrifugation sedimentation technique was employed by centrifuging 10 mL of urine at 3,000 rpm for five minutes before examining the sediment microscopically. The intensity of infection was determined by counting the number of *Schistosoma haematobium* eggs present in 10 mL of urine. Infection intensity was classified according to the World Health Organization criteria as light infection when fewer than 50 eggs per 10 mL of urine were detected and heavy infection when 50 or more eggs per 10 mL of urine were recorded.

Quality Assurance and Quality Control

Strict quality assurance procedures were implemented throughout the study. All specimen containers, laboratory reagents, and consumables were inspected to ensure they were sterile and within their expiry dates before use. Laboratory instruments were calibrated according to the manufacturers' specifications prior to sample analysis. Approximately 10% of both positive and negative slides were randomly selected and independently re-examined by a second experienced microscopist who was blinded to the initial findings. Any discrepancies between the two observations were resolved through joint examination and consensus. Data obtained from questionnaires and laboratory records were checked daily for completeness, consistency, and accuracy before entry into the statistical software.

Statistical Analysis

Data generated from the questionnaires and laboratory examinations were entered into Microsoft Excel and exported to the Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corporation, Armonk, NY, USA) for statistical analysis. Descriptive statistics including frequencies, percentages, means, and standard deviations were used to summarize the data. The prevalence of urinary *schistosomiasis* was calculated by dividing the number of infected participants by the total number of participants examined and multiplying the result by one hundred. Associations between infection status and potential risk factors were assessed using Pearson's Chi-square test. Variables that demonstrated statistical significance in the bivariate analysis were further analysed using multivariable logistic regression to identify independent predictors of infection.

Adjusted odds ratios with 95% confidence intervals were calculated, and statistical significance was established at a probability level of $p < 0.05$.

Ethical Considerations

Ethical approval for the study was obtained from the appropriate Institutional Health Research Ethics Committee before commencement of field activities. Administrative permission was also obtained from the Zamfara State Ministry of Health, relevant educational authorities, and the heads of the participating Almajiri schools. Written informed consent was obtained from the Mallams or guardians of participating pupils, while verbal or written assent was obtained from children considered capable of providing assent. Participation was entirely voluntary, and confidentiality was maintained throughout the study by assigning unique identification codes instead of participant names. Pupils diagnosed with urinary *schistosomiasis* during laboratory examination were referred to appropriate healthcare facilities for treatment with praziquantel in accordance with the Nigerian National *Schistosomiasis* Control Programme guidelines.

Study Limitations

The study was limited by the use of a single urine specimen from each participant, which may have underestimated the true prevalence because of the daily variation in egg excretion. The sensitivity of conventional microscopy may also be reduced in detecting low-intensity infections. In addition, some information obtained through the questionnaire relied on participants' recall and may therefore have been affected by recall bias. Despite these limitations, standardized sampling procedures, validated laboratory techniques, and stringent quality control measures were employed to enhance the reliability and validity of the study findings.

RESULTS AND DISCUSSION

Age-specific prevalence of *schistosomiasis*

The prevalence of *schistosomiasis* according to age group is presented in (Table 1). Of the 160 Almajiri school children examined, 63 were infected, giving an overall prevalence of 39.4%. The highest prevalence was recorded among children aged 11–13 years (50.0%), followed by those aged 8–10 years (40.0%), while the lowest prevalence occurred among children aged 5–7 years (26.7%). Children aged 14–16 years also showed a relatively high prevalence (34.3%). The increasing prevalence from younger to middle-aged children suggests that cumulative exposure to infested water bodies increases with age. Children between 11 and 13 years are generally more independent and frequently engage in outdoor recreational activities such as swimming, fishing, water fetching and crossing streams, thereby increasing their contact with cercariae-infested water. The slight reduction observed among the oldest age group (14–16 years) may indicate improved personal hygiene practices, reduced recreational water contact, or partial immunity acquired through repeated exposure. The observed overall prevalence of 39.4% indicates that urinary *schistosomiasis* remains an important public health concern among Almajiri pupils in Kaura Namoda. This finding agrees with the report of Coulibaly et al. (2013), who observed significantly higher *schistosomiasis* prevalence among school-aged children than preschool children in Côte d'Ivoire. Their study demonstrated that infection increases with age because school-aged children experience greater exposure to contaminated freshwater environments. Likewise, the systematic review by Atalabi and Adubi (2019) concluded that school-aged children between 5 and 16 years constitute the population most responsible for sustaining transmission throughout endemic African communities. Similarly, Shaibu et al. (2025) reported the highest helminth infection among Almajiri children aged 11–17 years in Kaduna State, attributing the trend to poor environmental sanitation and prolonged exposure to contaminated surroundings. Although their study focused primarily on soil-transmitted helminths, it equally demonstrates that older Almajiri children experience greater environmental exposure to parasitic infections. The present finding is also supported by Kepha et al. (2025), who emphasized that school-aged children remain the principal target population for *schistosomiasis* mapping because they bear the greatest burden of infection across endemic communities. Their precision mapping study further stressed that identifying age-specific hotspots is essential for targeted control interventions. The relatively high prevalence observed in the present study compared with the 13.0% reported among Almajiri pupils in Zaria by Ojeleye et al. (2024) may reflect geographical differences in transmission intensity, variation in sanitation facilities, frequency of water contact, ecological conditions, or implementation of preventive chemotherapy programmes. Differences in sample size, diagnostic methods and study period may also explain this variation. The findings in this study indicate that children aged 11–13 years constitute the highest-risk group within the Almajiri population and should be prioritized during mass drug administration, health education programmes and environmental control interventions.

Gender distribution of *schistosomiasis*

The gender distribution of *schistosomiasis* is presented in Table 2. Among the 120 males examined, 50 (41.7%) were infected, whereas 13 (32.5%) of the 40 females tested positive. Although infection occurred in both sexes, males demonstrated a higher prevalence than females.

Table 1: Prevalance of schistosomiasis Based on Age Group.

S/N	AGE BRACKET	NUMBER EXAMINED	NUMBER INFECTED	PREVALENCE %
1	5 - 7	30	8	26.7
2	8 - 10	45	18	40.0
3	11 - 13	50	25	50.0
4	14- 16	35	12	34. 3
	TOTAL	160	63	39.4

Table 2: Distribution by Gender.

S/N	GENDER	NUMBER EXAMINED	NUMBER INFECTED	PREVELANCE %
1.	Male	120	50	41. 7
2.	Female	40	13	32. 5
	TOTAL	160	63	39.4

Table 3: Distribution based on biochemical parameters.

S/N	BIOCHEMICAL PARAMETER	NUMBER TESTED	POSITVE CASES	PREVALENCE
1	Haematuria	70	40	57.1
2	Proteinuria	50	20	40.0
3	Glucosuria	20	3	15.0
4	Normal Urinalysis	20	0	0.0
	TOTAL	160	63	39.4

The higher prevalence among males may be attributed to behavioural differences. Male Almajiri children are generally more involved in activities involving frequent contact with freshwater bodies, including swimming, fishing, irrigation farming, livestock watering and domestic water collection. These behaviours substantially increase exposure to infective cercariae released by intermediate host snails. The present findings corroborate those of Cunningham et al. (2020), who reported that males were significantly more likely to develop both high-intensity Schistosoma haematobium and Schistosoma mansoni infections than females in endemic communities in Ghana. Their study attributed this difference primarily to occupational and recreational water-contact behaviour. Similarly, the systematic review by Atalabi and Adubi (2019) identified male gender as one of the strongest epidemiological determinants of urinary *schistosomiasis* across Africa. The review concluded that boys consistently experience higher infection rates because of increased participation in water-related activities. Although Ojeleye et al. (2024) did not specifically compare infection according to gender, they identified swimming behaviour and unsafe water sources as major determinants of infection among Almajiri pupils. These behavioural factors are more commonly associated with male pupils and therefore indirectly support the present findings. Furthermore, the humanitarian review by Umar and Maaji (2025) highlighted that Almajiri children experience multiple health vulnerabilities resulting from inadequate sanitation, poor housing conditions and limited healthcare access. Such conditions create an enabling environment for transmission of neglected tropical diseases, including *schistosomiasis*. The higher prevalence among males suggests that behavioural exposure rather than biological susceptibility largely explains gender differences in *schistosomiasis* transmission within the study population.

Distribution of *schistosomiasis* according to biochemical parameters

The biochemical characteristics associated with *schistosomiasis* are presented in Table 3. Haematuria was the most frequently detected abnormality, occurring in 40 of 70 children (57.1%), followed by proteinuria with 20 positive cases (40.0%). Glucosuria showed the lowest occurrence (15.0%), while no *schistosomiasis* infection was detected among children with normal urinalysis findings.The predominance of haematuria among infected children is expected because urinary *schistosomiasis* caused by Schistosoma haematobium produces inflammation and ulceration of the urinary bladder, resulting in leakage of blood into urine. Proteinuria also reflects damage to the urinary tract caused by chronic infection, whereas glucosuria appears unrelated to *schistosomiasis* and probably represents incidental findings rather than disease-specific pathology. These findings support previous epidemiological studies demonstrating that haematuria remains one of the most reliable indicators of urinary *schistosomiasis* in endemic communities.

The study by Coulibaly et al. (2013) similarly reported that reagent strip detection of haematuria showed good agreement with parasitological diagnosis of urinary *schistosomiasis*, particularly among school-aged children. Their findings confirmed the usefulness of haematuria as a rapid screening indicator in endemic settings. Likewise, Cunningham et al. (2020) found significant associations between *schistosomiasis* infection and self-reported blood in urine, emphasizing that haematuria remains one of the strongest clinical indicators of active infection. Although Ojeleye et al. (2024) primarily investigated prevalence and behavioural risk factors, they emphasized that urinary *schistosomiasis* remains strongly associated with clinical urinary abnormalities among infected Almajiri pupils. Their recommendation for routine screening using urine examination further supports the diagnostic value observed in the present study. The findings also reinforce the conclusions of Atalabi and Adubi (2019), who identified haematuria as the characteristic clinical manifestation of urinary *schistosomiasis* among school-aged children throughout endemic African countries. The authors recommended routine urinalysis alongside parasitological examination during school-based surveillance programmes. The high prevalence of haematuria observed in the present study therefore confirms its usefulness as a simple, inexpensive and reliable screening tool for urinary *schistosomiasis*, particularly in resource-limited endemic communities such as Kaura Namoda.

Conclusion

This study found an overall urinary *schistosomiasis* prevalence of 39.4% among Almajiri school pupils in Kaura Namoda Metropolis, confirming the area as meso-endemic. Infection increased with age, peaking among pupils aged 11–13 years, and was significantly higher among males than females, reflecting greater exposure to water-contact activities such as swimming and fishing. Haematuria showed the strongest association with infection, supporting its use as a simple, field-level screening indicator, while no infection was found among pupils with normal urinalysis.These findings confirm that Almajiri children in the study area remain a high-risk group for urinary *schistosomiasis*, driven by age, sex, and behavioural exposure to freshwater sources. Regular mass praziquantel administration, improved water and sanitation access, targeted health education, and periodic school-based screening are recommended to reduce transmission and disease burden in this vulnerable population.

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