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MOLECULAR DETECTION OF *SCHISTOSOMA HAEMATOBIUM* INFECTION IN ISOKO SOUTH, DELTA STATE, NIGERIA

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ABSTRACT
Schistosomiasis is a neglected tropical disease caused by parasitic worms, posing significant public health challenges in Nigeria. This study investigated the molecular detection of Schistosoma haematobium infection in Isoko South, Delta State, among patients presenting with symptoms suggestive of schistosomiasis. A cross-sectional survey was conducted at Egbo-Igbide Health Center, Igbide; General Hospital, Oleh; Irri Primary Health Center; General Hospital, Aviara; and Umeh Primary Health Center. A total of 120 participants were recruited. Sociodemographic data and information on knowledge, attitude, and practices were collected using a structured questionnaire. Urine samples (≈10 ml each) were collected and analyzed using conventional PCR and end-point PCR (EP-PCR) techniques. Agarose gel electrophoresis was used to confirm the presence of *S. hematobium* which resulted at 480bp. Statistical analysis were performed using IBM SPSS software version 26.0 with significance set at $p<0.05$ at a 95% confidence level. Participants aged 40 years and above formed the majority (55.9%). Igbide had the highest number of positive cases, with 17 of 24 individuals (14.2%). Among males, 22 of 60 (18.3%) tested positive, while 17 of 60 females (14.2%) were infected. Significant associations were observed between knowledge level and infection status ($p = 0.045$) and between attitude toward schistosomiasis prevention and infection prevalence ($p = 0.038$). The study confirms the effectiveness of molecular methods in detecting *S. haematobium* and emphasizes the need for integrated, community-based control programs that consider local socio-demographic factors and endemicity patterns.

KEYWORDS: Schistosomiasis, *Schistosoma hematobium,* molecular detection, PCR, Urinary schistosomiasis, Delta State

INTRODUCTION

Schistosomes are parasitic flatworms that cause schistosomiasis, which is sometimes referred to as snail sickness, bilharzia, and Katayama fever.[1] There could be an infection in the intestines or urinary tract. Diarrhoea, bloody stools, blood in the urine, and abdominal pain are some of the symptoms. Chronic infections can lead to bladder cancer, infertility, liver damage, and renal failure. Children may experience learning challenges and limited growth as a result.[2] The illness is conveyed through contact with fresh water contaminated by the parasites. These parasites are spread across the ecosystem by infected freshwater snails alongside other parasites of zoonotic origin.[3] Children in developing countries are particularly vulnerable to the illness because they are more likely to play in contaminated water.[4] Schistosomiasis is also common in women, who may be more vulnerable because of regular water-related activities like fetching water and doing washing. Other high-risk populations include farmers, fisherman, and people who utilize contaminated water daily. It belongs to the group of helminth infections. A diagnosis can be made if parasite eggs are found in a person's stools or urine. To confirm the sickness, antibodies against it can also be detected in the blood.[5]

Schistosome eggs are expelled by humans through their faeces or urine. After hatching, some snails become infected with miracidia and produce cercariae. Schistosome cercariae can penetrate human skin during both household and leisure activities, such as bathing, swimming in unprotected open freshwater bodies, or cleaning clothes or dishes.[6] Some of the factors that have been shown to contribute to the spread of schistosomiasis in Africa include living close to freshwater bodies (such as rivers, small dams, irrigation systems, and lakes), socioeconomic factors that impact occupational activities (such as impoverished people without running water at home are likely to come into contact with freshwater bodies), and climate change. Open urine and faeces are a result of poor sanitation, contaminating the environment and accelerating the spread of schistosomiasis.[7]

In order to identify schistosomiasis infections and produce data that impact decisions about individual and community treatment, prognosis and morbidity assessment, chemotherapeutic evaluation, and other control measures, diagnosis is essential.[8] Nevertheless, some of the diagnostic methods have drawbacks. The majority of epidemiological assessments of the burden of schistosomiasis have relied on microscopy,[9] despite the fact that it is laborious and time-consuming. In many countries where schistosomiasis is endemic, microscopy is a relatively simple and affordable method for identifying and estimating the intensity of schistosome eggs in faecal and urine samples. However, it is widely known that there is insufficient sensitivity due to significant variations in egg production in urine or faeces, and the challenges of fulfilling the repeated sampling required for traditional parasitological diagnosis frequently result in less than ideal outcomes.[10]

Though antibody-based assays are sensitive, they are unable to differentiate between an ongoing infection and a history of exposure; they also exhibit cross-reaction with other helminths and are difficult to use in field settings.[11] However, circulating cathodic antigen detection in urine has been proved to be a useful, field-applicable technique for identifying *Schistosoma mansoni* infections, the test is less sensitive for infections with *Schistosoma haematobium*.[12] A wide variety of parasites have been detected using polymerase chain reaction (PCR)-based techniques, which have demonstrated great sensitivity and specificity for the detection of parasitic DNA. Their application in human epidemiological surveys has been restricted up to this point, with more research examining the possibilities of schistosome-specific PCR concentrating more on the snail vector than its definitive host. DNA amplification is now a viable substitute for microscopy-based diagnostic techniques due to recent advancements in the simplicity of DNA isolation processes and PCR technology, particularly real-time PCR.[13] The objective of this study was to molecularly detect Schistosoma haematobium infection among symptomatic patients in Isoko South, Delta State, Nigeria, and to assess its association with sociodemographic factors, knowledge, and preventive attitudes.

MATERIALS AND METHODS

Study area and duration

The sample used in this study was obtained from residents of the Isoko South area of Delta State, Nigeria. Isoko South Local Government Area is one of the administrative divisions of Delta State, Nigeria, with its headquarters located in Oleh (Figure 1). Geographically, the area lies approximately between latitudes 5°30′–5°45′ N and longitudes 6°10′–6°30′ E. It is situated within the tropical rainforest belt of the Niger Delta region and is characterized by a warm, humid climate with distinct rainy and dry seasons that support rich vegetation and diverse aquatic and terrestrial ecosystems. Isoko South is predominantly inhabited by the Isoko people, whose major occupations include farming, fishing, trading, and small-scale artisanal activities.[6] The study was conducted over a period of five (5) months, from January to May 2025.

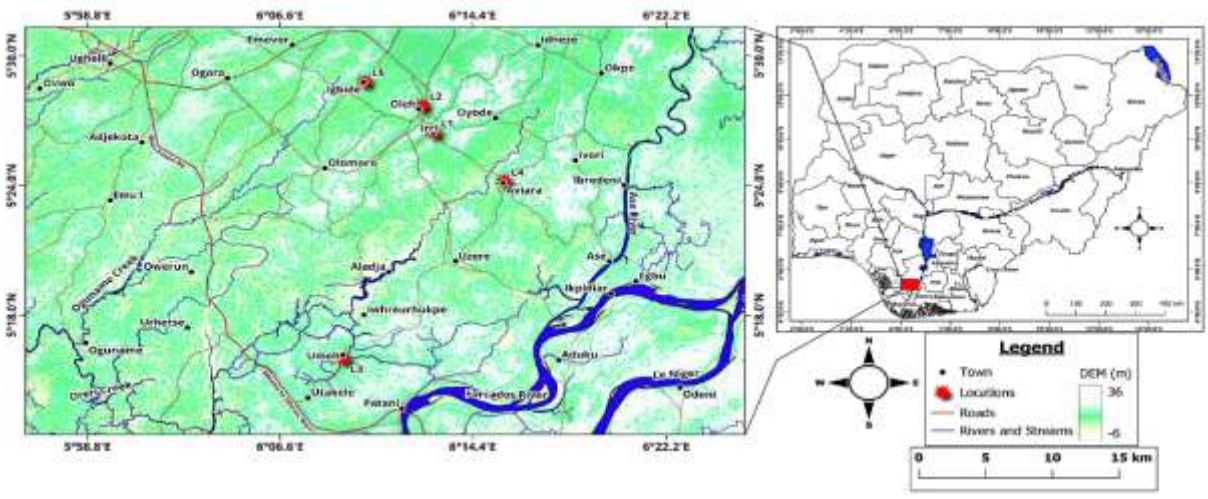

Figure 1: Map of Study

Source: Designed using QGIS

Study design

This study employed a descriptive, hospital-based survey methodology, utilizing a structured questionnaire as the primary data collection instrument.[14] The research was carried out at Egbo-Igbide Health Center, Igbide, General Hospital, Oleh, Irri Primary Health Center, General Hospital, Aviara, Umeh Primary Health Center, in Isoko South L.G.A., Delta State. Samples were collected from volunteers residing in the study area to ensure a representative dataset. The collected data were then analyzed using various quantitative techniques to derive meaningful insights. Additionally, a total of one hundred and twenty (120) urine samples were obtained from participants and

systematically screened for the presence of *Schistosoma haematobium* to assess the prevalence of infection within the study population. The sample size was determined using standard formula for prevalence studies.[15]

$n = Z^2P(1 - P) / d^2$

where:

n = required sample size

Z = standard normal deviation at 95% confidence level (1.96)

P = estimated prevalence (0.32)

d = margin of error (0.085)

Substituting into the formula:

$n = (1.96)^2 \times 0.32 \times (1 - 0.32) / (0.085)^2$

$n = 3.8416 \times 0.32 \times 0.68 / 0.007225$

$n = 3.8416 \times 0.2176 / 0.007225$

$n = 0.836 / 0.007225$

$n = 115.7$

The calculated sample size was approximately 116 participants. This value was rounded up to 120 to improve statistical robustness and account for possible sample loss or non-response.

Ethical approval

Ethical approval was gotten from the Faculty of Science ethical committee, Delta State University, Abraka, with reference number REC/FOS/2025/7, and the Delta State Ministry of Health, Asaba. Prior to sample collection, the enrolled patients' informed consent was obtained. The interested participants were informed of the study's purpose in a language that they could understand. Before the sample was collected, the patient's relative or any other person designated by the participant gave their agreement if the interested participant was unable to speak for themselves owing to a speech or hearing impairment. Assent was obtained for participants under 18 years old.

Collection and Analysis of Urine Samples

Each participant was provided with a structured questionnaire after giving informed consent. Approximately 10 mL of urine was collected from each participant between 10:00 am and 2:00 pm, coinciding with the peak period of *Schistosoma haematobium* egg excretion. Samples were collected in sterile, properly labelled universal containers, and strict confidentiality was maintained throughout the study. Urine samples collected were immediately stored in a cool box maintained at approximately 4°C and transported to the Scientific Laboratory Technology Mini-Laboratory at Delta State University, Abraka, within 4–6 hours of collection to preserve molecular integrity. Upon arrival, samples were either processed immediately or stored at −20°C prior to further molecular analysis.[16]

For parasitological examination, the sedimentation technique was employed. About 10 mL of each urine sample was transferred into a centrifuge tube and centrifuged at 3000 rpm for 5 minutes. The supernatant was carefully decanted, leaving the sediment, which was resuspended and examined microscopically. A drop of the sediment was placed on a clean glass slide, covered with a coverslip, and observed under a light microscope using a low-power objective. The presence of characteristic oval-shaped eggs with terminal spines confirmed *Schistosoma haematobium* infection.[6,9]

For molecular detection, DNA extraction was performed from the concentrated urine sediment rather than whole urine to increase sensitivity[7]. The extracted DNA was then subjected to polymerase chain reaction (PCR) amplification using species-specific primers targeting *Schistosoma haematobium* DNA sequences.[7,9,17]

Statistical Analysis

Statistical analysis was performed using IBM SPSS software version 26.0 to evaluate the molecular detection results of *Schistosoma haematobium* infection among the participants. Descriptive statistics such as frequencies and percentages were used to summarize the data. The association between infection status and sociodemographic variables (such as age, sex, knowledge, attitude, and practice scores) was assessed using the Chi-square (χ^2) test. In cases where expected cell counts were less than five, Fisher's exact test was applied as appropriate. All statistical tests were conducted at a 95% confidence level, and a p-value of less than 0.05 ($p < 0.05$) was considered statistically significant.

RESULTS

The survey results indicate that the majority of participants are aged between 40 and above (55.9%), followed by those aged 29 - 39 (25.8%) and the smallest group being those aged 18-28 years (18.3%). In terms of gender distribution, the sample comprises an equal distribution of males and females (50% each) (Table 1).

Among the 120 urine samples analyzed, Igbide recorded the highest number of positive cases with 17 out of 24 individuals (14.2%), followed by Irri with 12 cases (10%), and Oleh with 5 cases (4.2%). Umeh recorded only 2 cases (1.6%), while Aviara had no detected infections (0%). Overall, the total prevalence of infection among the

sampled population was 30%, indicating a notable presence of urinary schistosomiasis in the study area, with considerable variation among the communities (Table 2).

Out of the 60 male participants, 22 tested positive, representing an 18.3% infection rate, while 17 out of 60 female participants were infected, accounting for 14.2%. This brings the overall prevalence to 32.5% among the 120 individuals sampled (Table 3).

Among the 91 participants with low knowledge scores (0–2 correct answers), 31 individuals (34.1%) were infected, whereas only 7 out of 29 participants (24.1%) with high knowledge scores (3–5 correct answers) tested positive. The p-value of 0.045 indicates a statistically significant association between knowledge level and infection status, suggesting that lower knowledge about schistosomiasis may be linked to a higher risk of infection (Table 4).

Of the 48 participants with low attitude scores (0–2 correct answers), 22 (45.8%) were infected, compared to 17 infections (23.6%) among the 72 participants with high attitude scores (3–5 correct answers). The p-value of 0.038 indicates a statistically significant association, implying that a poorer attitude toward schistosomiasis prevention may be linked to a higher prevalence of infection (Table 5).

Among the 41 participants with low practice scores (0–2 correct answers), 33 (33.7%) were infected, while only 5 (22.2%) out of 22 participants with high practice scores (3–5 correct answers) were infected. The p-value of 0.421 indicates that the difference in infection rates between the two groups is not statistically significant (Table 6).

Molecular analysis revealed successful molecular detection of *Schistosoma haematobium* in microscopy-positive urine samples (Figure 2 and 3).

Table 1: Sociodemographic Characteristics of Participants

Variables	**Categories**	**Number Of Participants n=50 (%)**
Age (Years)	18-28	22 (18.3%)
	29-39	31 (25.8%)
	40 and above	67 (55.9%)
Gender	Males	60 (50.0%)
	Females	60 (50%)

p-value less than 0.05 is typically considered statistically significant

Table 2: Prevalence of *Schistosoma haematobium* infection in various communities in Isoko South.

Communities	**No. of samples**	**No. of positive (%)**
Igbide	24	17 (14.2%)
Oleh	24	5 (4.2%)
Irri	24	12 (10.0%)
Aviara	24	0 (0.0%)
Umeh	24	2 (1.6%)
Total	120	6 (30.0%)

Table 3 Prevalence of *Schistosoma haematobium* in relation to sex of respondents at various communities in Isoko South

Sex	**No. of samples**	**No. of positive (%)**
Males	25	22 (18.3%)
Females	25	17 (14.2%)
Total	120	39 (32.5%)

Table 4: Association between knowledge level and *Schistosomiasis Infection*

Knowledge level category	**No. of participants**	**No. of infected (%)**	**p-value**
Low (0-2 correct answers)	91	31 (34.1%)	
High (3-5 correct answers)	29	7 (24.1%)	0.045*

p-value < 0.05 indicates a significant relationship between the variables being compared

Table 5: Association between Attitude score and *Schistosomiasis Infection*

Attitude score category	**No. of participants**	**No. of infected (%)**	**p-value**
Low (0-2 correct answers)	48	22 (45.8%)	
High (3-5 correct answers)	72	17 (23.6%)	0.038*

p-value < 0.05 indicates a significant relationship between the variables being compared.

Table 6: Association between practice score and *Schistosomiasis Infection*

Practice score category	No. of participants	No. of infected (%)	p-value
Low (0-2 correct answers)	98	33 (33.7%)	
High (3-5 correct answers)	22	5 (22.2%)	0.421

p-value < 0.05 indicates a significant relationship between the variables being compared

Figure 2: Schistosoma haematobium egg observed under 40× objective magnification

Figure 3: Gel electrophoresis image of microscopy-positive samples showing PCR amplification of S. haematobium DNA at 480 bp

MW indicates the 100 bp DNA ladder; lanes a–e represent amplified DNA bands of S. haematobium samples.

DISCUSSION

The sociodemographic data revealed that older adults (≥40 years) formed the majority of the study participants, and males and females were equally represented. The higher participation of older adults may reflect their dominant presence in household-level water-related activities in rural communities. Adults in such age groups often continue to engage in agricultural and domestic water-contact activities such as fishing, washing, or irrigation—common in water-endemic zones like the Niger Delta. It was previously reported that community-level water dependence remains high in Delta State, with persistent misconceptions about schistosomiasis transmission across all age groups.[18] This underscores the need for broad-based educational campaigns that target all age brackets, not just school-aged children.

The 30% overall prevalence of *Schistosoma haematobium* found in the five communities, with the highest cases in Igbide and Irri, is consistent with earlier research that identified these locations as endemic foci. Ito reported hyper-endemic levels in Igbide (52.7%) and Aviara (61.1%) among school children, indicating that transmission persists despite public health interventions[12]. Although Aviara showed no infection in the current sample, the small sample size may not reflect community-level endemicity. Ekwunife *et al* also found similar patterns in Delta State, with some villages recording nearly 50% prevalence.[19] These variations may be tied to local water use behaviors and access to improved sanitation, further stressing the need for localized interventions as previously buttressed.[6]

Gender-related findings showed a slightly higher infection rate in males (18.3%) than females (14.2%), though not markedly different. This pattern aligns with the often-documented greater exposure of males to high-risk water bodies due to occupational roles such as fishing or swimming. A comparable observation was made by Ekpo *et al* who noted that Nigerian boys frequently have more prolonged freshwater exposure, increasing infection risk.[20] However, the marginal sex difference here suggests that in these communities, both genders may be similarly engaged in risky water-contact activities, a finding also highlighted in Onyeneho *et al* where both men and women in Delta State exhibited high river-contact rates.[18]

Knowledge level was significantly associated with infection status, with lower knowledge correlating with higher infection rates (34.1% vs. 24.1%, $p = 0.045$). This emphasizes the protective role of awareness in schistosomiasis control. As shown by Onyeneho *et al*, gaps in knowledge and misconceptions in Delta communities contribute to ongoing transmission, even in areas exposed to control campaigns.[18] Similarly, Ude *et al* found a direct association between poor knowledge and higher infection rates among schoolchildren, reinforcing the importance of incorporating culturally relevant health education into endemic-area interventions.[21] Attitude scores were also significantly associated with infection, with those holding less favorable attitudes toward prevention being more likely to be infected (45.8% vs. 23.6%, $p = 0.038$). This mirrors findings by Adelaiye and Jamda in Paikon-Kore, where positive health attitudes were strongly linked to safer water practices and reduced exposure.[21,22] Poor attitudes, such as believing schistosomiasis is not serious or curable, undermine compliance with behavioral recommendations as reported in similar study.[17]

Practice scores, however, were not statistically associated with infection ($p = 0.421$), although the trend still indicated lower infection rates among those with better practices. This non-significant result may be due to small sample size or overlap in exposure routes even among individuals with good practices. Specific practices such as wading in streams, open urination, or washing in rivers are crucial behavioral predictors of infection.[20,23] These results reinforce that improving practice alone may be insufficient without corresponding knowledge and attitude improvements.

CONCLUSION

Schistosoma haematobium infection remains a notable public health concern in Isoko South LGA, Delta State. The findings emphasize the role of knowledge and attitudes in influencing infection risk, underscoring the need for targeted health education. Integrated control measures, including community awareness, improved sanitation, and regular screening, are essential. Strengthening these interventions will help reduce transmission and improve health outcomes in endemic communities.

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