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Research Article

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Urinary Infections and Urogenital Schistosomiasis in Okigwe School Children, Imo state

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Abstract

Background and Objective
Urinary tract infections (UTIs) and urogenital schistosomiasis remain important causes of morbidity among school-aged children in low-resource settings. However, the relative burden of bacterial and parasitic urinary infections in southeastern Nigeria is not well documented. This study assessed the prevalence of urinary bacterial infections and urogenital schistosomiasis among primary school pupils in Okigwe, Imo State, Nigeria.

Methods
A cross-sectional study was conducted between April and December 2024 among 1,092 pupils aged 5–14 years selected using multistage sampling from urban, peri-urban, and rural schools. Midstream urine samples were examined microscopically for Schistosoma haematobium (S. haematobium) ova using sedimentation techniques. Bacteriological analysis was performed using standard culture and biochemical identification methods. Descriptive statistics were used to estimate prevalence, while Chi-square tests assessed associations between UTI prevalence and demographic variables. Statistical significance was set at $p < 0.05$.

Results
None of the 1,092 pupils tested positive for S. haematobium ova, indicating a 0.0% prevalence of urogenital schistosomiasis. In contrast, 101 pupils (9.3%) had significant bacteriuria. The predominant isolates were Escherichia coli (7.2%), followed by Staphylococcus aureus (1.8%) and Proteus species (0.2%). There was no statistically significant difference in UTI prevalence between sexes ($p = 0.13$), although slightly higher rates were observed among pupils aged ≥10 years.

Conclusion
The absence of S. haematobium suggests a possible interruption of urogenital schistosomiasis transmission in the study area. However, the notable burden of bacterial UTIs highlights an ongoing public health concern. There is a need to integrate routine UTI screening into school health programs, alongside sustained improvements in water, sanitation, and hygiene (WASH) and continued surveillance for urogenital schistosomiasis to prevent potential resurgence.

Keywords: Urinary Tract Infection, Urogenital Schistosomiasis, Schistosoma Haematobium, Bacteriuria, Schoolchildren, Nigeria

1. Introduction

Intestinal and urinary parasitic infections remain a major public health concern in many low- and middle-income countries, disproportionately affecting children due to increased exposure to contaminated environments and underdeveloped immunity [1,2]. Among these, urinary schistosomiasis caused by Schistosoma haematobium is historically associated with significant morbidity in Nigeria, including hematuria, hydronephrosis, bladder fibrosis, and, in severe cases, bladder cancer [3]. School-aged children are particularly vulnerable due to frequent contact with contaminated freshwater bodies during domestic and recreational activities [4]. Nigeria remains one of the most affected countries globally, with considerable spatial heterogeneity in transmission. Earlier studies have reported prevalence rates ranging from low (<10%) to hyperendemic levels exceeding 50% in different communities, reflecting localized transmission dynamics influenced by environmental and behavioral factors [5.6]. More recent national surveys have shown an average prevalence of approximately 10%, although some locations now report zero transmission, suggesting progress toward control and possible interruption in selected areas [2,7]. This heterogeneity highlights the importance of localized epidemiological assessments, particularly in regions where recent data are lacking.

Southeastern Nigeria, including Imo State, has historically been considered endemic for urinary schistosomiasis; however, contemporary data from many communities remain sparse. Okigwe, the present study area, is characterized by a mix of urban, peri-urban, and rural settlements with variable access to potable water and sanitation. Seasonal rainfall patterns, poor drainage systems, and reliance on streams and wells create conditions that previously supported transmission [6]. Additionally, school-aged children in this region commonly engage in water-contact activities such as bathing, washing, and recreational swimming, which are recognized risk factors for infection. Despite these conditions, recent public health interventions—including mass drug administration (MDA) with praziquantel, improved water, sanitation, and hygiene (WASH) infrastructure, and school-based health education may have altered the transmission dynamics [5, 10]. However, there is limited empirical evidence to confirm whether transmission persists or has been interrupted in Okigwe, thereby justifying its selection as a study site.

Recent studies from other parts of Nigeria illustrate a changing epidemiological landscape. While some communities continue to report high or moderate prevalence, others have documented low or zero prevalence, suggesting that transmission may be highly focal and, in some settings, potentially interrupted [11,8]. This emerging pattern underscores a critical transition phase in schistosomiasis control in Nigeria from widespread endemicity toward localized persistence and possible elimination in specific foci. This shift aligns with the goals of the World Health Organization Neglected Tropical Diseases Roadmap 2021–2030, which emphasizes elimination of schistosomiasis as a public health problem and advocates for a transition from morbidity control to interruption of transmission and post-elimination surveillance [1]. The roadmap defines elimination targets based on reducing heavy-intensity infections to below 1% and highlights the need for sustained surveillance, improved diagnostics, and context-specific interventions to prevent resurgence.

In parallel, urinary tract infections (UTIs) caused by bacterial pathogens such as *Escherichia coli*, *Staphylococcus aureus*, and *Proteus species* are increasingly recognized as significant contributors to urinary morbidity in children [16,20]. These infections can lead to recurrent illness, renal complications, and long-term health consequences if untreated [16]. The clinical overlap between urinary schistosomiasis and bacterial UTIs—particularly symptoms such as dysuria and hematuria—poses diagnostic challenges and underscores the need for integrated assessment of both conditions [17,18]. Given these evolving dynamics, there is a critical need to reassess the burden of urinary parasitic and bacterial infections in specific local contexts. This study therefore investigated the prevalence of *S. haematobium* infection and urinary bacterial pathogens among primary school pupils in Okigwe, Imo State, Nigeria. By providing updated local evidence, this study contributes to understanding whether transmission has been interrupted and informs the transition toward surveillance-driven strategies consistent with national and global elimination goals.

2. Materials and Methods

2.1. Study Area

The study was conducted in Okigwe, a semi-urban town in Imo State, southeastern Nigeria. Okigwe lies within the humid tropical rainforest zone (latitude 5°36′N and longitude 7°21′E) and has an estimated population of over 130,000 residents. The area experiences high annual rainfall (April–October), leading to the formation of stagnant water bodies that can support transmission of water-related infections, including urogenital schistosomiasis [6]. Despite increasing urbanization, many communities in Okigwe rely on unprotected water sources such as streams and shallow wells, while sanitation infrastructure remains suboptimal. Previous epidemiological reports from southeastern Nigeria have identified similar ecological settings as conducive to *Schistosoma haematobium* transmission, although recent control interventions, including mass drug administration (MDA) and water, sanitation, and hygiene (WASH) improvements, may have altered local transmission dynamics. These characteristics make Okigwe a suitable setting for reassessing the current epidemiology of urogenital schistosomiasis and urinary bacterial infections [5,10].

2.2. Study Design

This was a cross-sectional, school-based epidemiological study conducted between April and December 2024 to determine the prevalence of *Schistosoma haematobium* infection and urinary bacterial infections among primary school pupils in Okigwe, Imo State, Nigeria.

2.3. Study Population

The study population comprised primary school children aged 5–14 years enrolled in selected public and private schools. To ensure adequate exposure history, only pupils who had resided in the study area for at least six months prior to the study were included [13,14]. Children who had received antibiotics or anti-helminthic treatment within two weeks prior to sample collection were excluded to avoid interference with laboratory results. In addition, pupils with known chronic illnesses—defined in this study as conditions such as diabetes mellitus, chronic kidney disease, or structural urinary tract abnormalities—were excluded due to their potential to confound the occurrence of urinary infections.

2.4. Sampling Technique and Sample Size Determination

A multistage sampling technique was employed to ensure representation across different settlement types within Okigwe. First, the study area was stratified into three geographical clusters: urban, peri-urban, and rural communities. Within each stratum, a list of eligible schools was compiled, and schools were selected using simple random sampling. Subsequently, pupils within selected schools were recruited proportionately based on school population using systematic random sampling until the required sample size was achieved [14].

The sample size was determined using the standard formula for single proportion studies:

$$\mathbf{n = Z^2 \times p\ (1-p)\ d^2 n}$$

Where
n is the minimum sample size,
Z is the standard normal deviate at 95% confidence level (1.96),
p is the assumed prevalence (50% to maximize sample size), and
d is the margin of error (0.05).

After adjusting for a 10% non-response rate, a total sample size of 1,092 pupils was obtained, consistent with established epidemiological methods.

2.5. Sample Collection and Handling

Midstream urine samples were collected from participants between 10:00 AM and 2:00 PM. This time window was selected because *S. haematobium* egg excretion [15] peaks during late morning to early afternoon due to circadian variation, thereby increasing diagnostic sensitivity. The same samples were used for bacteriological analysis to ensure consistency and minimize repeated sampling, as properly collected midstream urine remains suitable for bacterial culture within a limited time frame.

Samples were collected in sterile, labeled containers and transported to the laboratory within four hours using cold boxes maintained at approximately 4–8°C. The use of cold boxes helped preserve bacterial viability while preventing overgrowth or contamination, thereby ensuring the reliability of culture results.

2.6. Laboratory Procedures

2.6.1. Parasitological Examination

Urine samples were processed using sedimentation techniques. Approximately 10 mL of urine was centrifuged at 3,000 rpm for 5 minutes, and the sediment was examined microscopically under ×10 and ×40 magnifications. *Schistosoma haematobium* eggs were identified based on their characteristic oval shape and the presence of a terminal spine, which distinguishes them from other schistosome species [13].

2.6.2. Bacteriological Examination

For bacteriological analysis, urine samples were cultured on Cystine Lactose Electrolyte Deficient (CLED) agar and MacConkey agar using a calibrated loop. Plates were incubated at 37°C for 24 hours. Significant bacteriuria was defined as $\geq 10^5$ colony-forming units (CFU)/mL.

Bacterial isolates were identified using standard microbiological procedures, including Gram staining to differentiate Gram-positive and Gram-negative organisms, followed by biochemical tests such as catalase and coagulase tests for *Staphylococcus aureus*, and indole, citrate utilization, and urease tests for Gram-negative enteric bacteria including *Escherichia coli* and *Proteus species* [13,16–18].

Molecular confirmation of isolates was not performed in this study and is acknowledged as a limitation

2.7. Data Collection and Analysis

Demographic data, including age, sex, and residence characteristics, were collected using a structured questionnaire administered to participants with the assistance of teachers and caregivers. Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics (frequencies and percentages) were used to summarize prevalence rates, while inferential statistics (Chi-square test) were used to assess associations between categorical variables.

2.8. Ethical Consideration

Ethical approval for this study was obtained from the Imo State Ministry of Health Ethical Review Committee. Permission to conduct the study was also obtained from the Imo State Universal Basic Education Board and the authorities of participating schools. Written informed consent was obtained from parents or guardians, and assent was obtained from participating pupils. Participation was voluntary, and confidentiality of all collected data was strictly maintained. All procedures were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki [1].

3. Results

3.1. Prevalence by School Group

A total of 1,092 primary school pupils were examined across five school groups in Okigwe. No cases of urogenital schistosomiasis were detected, indicating a prevalence of 0.0%.

In contrast, urinary bacterial infections were identified in 100 pupils, giving an overall prevalence of 9.2%. The predominant isolate was *Escherichia coli* (7.2%), followed by *Staphylococcus aureus* (1.8%) and *Proteus species* (0.2%).

Table 1 presents the **prevalence of bacterial infections within each school group.** The highest prevalence was observed in rural schools (15.0%), followed by peri-urban schools (14.4%). Semi-rural schools recorded a prevalence of 8.8%, while urban (4.7%) and serviced peri-urban schools (3.8%) had the lowest prevalence.

Group	Total Examined (%)	Infected with *Schistosomiasis* (%)	*E. coli* (%)	*S. aureus* (%)	*Proteus spp.* (%)	Total Bacterial Infections (%)
Group 1 (Urban)	234 (21.4)	0 (0.0)	11 (4.7)	0 (0.0)	0 (0.0)	11 (4.7)
Group 2 (Peri-urban)	208 (19.1)	0 (0.0)	19 (9.1)	11 (5.3)	0 (0.0)	30 (14.4)
Group 3 (Rural)	200 (18.3)	0 (0.0)	26 (13.0)	3 (1.5)	2 (1.0)	30 (15.0)
Group 4 (Semi-rural)	240 (21.9)	0 (0.0)	15 (6.3)	6 (2.5)	0 (0.0)	21 (8.8)
Group 5 (Serviced Peri-urban)	210 (19.2)	0 (0.0)	8 (3.8)	0 (0.0)	0 (0.0)	8 (3.8)
Total	1092 (100)	0 (0.0)	79 (7.2)	20 (1.8)	2 (0.2)	100 (9.2)

Table 1: Prevalence by School Group (n = 1,092)

3.2. Prevalence by Gender

No cases of *urogenital schistosomiasis* were detected in either sex. However, bacterial infections were slightly higher among male pupils (10.1%) compared to females (8.4%), although this difference was not statistically significant (p = 0.13).

Escherichia coli were the predominant isolate in both sexes, accounting for 8.5% among males and 5.9% among females. *Staphylococcus aureus* and *Proteus* species were more frequently observed among females, indicating greater pathogen diversity despite a lower overall prevalence.

Sex	Total Examined (%)	*Schistosomiasis* (%)	E. coli (%)	S. aureus (%)	Proteus spp. (%)	Total Bacterial Infections (%)
Male	566 (51.8)	0 (0.0)	48 (8.5)	9 (1.6)	0 (0.0)	57 (10.1)
Female	526 (48.2)	0 (0.0)	31 (5.9)	11 (2.1)	2 (0.4)	44 (8.4)
Total	1092 (100)	0 (0.0)	79 (7.2)	20 (1.8)	2 (0.2)	100 (9.2)

Table 2: Prevalence by Gender (n = 1,092)

3.3. Prevalence of Urinary Infections by Age Group

No cases of *urogenital schistosomiasis* were detected across all age groups.

Figure 1 shows the distribution of urinary bacterial infections across age groups as a proportion of total infected cases (n = 100). The highest proportion of infections occurred among children aged 6–10 years, accounting for 61.4% of all cases. This was followed by the 11–15 years age group. Minimal proportions were observed among children aged 1–5 years and those aged ≥16 years.

This pattern indicates that early school-aged children bear the greatest burden of infection.

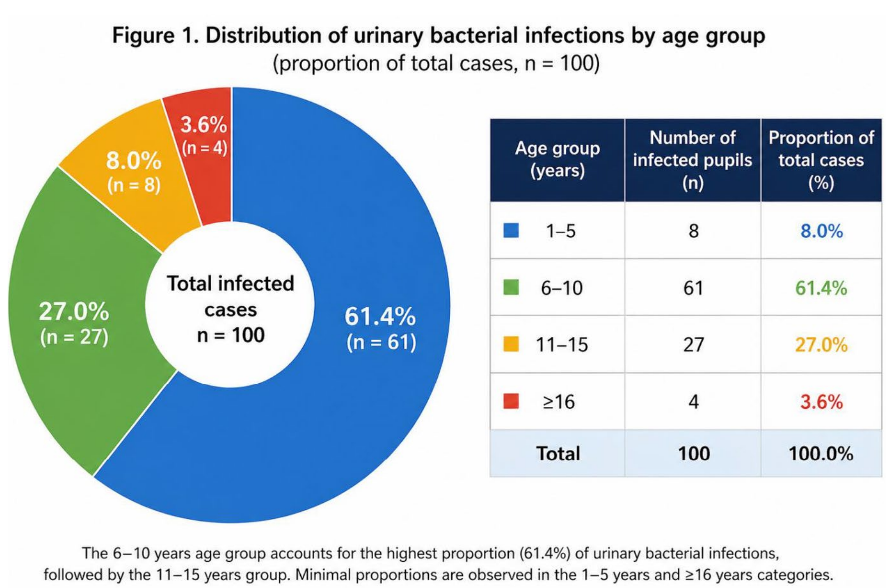

Figure 1: Distribution of urinary bacterial infections by age group (proportion of total cases, n = 100). The 6–10 years age group accounts for the highest proportion (61.4%) of infections, followed by the 11–15 years group. Minimal proportions are observed in the 1–5 years and ≥16 years categories

4. Discussion

This study provides important insights into the current epidemiology of urinary tract conditions among primary school pupils in Okigwe, Nigeria. The complete absence of *Schistosoma haematobium* infection alongside a measurable burden of urinary bacterial infections highlights a possible epidemiological transition in urinary health risks within the study area.

4.1. Absence of Schistosoma Haematobium Infection

This study demonstrates a complete absence of *Schistosoma haematobium* infection among schoolchildren in Okigwe. This finding contrasts with earlier reports from Nigeria that documented moderate to high prevalence levels. For instance, a study in Bauchi State reported a prevalence of 14.6% among school-aged children [9], while research conducted in Osun State documented a prevalence of 15.2% in a similar population [8]. In contrast, Ogunleye *et al*. (2025) reported a markedly lower prevalence of 2% in WASH-supported communities in Ogun State [11]. The zero prevalence observed in the present study may therefore reflect a continuation of this declining trend and suggests a possible interruption of transmission in the study area.

The observed absence of infection may be attributed to sustained mass drug administration (MDA) with praziquantel, improved access to potable water, and enhanced sanitation and hygiene practices. Environmental changes, including reduced dependence on natural water bodies, may also have limited human–snail contact [5,10]. However, this finding should be interpreted cautiously, as the use of a single urine sample and reliance on microscopy may reduce sensitivity, particularly in low-intensity infections [13,15]. It is therefore possible that very light or subclinical infections were missed, as previously highlighted in parasitological studies [13,15].

4.2. Burden and Pattern of Urinary Bacterial Infections

In contrast to *schistosomiasis*, this study identified a notable burden of urinary bacterial infections, with an overall prevalence of 9.2–9.3%. *Escherichia coli* was the predominant isolate, consistent with previous reports identifying it as the leading uropathogen in children [16], as well as studies conducted in Nigeria [17,18].

The distribution of infections across school groups highlights the role of environmental and infrastructural factors. Higher prevalence in rural (15.0–15.5%) and peri-urban (14.4%) schools suggests an association with limited access to clean water and sanitation. Similar findings have been reported in Nigerian studies linking poor WASH conditions to increased risk of urinary infections among school-aged children [17,18]. These results reinforce the importance of environmental determinants in shaping infection risk.

4.3. Age-Related Patterns of Infection

A key finding of this study is the disproportionately high burden of infections among children aged 6–10 years, who accounted for over 60% of all cases. This pattern may be explained by several factors. Children in this age group are typically more active, engage in outdoor play, and may have increased exposure to contaminated environments. Additionally, they often exhibit suboptimal personal hygiene practices, including improper genital hygiene and irregular hand-washing, which increase susceptibility to infection. Similar age-related vulnerability has been reported in pediatric infection studies, where early school-aged children show higher exposure-related risks [16,17].

Younger children (1–5 years) showed minimal infection rates, possibly due to closer parental supervision and reduced environmental exposure. Similarly, older children (≥16 years) exhibited lower infection proportions, which may reflect improved hygiene awareness and behavioral maturity.

4.4. Gender Differences in Infection

Although not statistically significant, the slightly higher prevalence of infections among males (10.1%) compared to females (8.4%) is noteworthy. This pattern contrasts with some studies that report higher UTI prevalence among females due to anatomical susceptibility [16]. In this setting, the higher rate among males may be linked to behavioral factors, such as increased outdoor exposure, contact with contaminated environments, and lower adherence to hygiene practices.

Interestingly, females exhibited greater diversity of bacterial isolates, including higher proportions of *Staphylococcus aureus* and *Proteus* species. This may reflect differences in hygiene practices, biological susceptibility, or healthcare-seeking behavior, as suggested in previous microbiological studies [17,18], and warrants further investigation.

4.5. Implications for WASH Interventions

The observed distribution of infections strongly underscores the role of Water, Sanitation, and Hygiene (WASH) conditions in shaping urinary health outcomes. The higher infection burden in rural and peri-urban schools suggests the presence of critical WASH gaps, including:

- Limited access to safe and potable water
- Inadequate or poorly maintained toilet facilities
- Lack of hand-washing stations with soap
- Poor hygiene education among pupils

Addressing these gaps requires targeted and context-specific interventions. These may include:

- Provision and maintenance of functional school sanitation facilities
- Installation of accessible hand-washing stations
- Ensuring reliable water supply within school premises
- Implementation of school-based hygiene education programs
- Promotion of behavioral change interventions, particularly among younger pupils

Such interventions are likely to directly reduce bacterial contamination and transmission, thereby lowering the burden of urinary infections.

4.6. Environmental and Seasonal Considerations

Although not directly assessed in this study, environmental factors such as seasonal variation, water availability, and sanitation conditions may influence infection patterns. For instance, increased water scarcity during dry seasons may compromise hygiene practices, while the rainy season may increase environmental contamination. Future studies should incorporate seasonal analysis to better understand these dynamics.

4.7. Public Health and School Health Implications

The findings of this study have important implications for school health programs. The absence of *schistosomiasis* suggests that control efforts may be yielding positive outcomes; however, the persistence of bacterial infections indicates an unmet need in school health services.

Integrating routine screening for urinary infections into school health programs could facilitate early detection and treatment. Additionally, strengthening WASH infrastructure and promoting hygiene education should be prioritized as cost-effective strategies to improve child health outcomes.

Institutional Review Board Statement

Ethical approval was obtained from the Imo State Ministry of Health Ethical Review Committee.

Informed Consent Statement

Written and verbal informed consent was obtained from all participants involved in the study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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