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Prevalence of urinary schistosomiasis among school children

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ABSTRACT

Objectives: This cross-sectional study was conducted to assess the prevalence of urinary schistosomiasis among schoolchildren in Ogbese, a community targeted for the mass distribution of praziquantel, and to evaluate the proportion of examined children who had access to mass drug administration (MDA).

Materials and Methods: Between April and August 2022, mid-stream urine samples were collected from randomly selected schoolchildren attending public schools within the community. Participation was contingent on the children's assent and written informed consent from their parents. Each urine sample, measuring 10 milliliters, was examined macroscopically for visible hematuria. *Schistosoma haematobium* eggs, identified by their characteristic terminal spine, were detected using the urine sedimentation technique. The intensity of infection was quantified as the number of eggs per 10 mL of urine (eggs/10 mL), with infections classified as mild (1–49 eggs/10 mL) or heavy (≥50 eggs/10 mL). A structured questionnaire was administered to collect participants' biodata and additional information, such as their history of MDA intake. Data were analyzed using Pearson's Chi-square test to assess associations between variables.

Results: A total of 260 children were examined, out of which 138 (53%) were male and 122 (47%) were female. Results obtained from this study revealed that the overall prevalence of urinary schistosomiasis in school children was 20%. The infection rate was higher in males (22%) compared to females (18%), though this difference was not statistically significant ($P = 0.458$). The 10–14 year age group had the highest prevalence of infection at 31%, but this difference was not statistically significant compared to other age groups ($p = 0.090$). Only 26% of the children had knowledge of urinary schistosomiasis.

Conclusion: This study established that urinary schistosomiasis remains endemic in the study area with a prevalence of 20%. While this is lower than the national average of 35%, it underscores the mesoendemic status of urinary schistosomiasis in Ondo State.

Keywords: Endemic, Ondo State, School children, Schistosoma haematobium, Urinary schistosomiasis

INTRODUCTION

Bilharziasis, commonly known as schistosomiasis, is one of the common neglected tropical diseases responsible for high mortality and morbidity rates, particularly in Africa and the Middle East.[1] Some of the adverse outcomes of schistosomiasis include school absenteeism, stunted growth, anemia, bladder cancer, female genital schistosomiasis, and overall reduced quality of life.[1] It is a parasitic infection caused by a trematode of the genus Schistosoma, which causes both acute and chronic diseases. After malaria, schistosomiasis is considered the second most parasitic disease that causes socioeconomic damage.[2] There are five major species of schistosomes, of which Schistosoma haematobium causes urinary and urogenital schistosomiasis, while *Schistosoma* *intercalatum, Schistosoma mansoni, Schistosoma japonicum*, and *Schistosoma mekongi* cause intestinal schistosomiasis, although, the most prevalent species in the sub-saharan region of africa are *S. hematobium* and *S. mansoni*.[3] Nearly 700 million individuals are thought to reside in endemic areas of the disease. According to Ossai *et a*l.,[4] over 200 million infected individuals worldwide, spread across 76 countries, have been reported. Sub-Saharan Africa and certain regions of Asia have the highest endemicity. 90% of infected cases are in Sub-Saharan Africa, where the disease is thought to claim the lives of 11,700 people each year.[5] Nigeria is among the most severely affected nations in Sub-Saharan Africa in terms of urinary schistosomiasis, contributing to over 14% of cases globally.[6] In 2015, the first epidemiological data on the disease prevalence were released by Nigeria's Federal Ministry of Health, revealing a prevalence rate of nearly 9.5%. This indicated that almost 24 million people in Nigeria were at risk of contracting the disease.[7] Humans serve as the definitive host for *S. haematobium*, a blood fluke, while snails act as its intermediate host. Humans get infected by contact with water containing the free-living cercariae, which are shed by snails throughout their lives. The cercariae penetrate the skin using their anterior spines and cytolytic secretions of the cephalic glands.[8] The main manifestations of *S. haematobium* infections are hematuria, urogenital schistosomiasis, dysuria, malnutrition, renal failure, an increased risk of bladder cancer, and growth retardation in children.[9] Various factors have contributed to the persistence of this parasitic infection, particularly among school-aged children, through agricultural, recreational, and domestic activities that frequently expose them to bodies of water[10] Nigeria has been categorized into three zones based on the endemicity of urinary schistosomiasis. Communities in the hyperendemic zone have a disease prevalence of more than 50%. Affected states include Abia, Ebonyi, Enugu, Osun, Ogun, Lagos, Rivers, Cross River, Edo, Benue, Kano, Oyo, Ekiti, and Plateau. Furthermore, mesoendemic zones include states with a disease burden ranging from 10% to 50%. The states in the mesoendemic category include Anambra, Ondo, Imo, Delta, Borno, Kaduna, Niger, and Katsina. The hypoendemic zone consists of states with a disease burden of 1% to 10%. These states include Kogi, Taraba, Adamawa, Kebbi, Sokoto, Bauchi, Yobe, Kwara, Zamfara, Abuja, Akwa Ibom, Bayelsa, Nasarawa, Jigawa, and Gombe.[11] Since the present prevalence for the nation and its sub-regions is unclear, it is difficult to determine objectively whether the efforts to control and eliminate the infection, particularly in endemic areas using mass drug administration with praziquantel, are effective.

Therefore, the purpose of this research was to determine the current prevalence of urinary schistosomiasis among school-aged children in the Ogbese community, where there has been a mass drug administration for the prevention of this disease.

MATERIALS AND METHODS

Study area and population

This cross-sectional study was conducted among school-aged children attending primary and secondary schools in the Ogbese community, Akure North local government of Ondo State, Nigeria. The Ogbese community lies at latitude E6^{0}SE8^0 and longitude N4^{0}N6^{0}E in southwestern Nigeria. The Ogbese river has its source in Ayede-Ekiti State, and flows through the Ogbese community in Ondo State to Edo State. This river serves as the primary source of water for both domestic and agricultural use in the community, as well as the primary point of contact for the community. [Figure 1]

Figure 1: The Ogbese river in Ogbese, Ondo State.

The minimum sample size was calculated using the formula $n = z^2 p(1\text{-}p)/d^2$, where N was the sample size, z was the confidence level at 95% confidence interval, D was the desired margin of error at 5% (0.05), and P was the proportion of schistosomiasis in the population based on the prevalence of 19% reported by a previous study carried out in Southwest Nigeria.[12] After substituting the values, the calculated minimum sample size was 236, and 260 participants were recruited, to account for a 10% attrition rate.

Ethical consideration

Before the commencement of sample collection, approval was obtained from the Health Research and Ethics Committee of the Federal Medical Centre, Owo, Ondo State. Informed consent was sought from parents and guardians of children who met the inclusion criteria for this study.

Inclusion criteria

Children who are of school age and <18 years and willingness by parents and guardians to give informed consent to participate in this study. We also obtained consent from children above 11 years old.

Exclusion criteria

Participants 18 years and above, failure to give informed consent.

Methodology

A simple random sampling technique was used to select participants for this study between April and August 2022, and mid-stream urine samples were collected from schoolchildren randomly chosen from three public schools (two primary schools and one secondary school). These schools were conveniently selected due to security concerns in the Ogbese community. Children whose parents provided consent and who personally assented to participate were selected through a paper shuffling method. Students who picked "Yes" were included in the study, while those who picked "No" were excluded.

Urine samples were collected from 10 am to 2 pm when *S. haematobium* excretion was anticipated to be at its peak.[6] A sequentially numbered, sterile universal container was provided to each consenting child for the collection of urine. The urine samples were immediately transported to the laboratory for analysis. Samples that could not be immediately processed were stored in the refrigerator at 4°C till the following day. The presence of *S. haematobium* eggs was detected using urine sedimentation techniques. Ten milliliters of the freshly passed urine sample was well mixed, poured into a test tube, and allowed to stand for 1 h on the bench. The supernatant was discarded, and the sediment was transferred into a centrifuge tube and spun at 2000 rpm for 2 min. The sediment was resuspended, and a drop was placed on a glass slide and mounted on a microscope. The sediment was examined for *S. haematobiu*m eggs under a light microscope with ×10 and ×40 objective lenses to focus and view, respectively. All samples were examined independently by two microscopists, one of whom was an experienced Medical Laboratory Scientist, for confirmation of the results. For quality control, 15% of all positive and negative slides were re-examined by a third independent microscopist who was blinded to the first two results. The *S. haematobium* infection intensity was expressed as the number of eggs detected in 10 mL of urine (eggs/10 mL). The counted eggs were categorized into a light infection (1–49 eggs/10 mL of urine) and heavy infections (≥50 eggs/10 mL of urine).[12] The incidence of ectopic egg excretion was measured as either positive or negative. Ectopic egg elimination refers to detecting *S. haematobium* eggs in unusual routes, for example, *S. haematobium* eggs in feces or S mansoni eggs in urine. Furthermore, snails were collected from the rivers and streams at the study location for species identification and speciation. Children found positive for schistosome species were treated with 40 mg/kg praziquantel by the study team. The study participants were also given a questionnaire to collect information on their water-related activities and socio-demographic habits that would predispose them to the infection.

Statistical analysis

The results obtained were entered into Microsoft Excel (version 2010), and the data were analyzed using Pearson's Chi-square test to assess the association between variables.

RESULTS

A total of 260 school-aged children participated in the study, with a nearly equal gender distribution of 53% male (138) and 47% female (122). The mean age of the participants was 12.16 ± 3.51 years [Table 1]. The participants were categorized into three age groups: 5–9 years (34%), 10–14 years (33%), and 15 years and older (33%). The children attended either high school (49%) or primary school (51%). The overall prevalence of urinary schistosomiasis among the children was 20% (52 out of 260) [Table2]. The level of education attained by the children showed no significant relationship with the rate of infection with *S. haematobium* in the examined children, *P* = 0.942. The prevalence of urinary schistosomiasis was not significantly associated with the father's occupation (*P* = 0.603) or the mother's occupation (*P* = 0.278) [Table 1]. The infection rate was higher in males (30/138, 22%) compared to females (22/122, 18%), though this difference was not statistically significant (*P* = 0.458) [Table 2]. The 10–14 year age group had the highest prevalence of infection at 31%, although this was not significantly different from other age groups (*P* = 0.090) [Table 3]. The mean worm burden was also highest in this age group (8.80 ± 2.25).

Seventy percent of the participants (182/260) reported receiving deworming medication from the government, while 75% of the participants (195/260) received medication from their parents [Table 4]. Children who engaged in water-related activities, such as swimming (50%), bathing (46%), and fishing (35%), had higher infection rates, whereas those who did not participate in any of these activities showed no infections. Only 26% (67/260) of the children had heard of schistosomiasis, and 73% engaged in regular water contact activities [Appendix 1].

Figure 2 shows the presence of eggs of *S. haematobium* in the urine of a child examined during the study. Visible hematuria was most common among individuals aged 10–14 years, 14/85 (17%), although this difference was not statistically significant, *P* = 0.154 [Figure 3].

DISCUSSION

Urinary schistosomiasis is reported to be endemic in virtually all rural regions of Nigeria, due to the widespread occurrence of ecological and socioeconomic factors that contribute

Table 1: The demographic and socioeconomic characteristics of the participants (*n*=260)

Characteristics	*n* (%)
Gender	
Males	138 (53)
Females	122 (47)
Age	12.16±3.51
Age groups	
5–9 years	90 (34)
10–14 years	85 (33)
>15 years	85 (33)
Type of schools	
High School	126 (49)
Primary School	134 (51)
Father's occupation	
Farmer	116 (45)
Trader	38 (15)
Business	15 (6)
Engineer	7 (3)
Driver	12 (5)
Fashion designer	14 (5)
Civil servant	27 (10)
Welder	20 (8)
Clergy	9 (3)
Mother's occupation	
Trader	152 (59)
Farmer	38 (14)
Business	15 (6)
Fashion designer	16 (6)
Hairdresser	18 (7)
Caterer/food seller	11 (4)
Civil servant	10 (4)

± denotes standard deviation (SD).

Table 2: Distribution of urinary schistosomiasis in relation to sex (*n*=260)

Sex	No. (%) examined	No. (%) positive	No. not infected (%)	*P*-value
Male	138 (53)	30 (22)	108 (78)	0.458
Female	122 (47)	22 (18)	100 (82)	
Total	260 (100)			

to the disease. Unfortunately, *S. haematobium* is one of the most neglected common parasitic diseases of childhood in the country. It is a significant cause of clinical morbidity and mortality in endemic countries of Africa and the Middle East.[1] The prevalence of urinary schistosomiasis among schoolchildren in the Ogbese community, Akure North LGA, Ondo State, Nigeria, was evaluated in this study. Results obtained from this study of 260 children revealed an overall prevalence of urinary schistosomiasis in schoolchildren of 20%. This is higher than the 16.57% prevalence reported in a 2022 study conducted in Ogbese.[13] However, the result is lower than other studies within and outside Ondo State, Nigeria, and Africa.[14-20]

This study found no statistically significant association between gender and the transmission of urinary schistosomiasis. However, the prevalence of infection was slightly higher in male children (22%) compared to females (*P* = 0.458). This is consistent with observations by other authors.[15,19] Boys tend to engage more in water contact activities such as swimming.[19] A study conducted in northern Nigeria found that the prevalence of urinary schistosomiasis was highest among children aged 10–14 years (31%), compared to other age groups. However, this difference was not statistically significant, with a *P*-value of 0.090,[21] Children in this age group are more likely to participate in activities such as swimming, washing, and bathing, which increase their exposure to contaminated water sources. This likely explains the higher infection rates observed.[22] Similar findings have been reported in other studies, which identify middle childhood to early adolescence as the peak period for schistosomiasis infection, largely due to heightened water contact activities during these years.[20,22,23] This study also observed that children who do water contact activities such as swimming, bathing, and fetching water were associated with urinary schistosomiasis. Notably, those who engaged in swimming and bathing had the highest infection rates, at 50% and 46%, respectively. It is well established that children are particularly vulnerable to urinary schistosomiasis due to their frequent engagement in water-based activities, often in contaminated water bodies harboring snail hosts of *S. haematobium.* These snails release the infective stage of the parasite, allowing Schistosoma larvae to penetrate the skin during contact with water.[24-26] The association between water contact activities and schistosomiasis is well-documented, underscoring the importance of environmental

Table 3: Distribution of urinary schistosomiasis by age group (*n*=260)

Age group	No. examined (%)	No. positive (%)	No. not infected (%)	Mean of worm burden	*P*-value
5–9 years	90 (34)	18 (20)	72 (80)	6.23±1.4	0.090
10–14 years	85 (33)	26 (31)	59 (69)	8.80±2.25	
>15 years	85 (33)	8 (9)	77 (91)	6.10±1.55	
Total	260 (100)	52 (20)	208 (80)		

± denotes standard deviation (SD).

Table 4: Frequencies of dichotomous responses to awareness and medication

Variable	*n* (%)
Heard of schistosomiasis	
Yes	67 (26)
No	193 (74)
Received worm medicine from the government	
Yes	182 (70)
No	78 (30)
Received worm medicine from parent	
Yes	195 (75)
No	65 (25)

Appendix 1: Relationship between urinary schistosomiasis and water activities of the school-aged children in Ogbese

Water contact activities	No. (%) examined	No. (%) of those positive	No. not infected (%)
Bathing	24 (9)	11 (46)	13 (54)
Swimming	22 (9)	11 (50)	11 (50)
Playing games	17 (6)	2 (12)	15 (88)
Fetching water for drinking/farming	52 (20)	12 (23)	40 (77)
Washing clothes	53 (20)	8 (15)	45 (85)
Fishing	23 (9)	8 (35)	15 (65)
No activity	69 (27)	0 (0)	69 (100)

factors in disease transmission. Parents' occupation did not show a statistically significant correlation with the prevalence of urinary schistosomiasis (father, P = 0.603 and mother, P = 0.278). This finding suggests that the socioeconomic status associated with parental occupation may not be a primary determinant of schistosomiasis risk in this population. Previous studies have yielded mixed results regarding the impact of socioeconomic factors on schistosomiasis, with some suggesting a correlation while others have not found a significant relationship.[23,26] The lack of significance in this study may reflect the uniformity of exposure risk across different occupational groups in the study area. Only 26% of the children had heard of schistosomiasis, which highlights a gap in health education within this community. Despite this low awareness, a majority (70%) reported receiving worm medicine from the government, and 75% of the children received the worm medicine from their parents. Our study did not verify the frequency of MDA, if any, in the community, which is one of the study's limitations. Regular MDA programs are effective in reducing the prevalence of schistosomiasis in endemic areas.[27] Visible hematuria, a common symptom of urinary schistosomiasis, was most frequently observed among children aged 10–14 years, with a prevalence of 17%. However, this finding was not statistically

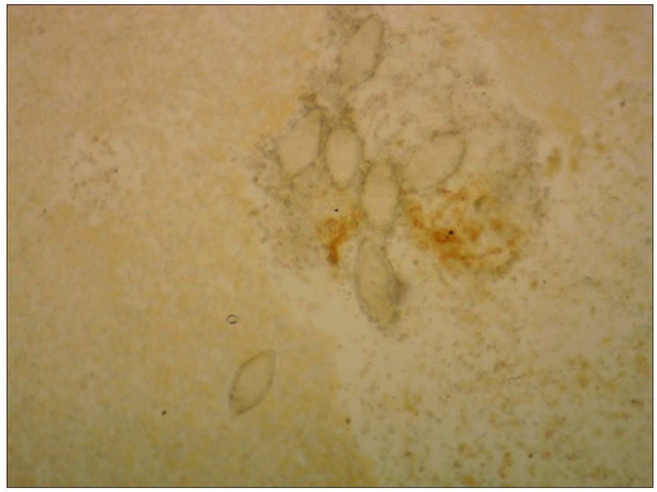

Figure 2: The eggs of *Schistosoma haematobium* in the urine of a child examined.

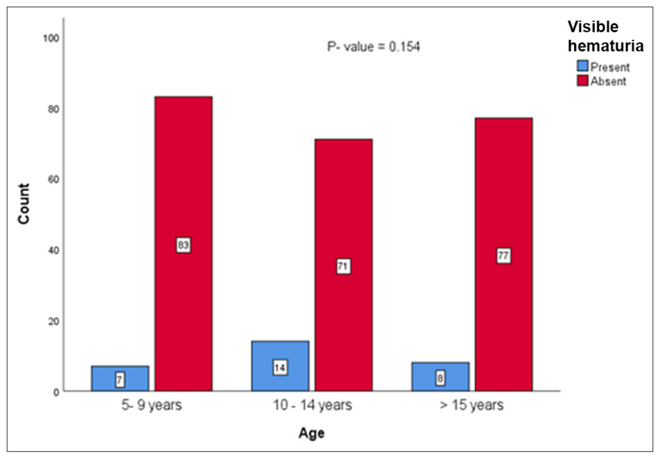

Figure 3: The number of visible hematuria in relation to age.

significant (P = 0.154). The lack of statistical significance could be due to the small sample size or the influence of other confounding factors that could not be accounted for in the analysis. In addition, the level of education attained by the children was found to have no significant association with the infection rate (P = 0.942). This suggests that educational interventions alone may not be adequate to reduce the prevalence of schistosomiasis unless they are complemented by efforts to address behavioral patterns and environmental factors that contribute to transmission.

CONCLUSION

This study established that urinary schistosomiasis remains endemic in the study area with a prevalence of 20%. While this is lower than the national average of 35%, it underscores the mesoendemic status of urinary schistosomiasis in Ondo State. To address this, it is recommended that policymakers strengthen preventive chemotherapy programs in the area.

The community will also benefit from an integrated disease control program, which combines educational interventions to increase community awareness and control of snail populations that serve as intermediate hosts for *Schistosom*a species.

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