Original Article

Schistosomiasis Among School-age Children in an Endemic Community of Cross River State, Nigeria: Can Mass Drug Administration Stem Transmission?

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ABSTRACT

Urinary schistosomiasis which is endemic in several rural and sub-urban communities in Nigeria affects school-age children. A cross-sectional study was conducted to determine the prevalence and intensity of urinary schistosomiasis among 300 school-age children (5-16 years) in Abini, Biase Local Government Area, Cross River State. Urine samples collected from the subjects were examined by microscopy using the standard filtration technique. The overall prevalence of urinary schistosomiasis among school-age children examined was 40%. Males had higher infection rate (41.8%) than females (37.8%) ($p>0.05$). Infection rate varied between age-groups, the peak (50%) occurring in children aged 11-13 years. Mean intensities of urinary schistosomiasis infection were light and ranged between 2.63 and 3.75 ova/10mL of urine. The findings reveal a continued infection with Schistosoma haematobium in Abini community, Cross River State.

Keywords: School-age children; Schistosoma haematobium; Urinary schistosomiasis; Prevalence; Intensity

INTRODUCTION

Schistosoma haematobium infection is a waterborne infection which affects more than 800 million people globally[1]. More than 90% of people infected live in sub-Saharan Africa, a region characterized by poor access to clean water and sanitary facilities[1, 2]. Other species of *Schistosoma* causing schistosomiasis in humans include *Schistosoma intercalatum*, *S. mekongi*, *S. mansoni* and *S. japonicum*[3]. These parasites cause morbidity and mortality in many rural communities in endemic regions[4].

Urinary schistosomiasis (caused by *Schistosoma haematobium*) has been reported to be more prevalent in Nigeria than intestinal schistosomiasis (caused by *S. mansoni*)[5,6]. This is because of a wider distribution of its snail host, *Bulinus* species[7]. Urinary schistosomiasis affects people living in poor rural areas with inadequate safe water sources and sanitary facilities resulting in dependency on contaminated water bodies which constitute major factors associated with the disease transmission[4]. Children of school-age are reported to have highest prevalence and intensity of the infection[8,9,10].

Nigeria has the highest number of schistosomiasis cases worldwide, and in the African region, with over 20% of people requiring chemotherapy residing in Nigeria[11]. Several authors in Nigeria

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have reported the occurrence of schistosomiasis in school-age children aged 5-20 years[12, 13, 14, 15]. In Nigeria, schistosomiasis continues to have negative impacts on the general health status and fitness of school children[16]. Infections often lead to wasting, iron deficiency anaemia, diarrhoea, listlessness, and chronic pain[13,17].

Cross River State is endemic for urinary schistosomiasis, and haematuria has been reported from people of endemic rural areas[6,18,19]. There is also an established linkage of environmental, topography and weather conditions that favour sustenance of *Schistosoma haematobium* snail vectors as established by Ajakaye et al.[20] and Adie et al.[21] all of which typify the tropical rainforest vegetation of Cross River State. This makes urinary schistosomiasis a permanent public health problem despite interventions using the Mass Drug Administration of Praziquantel.

Ejezie et al.[22] reported a prevalence of 43.5% among subjects in Adim, a community in Biase Local Government Area (LGA), Cross River State (CRS). A similar study conducted by Opara et al.[23] among pre-school children aged 0-5 years revealed a prevalence of 19.8%. Also, Okon et al.[24] reported a prevalence of 35% among school children in Abini community, Biase LGA while a recent study conducted by Opara et al.[5] reported a prevalence of 6.03% in Biase LGA.

This study was initiated following a 2-year cessation of mass chemo-prophylactic treatment of primary school-age children in Cross River State. The authors reasoned that within the 2 years of interruption, some pupils who would have had Mass Drug Administration in the preceding years would have moved on from the primary into the secondary school level. Thus, infection intensity/worm burden among these two categories of school children becomes necessary. The study was set up to determine urinary schistosomiasis infection among primary school pupils as well as lower secondary school students in Abini community, Biase LGA, Cross River State, Nigeria in the era of preventive chemotherapeutic intervention.

MATERIALS AND METHODS

Study Area

The study was conducted in Abini, a community in Biase Local Government Area, Cross River State. Abini is situated at $5^0$41'29" North Latitude and $8^0$3'45" East Longitude. It is a typical rural community situated about 110 kilometres to the North of Calabar, the capital of Cross River State. It has a population of 12,414, children aged <15 years constitute about 47% of the population[26].

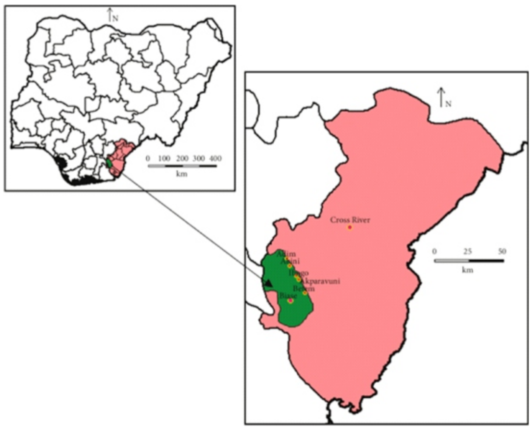

Figure 1: Map showing Abini community on Biase Local Government Area, Cross River State.

The inhabitants are predominantly subsistence farmers, growing rice, yam, cassava, and vegetables[25]. As there is no pipe-borne water, the alternate sources of water are freshwater streams, ponds, collected rainwater and springs around the community and their private dug water sources. Government facilities in the area include a primary school, a secondary school, and a health centre. Sewage disposal is by "community open toilets," which are cleared sites located on village areas.

Sample Size Determination

The sample size was determined following guidelines recommended by the World Health Organisation concerning surveys on schistosomiasis and soil-transmitted helminth infections. The guideline recommends that when an epidemiological survey is organized to determine the prevalence and intensity of infection, a sample size of 200–250 school aged children is adequate[27] . A total of 300 children (159 from the Community Secondary school and 141 from Presbyterian Primary school, Abini) consented and participated in the study.

Ethical Clearance

Ethical approval was obtained from the Ministry of Health, Cross River State. Permission was also obtained from the Local Government Education Authority. The Principal and Headmaster of the selected primary and secondary school was duly informed about the study. Written informed consent was obtained from parents/guardians and registered children were informed on the impact and or benefit of the study to the community before samples were collected.

Selection of Study Sites and Subjects

A cross sectional study was conducted between January and March 2021 among the participants, aged 5-16 years in Abini community, Biase Local Government Area, Cross River State. The schools selected were Community Secondary School and Presbyterian Primary School, Abini.

Following consent from teachers and parents of the pupils, the pupils willingly participated in the study. Subjects were selected randomly from each class using the class register. With the help of the teachers, efforts were made to balance the number of male and female participants. Only children aged between 5-16 years were included in the study. Each pupil selected was registered according to their age, gender, and class. Specimen bottles were later given out with each participant's name and a serial number assigned. Instructions were given on how to void (pass) urine into the screw-capped transparent plastic containers (universal bottles).

Inclusion Criteria

The participants must have resided in the community prior to at least two years before 2019 and have no history of having been administered praziquantel or any other anti-schistosomal drugs within the previous two years. The participants must also show no clinically obvious genito-urinary lesion or trauma.

Exclusion Criteria

Any participant child resident for less than two years in the community prior to the commencement of the study and with history of current intake of praziquantel or any other anti-schistosomal drugs within two years of the day of urine specimen collection were excluded from the study.

Collection of Urine Samples and Parasitological Analysis

Clean 30ml size universal containers were issued to 300 subjects for collection of urine samples. Samples were collected after a brisk exercise of getting the pupils/students run across the school field and back. This was done between 09.00 and 14.00 hours of the days. Gross macroscopic examination of the urine for haematuria was noted. About 10mls of each sample were fixed with 5ml of 1% carbol fuchsin in water to preserve and stain ova before being transported to the Microbiology and Parasitology laboratory of the University of Calabar Teaching Hospital, Calabar.

Filtration of Samples

Urine samples were examined using the filtration technique described by the WHO[28] . Each urine sample had one to two drops of eosin stain added to it. After shaking the urine sample, an aliquot of 10 ml was taken and filtered through Grade 1 Whatman Qualitative filter paper. To remove extra fluid from the filter paper, a 20 ml aliquot of 10% Lugol's iodine was passed through, followed by a syringe full of air.To make the eggs visible for examination, the filter paper was carefully removed with a pair of forceps, placed on a drop of highly saturated ninhydrin stain on a glass slide, and allowed to air dry at room temperature[29]. Microscopic examination at ×20 and ×40 magnifications revealed the distinctive terminal spines of Schistosoma haematobium eggs, which allowed for their identification. S. haematobium eggs were recognized by their distinctive terminal spines upon microscopic examination at using the ×20 and ×40 magnifications; the number of eggs on the whole filter paper was counted and reported as the number of eggs in 10 ml of urine (eggs/10 ml of urine). The intensity of infection by ova count was graded according to the WHO standardization as follows: light infection: 1-49 ova/10ml of urine; heavy infection: ≥ 50 ova/10ml of urine[30].

Data Analysis

The results obtained were subjected to statistical analysis using R version 4.1.2. The prevalence and intensity of urinary schistosomiasis were calculated using descriptive statistics. Chi-square test was used to evaluate the associations and differences between the data on demographic characteristics and the results from specimen examinations. A comparison of means was used to compare the average intensity of infection between gender and age-groups. Differences and associations were considered significant at a probability (P) value less than 0.05 ($P < 0.05$).

RESULTS

Among the 300 participants, 165 (55%) were males and 135 (45%) were females, comprising 55 (18.3%), 70 (23.3%), 120 (40%) and 55 (18.3%) children aged 5-7, 8-10, 11-13 and 14-16 years, respectively. Overall, 159 (53%) of the respondents attended Community Secondary school, Abini, while 141 (47%) attended Presbyterian Primary school, Abini (Table 1).Overall, 40% (120/300) of the participants were found to be positive for urinary schistosomiasis.

The infection was higher among males than females (41.8% versus 37.8%; $P = 0.5537$) (Table 2). The highest prevalence was reported among participants aged 11-13 years (50%) while those aged 5-7 years had the lowest prevalence (27.3%) ($P = 0.0228$) (Table 2). All Schistosoma-positive urine samples were of light intensities with a mean of about three eggs per 10ml of urine. Mean intensities according to gender and age distribution showed no significant variation (Table 2) .

School-age children of Community Secondary school had a higher prevalence of 48% (76/159) compared with children of Presbyterian Primary School (31%; 44/141). This difference varied significantly (P=0.0049). However, overall mean intensity of *Schistosoma haematobium* infection was higher in Presbyterian Primary School (3.5±1.86) compared with Community Secondary school (2.78±1.11), although this was not statistically significant (P= 0.5138) (Table 3).

Table 1: Demographic characteristics of the participants from Abini, Cross River State (n = 300)

Variables	N (300)	%
Gender		
Males	165	55
Females	135	45
Age groups (years)		
5-7	55	18.3
8-10	70	23.3
11 -13	120	40
14 -16	55	18.3
Schools		
Community Secondary school	159	53
Presbyterian Primary school	141	47

Table 2: Prevalence of *Schistosoma haematobium* infection by age-group and gender

Variables	No. examined	No. positive (%)	Mean egg count/10mL
Age (Years)			
5-7	55	15 (27.3)	**2.67±1.21**
8-10	70	25 (45.5)	**3.42±1.88**
11 -13	120	60 (50)	**3.6±2.17**
14 -16	55	20 (28.5)	**1.63±0.72**
Total	300	120 (40)	**3.07±1.97**
P value		0.0228	**2.8388**
Males	165	69 (41.8)	2.63±1.10
Females	135	51 (37.8)	3.75±1.96
Total	300	120 (40)	3.07±1.97
P value		0.5537	0.581

Table 3: Prevalence of Schistosoma haematobiun infection in the Schools Surveyed

School	No. examined	No. positive (%)	Meanegg count/10mL
Community Secondary school, Abini	159	76 (47.8)	2.78±1.11
Presbyterian Primary school, Abini	141	44 (31.2)	3.5±1.86
P value		0.0049	0.5138

DISCUSSION

This study further confirms that urinary schistosomiasis is still an important public health problem in Abini community, Biase Local Government Area, Cross River State. The overall prevalence rate of infection was 40% and is moderate according to the classification of the WHO Expert Committee on the control of schistosomiasis[28] . Similar findings have been reported in the area[24] . The WHO recommended strategy for such area is school based Mass Drug Administration of praziquantel to school-age children with additional interventions of improved water supply, sanitation, and health education[31] .

A preliminary report by Ejezie et al.[32] showed that *Schistosoma haematobium* infection with a prevalence of 43.5% is endemic in Adim, a community located about six kilometres from Abini. Ekanem et al.[33] equally reported the endemicity of urinary schistosomiasis in Ijiman (44%) an adjoining area from Adim. Despite these reports in the area, the residents show a low perception of the disease coupled with a high degree of ignorance of the causative agent and the vector. This is so as it was observed that these children predominantly took part in activities such as bathing, wading and collection of water for domestic purposes in the several streams around the community. Older children, especially, were ready source of family hands in farming activities, including the cultivation of paddy rice in the extensive swamps. These activities could have been a source of exposure to the snail intermediate host of the disease. There is therefore an urgent need to scale up and sustain national control measures for schistosomiasis.

Gender related prevalence of schistosomiasis showed the females to be less infected with urinary schistosomiasis, although this difference was not statistically significant. Similar observations have been reported in previous studies in Taraba, Katsina and Rivers States of Nigeria[10, 34, 35] . Several reports have also confirmed that *Schistosoma haematobium* infection was not significantly associated with gender[36, 37, 38]. This shows that both sexes are at equal risk of exposure to *S. haematobium* parasite. However, there have also been studies suggesting that *S. haematobium* infection is significantly associated with the male gender[38,40,41].

The highest infection rate was reported among pupils within the age group of 11-13 years with prevalence of 50% in this study.There are reasons which may account for this, one of which being spending relatively longer leisure time outdoors playing or swimming as against the other age groups. The 5-7 year olds are either too young to be actively involved in extensive exercises and field activities, while the 14-16 age group may consider themselves as having outgrown such recreational activities. At this age range (11-13 years), some researchers had demonstrated the peak of water contact to be within this age range[42]. Agi and Okafor[43] have reported similar findings, in Odau community in the Niger Delta region and Adie et al.[18] in Cross River State.

The mean intensity of *Schistosoma haematobium* infection was low and this could be a result of the ongoing deworming exercise. Similar finding has been reported by Akpan et al.[6] in Ikom Local Government Area, Cross River State. Although intensity was low, affected individuals could serve as a source of reinfection to otherwise healthy individuals. There is therefore the need for a continued integrated interventions to complement Mass drug administration in the control of *Schistosoma haematobium* infection in the study area.

Despite the mass chemotherapy aimed at reducing morbidity, the prevalence of the disease in Nigeria may be increasing due mainly to the absence of water and sanitation facilities, ignorance, inadequate or lack of public health facilities, low illiteracy level and inadequate social infrastructure as visibly observed in the study community[16, 21, 44]. The lack of scientific information on the disease in many rural communities among the high-risk groups particularly school age children is another key factor that has adversely affected control efforts of urinary schistosomiasis.

Although the 11-13 age group had markedly higher intensity of infection from the other age groups, several factors may be responsible. MDA coverage at either of community-wide or school-based levels comes with its challenge.

Non-compliance or outright refusal of parents to participate in MDA, poor supervision by school teachers, and school absenteeism of children during drug administration rounds are common barriers to the successful MDA exercise, as experienced by these authors. Conversely, positive impacts are observed when there is high compliance and MDA coverage levels.

CONCLUSION

This study has demonstrated that *Schistosoma haematobium* infection is still prevalent among school-age children in Abini community, Biase Local Government Area, Cross River State.

While a disruption in the yearly MDA exercise may be contributory to the relatively high infection intensity, increased community awareness, mobilization and participation will ensure more control benefits from MDA as this intervention strategy remains the most cost-effective intervention method in rural endemic communities.

Recommendations

It is important to implement comprehensive health education programmes targeting members within a given community. There should be focus on raising awareness about the transmission, symptoms, and preventive measures of urinary schistosomiasis. This could include interactive workshops, community meetings, and informative materials. Furthermore, there should be improved access to clean and safe water sources, as well as proper sanitation facilities. Reducing contact with contaminated water bodies can significantly contribute to the prevention of schistosomiasis transmission.

Limitations of the Study

The study's cross-sectional design provides a snapshot of prevalence and intensity at a specific point in time, limiting our understanding of temporal trends and causality. Also, the sample size of 300 school-age children from a single community may not fully represent the broader population. Findings may not be generalizable to other communities or regions.

Lastly, microscopic examination using the standard filtration technique has limitations in sensitivity, potentially leading to underestimation of prevalence and intensity.

Authors' Contributions

EUE and IEE conceptualized the study. EUE, IEE and OPA designed the study. IAA, OGI, ABA and IEE participated in fieldwork and data collection. EUE and IEE performed the data analysis and interpreted the data. EUE prepared the first draft of the manuscript, reviewed by IEE, IAA, OGI, ABA and OPA. All authors contributed to the development of the final manuscript and approved its submission.

Disclosure of Conflict of Interest

The authors declare no conflict of interest exist.

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