

Status of urinary schistosomiasis among residents of Ebonyi Local Government Area, Ebonyi State, Nigeria

Okpete, E. C.*¹  and Ani¹, O. C.

¹Department of Applied Biology, Faculty of Science, Ebonyi State University, Abakaliki, Ebonyi State.

*Corresponding Author: Emmanuela C. Okpete. okpetecella@gmail.com

Received: 07 March, 2024

Revised: 03 May, 2024

Accepted: 30 May, 2024

Keywords: Intensity, Prevalence, Urinary schistosomiasis, Participants.



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Introduction

Schistosomiasis is a complex water-borne disease that is caused by parasitic helminths of the genus *Schistosoma*, a blood-dwelling trematode, which lives and reproduces in the circulatory system of the hosts (Colley *et al* 2014). The disease is endemic in 78 tropical and subtropical countries with 51 endemic countries requiring large scale treatment (Peletu *et al* 2023; WHO 2023). It is one of the major public health problems facing humanity, with severe socio-economic consequences. It is classified by the World Health Organization (WHO) as a neglected tropical disease (NTD) and is among the seven most prevalent ones (WHO 2012). The infection poses a significant public health challenge in low and middle-income countries where it causes significant morbidity and mortality in certain areas (WHO 2017; 2023). Although highly preventable, the disease ranks second only to malaria in terms of prevalence and socio-economic importance (Adenowo *et al* 2015). Currently, it has been reported that it affects almost 240 million people worldwide and more than 700 million people live in endemic areas with an annual death toll of 280,000 (Atalabi *et al* 2018; WHO 2023). Sub-Saharan African countries with about 90% of the world's total cases are the most affected regions. Nigeria is the most affected country in the world as 101.3 million Nigerians are living in close proximity to various endemic foci and 20 million people need to be treated annually (Oyeyemi *et al* 2020). School-age children (SAC) within 5 and 20 years, pregnant mothers, adolescents and young adults whose activities involve contact with freshwater bodies are at high risk of infection and prevalence usually

Abstract

Schistosomiasis is a neglected tropical disease prevalent in the sub-Saharan Africa. The present study determined the prevalence of urinary schistosomiasis in Ebonyi Local Government Area, Ebonyi State, Nigeria. Six hundred (600) mid-stream urine samples from 348 males and 252 females were collected from the study participants and screened for the presence and intensity of *Schistosoma haematobium* ova using urine centrifugation microscopy. Out of the 600 urine samples examined, 408 (68.00%) were infected. Males were more infected 242 (69.54%) than females 166 (65.87%). The highest prevalence (85.15%) was observed among age group 11-20 years while age group 31-40 years had the least (36.00%). There were significant differences in parasite prevalence among age groups and sexes ($p < 0.05$). It was also observed that 188 (31.33%) and 220 (36.67%) participants excreted < 50 eggs/10ml urine and ≥ 50 eggs/10ml urine, respectively with an average infection intensity of 36.72 eggs/10ml urine. This baseline study for Ebonyi LGA shows that urinary schistosomiasis is a public health problem in the study area. Integrated control approach is therefore recommended to ensure significant reduction or possible elimination of the disease in the area.

peaks between the ages of 8 and 20 years (Balogun *et al* 2022; WHO 2023).

These infections mainly affect the poor and communities that are characterized by poor sanitation and hygiene, lack of potable water, inadequate health facilities, poor housing, overcrowding, and squalid environment (Rujeni *et al* 2017; WHO 2020). Infection occurs when the parasite's larvae penetrate a person's skin during contact with infested water, often through fishing, swimming, bathing, fetching water and washing clothes (Umoh *et al* 2020; Peletu *et al* 2023). The length of exposure is proved to positively influence the prevalence and intensity of the infection (Anyolitho *et al* 2022; Aribodor *et al* 2023). Important species causing human schistosomiasis are *Schistosoma haematobium*, *S. mansoni*, *S. japonicum*, *S. mekongi*, *S. intercalatum* and *S. guineensis* (Rollinson 2009).

Typical signs of urinary schistosomiasis are macro and micro haematuria, dysuria, proteinuria and leukocyturia (Ross *et al* 2012; Jaureguiberry *et al* 2010). The risk of long-time morbidity such as anaemia and iron deficiency, lesion of the bladder and genital organs, kidney failure, child growth retardation and Human Immunodeficiency Virus (HIV) transmission are well established (Adenowo *et al* 2015; WHO 2023). At times, it gives rise to malignancies, which can lead to death. Mostly adults with few schistosome worms remain asymptomatic while nearly 80% of infected children show early symptoms and signs of the disease (WHO 2021). The drug of choice for the treatment of schistosomiasis is praziquantel and there is currently no vaccine for it. Integration of control programs such as health education, sanitation and personal hygiene and

supplemental mollusciciding have been adopted (WHO 2021).

Studies on urinary schistosomiasis in Ebonyi State have primarily focused on school aged children (Elom *et al* 2017; Agumah, *et al* 2019; Umoh *et al* 2020; Anorue *et al* 2021), adults (Anosike *et al* 2006) or both (Afiukwa *et al* 2019; Chiamah *et al* 2019). However, studies have identified areas of prevalence indicating a need to assess the burden more comprehensively in the state. The choice of the study area was necessitated by lack of information on the disease, presence of open water bodies, absence of good road network and intense farming activities going on in the area. It then became imperative that the true picture of the disease in the area is known. Such information will aid relevant stakeholders in designing control programmes and advocacies as the World Health Assembly targets year 2030 for elimination of schistosomiasis as public health and socio-economic problem and the interruption of its transmission is getting near.

Materials and methods

Study area

This study was carried out in Ebonyi Local Government Area (LGA) of Ebonyi State, Southeast Nigeria. The LGA covers an area of approximately 1,739 square kilometers and is situated between latitude 5°38' and 6° 22'N and longitude 7°42' and 8° 25'E (Figure 1). It is composed of eleven communities (Ishieke, Ndiebor Ishieke, Agalegu Ishieke, Mbeke Ishieke, Ndiegu Ishieke, Agalegu-Onuenyim Ishieke, Nkaleke-Echara, Nkaleke-Echara Unuhu, Nkaleke-Echara Ndiebor, Nkaleke-Echara Ndiegu and Oguzoro-onweya) with a projected total population of 198,500 in 2022 by National Population Commission of Nigeria (2023). There are two distinct seasons in the area; wet and dry seasons with the former beginning from April to October while the latter occurs from November to March. The mean annual rain fall is 240cm with relative humidity of 75±10%.

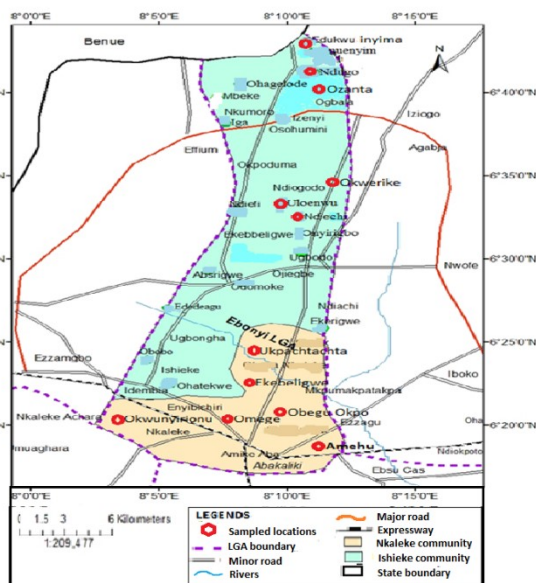


Figure 1. Map of Ebonyi LGA showing sampled areas

The LGA is characterized by the presence of various bodies of water. Some of these are man-made pools, quarry pits, ponds, streams and rivers, some of which are habitats to aquatic plants that may aid in the breeding of the snail intermediate hosts of schistosome. There is also no good road network within the study communities and human vehicular movements along the parts usually create marks on the road, which has the capacity to hold water when it rains. These usually in turn form breeding grounds for snail vectors that may harbour viable eggs of *S. haematobium* introduced in the water through open defecation and urination. The eggs may eventually emerge as cercaria and locate humans that come in contact with water. The major occupation of the people of Ebonyi LGA is farming. Other economic activities of the residents of the study area include palm wine tapping, fishing and snail gathering. These activities may expose them to the site of schistosome infection.

Ethical considerations

Ethical approval was obtained from Ebonyi State Ministry of Health with clearance number EBSHREC/22/02/2022/43.

Advocacy visit/consent

The ethical approved letter from the State Ministry of Health, introduction letter from the Department of Applied Biology, Ebonyi State University, Abakaliki and informed consent forms were taken to the Chairman Ebonyi LGA Officers in-charge (OIC) of the Primary Health Care Centres, Ebonyi LGA Chapter as well as community leaders for their approval of the study in their respective communities. Informed consent of the participants was sought through community mobilization and sensitization. The residents were informed of the potential benefits and the procedures of the research in local dialect and were allowed to consent freely. For under aged children, consent was got from their parents/caregivers.

Study design/ selection of communities and villages

This was a community-based cross-sectional study. Using Simple Random Sampling, six out of the eleven communities that make up the LGA were selected by lottery method. From the six communities (Agalegu-Onuenyim Ishieke, Ishieke, Ndiegu Ishieke, Nkaleke-Echara Ndiebor, Nkaleke-Echara Ndiegu and Nkaleke-Echara Unuhu), twelve villages (Amaehu Nkaleke, Edukwu-inyima Ishieke, Ekebeligwe Nkaleke, Ndiechi Ishieke, Ndiugo Ishieke, Obegu-Okpo Nkaleke, Okerike-Agalegu Ishieke, Okwunyionu Nkaleke, Omege-Echara Nkaleke, Ozanta Ishieke, Ukpachacha Nkaleke and Uloenwu Ishieke) were selected using the same method and fifty (50) participants from each of the 12 villages were selected. The selection criteria were based on proximity to water sources and those whose occupations predispose them to the infection. A Global Positioning System (GPS) was used to get the accurate location of the villages in longitudes and latitudes. This method had been used elsewhere by Umoh *et al* (2020) and Anorue *et al* (2021).

Sample collection

A total of 600 urine samples were collected from 600 participants between September and November, 2022 during house-to-house and school visitation. The urine samples were collected between the hours of 10am and 2pm following the guidelines of WHO (2012). Each participant was given a 20ml capacity clean, screw-capped and well labelled universal plastic container. The age, sex, village of the participant and sample number were noted on the containers to avoid mixing up the samples. The subjects were instructed on proper urine collection techniques and hygiene. Collected urine samples were put in a dark box containing ice pack to avoid hatching of the eggs as a result of exposure to light and transported quickly to Applied Biology Laboratory, Faculty of Science, Ebonyi State University, Abakaliki for analysis. Two drops of ordinary house hold bleach was added to the samples that were not analysed the same day to preserve *Schistosoma ova* (Cheesbrough 2006).

Laboratory techniques

Examination of the urine samples was done using definitive diagnosis (direct diagnosis – centrifugation). This was employed for the detection of *S. haematobium* eggs in the urine samples as described by Cheesbrough (2006). Eggs were identified as having terminal spine, golden yellowish in colour and elliptical in shape. For positive samples, egg counting was carried out and average count was recorded as number of eggs per 10ml of urine. Infection intensity, which is defined as the number of *S. haematobium* eggs contained in 10ml of urine was categorized as light (<50 eggs/10ml of urine) and heavy (≥ 50 eggs/10ml of urine) infections (Cheesbrough 2006). Infected persons were advised to visit any nearby health centre or Alex Ekwueme Federal University Teaching Hospital, Abakaliki for confirmation and treatment.

Data analysis

The data collected were validated on a daily basis to ensure accuracy, completeness and that there was no mix up. All data were entered into Microsoft Excel sheets and analysed using both descriptive and inferential statistics. Prevalence and intensities of *S. haematobium* at the various groups were tested for significance using t-test and values were considered significant at $p < 0.05$. All statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS) Version 21.

Results

Prevalence of urinary schistosomiasis in the study area

Out of the 600 urine samples examined for prevalence and intensity of *S. haematobium* infection, 408 (68.00%) were infected (Figure 2; Plate 1).

Prevalence and intensity of *S. haematobium* in relation to age groups in the study area

The highest prevalence (85.15%) of infection by age groups was among participants aged 11-20 years while 31-40 years old had the least (36.00%, Table 1). Among

all age groups, 188 (31.33%) subjects had light infection while 220 (36.67%) had heavy infection with overall mean intensity of 36.72 eggs/10ml of urine. The highest number of light infections 94 (36.72%) occurred in the age group 11-20 years and they also had the highest heavy infections 124 (48.44%) with a mean intensity of 38.22 eggs/10ml of urine while age group 21-30 years had the least of both light and heavy infections at 17 (29.31%) and 6 (10.34%), respectively with a mean intensity of 9.33 eggs/10ml of urine. There was no infection in age groups 41-50 and >50 years. Statistically, there was significant difference in parasite prevalence and intensity among age groups ($p < 0.05$).

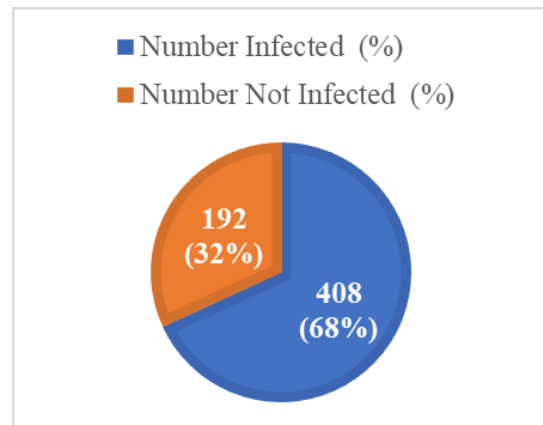


Figure 2. Prevalence of urinary schistosomiasis in the study area



Plate 1. Ova of *S. haematobium* encountered

Prevalence and intensity of urinary schistosomiasis in relation to sex

The prevalence of *S. haematobium* infection by sex is shown in Table 2. Higher prevalence (69.54%) was recorded among males than females (65.87%). Light intensity (<50 eggs/10ml urine) was higher in females at 87 (34.52%) than in males at 101 (29.02%), while heavy intensity (> 50 eggs/10ml urine) was higher in males at 140 (40.23%) than females at 80 (31.75%). The mean intensity (eggs/10ml urine) of 38.68 and 33.86 were observed in males and females, respectively. There was significant difference between the prevalence of infection among the sexes ($p < 0.05$) but there was no significant difference in intensity with respect to sexes of the participants ($p = 0.15$).

Prevalence of urinary schistosomiasis in relation to villages in the study area

Results showed that the highest prevalence of *S. haematobium* infections occurred in subjects from Okwerike-Agalegu Ishieke and Ekebeligwe Nkaleke (86.00% each) while subjects from Omege-Echara Nkaleke had the least (22.00%). Ekebeligwe Nkaleke

subjects had highest light infections 31 (62.00%) with mean intensity of 23.30 eggs/10ml of urine while Ndiechi Ishieke subjects had the highest heavy infections 33 (66.00%) with mean intensity of 50.23 eggs/10ml of urine. Statistically, there was significant difference in parasite prevalence and intensity among the villages studied ($p < 0.05$, Table 3).

Table 1: Prevalence and intensity of urinary schistosomiasis among age groups

Age (years)	Number Examined	Number Infected (%)	Intensity		Mean Intensity (Eggs/10 ml of urine)
			Number with Light Infection (%)	Number with Heavy Infection (%)	
1 – 10	194	149 (76.80)	59 (30.41)	90 (46.39)	40.01
11 – 20	256	218 (85.15)	94 (36.72)	124 (48.44)	38.22
21 – 30	58	23 (39.65)	17 (29.31)	6 (10.34)	22.61
31 – 40	50	18 (36.00)	18 (36.00)	0 (0.00)	9.33
41 – 50	29	0 (0.00)	0 (0.00)	0 (0.00)	0.00
>50	13	0 (0.00)	0 (0.00)	0 (0.00)	0.00
Total	600	408 (68.00)	188 (31.33)	220 (36.67)	36.72
p-values		0.04			0.03

Table 2: Prevalence and intensity of urinary schistosomiasis in relation to sex

Sex	Number Examined	Number Infected (%)	Intensity		Mean Intensity (Eggs/10ml of urine)
			Number with Light Infection (%)	Number with Heavy Infection (%)	
Male	348	242 (69.54)	101 (29.02)	140 (40.23)	38.68
Female	252	166 (65.87)	87 (34.52)	80 (31.75)	33.86
Total	600	408 (36.00)	188 (31.33)	220 (36.67)	36.72
p-values		0.017			0.15

Table 3: Prevalence and intensity of urinary schistosomiasis in relation to villages in the study area

Villages	No. Examined	No. infected (%)	Intensity		Mean Intensity (Eggs/10ml of urine)
			No. with light infection	No. with heavy infection	
Amachu Nkaleke	50	40 (80.00)	15 (30.00)	25 (50.00)	41.08
Edukwu-inyima Ishieke	50	24 (48.00)	14 (28.00)	10 (20.00)	30.50
Ekebeligwe Nkaleke	50	43 (86.00)	31 (62.00)	12 (24.00)	23.30
Ndiechi Ishieke	50	41 (82.00)	8 (16.00)	33 (66.00)	50.23
Ndiugo Ishieke	50	25 (50.00)	16 (32.00)	9 (18.00)	27.60
Obegu-Okpo Nkaleke	50	40 (80.00)	19 (38.00)	21 (42.00)	35.98
Okwerike-Agalegu Ishieke	50	43 (86.00)	13 (26.00)	30 (60.00)	44.74
Okwunyionu Nkaleke	50	40 (80.00)	25 (50.00)	15 (30.00)	28.38
Omege-Echara Nkaleke	50	11 (22.00)	7 (14.00)	4 (8.00)	27.73
Ozanta Ishieke	50	38 (76.00)	12 (24.00)	26 (52.00)	44.05
Ukpachacha Nkaleke	50	32 (64.00)	19 (38.00)	13 (26.00)	29.56
Uloenwu Ishieke	50	31 (62.00)	13 (26.00)	18 (36.00)	38.71
Total	600	408 (68.00)	192 (32.00)	216 (36.00)	36.72
p-values		<0.001			<0.001

Prevalence and intensity of urinary schistosomiasis in relation to communities

The prevalence of infection was highest (80.00%) in subjects from Nkaleke-Echara Unuhu community while the least (51.00%) was recorded in subjects from

Nkaleke-Echara Ndiebor community (Table 4). The highest number of light infections (50.00%) was observed in subjects from Nkaleke-Echara Ndiegu community while the least (21.00%) was in subjects from Ishieke Community. The highest number of heavy

infections (51.00%) was recorded in subjects from Ishieke community while the least (25.00%) occurred in both subjects from Nkaleke-Echara Ndiebor and Nkaleke-Echara Ndiegu communities. The highest mean intensity (eggs/10ml of urine) of 45.26 was recorded in Ishieke Community while the least mean

intensity of 25.97 was observed in Nkaleke-Echara Ndiegu community. The differences in the prevalence and intensity of *S. haematobium* infection among the sampled communities were statistically significant ($p < 0.05$).

Table 4: Prevalence and intensity of urinary schistosomiasis in relation to communities in the study area

Communities	Number Examined	Number Infected (%)	Intensity		
			Number with Light Infection (%)	Number with Heavy Infection (%)	Mean Intensity (Eggs/10ml of urine)
Agalegu Onuenyim	100	68 (68.00)	29 (29.00)	39 (39.00)	38.44
Ishieke	100	72 (72.00)	21 (21.00)	51 (51.00)	45.26
Ndiegu Ishieke	100	62 (62.00)	26 (26.00)	36 (36.00)	38.81
Nkaleke-Echara Ndiebor	100	51 (51.00)	26 (26.00)	25 (25.00)	34.19
Nkaleke-Echara Ndiegu	100	75 (75.00)	50 (50.00)	25 (25.00)	25.97
Nkaleke-Echara Unuhu	100	80 (80.00)	40 (40.00)	40 (40.00)	34.73
Total	600	408 (68.00)	192 (32.00)	216 (36.00)	36.72
p-values		0.00001			0.0001

Discussion

The overall prevalence of 68.00% obtained with microscopy, which is the gold standard for urinary schistosomiasis diagnosis is a pointer that the disease is actively being transmitted in the area. The result also suggests that the study area falls within the WHO classification as hyperendemic area (Ezeh *et al* 2019). The prevalence in the present study is higher than the findings of previous researchers in Ebonyi State, 27.00% by Elom *et al* (2017) in Onicha, 3.97% by Nwachukwu *et al* (2018) in Afikpo North, 59.00% by Agumah *et al* (2019) in Ezza North, 8.00% by Umoh *et al* (2020) in Ohaukwu and Ikwo and 13.10% by Anorue *et al* (2021) in Ohaukwu, Onicha and Ikwo. Similarly, it was equally higher than the 8.3% reported in Hausa communities in Kano State, Nigeria (Dawaki *et al* 2016), 25.60% in Anambra and Enugu, Nigeria (Onyishi 2010) and 48.00% reported for Wamakko Local Government Area, Sokoto State, Nigeria by Muhammad *et al* (2019). However, the prevalence was lower than the findings of Ibor *et al* (2015) in three rural communities (Okwel-Obudu (81.00%), Adim (74.5%) and Abini (71.00%)) of Cross River State, Nigeria. The variations between the present finding and those of earlier researchers can be attributed to the variations in the degree of exposure to the infection, awareness of the infection as well as the variation in the ecological conditions necessary for the breeding of the snail intermediate hosts of the parasites.

Age is generally recognized as one of the most important factors determining the severity of infection. The age related prevalence and intensity was highest among subjects within 11-20 years and declined gradually in older age groups 21-30 years while age groups 41-50 and >50 had no infection. Similar reports have been made by previous researchers (Agumah *et al* 2019 and Umoh *et al* 2021) who in their separate

studies reported higher prevalences in lower age groups than older groups. The present finding also corroborates the findings of Onyishi (2010) where both prevalence and intensity of *S. haematobium* infection peaked at the second decade of life before declining in older age groups. These are the most active age groups that frequently engage in activities that bring them in contact with infested water bodies, which are possible transmission sites. The observed drop in infection in the older age groups could be due to either a decrease in transmission rate due to reduced water contact or reduced survival and fecundity of parasitic worms already in the human host. This is consistent with the knowledge of slowly acquired immunity to parasitic infection (CDC 2020).

The sex-related pattern of distribution of infection among the inhabitants showed that males were more infected than their female counterparts. The higher prevalence in males may be attributed to the higher number of male participants sampled and their behavioural practices (outdoor activities), which they engage in more than their female counterparts who usually engage more in domestic activities. This result corroborates the reports of previous researchers in the state (Elom *et al* 2017; Afiukwa *et al* 2019; Agumah *et al* 2019), where differences in prevalence among the sexes were statistically significant. A close look at the prevalence of the infection across study locations showed significant difference among the six communities and twelve villages, which may be due to proximity to water bodies, their choice of water, unavailability and lack of access to borehole water and the number of younger age groups sampled in some communities and villages.

Considering the egg count intensity of the infection, most infected individuals had heavy infection (≥ 50 eggs/10ml urine) while a small proportion of the

population had light intensity (1-49 eggs/10ml urine). This agrees with the reports of Ozawara *et al* (2011) and Elom *et al* (2017) all in Ebonyi State. This could be as a result of some individuals being more exposed to infection than others owing to the differences in water contact. Individual differences in the immunological capacity of the inhabitants may be a contributory factor.

Conclusion

The 68.00% overall prevalence in this study has shown that urinary schistosomiasis is highly endemic in Ebonyi Local Government Area, Ebonyi State, Nigeria, and could be a threat to health and important socio-economic activities in the area. There is therefore, urgent need for the Local Government Area NTDs authority as well as that of the State Government to formalize and establish feasible control programmes in the area. It firmly points to the need for integrating community health education, mass diagnosis and mass treatment of members of the communities into Ebonyi State NTDs control programme. The rehabilitation and repair of the existing water borehole system in the communities should be effected.

Acknowledgement

We sincerely thank the Chairman, Ebonyi Local Government Area, the Traditional Rulers and the Village Heads of the study communities and villages, parents, caregivers and Head Teachers of the participating schools for permission granted to carry out this study and their unalloyed assistance during the urine sample collection.

Conflict of Interest

The authors declare no conflict of interest.

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ORCID

Emmanuela C. Okpete: 0009000520249641