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Prevalence of *Schistosoma haematobium* and Its Intermediate Hosts in Makurdi Metropolis

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Authors' contributions

This work was carried out in collaboration between all authors. Authors EUA and VUO designed the study. Author PSA and VUO performed the statistical analysis. Authors EUA, VUO and PSA wrote the protocol and wrote the first draft of the manuscript. Authors EUA, VUO and PSA managed the analyses of the study. Author PSA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Urinary Schistosomiasis (US) is a chronic water-borne infection caused by digenetic trematode belonging to the genus *schistosoma*, it is generally caused by *Schistosoma haematobium*. *Bulinus globosus* is a species of a tropical freshwater snail that acts as an intermediate host of *Schistosoma haematobium*. Aim: The study was aimed at ascertaining the prevalence of *Schistosoma haematobium* infection and to describe its intermediate hosts among school children in Makurdi.

Methodology: Snails were collected by hand picking and scooping net methods. An epidemiological survey research on urinary Schistosomiasis was undertaken from September to November 2017 among students that volunteered in the selected schools within Makurdi metropolis. A total of 97 freshwater snails were collected and 200 urine samples involving pupils aged between 5 to 18 years were collected and analyzed for the eggs of *Schistosoma haematobium* by microscopy using Urine Syringe Filtration Technique (USFT). Statistical analysis was performed using SPSS 20. Chi-square test was used to determine the significant difference between variables.

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Results: Out of the 97 species of freshwater snails that were caught 41(42.3%) was *Bulinus* spp. Of the 200 urine samples analyzed, 49(24.5%) were found to be infected with ova of *S. haematobium*. The infection was higher among males 30(25.6%) than females 19(22.9%) although the difference was not statistically significant (χ^2_{CAL}=0.19, χ^2_{TAB}=3.84). The prevalence of *Schistosoma haematobium* infection among school children in relation to age showed that ages 15-19 years had the highest prevalence 13(38.2%) and ages 5-9 had the lowest prevalence 3(8.5%). The statistical analysis also revealed that there is no significant difference (8.302) in *Schistosoma haematobium* infection among the four schools in the study area. The presence of many snail species especially the *Bulinus* spp and increased contact time with the *Schistosoma haematobium* infested freshwater habitat was thought to be responsible for the prevalence of the disease in the area. Finding of this study shows that urinary Schistosomiasis was found to have a low prevalence in the area studied and there is the need to intensified integrated control measures to reduce or completely eradicate the disease.

Keywords: Schistosoma haematobium; intermediate hosts; Makurdi; Metropolis.

1. INTRODUCTION

Urinary Schistosomiasis also called Bilharzias is a parasitic disease caused by a digenetic blood fluke of the genus *Schistosoma* called *Schistosoma haematobium*. *Schistosoma haematobium*is the causative agent of urinary Schistosomiasis The disease is the second most prevalent neglected tropical diseases after hookworm and remains an important public health problem globally especially in Sub-Saharan Africa [1]. *Schistosoma haematobium* infection is endemic in over 50 countries in Africa, [2]it was reported as the most devastating prevalent parasitic disease due to morbidity and mortality for developing countries in Africa [3].

School children of the age groups 5 to 15 often swim and fish in some of the water bodies around their school during breaks and vacations. Some of the pupils engage in fishing during vacation as seen in the study area. There have been reports on the high prevalence of urinary schistosomiasis in Makurdi and its environs [4, 5], hence the need to study the prevalence of urinary schistosomiasis and its intermediate hosts in Makurdi. Previous studies had reported a high prevalence of urinary schistosomiasis amongst children in two local government areas in Benue state (Buruku and Katsina-Ala) [4] with an overall prevalence of 41.5% among the 1,124 children examined. Another study carried out in Gboko, Benue State [4] reported a 41% prevalence of *S. heamatobium*. While a study in Keffi [5] reported 30.5% prevalence of *S.haematobium* among school children in Keffi town in Nassarawa state.

2. MATERIALS AND METHODS

Makurdi is the capital of Benue State of Nigeria. The city is located in central Nigeria along the Benue River and holds the base for the Nigerian Airforce aircraft squadrons. Makurdi has an estimated population of 500,797 persons. The major ethnic groups inhabiting the city are the Tiv, Idoma, Igede and etulo. It holds the Benue State University and the Federal University of Agriculture. It is located on latitude 7.7306°N and longitude 8.5561°E along the banks of the Benue River which is a major tributary to the Niger River.

2.1 Sampling Site for Urine Collection

The consent of the management of four different schools within Makurdi Local Government Area was sort for through a letter of introduction from the Head of the Department of Biological Sciences, Benue State University and an Ethical approval from the Benue State Ministry of Health to allow urine samples to be collected from their students. Sampling within all four schools was based on random selection. The four schools include; Daddy Memorial Nursery and Primary School. Yagba, Josephine Nursery and Primary School, North Bank, Holy Family Nursery and Primary School Kanshio and Local Government Education Authority Nursery and Primary School North Bank.

The sampling sites were water bodies that are at proximity to the schools sampled. Snails' samples were collected using the method of scooping nets and hand picking as described in Oguoma [6]. *Bulinus* spp snail which has been reported as intermediate hosts of *S.haematobium* [7] were collected from freshwater habitat found in Makurdi, Benue State.

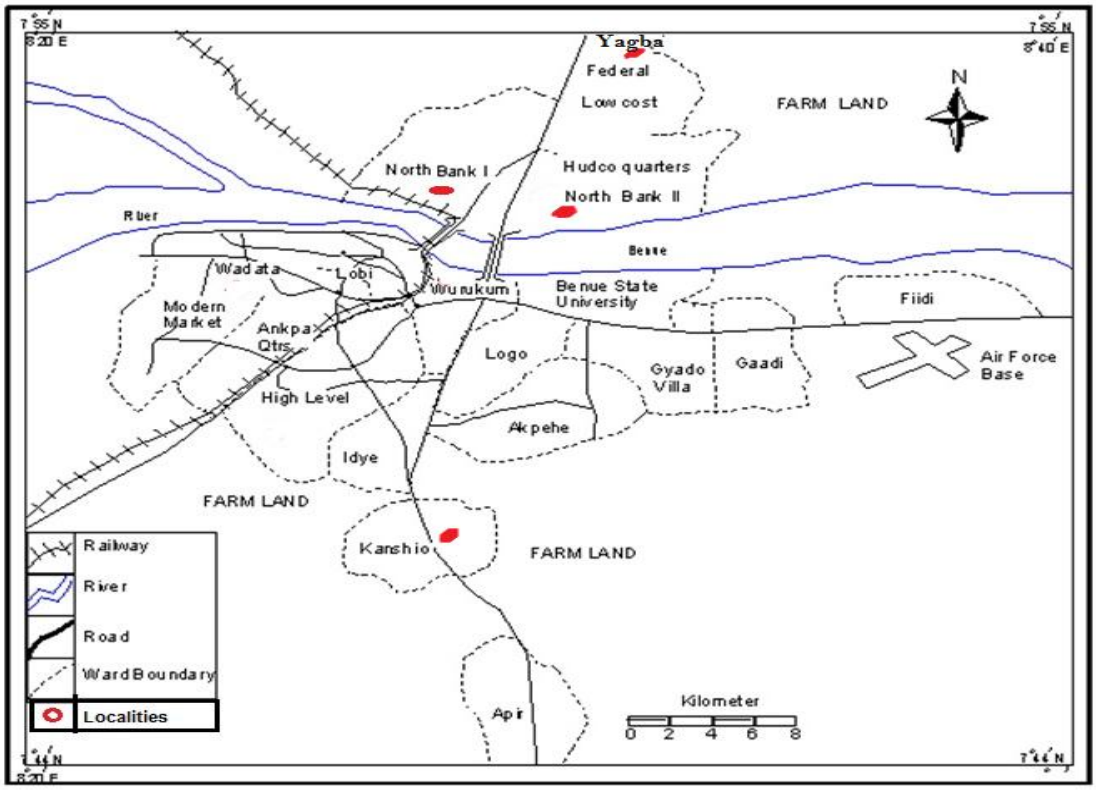

Fig. 1. Makurdi township showing sampled sites (source; google maps)

2.2 Sampling Materials

The following materials were used for the research: running water, a light microscope, a centrifuge, universal specimen bottles, slides, gloves, Polycarbonate membrane filter, detergent, 10ml syringe, laboratory coat, a record notebook, forceps, Questionnaires, scoop net, rain boots and a collection tray.

2.3 Ethical Clearance

Before the commencement of the study, a letter of introduction was obtained from the Head of Department, Biological Science, Benue State University, an official ethical clearance was obtained from the Benue StateMinistry of Health. The letter was followed up by enlightenment to the authorities of the above-mentioned schools where these samples were collected.

2.4 Study Design

The study was conducted from September to November 2017. Sampling was completely randomized, as there was no restriction whatsoever as to age, class, or sex. The research was conducted on every student that volunteered. A total of 200 students of those who volunteered were sampled at random from the four different schools.

A questionnaire was used in the primary school as the pupils were interviewed to provide information such as age, sex, class, the source of drinking water, bathing water and parental occupation.

Ten to fifteen millilitres (10- 15ml) to of Urine specimens were collected, using clean and sterile, wide-mouthed, screw-cap plastic containers according to WHO recommendation between the hours of 10 a.m. and 2 p.m to coincide with the period when excretion of *S. haematobium* eggs is highest [4].

The colour of the urine samples was noted, some smoky brown, bloody, turbid and cloud appearance was observed.

Each urine sample was poured into a clean 10ml test tube and properly labelled.

Chemical Examination of the urine was carried out on a sample using commercially prepared test-strip (Combi 9 urine test-strip) noting the various parameter Glucose, Protein, Blood, Urobilinogen, Nitrite, Bilirubin, pH, Ketone and Ascorbic acid.

Polycarbonate membrane filters (Millipore Comp.) of 13 mm diameter and 12-14 µm pore size were used for filtration of *Schistosoma haematobium* eggs from urine[8]. The filters were removed at the laboratory from filter holders using a blunt-ended forceps and transferred to a microscope slide, face upwards and stained with methylene blue [8].

The entire filter was systematically examined for eggs of *Schistosoma haematobium*. The number of eggs in the preparation was counted and recorded.

1-50 eggs per 10ml of urine were considered as light infection, 51-200 eggs per 10ml of urine as moderate infection and over 200 eggs per 10ml of urine as heavy infection [8; 9].

On examination of the samples using the microscope, the parasite, *Schistosoma haematobium*, was identified by the presence of its ova or egg. The eggs or ova of *S. haematobium* have a characteristic terminal spine, are large, oval in shape and pale yellow-brown in color. In most cases, the presence of the ova in urine is associated with the presence of pus cells and red blood cells (RBCs) [8].

The data were analyzed using the chi-square test with a P-value of 0.05. The chi-square test was used to determine if the observed frequency of occurrence of any value conformed to the expected frequency of that value. All data were entered into an Excel spreadsheet, checked for errors and analyzed using SPSS for Windows (version 15.0, SPSS Inc, Chicago, USA). Simple percentages were used to calculate the prevalence of infection amongst the students sampled. Pearson Chi-square was used to analyze the prevalence of urinary schistosomiasis and to assess the associations between the demographic characteristics of the study subjects and the findings of the test samples.

3. RESULTS

Two hundred (200) urine samples of subjects from across four different schools within Makurdi LGA were collected and examined for ova of *S. haematobium*, 117 male and 83 female school children were involved as indicated in Table 1 below.

An overall prevalence of 49 (24.5%) school children tested positive for *S. haematobium* infection. Males recorded a higher prevalence of 30 (25.6%) than females 19 (22.9%) Table 3 below.

Table 1 shows the different prevalence of the infection in different areas within Makurdi LGA. Daddy Memorial Nursery and Primary School and Holy Family Nursery and Primary School, Kanshio showed a prevalence of 15.1% and 20.5% to the infection respectively. LGEA Nursery and Primary School show the highest prevalence of 37.9% and Josephine international school north bank shows the lowest prevalence of 10.3%. Upon chi-square analysis of the data in Table 1, the results revealed there was a significant difference in the prevalence recorded in the different schools (χ^2_{CAL}=13.77, χ^2_{TAB}=7.81 and df = 3). Table 2 shows the Abundance of freshwater snails in the different freshwater bodies areas located close to the various schools that were sampled for schistosoma infection within Makurdi LGA. A total of 97 freshwater snails were sampled. The dam close to Daddy Memorial Nursery And Primary School had a total of 22(22.6%) snails while that of Holy Family Nusery And Primary School, Kanshio had a total of 21(21.6%). Local Government Education Authority (L.G.E.A) Nursery And Primary School had the highest number of 36(37.1%) and Josephine International School North Bank shows the lowest number of 18(18.5%). Table 3 shows the prevalence of *S. haematobium* infection in relation to sex distribution. More males than females volunteered for the study; males tested positive to the infection with a prevalence of 25.6% while females with a prevalence of 22.9% Upon chi-square analysis of the data in Table the results revealed there was no significant difference between the prevalence of both sexes (χ^2_{CAL}=0.19, χ^2_{TAB}=3.84 and d.f = 1).

Table 4 shows the age distribution of the prevalence of the infection. School children between the ages 15-19 are most infected with a prevalence of 38.2%, with children between the ages 5-9 recording the lowest prevalence of 8.5%. The study reveals that school children with in all ages are infected with the parasite. Upon chi-square analysis of the data in Table 4, the

Table 1. Prevalence of *S. haematobium* Infection among School Children In Makurdi LGA

School	No. examined	No. infected (%)
Holy family Nursery & primary school Kanshio	39	8(20.5)
LGEA Primary school North Bank.	79	30(37.9)
Daddy Memorial Primary School North Bank.	53	8(15.1)
Josephine international school North Bank	29	3(10.3)
Total	200	49(24.5)

(χ^2_{CAL}=13.77, df = 3).

Table 2.Abundance of freshwater snails in the different water bodies areas located close to the various schools

School	Type of fresh water snail				
	Melanoides spp	***Bulinus globolus***	***Bulinus forskali***	***Bulinus succiniodes***	**other types**
Holy family nursery & primary school. Kanshio.	3	4	3	2	9
LGEA primary school North Bank.	15	7	2	4	8
Daddy memorial primary School,North Bank.	5	11	2	0	4
Josephine Int'l School North Bank	4	3	3	0	8
TOTAL	27	25	10	6	29

results revealed there was no significant difference between the prevalence of the different age groups amongst the school children (χ^2_{CAL}=8.302, χ^2_{TAB}=5.99and d.f = 2).

Table 3. Sex Distribution of *S. haematobium* among School Children Examined

Sex	No. examined	No. infected (%)
Male	117	30(25.6)
Female	83	19(22.9)
Total	200	49(24.5)

(χ^2_{CAL}=0.19and d.f = 1)

Table 4. Age distribution of *S. haematobium* infection among school children in Makurdi LGA

Age	No. examined	No. infected (%)
5-9	35	3(8.5)
10-14	131	33(25.2)
15-19	34	13(38.2)
Total	200	49(24.5)

(χ^2_{CAL}=8.302, d.f = 2)

Some plants were found to be associated with some freshwater snails (intermediate host of *S. haematobium*) as they were attached to the roots and leaves of these plants. These plants included the following.

1. Water lilly (Nymphaea lotus)
   Scientific classification
   Kingdom: Plantae
   Clade: Angiosperms
   Order : Nymphaeales
   Family : Nymphaeaceae
   Genus : Nymphaea
2. Bind weed (Convovulus arvensis)
   Other names include; field bindweed,European bindweed.
   Scientific classification
   Kingdom: Plantae
   Clade: Angiosperms
   Clade: Eudicots
   Clade: Asterids
   Order : Solanales
   Family : Convolvulaceae
   Genus : Convolvulus
   Species: *C. arvensis*
3. Creeping Jenny (Lysimachia nummularia)

   Other names include;

   Money wort, herb two pence and two penny thot.
   Scientific classification
   Kingdom: Plantae
   (unranked): Angiosperms
   (unranked): Eudicots
   (unranked): Asterids
   Order : Ericales

Family : Primulaceae
Genus : Lysimachia
Species: *L. nummularia*

4. DISCUSSION

This work revealed a total prevalence of 49 (24.5%) for *S. haematobium* infection. This means only 49 school children out of the 200 respondents were infected by *S. haematobium* at Makurdi LGA. This is higher to reports with an overall prevalence rate of 17.8% [10], also earlier study recorded a prevalence rate of 15.7% [9] and a prevalence rate of 17% of the infection within Gboko town [5]. This could be attributed to contact with water contaminated with the cercariae of the parasite. The low prevalence observed in Josephine international school North Bank as compared to the three other schools. This could be due to the fact that Josephine international school is a private school and is mostly attended by middle class persons and a greater percentage of her students' source their bathing and drinking water from boreholes which correlates with less contact with contaminated water. LGEA primary school north Bank, on the other hand, has a greater number of her students depending on well and stream water and is located in the rural region of Makurdi LGA. The school is a public school and it's attended by pupils whose parents are low class.

The sex distribution of *S. haematobium* infection among school children in makurdi LGA showed a higher prevalence rate in males 30(25.6%) than in females 19(22.9%), this is similar to a previous [11] on the prevalence of the infection. Prevalence of urinary schistosomiasis is known to be generally higher among males than females [2,4,10,12] this difference in prevalence is however statistically not significant. The prevalence of *S. haematobium* infection in relation to age indicates that the prevalence is highest in the age group 15-19 and lowest in the age group 5-9. The difference in prevalence is however not significant. This is similar to reports from previous studies [3,5,13,14] on the prevalence of the infection in different study areas in Nigeria. The low prevalence recorded within the 5-9 age groups may be due to less exposure to epidemiologic factors that predispose school children to the infection.

The prevalence of *Schistosoma haematobium* to the parasite was compared with the abundance of freshwater snails and the various plant species where they are attached to. Most intermediate hosts of human *Schistosoma* parasites belong to *Bulinus.*

North bank location which had the highest number of snails (54) correlates with LGEA nursery and primary school which the highest rate of infection. The high prevalence of *S. haematobium* in Northbank location might be due to the abundance of surface water, which enhances the development of high snail population, human water contact behavior and environmental factors that affect snail population favourably [15].

A high number of freshwater snail signifies a high number of cercariae shed and this invariably increases the incidence of infection [16].

Water Snail populations fluctuated strongly decreasing towards the end of rainy season. The preference for different environmental conditions such as abundant microflora, oxygen content and other physicochemical factors could be one reason why the water snail populations showed marked differences in each locality. Another factor could be the natural behavioral mode of adaptation which is different for each species. *Melaniodes spp* is a quiet water, surface feeding snail and could be washed down to the dam easily. It finds a resting place when the speed of water current becomes greatly reduced whereas *B. globosus* can cling to or settle to the bottom of the water and later come out to the surface. This would be made easier by the rocky nature of the substratum or bed of the Ichwa dam along the road to the Federal University of Agriculture,

Table 5. Plants found in freshwater bodies at the various locations

Location	No. examined	No. of fresh water snails	Species of plant
Kanshio	39	21	Water lilly and Bind weed
North Bank.	108	54	Water lilly, Bind weed, Creeping Jenny
Yagba	53	22	Water lilly and Bind weed
Total	200	97	

Makurdi. also [16] large numbers of *B. globosus* occurred in habitats that were slightly polluted with faeces or decaying vegetation. Careless discharge of effluent, piggery and domestic wastes may be another reason why more snails were recorded at dams close to the LGEA nursery and primary school. Though there was no particular trend in the variation of prevalence, it could be said from the result that increase in snail populations may result in an increase in the infection of humans by schistosome cercariae with increased human water contact activities.

The species involved can be identified by the shape of the outer shell. This was based on the fact that the school children come in contact with open bodies of water.

School children that that was found close to the dam and streams located at the north bank had the highest prevalence of the infection compared with those who were usually in contact with fresh water snail in the various dams. Notably, those school children who frequented and had prolonged contact with streams or rivers had the highest prevalence compared with those who rarely frequented open bodies of water as they come in contact with the intermediate host more often.

Species of Plants associated with the intermediate host were also found in these areas where the snails were abundant, from the table, most species of plants associated with the parasite were located at the north bank

5. CONCLUSION

The results from this study reveal that *S. haematobium* infection has a prevalence rate of 24.5% amongst school children within Makurdi LGA, with the parasite was noted to affect the rural population of school children more than those who lived within the township region of the LGA. The study reveals Male school children are more infected than females although this is insignificant. Also, school children within the age group 15-19 years have been revealed to be more infected by the parasite. The study reveals that school children who expose themselves to water from wells and streams are more affected by the parasite than those who do not. Also, school children whose parents are farmers are more susceptible to infection by the parasite than others. This points to the fact that epidemiologic factors that enhance susceptibility to the infection are still very much existent within the study area. These include ignorance, parental influence, poverty and poor personal hygiene.

Lack of potable water, exposure to contaminated water, exposure to the intermediate host, lack of health education and poor personal & public hygiene contribute to the spread of the infection.

Symptoms in persons infected with *S. haematobium* vary dramatically, ranging from mild symptoms to severe damage of the urinary tract including the kidney and bladder. It is in view of the above that it is suggested that the prevention and control of the disease be a major priority by both individuals and the Government.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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