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Transmission potentials of urinary schistosomiasis in Selected Local Government areas (LGAS) in Ogun State

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Abstract

Urinary schistosomiasis, a neglected tropical disease caused by Schistosoma haematobium, is prevalent in sub-Saharan Africa, including Ogun State which was rated the most endemic state in the country for the disease. The disease was found to be most endemic among school-age children. Water contact and presence of appropriate snail intermediate host is a major factor in the transmission of schistosomiasis. This study aimed to assess the transmission potential of urinary schistosomiasis in ten selected Local Government Areas (LGAs) across Ogun State by examining the presence of Bulinus snails, the intermediate host of S. haematobium, and evaluating the interaction of residents with local water bodies. A total of 790 Bulinus snails were collected, with 17% found to be infected with cercariae of S. haematobium. The study also revealed significant interaction of the local population with the water bodies indicating active transmission of schistosomiasis and contributing to the spread of the disease in the area. The infection rate and the interaction of residents with the local water bodies were found to be significant in the study area. The findings underscore the need for enhanced public health interventions, including education on the risks of water contact, improved sanitation, and consistent distribution of praziquantel to control the disease.

Keywords*: Schistosomiasis, intermediate host, endemic, cercariae, transmission*

INTRODUCTION

Schistosomiasis is a neglected tropical disease (NTDs) caused by digenetic blood trematode worms of the family Schistosomatidae (Ekpo et al., 2017). Okwori (2014) reported that the disease was classified as the global second most important human parasitic disease after malaria by the World Health Organization (WHO). Over 200 million persons were affected, while about 700 million persons worldwide are estimated to be at risk of schistosomiasis infection (Bajiro et al., 2016). More than 90% of the infection population was found in sub-Saharan Africa, while about 150,000 deaths are recorded annually in Africa from schistosomiasis (Hailegebriel et al., 2020).

Urinary schistosomiasis is caused by Schistosoma haematobium (Aula et al., 2021). Major factors in the disease transmission include contact with contaminated water bodies and inadequate sanitation. The trend and scale of the disease burden in Sub-Saharan Africa varies with marginalized and impoverished environments having the highest infection rates (Houweling et al., 2016). These populations are identified with limited access to clean water, low socio-economic status as well as inadequate sanitation. Increase in the progression of schistosomiasis in the region is

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complicated with devastating and long-lasting effects.

People working in contact with natural water bodies especially women and children continue to be at great risk of schistosomiasis infection across Sub-Saharan Africa (Navas et al., 2016). Houweling et al. (2016) reported that there would be ultimate reduction in the population prevalence of schistosomiasis when maximum prevention is achieved among these susceptible groups as this can reduce the transmission rate among the general population. Lack or inadequate knowledge, negative beliefs and attitudes about the disease, poor sanitation and risky water practices have been attributed to the increased risk of infection among those groups in countries across Sub-Saharan Africa. Redekop et al. (2017) also observed that low educational status among women to be an important predictor of infection.

The transmission of S. haematobium is completed in two hosts. Man is the definitive or primary host, while the genus of Bulinus snail is the intermediate hosts. The intermediate host of schistosomiasis shed the cercariae into water. Inside the water, the cercariae come in contact with the definitive host which is human being and enter into the body through penetration of the skin (McManus et al., 2018).

The report of Ezeh et al. (2019) indicated that Ogun State is the most endemic state in Nigeria, while Uthman et al. (2024) reported high prevalence of schistosomiasis among school-age children in Ogun State. Hence, the broad objective of this study is to examine the transmission potentials of urinary schistosomiasis in selected Local Government Areas (LGAs) in Ogun State.

MATERIALS AND METHODS

Study Area

The study was conducted in ten selected Local Government Areas (LGAs) across the three geo-political zones in Ogun State, Nigeria. Ogun State falls in the tropical rain forest zone and is inhabited by the Yoruba race of the Nigeria Southwest community. Ogun State is bordered to the north by the states of Osun and Oyo, to the south by Lagos State, to the west by the Republic of Benin, and to the east by Ondo State. It falls within the coordinates 6.9980° N, 3.4737° E. It has twenty LGAs with an approximate population of 3.7million people (NPC, 2006). The ten LGAs selected for the study are as follows: Abeokuta North (Ogun river), Ado-Odo/Ota (Totowu river), Ifo (Akinsinde river), Ijebu North (Omi river), Ikenne (Uren river), Imeko/Afon (Opotoloko river), Odeda (Sokan river), Ogun Waterside (Sowore river), Remo North (Ajayi river) and Yewa North (Roori river) LGAs.

Snail Sampling and identification

A river was randomly selected in each of the LGAs and was sampled for the presence of water snails. Snail sampling was carried out at about 8:00am. During each visit, a period of 30 minutes was spent at each of the streams and different parts of it were sampled. Snails were collected from pebbles, aquatic plants, fallen leaves and twigs. All snail specimens collected were transported to the laboratory in buckets with perforated covers. The snails were identified, sorted into species. The identification of snails was done based on the guidelines described by Brown and Kristensen (1993) and Danish Bilharziasis Laboratory, (1980). The B. globosus species in the snails were taken to the laboratory for examination.

Schistosome infection determination

In the laboratory, the B. globosus snail species were screened for patent infection by exposing each snail in test-tube containing dechlorinised water to direct sunlight for about 6 hours. The water was thereafter examined under the microscope. In cases where no cercariae were observed, the snails were taken through prepatent screening. To do this, each small-sized snail specimen was crushed between two glass slides. Fluid from the soft tissue was picked with micropipette and observed under the microscope. For large-sized snails, each of the specimens was crushed with mortar and pestle and put in a petri dish containing water and are then dissected by slitting open the mantle cavity. Microscopic examinations were then carried out using dissecting microscope.

Questionnaire administration

Structured questionnaires were administered to 1,812 school-age children living near the rivers. The survey assessed water usage, hygiene practices, and awareness of schistosomiasis. Responses were evaluated using a Likert scale, with a mean score compared against a median of 3.0.

Data analysis

Descriptive statistics were computed using SPSS version 22. Chi-square tests were used to analyse the association between snail infection rates and human behaviour. A p-value < 0.05 was considered significant.

RESULTS AND DISCUSSION

A total of 790 Bulinus snails were collected in the ten sampled rivers across the State. The Bulinus snails collected were tested for presence of cercariae of schistosome. Table 1 showed the distribution of the Bulinus snails collected and those tested positive for cercarial infection in the selected LGAs in the study area from June, 2023 to May, 2024.

The results showed that there was no Bulinus snail collected in the month of January, 2024 except in Ogun Waterside LGA. Bulinus snails were only collected in Imeko/Afon, Ogun Waterside and Yewa North LGAs in the month of February, 2024. Bulinus snail was not found in Ikenne and Remo North LGAs throughout the period of study. It was not also found in Abeokuta North, Ifo and Odeda LGAs in the month of December, 2023. Meanwhile, cercarial infection was not found among the Bulinus snails collected in Abeokuta North, Ado Odo/Ota and Odeda LGAs in August, 2023, Odeda and Ogun Wasterside LGAs in October, 2023, Yewa North LGA in February, 2024, Ado Odo/Ota LGA in March and April, 2024 and as well as in Ado Odo/Ota and Odeda LGAs in May, 2024. The highest collection of Bulinus snail was in Ogun Waterside LGA while the lowest was in Odeda LGA. There was no collection of Bulinus snail in Ikenne and Remo North LGAs throughout the study period.

A total of 134 (17%) of the Bulinus snails collected were shown to be infected by cercariae (Table 2). The highest infection rate was observed in Yewa North LGA, while Odeda LGA had the lowest cercarial infection of the Bulinus snail. The infection rate was statistically significant ($p < 0.001$) in the study area.

Table 1. Distribution of monthly collection of Bulinus snails in the selected LGAs in Ogun State

	Abeokuta North	Ado Odo/ Ota	Ifo	Ijebu North	Ikenne	Imeko / Afon	Odeda	Ogun Water side	Remo North	Yewa North	Total	%
Jun, 2023	9	5	11	11	0	8	2	18	0	9	73	9.24
Jul, 2023	10	5	7	9	0	10	4	11	0	11	67	8.48
Aug. 2023	11	10	14	4	0	8	4	13	0	9	73	9.24
Sep. 2023	12	5	16	12	0	9	9	9	0	10	82	10.38
Oct. 2023	8	6	13	7	0	5	6	5	0	4	54	6.84
Nov. 2023	16	10	11	12	0	6	4	11	0	11	81	10.25
Dec. 2023	0	11	0	14	0	7	0	19	0	15	66	8.35
Jan. 2024	0	0	0	0	0	0	0	26	0	0	26	3.29
Feb. 2024	0	0	0	0	0	4	0	23	0	5	32	4.05
Mar. 2024	10	5	7	15	0	9	0	20	0	6	72	9.11
Apr. 2024	12	6	7	17	0	13	5	14	0	12	86	10.89
May, 2024	10	5	15	10	0	11	4	13	0	10	78	9.87
Total	98	68	101	111	0	90	38	182	0	102	790	100
%	12.41	8.61	12.78	14.05	0	11.39	4.81	23.04	0	12.91		

Keys: % = Percentage, Jan. = January, Feb. = February, Mar. = March, Apr. = April, Jun. = June, Jul. = July, Aug. = August, Sep. = September, Oct. = October, Nov. = November, Dec. = December.

Table 2. Distribution of *Bulinus* snails and infection rates by LGA.

LGAs	Snails Collected	Cercarial Infected Snails	Infection Rate (%)
Abeokuta North	98	9	9.18
Ado Odo/Ota	68	8	11.76
Ifo	101	14	13.86
Ijebu North	111	15	13.51
Ikenne	0	0	0.00
Imeko/Afon	90	16	17.78
Odeda	38	2	5.26
Ogun Waterside	182	40	21.98
Remo North	0	0	0.00
Yewa North	102	30	29.41
TOTAL	790	134	17.00

Chi-square (x^2) = 42.73, d = 9, $p < 0.001$

Interaction of respondents with water bodies in the study area

The opinions of one thousand eight hundred and twelve (1,812) respondents were collected across the selected LGAs in Ogun State in relation to their interactions with the respective water body in their areas. Tables 2 showed the responses of respondents with respect to their knowledge and interactions with water body in each of the LGAs. The mean and the median scores were calculated. With the median score is 3.00, any mean above the median is categorized as high and as such affirms the question significantly, while any mean below the median was categorized as low and as such negates the question.

The result shows that the means are more than the median in all the questions to determine the interactions of residents with rivers in their respective LGAs. This implied general positive interactions of the residents with the rivers in their respective LGAs. The frequent contacts of people with the water from the rivers exposed the people to water transmitted diseases like schistosomiasis.

Table 3. Respondents' interaction with rivers in the selected LGAs in Ogun State.

	Rivers	LGAs	Number	Mean	Median
The stream is very important to the area	Ogun	Abeokuta North	207	3.51	3.00
	Totowu	Ado-Odo/ Ota	201	4.00	3.00
	Akinsinde	Ifo	247	3.34	3.00
	Omi	Ijebu North	232	3.41	3.00
	Uren	Ikenne	194	3.19	3.00
	Opotoloko	Imeko/ Afon	132	3.92	3.00
	Sokan	Odeda	158	3.62	3.00
	Sowore	Ogun Water Side	197	3.18	3.00
	Ajayi	Remo North	121	3.55	3.00
	Roori.	Yewa North	123	3.62	3.00
		Total	**1,812**	**3.53**	**3.00**
The stream is used for laundry and washing of vehicles	Ogun	Abeokuta North	207	2.96	3.00
	Totowu	Ado-Odo/ Ota	201	3.10	3.00
	Akinsinde	Ifo	247	3.34	3.00
	Omi	Ijebu North	232	3.00	3.00
	Uren	Ikenne	194	2.33	3.00
	Opotoloko	Imeko/ Afon	132	3.21	3.00
	Sokan	Odeda	158	2.88	3.00
	Sowore	Ogun Water Side	197	3.31	3.00
	Ajayi	Remo North	121	2.75	3.00
	Roori.	Yewa North	123	3.98	3.00
		Total	**1,812**	**3.09**	**3.00**
The water is used for drinking by the people in the area	Ogun	Abeokuta North	207	3.46	3.00
	Totowu	Ado-Odo/ Ota	201	4.00	3.00
	Akinsinde	Ifo	247	3.44	3.00

	Omi	Ijebu North	232	3.56	3.00
	Uren	Ikenne	194	3.28	3.00
	Opotoloko	Imeko/ Afon	132	3.38	3.00
	Sokan	Odeda	158	3.56	3.00
	Sowore	Ogun Water Side	197	3.21	3.00
	Ajayi	Remo North	121	3.59	3.00
	Roori.	Yewa North	123	3.54	3.00
		Total	**1,812**	**3.50**	**3.00**
People bath directly or indirectly in the water	Ogun	Abeokuta North	207	3.42	3.00
	Totowu	Ado-Odo/ Ota	201	4.00	3.00
	Akinsinde	Ifo	247	2.98	3.00
	Omi	Ijebu North	232	3.36	3.00
	Uren	Ikenne	194	3.07	3.00
	Opotoloko	Imeko/ Afon	132	3.18	3.00
	Sokan	Odeda	158	3.15	3.00
	Sowore	Ogun Water Side	197	3.06	3.00
	Ajayi	Remo North	121	2.84	3.00
	Roori.	Yewa North	123	3.01	3.00
		Total	**1,812**	**3.21**	**3.00**
People in the area dispose their wastes into the water	Ogun	Abeokuta North	207	3.17	3.00
	Totowu	Ado-Odo/ Ota	201	3.37	3.00
	Akinsinde	Ifo	247	2.75	3.00
	Omi	Ijebu North	232	2.72	3.00
	Uren	Ikenne	194	2.61	3.00
	Opotoloko	Imeko/ Afon	132	3.80	3.00
	Sokan	Odeda	158	2.25	3.00
	Sowore	Ogun Water Side	197	3.51	3.00
	Ajayi	Remo North	121	2.91	3.00
	Roori.	Yewa North	123	3.13	3.00
		Total	**1,812**	**3.02**	**3.00**
Animals from the stream are consumed by the people in the area	Ogun	Abeokuta North	207	3.23	3.00
	Totowu	Ado-Odo/ Ota	201	3.11	3.00
	Akinsinde	Ifo	247	3.18	3.00
	Omi	Ijebu North	232	3.61	3.00
	Uren	Ikenne	194	3.08	3.00
	Opotoloko	Imeko/ Afon	132	3.15	3.00
	Sokan	Odeda	158	3.27	3.00
	Sowore	Ogun Water Side	197	3.10	3.00
	Ajayi	Remo North	121	3.35	3.00
	Roori.	Yewa North	123	3.68	3.00
		Total	**1,812**	**3.28**	**3.00**

DISCUSSION

Examination of collected Bulinus snails

Bulinus snails are the intermediate hosts of urinary schistosomiasis. Apart from Ikenne and Remo North LGAs where no Bulinus was collected, the snails were collected from rivers sampled in other LGAs in the state. This implied that majority of the rivers visited across the state are potential transmission sites of urinary schistosomiasis.

Since the cercarial infection of Bulinus snails collected from the rivers across the LGAs in the state was significant ($P<0.001$), it showed consistent release of cercariae into the water bodies. However, the findings of Uthman et al. (2024) also established the prevalence of urinary schistosomiasis in the study area.

Interaction of respondents with water bodies in the study area

Responses from all the respondents show that the water bodies are very important to people in the area and also that people majorly visit the rivers for the purpose of laundry, washing of vehicles and search for water animals. Apart from majority of respondents from Abeokuta North, Ikenne, Odeda, and Remo North LGAs, majority of respondents in other LGAs indicated that people drink water from the rivers. It was only

respondents from Ifo and Remo North LGA that expressed that people did no bath with water from the rivers. Some of the respondents from Ifo, Ijebu North, Ikenne, Odeda and Remo North held that wastes were not disposed into the rivers in the area.

The confirmation of the selected rivers across the LGAs in the state as transmission foci for urinary schistosomiasis due to the presence of cercariae infected Bulinus snails and establishment of continuous and frequent interactions of the residents with the rivers had shown that there is ongoing and active transmission of urinary schistosomiasis in the study area. Earlier researchers including Okeke et al. (2020) had established that the Bulinus snails are the intermediate hosts of schistosomiasis. It was observed that the reasons for the interactions include laundry, washing of vehicles, bathing, scouting for water snails and other animals as well as fetching of water for sundry domestic uses.

CONCLUSION

The abundance and infection of the Bulinus snail intermediate host of S. haematobium in the rivers sampled in the study area made the water bodies susceptible transmission sites for schistosomiasis. There is active and continuous transmission of the urinary schistosomiasis in the study area since the people had frequent interaction with various water bodies across the State, majority of which had been indicted for the presence of Bulinus snails which is the intermediate host of the disease. Scarcity of alternative source of water as well as quest for water snails and other aquatic animals are some of the factors that increased the contacts of people to the infected water bodies where humans are being infected with the cercariae of S. haematobium.

RECOMMENDATIONS

Since it has been established that people are susceptible to infection due to the frequent contacts with water bodies which harbour the snail intermediate host of schistosome, there should be mass orientation of the people in the state on the effect of the direct contact with the water bodies and education of the populace about the incidence of the disease as well as the need to maintain good hygienic environment.

In order to reduce the number of snail vectors in the state, the government and stakeholders should implement integrated vector control, which includes the use of environmentally friendly molluscicides and management techniques. To achieve effective control, strategies should be developed to map infection foci as well as the presence of snail intermediate hosts in various contaminated water bodies.

The government should also improve her effort towards providing quality health services for the people and provision of potable water. These would greatly reduce susceptibility of the people in the area to schistosome infection and access to healthcare. To combat the spreading trend of schistosomiasis throughout the State, it would also be essential to provide children with a safe recreational water source that is powered on a regular basis, motorized pipe-borne water supply for family use, and adequate health education.

Establishment of snail vectors should be controlled in irrigation canals by dredging and re-concreting the canals.

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