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Schistosomiasis Transmission and Water Contact Pattern in River Ureje in Ado-ekiti Local Government Area, Ekiti State

[1]A.O. Omonijo, [2]S.O. Asaolu and [3]I.E. Ofoezie
[1]Department of Biotechnology, Federal University Oye Ekiti, Nigeria
[2]Department of Zoology, Obafemi Awolowo University, Ile- Ife, Nigeria
[3]Institute of Ecology and Environmental Studies, Obafemi Awolowo University, Ile-Ife, Nigeria

Corresponding Author: A.O. Omonijo, Department of Biotechnology, Federal University Oye Ekiti, Nigeria

ABSTRACT

An investigation of human water contact patterns and *Schistosoma* infection was carried out in River Ureje for a period of 12 months with a view to relate the contact patterns to schistosomiasis transmission potential in the river. Generally, human water contact activities in the study area revealed a marked seasonal variation in both the frequency and duration of water contacts ($p<0.01$). More contacts were observed in the rainy season than in the dry season. A cross-sectional study on the sex and age-specific water contact activities showed that the frequency and duration of contact that males made with the water were significantly more than females ($p<0.01$). Personal and economic activities were the principal activities of both males and females. The highest frequency of contact was recorded among school children and teenagers of age groups (10-19 years) and young adults (20-29 years). The distribution of contacts also varied significantly among the various sites investigated ($p<0.01$) to 41.9% of water contact pattern occurring on site, S2, the same site S2 where snails that were infected with human schistosome ceracariae were recovered in January making it appear that site S2 was the transmission site in River Ureje.

Key words: *Bulinus*, infection, schistosomiasis, snail, cercaria, human water contact

INTRODUCTION

Schistosomiasis is one of the major parasitic infections in the tropical areas of the world. Five hundred million people were estimated to be at risk in the world (Larotski and Davis, 1981) while 200 million people were estimated to have schistosomiasis in 74 countries, 85% of whom live in sub-Saharan Africa (Chitsulo *et al*., 2000). In Ekiti State, schistosomiasis infection has been reported to be endemic (Olofintoye, 2004; Adewole *et al*., 2001) although, adequate knowledge of its spread and transmission in the study area is not fully known. However, in order to achieve an effective control strategy, it is necessary to understand the infection pattern of snail intermediate host and the human water contact pattern among the regular users of the water body.

Many studies have shown that determination of age and sex patterns of exposure from the corresponding pattern of water contacts can be used to implement control strategies in endemic areas (Owojori *et al*., 2006a; Ofoezie *et al*., 1998).

The purpose of human water contact studies is to observe who in a study population visits natural water bodies, the purpose of visits, the site of contacts, when and duration of contact and finally the type of exposure (Jordan and Webbe, 1993). The data obtained are analyzed to determine the relative risks of types of contact in the different age groups. In transmission studies,

information from water contact observation and snail studies are used to identify transmission sites and in combination with findings on human parasitological profile, helps to explain the relationship between risk and actual infection in a community (WHO, 1979).

This study therefore investigated the infection patterns of each established intermediate host species and relate this to human water contact patterns among the regular users of the water body with a view to identify the risky water contacts as well as a transmission site in the river.

MATERIALS AND METHODS

Study area: The study was carried out in River Ureje in Ado Local Government Area, Ekiti State. River Ureje is located between Latitudes 07°35[1]-07°40[1]N and Longitudes 005°10[1]- 005°15[1]E. It flows from Ikere Ekiti in Ikere Local Government to Ado in Ado Local Government Area from there it flows to Ilokun in Ifelodun Local Government (Fig. 1).

Human water contact patterns: Seven sites (S1-S7) were observed for human water contact patterns on River Ureje. These sites were chosen based on their ease of accessibility and frequency of human visit. The seven sites were visited twice every month for a period of twelve months (February 2009-January 2010). Observation of human water contact patterns, degree of body contact and record of biodata (sex, age) of individual subjects were made from 8:00-18:00 h.

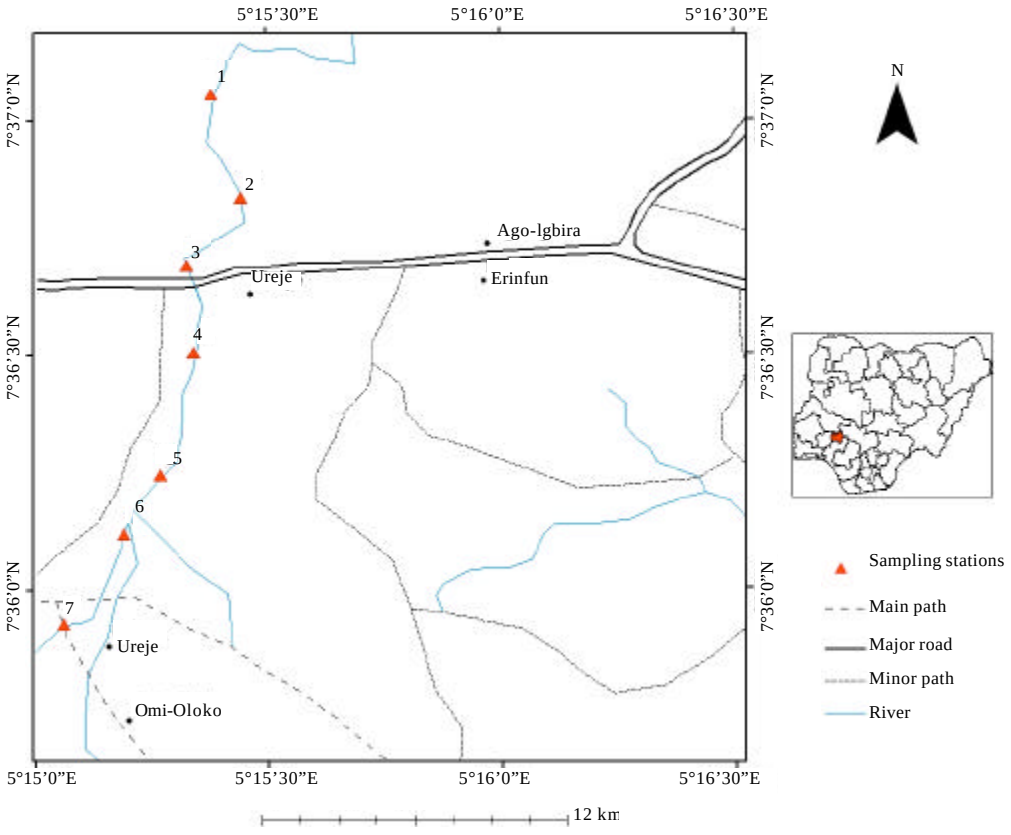

Fig. 1: River Ureje at Ado-Ekiti Local Government Area, Ekiti State showing the sampling stations, Adapted from the Map of Ado-Ekiti through the Ministry of Lands and Housing, Ado-Ekiti, Ekiti State

Water contact activities were classified as domestic (fetching water, washing cloth and motorcycle), recreational (swimming and playing in water), personal (bathing, walking and washing limbs) and economic (fishing, watering vegetables, washing farm produce and farm equipments). These contacts were further reclassified on the basis of extent of body exposure as limited, partial or complete (Chandiwana, 1987; Wilkins, 1987).

Snail study: Each station was randomly sampled fortnightly for snails using a long-handled scoop-net designed to WHO (1965) specification. Snail sampling was carried out for each of seven designated spots and lasted for a period of 40 min. From each spot six passes of the scoop were taken across each semi-circular curve and dragging along on-shore direction. Each dragged scoop was searched for about 10 min for snail. Snails that were found were transported to the laboratory in pre-labelled plastic containers containing damp and decaying leaves, covered with perforated lids. The snails were sorted and identified to species according to the method by Brown and Christensen, 1993. The established host species were measured and examined for *Schistosoma* infection by crushing method (Teesdale *et al*., 1986).

Statistical analysis: Contingency tests were used to determine the differences in the frequency of contact between sites, time of day, seasons and age groups. Mann Whitney test was used for testing differences in duration of contact. Kruskal-Wallis (one way analysis of variance) was used for factors with more than two levels (Siegel and Castellan, 1988). Total sum of snails from each site was obtained to give each month's value.

RESULTS

Human water contact studies: A total of 14400 min was spent at the collection sites to study patterns of human water contacts in River Ureje. From observation of human water contacts pattern, contacts were observed in 5058 min during which eleven different primary water contact activities were identified (Table 1) from a total of 277 exposures. The primary activities recorded include fetching, bathing, washing farm produce, watering vegetables, washing limb, washing cloth, fishing, washing cutlass, swimming, walking and washing motorcycle. The duration of individual contacts ranged from about 2 min of fetching for more than 2 h of fishing. Three main activities were found to be common-washing limb, washing farm produce and bathing.

A breakdown of 5058 min of total contacts showed that 2384 min (47.1%) were spent on personal purpose (i.e., washing limb, bathing), 1082 min (22.5%) on domestic (i.e., washing cloth, washing motorcycle and fetching), 130 min (2.6%) on recreational (swimming) and 1462 min (28.9%) on economic (fishing, watering vegetables, washing farm produce and tools). Out of the 277 exposures, 44 (15.9%) were partial exposures, 189 (68.2%) were limited exposures and 44 (15.9%) were complete exposures. The combined frequency of both limited and complete exposures constituted 83.5% of the total observed contacts while partial exposures constituted only 16.2%. Also of the 277 contacts recorded, males made 196 (70.8%) and females made only 81 (29.2%) (Table 1).

Variation in human water contact between sites: The distribution of contacts varied significantly among the various sites investigated ($p<0.01$). Table 1 shows the result of a contingency test on differences in the frequency of the various activities between the seven sites in River Ureje. The pattern of human water contact activity was dependent on the nature, accessibility and suitability of each site. The sites that were most frequently visited were less

Table 1: Types, duration and frequency of water contact recorded at seven water contact sites in River Ureje Ado-Ekiti (February 2009-January 2010)

	No. of contact			Duration of contact (min)		
Activity	Male	Female	Total	Minimum	Maximum	Total
Fetching	0	2	2	2	5	7
Bathing	36	3	39	10	30	1560
Washing farm produce	1	41	42	25	100	652
Watering vegetables	2	2	4	30	120	210
Washing limb	88	20	108	3	7	762
Washing cloth	12	13	25	10	100	795
Fishing	4	0	4	60	250	430
Washing cutlass	34	0	34	5	10	170
Swimming	5	0	5	10	30	130
Walking	7	0	7	4	10	62
Washing motorcycle	7	0	7	50	100	280
p-value		0.000			0.000	
Total	196	81			250	
Purpose of contact						
Personal	131	23	154	3	50	2384 (47.1%)
Domestic	19	15	34	2	12	1082 (22.5%)
Recreational	5	0	5	10	30	130 (2.6%)
Economic	41	43	84	25	250	1462 (28.9%)
p-value		0.000			0.000	
Total	196 (70.8%)	81 (29.2%)	277	2	250	5058
Degree of contacts						
Partial	40	4	44 (15.9%)	2	250	817
Limited	115	74	189 (68.2%)	2	100	2551
Complete	41	3	44 (15.9%)	10	30	1690
p-value		0.000	277		0.000	
Total	196	81	277	2	250	5058

swampy (Table 2). Site 2 was the most significant and most frequently visited for nearly all activities except watering of vegetables with 116 persons visiting the site ($p<0.01$) (Fig. 2). Many people returning from farms and those crossing the river were seen taking their bath often on this site. Farming activities were observed at all sites investigated at the river. In general, washing limbs, vegetables, clothes and farm tools were found to be activities of importance. Washing of motorcycle was observed only in sites S1 and S2 (Table 2).

Variation of contact behavior by age and sex: Water contact behaviour in the sampling sites was age and sex related. Table 1 shows the result of a contingency test for differences in frequency of contact. The number of males that made contact with the water was significantly more than females ($p<0.01$). The duration of contact was also significantly higher in males than in females. The contact rate increased from age group 0-9 years and reached the peak in the age group 10-19 years after which it declined to nearly zero in age group older than 60 years. 17 persons of age group 0-9 years had contact with the water with peak increase of 88 persons of age group 10-19 years. However, only 2 persons of age group older than 60 years had contact with the water ($p<0.01$) (Table 3) . People of age group 10-19 years dominated personal and recreational activities ($p<0.01$) while people of age group 20-29 years dominated domestic and economic activities ($p<0.01$) (Fig. 3).

Table 2: Frequency of water contact activities recorded at seven sites in River Ureje, Ado-Ekiti (February 2009-January 2010)

	No. of contacts								
Activity	S1	S2	S3	S4	S5	S6	S7	Total	(%) of overall
Fetching	2.0	0.0	0.0	0.0	0.0	0.0	0.0	2	0.72
Bathing	8.0	26.0	5.0	6.0	3.0	0.0	4.0	52	18.80
Washing farm produce	3.0	11.0	6.0	0.0	8.0	8.0	10.0	46	16.60
Watering vegetables	0.0	0.0	0.0	0.0	2.0	2.0	0.0	4	1.40
Washing limb	10.0	42.0	5.0	9.0	4.0	16.0	0.0	86	31.10
Washing cloth	8.0	15.0	5.0	5.0	0.0	6.0	0.0	39	14.10
Fishing	2.0	1.0	0.0	1.0	0.0	0.0	0.0	4	1.40
Washing cutlass	2.0	7.0	2.0	1.0	2.0	7.0	0.0	21	7.60
Swimming	2.0	3.0	0.0	0.0	0.0	0.0	0.0	5	1.80
Walking	0.0	7.0	0.0	0.0	0.0	0.0	0.0	7	2.50
Washing motorcycle	7.0	4.0	0.0	0.0	0.0	0.0	0.0	11	4.00
Total	44.0	116.0	23.0	22.0	19.0	39.0	14.0	277	
(%) of overall	15.9	41.9	8.3	7.9	6.9	14.1	5.1	100	100.00

p<0.01, S: Sites where contacts were observed

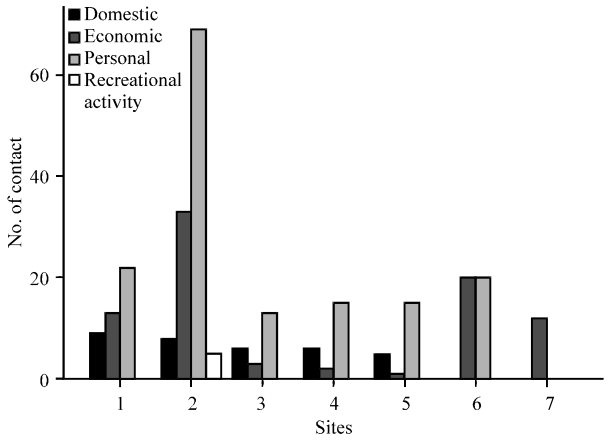

Fig. 2: Frequency of domestic, economic, personal and recreational water contact activities by site in River Ureje, (February 2009-January 2010)

Water contact pattern was highly seasonal. More contacts were observed in the rainy season than in the dry season. Frequency and duration of contact varied significantly between the seasons and between months ($p<0.01$). The highest number of contacts was observed in August while the lowest occurred in January (Fig. 4).

The longest duration was recorded in August and the shortest in January. (Table 4) showed the result of a contingency test for differences in frequency of contact among the different months. The data showed a unimodal pattern with a peak in August for both frequency and duration of contact. Frequency was 61 and duration of contact was 1708 min. Economic activities were seen throughout the study period with higher occurrence in rainy season. Peak personal activities occurred in the rainy season but peak domestic activities occurred in the dry season. Recreational contacts were mostly seen during the rainy season when water level is high. The pattern and duration (min) of water contacts during the day from 8.00-18.00 h varied significantly ($p<0.01$) as

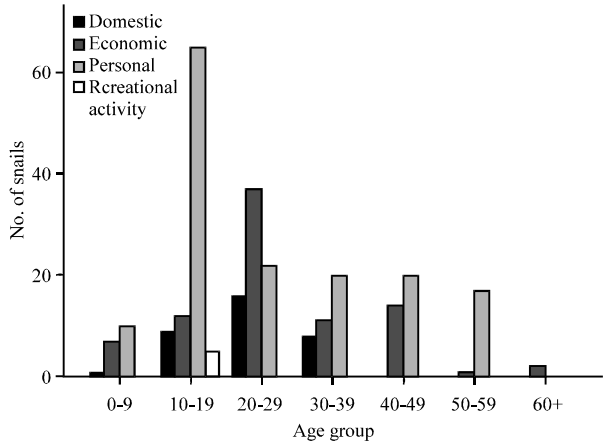

Fig. 3: Frequency of domestic, economic, personal and recreational water contact activities by age at seven sites in River Ureje (February 2009-January 2010)

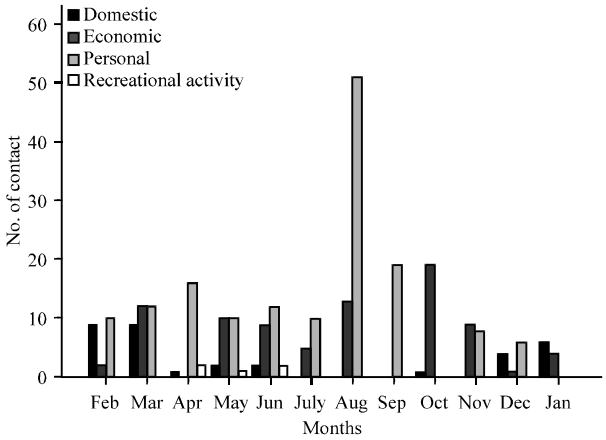

Fig. 4: Frequency of domestic, economic, personal and recreational water contact activities by months at seven sites in River Ureje (February 2009-January 2010)

Table 3: Age and sex related pattern of human water contact at River Ureje, Ado-Ekiti (February 2009-January 2010)

	Total contacts			Total duration (min)		
Age group (years)	M	F	Total	M	F	Total
0-9	17	0	17	40	0	40
10-19	65	23	88	1712	320	2034
20-29	60	16	76	1500	300	1800
30-39	20	20	40	510	226	736
40-49	22	12	34	100	110	210
50-59	10	10	20	130	48	178
60+	2	0	2	60	0	60
p-value	0.000		0.000			
Total	196	81	277	4052	1006	5058

M: Male, F: Female

Table 4: Monthly variation in water contact pattern at seven sites in River Ureje, Ado-Ekiti (February 2009-January 2010)

Months	Total contact	Total duration (min)
February	25	12
March	31	220
April	19	314
May	22	300
June	25	278
July	15	400
August	61	1708
September	19	420
October	20	534
November	17	320
December	12	350
January	11	94
p-value	0.000	0.000
Total	277	5058

Table 5: Variation in the pattern of human water contact between 8.00 and 18.00 h GMT in River Ureje, Ado-Ekiti (February 2009-January 2010)

Time of day	Total contacts	Total durations (min)
8-9	6	300
9-10	37	965
10-11	30	900
11-12	30	300
12-13	26	320
13-14	76	1753
14-15	20	300
15-16	30	100
16-17	15	100
17-18	7	20
p-value	0.000	0.000
Total	277	5058

shown in Table 5. Six persons visited the water at 8.00-9.00 h and a peak of 76 persons was observed to have visited the water at 13.00-14.00 h. Also the least duration of 20 min at 17.00-18.00 h and a peak of 1753 min at 13.00-14.00 h was observed.

The report from this study is an indication that the school children, teenagers and young adults are the population at risk of schistosomiasis infection and it will provide a guide for the treatment of people in the study area.

Snail study

Variation in snail density between sites: A total of 2534 snail specimens was caught in River Ureje during this study. These were 446 (17.4%) specimens of *Bulinus globosus*, 122 (4.8%) *B. truncatus*, 264 (10.3%) *Potadoma freethi*, 1628 (63.6%) *Melanoides tuberculata*, 58 (2.3%) *Lanistes varicus* and 16 (0.6%) *Biomphalaria pfeifferi*. Three species out of these snails are established intermediate hosts of schistosomiasis. These were: *B. globosus*, *B. truncatus* and *B. pfeifferi*. In terms of abundance *M. tuberculata* was the most abundant followed by *B. globosus*, *P. freethi*, *B. truncatus*, *L. varicus* while the least abundant was *B. pfeifferi*. Site S2 was the most

Table 6: Site distribution and density of snail species found in river Ureje (S1-S7) in Ado-Ekiti, (February 2009-January 2010)

Site	*Bulinus globosus*	*Bulinus truncatus*	*Lanistes varicus*	*Melanoides tuberculata*	*Potadoma freethi*	*Biomphalaria pfeifferi*	Total
S1	64	50	8	473	40	5	640
S2	102	20	31	59	60	3	275
S3	102	25	1	193	41	5	367
S4	37	10	5	224	34	1	311
S5	56	5	10	438	30	2	541
S6	41	12	3	240	59	0	355
S7	44	0	0	1	0	0	45
p-value	0.000	0.000	0.000	0.000	0.000	0.000	
Total	446 (17.4%)	122 (4.8%)	58 (10.3%)	1628 (63.6%)	264 (2.3%)	16 (0.6%)	2534

S: Sites where contacts were observed

densely populated with *B. globosus* while site S1 was the most densely populated with *M. tuberculata*. The density of all the six snail species observed in River Ureje varied significantly among sites as revealed by Table 6 . Snail infection with *Schistosoma* was site and season specific. Out of the bulinid snails examined for infection, only 2 (0.5%) specimens of *B. globosus* were found infected with longifurcate-pharyngeate distome cercaria. The snails were recovered from site S2 in January during the mid dry season.

DISCUSSION

Several authors who have worked on the relationship between human water contact patterns and schistosomiasis infection in endemic areas reported various patterns of contacts in the water bodies investigated (Chandiwana, 1987; Owojori *et al.*, 2006b). The results of human water contact activities in the study area shows a marked seasonal variation in both the frequency and duration of water contacts. A similar trend was reported by Owojori *et al.* (2006b). On the contrary, Ugbomoiko (1998) observed peak water activity during the dry season and least in the periods coinciding with heavy rainfall in Ikpeshi, Edo State Nigeria.

Personal and economic activities were found to be the principal activities of both males and females and are therefore considered as risky contacts. The highest frequency of contact recorded among school children and teenagers of age groups (10-19 years) and young adults (20-29 years) conforms to the reports of several workers in tropical Africa (Dalton and Pole, 1978; Tayo *et al.*, 1980; Kloos *et al.*, 1983; Husting, 1983; Chandiwana, 1987; Ugbomoiko 2004; Owojori *et al.*, 2006b). The report from this study is an indication that the school children, teenagers and young adults are the population at risk of schistosomiasis infection in the study area.

Snail study showed marked seasonal variation in density. Pulmonate species were more abundant in late dry season and tend to reduce in density in rainy season. Peak abundance of the snails was recorded in March for *B. globosus*, *B. truncatus* and *B. pfeifferi*. Generally, snail numbers increased in the dry season-but began to decline near the end of the dry season due to decrease in water level in the river. This is in agreement with the observation of Barnish and Prentice (1982). Although, highest water contacts were recorded in August, the pattern of seasonal variation observed in this study suggests that transmission occurs in dry season. However, a wide range of chemical, physical and biological factors influence the occurrence and spatial distribution of aquatic gastropods in different geographical locations, seasons and habitats (Brown, 1994, Ugbomoiko, 1998, Ofoezie, 1999). All the 3 pulmonate snails recorded in the study are known

intermediate hosts of schistosomiasis. *B. pfeifferi* is host to *S. mansoni* in Nigeria (Cowper, 1973; Adewunmi *et al.*, 1990) while *B. globosus* and *B. truncatus* are known intermediate hosts of *S. haematobium* in Nigeria (Hira, 1967, 1968, 1969; Hira and Muller, 1966; Christensen *et al.*, 1986; Ofoezie, 1997) and in other parts of Africa (Cowper, 1973; Doumenge *et al.*, 1987). The report of the presence of Bulinid snails in the study area agreed with the work of Olofintoye who had earlier reported the prevalence of schistosomiasis infection in the study area (Olofintoye, 2004).

Earlier authors have reported various cercariae from several established intermediate hosts of schistosomiasis (Donges, 1977; Ndifon and Umar-Yahaya, 1990; Owojori *et al.*, 2006b). However, only one furcocercous cercaria-longifurcate pharyngeate distome cercaria was recovered in this study. Infected snails were specimens of *B. globosus* recovered from site S2- the only site suspected as sole transmission site in River Ureje. The fact that infected snails were found only in this site and only in January emphasized the focality and seasonality of the schistosomiasis transmission (Webbe, 1962; Chu and Klumpp, 1978). All studies concerned with the cercarial shedding of human schistosomes have shown the circadian nature of the shedding pattern and have demonstrated maximum emission during the illuminated period of the light cycle (Theron, 1984). The 13.00-14.00 h peak for frequency and duration observed in this study is not insignificant in that it coincides with the period of maximum emission of cercaria which is capable of sustaining schistosomiasis infection in the area. The infection rate with schistosome cercariae recovered from *B. globosus* in this study appears low when compared with some past records in Nigeria (Owojori *et al.*, 2006b; Hira, 1969). However, report from literature confirms that generally, high infectivity in humans is sustained by low observed infection rate in snails (Mafiana and Beyioku, 1998). The low rate of infection in snails (0.50%) recorded in the present study could sustain a high level of transmission. The finding in the present study indicates a favourable situation for reports of schistosomiasis infection observed in the study area.

CONCLUSION

This study has established the transmission of urinary schistosomiasis in River Ureje in Ado-Ekiti Local Government Area of Ekiti State. Since personal and economic contacts were considered as the principal contacts in the water body, people making such contacts should be educated on the implication of their involvement with the water. While it may be difficult to refrain them from making such contacts because most people in the community rely on this water body, the frequency and duration can be reduced. Also, the report from this study is an indication that the schoolchildren, teenagers and young adults are the population at risk of schistosomiasis infection and it will provide a guide for the treatment of people and help in eradicating schistosomiasis infection in the study area. It is recommended that future studies should be carried out to determine the level of infection in the study area so as to help in implementing control measures against the disease.

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