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Transmission of Urogenital Schistosomiasis in Owena Reservoir Area, Ondo State Nigeria: Nexus Between Different Pathogenic Host Factors

Bayo Joshua Peletu[1], Ifeanyi Emmanuel Ofoezie[2], Aloysius Obinna Ikwuka[3*]

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ABSTRACT

A total of 25,482 snails, comprising 4,258 (16.7%) *Bulinusglobosus*; 213 (0.8%) *Bulinustruncatus*; 4,040 (15.9%) *Bulinusforskalii*; 4,770 (18.7%) *Biomphalariapfeifferi*; 6,024 (23.6%) *Melanoidestuberculata*; 1,730 (6.8%) Potadomafreethi; and 4,447 (17.5%) Pilaovata were collected over a period of 24 months during monthly site visits to Owena Reservoir Area which comprises of three communities namely Owena, Baiken and Kajola in Ondo East Local Government Area, Ondo State, Nigeria. Abundance of each of the snail species varied significantly ($p<0.05$), spatially, seasonally and annually throughout the period under study. The established intermediate snail host species were *Bulinusglobosus* and *Bulinustruncatus* for *Schistosomahematobium* transmission. The overall infection rate among *Bulinusglobosus* was 3.2% as 136 snails were found to shed cercariae out of 4,258 collected and examined for trematode infection. This occured at site 4 located in Kajola community. None of the *Bulinustruncatus* species was found to shed cercariae.

INTRODUCTION

Schistosomiasis is a disease caused by parasitic trematode worms of the genus *Schistosoma* (Weinland, 1858). Out of these trematode worms infecting humans, only *S.hematobium* and *S.mansoni* are of great medical importance. While *S.hematobium* causes urogenital schistosomiasis, the other species - *S.mansoni* causes intestinal schistosomiasis. The parasite *S.hematobium* is found in the venous plexus draining the urinary bladder of humans (Babatunde, 2013; WHO, 2014). Infections result from the parasites depositing terminal, spined eggs which clog the venous plexuses, thus preventing blood flow which leads to the bursting of the veins, allowing blood and eggs to enter the urinary bladder resulting in the characteristic symptom of blood in the urine (hematuria) (Ekpo, 2010; Peletu, 2016; Peletu, 2023b; WHO, 2014; WHO, 2015). In Nigeria, it has been reported that urogenital schistosomiasis is endemic in 23 out of the 36 states of Nigeria. Ondo State is one of the states where urogenital schistosomiasis occurs (Peletu, 2020; Peletu, 2023a; Peletu, 2023b; Peletu, 2023c). However, epidemiological information of the disease in Ondo State, especially in the three communities bordering Owena Reservoir/ Dam, is still very scanty. Information on the transmission of urogenital schistosomiasis and human water contact patterns in Ondo State is scanty despite the widespread distribution of the disease in some of its neighboring states (Peletu, 2020).

Water contact activities exposed the communities to urogenital schistosomiasis infection. It is recommended that health education on the transmission of urogenital schistosomiasis should be focused on mass sensitization, to emphasize the role commonly played by water contact activities of snail hosts (Peletu, 2023c). Contamination habits such as urination and defecation in the water bodies should be discouraged. People should avoid wading into infected water bodies indiscriminately (Peletu, 2023c).

Urogenital schistosomiasis is highly endemic in three communities (Owena, Baiken and Kajola) of Ondo State, Nigeria (Peletu, 2023a). There is a need for sustainable controls targeted towards behavioral modifications by mass sensitization and provision of pipe-borne water facilities and modern toilet systems with a view to discouraging people from having contact with cercacriae-infected water bodies (Peletu, 2023a).

Urogenital schistosomiasis and its concomitant hematuria are prevalent in Owena, Baiken and Kajola communities of Ondo East Local Government Area, Ondo State, Nigeria. In all three communities of Owena, Baiken and Kajola, urogenital schistosomiasis would be most difficult to treat and/or eradicate in Baiken community (Peletu, 2023b). Efforts by stakeholders should be geared towards implementing full control strategies such as the provision of pipe-borne water, modern toilet facilities, and regular chemotherapy controls to the school-age children and adults of the age group 21–30 years (Peletu, 2023b).

S.hematobium is transmitted by the intermediate host belonging to the genus *Bulinus* (Akinwale, 2010; Fradsen, 1984; Peletu, 2010). In the last decade, there has been considerable advancement in the knowledge of the basic relationship between *Bulinus* and *S.hematobium* (WHO, 2015).

[1] Department of Allied Health & Biological Sciences, College of Health Sciences (CHS), Legacy University, Banjul, Gambia
[2] Institute of Ecology & Environmental Studies, Obafemi Awolowo University, Ile-Ife, Nigeria
[3] Department of Clinical Sciences, College of Health Sciences (CHS), Legacy University, Banjul, Gambia
[*] Corresponding author's e-mail: aloysiussweet@yahoo.com

The resolutions of snail populations in a given aquatic habitat are influenced by abiotic factors such as temperature, ions e.g., sodium, calcium, biochemical oxygen demand (BOD), dissolved oxygen (DO), sunlight, alkalinity, water current velocity, rainfall, and biotic factors such as predator-prey interactions/relationships, food availability, habitat competitions, hydromicrophytes coverage (Ofoezie, 1995; Ofoezie, 2002; Peletu, 2010; Theron, 1986; Udonsi, 1990). The twenty-four month study (August 2013 – July 2015) was carried out with a view to determining the nexus between the different pathogenic host factors, the seasonal and spatial distribution of infection patterns (cercariae shedding) of identified local intermediate snail host species in the transmission of urogenital schistosomiasis in Owena Reservoir Area, Ondo East Local Government Area, Ondo State, Nigeria. This is especially necessary when planning sustainable control programs of the disease in the study area.

MATERIALS AND METHODS

Study Area

The twenty-four month study (August 2013 – July 2015) was carried out in Owena Reservoir and its adjoining three randomly selected communities namely Owena, Baiken and Kajola, which are rural to semi-urban settlements located in Ondo East Local Government Area, Ondo State, Nigeria. Owena Reservoir lies between latitudes $7^0 00' - 7^0 30'$N and longitudes $5^0 00' - 5^0 30'$E (see Fig. 1). The residents are generally peasant farmers, petty traders, local teachers, oil mill workers, fishermen, and auxiliary health officers. Owena Reservoir has a catchment area of approximately 900km2. Its major tributaries are rivers Owena and Anu. According to the National Population Commission (2006), the population of the communities is approximately 9,000.

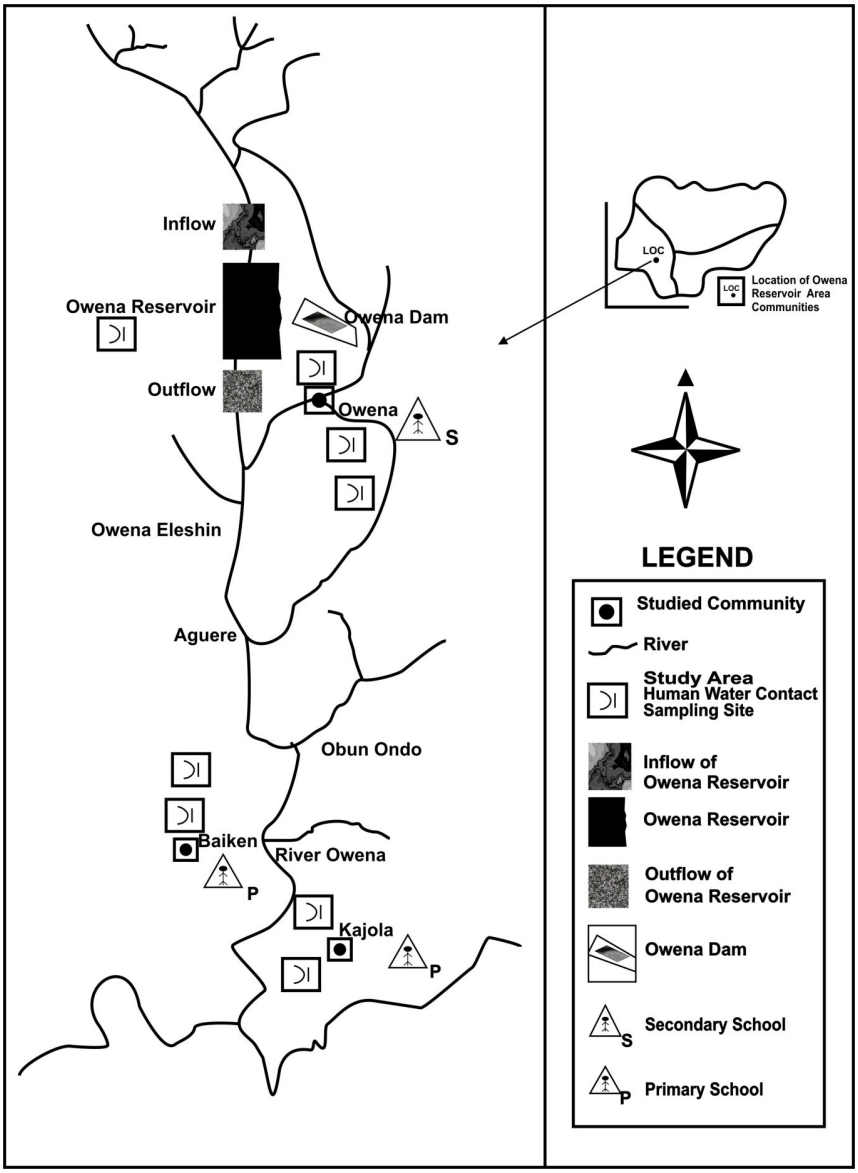

Figure 1: Map of Owena showing Owena Reservoir, Owena Dam, Owena River, and the eight sampling sites of Owena, Baiken, and Kajola communities

Source: Igboloro and Associates (Planners, Architects, and Engineers), 3 Ayodele Awodeyi Street, Ketu, Lagos State, Nigeria (2012)

Selection of Sampling Sites

The sampling sites were selected based on the fact that they are potential human water contact sites where the frequency of visitations by the inhabitants and proximity to their residences were considered paramount parameters for snail-breeding sites.

Snail Sampling

The eight sites selected were sampled once every month for twenty-four-months (August 2013 – July 2015). Sampling involved 30 passes of kitchen scoops and a manual search for 30 person-minutes (Asaolu, 1990; Peletu, 2010; WHO, 2014). All the snails collected were placed in pre-labeled plastic containers with decaying leaves, and transported to the Malacology Laboratory of Obafemi Awolowo University, Ile-Ife, Nigeria. Water used to shed cercariae was collected from each of the eight sites. Within 24 hours upon arrival at the Malacology Laboratory, the snails were identified to species level, counted, and recorded as number of snails per site, per date. The snails were identified using standard identification keys. The snails were then grouped into <3.0mm, 3.0mm-5.9mm, and 6.0mm-9.0+mm size classes, using a fine vernier caliper.

Examination of Snails for *Schistosoma* infection

The snails identified were examined for *Schistosoma* infection using the crushing method (Asaolu, 2003). Each of the snails was placed on a slide and was covered with another slide with minor pressure applied on the topmost slide to gently crush the snail. Some drops of dechlorinated water were added to the longer pieces of shell removed, using small forceps. The slide was then observed under a light microscope for the presence or absence of cercariae. The cercariae were identified to the genus level according to Frandsen and Christensen (Fradsen, 1984). However, only snails shedding *Schistosoma* cercariae were recorded as infected. Other data about size, species, date of collection, and site of selection of infected snails were recorded.

RESULTS AND DISCUSSION

Table 1 shows that for the period under study (August 2013 – July 2015), a total of 25,482 snails, comprising 4,258 (16.7%) *Bulinusglobosus*; 213 (0.8%) *Bulinustruncatus*; 4,040 (15.9%) *Bulinusforskalii*; 4,770 (18.7%) *Biomphalariapfeifferi*; 6,024 (23.6%) *Melanoidestuberculata*; 1,730 (6.8%) Potadomafreethi; and 4,447 (17.5%) Pilaovata were collected during monthly site visits to Owena Reservoir Area which comprises of three sampled communities namely Owena, Baiken and Kajola in Ondo East Local Government Area, Ondo State, Nigeria. Thus, *Bulinusglobosus* and *Bulinustruncatus* were the established intermediate host (see Table 1).

Out of the two intermediate snail host species identified, *Bulinusglobosus* was more abundant - 4,258 (16.7%) than *Bulinustruncatus* 213 (0.8%). The overall infection rate of *Bulinusglobosus* was 3.2% as 136 snails were infected out of the 4,258 collected (see Table 2). This was found in Site 4 located in Kajola community. Only *Bulinusglobosus* greater than 3.0mm were found to shed cercariae (infected).

Table 1: Total number of each of the seven snail species collected within twenty-four months during monthly site visits

Sites	*Bulinus globosus*	*Bulinus truncatus*	*Bulinus forskalii*	*Biomphalaria pfeifferi*	*Melanoides tuberculata*	*Potadoma freethi*	*Pila ovata*	**Total**
Owena								
Site 1	554	62	396	599	771	557	433	3,372
Site 2	567	46	425	485	623	784	713	3,643
Site 3	555	17	552	630	676	65	983	3,478
Kajola								
Site 4	607	11	645	739	955	101	953	4,011
Site 5	688	16	570	534	890	76	656	3,430
Baiken								
Site 6	511	16	544	558	670	92	345	2,736
Site 7	461	17	487	544	664	15	109	2,297
Embankment/Dam - Owena								
Site 8	315	28	421	681	775	40	255	2,515
Total	**4,258**	**213**	**4,040**	**4,770**	**6,024**	**1,730**	**4,447**	**25,482**

Table 2: The relative abundance and rates of *Schistosoma* infection (cercariae shedding pattern of small (3.0mm-5.9mm) and large (6.0mm-9.0+mm) *Bulinusglobosus* collected during monthly site visits to Owena Reservoir Area

Sites	**Small snails (3.0mm-5.9mm)**			**Large snails (6.0mm-9.0+mm)**			**Total**		
	Total Collected	**Total Infected**	**% Infection**	**Total Collected**	**Total Infected**	**% Infection**	**Total Collected**	**Total Infected**	**% Infection**
Owena									
Site 1	113	0	0	408	11	2.7	521	11	2.1

Site 2	163	0	0	413	15	3.6	576	15	2.6
Site 3	154	0	0	378	12	3.2	532	12	2.3
Kajola									
Site 4	158	6	3.8	466	47	10.1	624	53	8.5
Site 5	176	0	0	504	6	1.2	680	6	0.9
Baiken									
Site 6	131	0	0	399	13	3.3	530	13	2.5
Site 7	121	0	0	357	24	6.7	478	24	5.0
Embankment/Dam - Owena									
Site 8		0	0	237	2	0.8	317	2	0.6
Total	**1,096**	**6**	**0.6**	**3,162**	**130**	**4.1**	**4,258**	**136**	**3.2**

CONCLUSION

Bulinusglobosus and *Bulinustruncatus* are the only identified intermediate hosts of *Schistosomahematobium* in Owena Reservoir Area. *Bulinusglobosus* showed predominance compared to the other intermediate snail host species at Owena Reservoir Area. Therefore, intervention strategies for sustainable control of urogenital schistosomiasis in Owena Reservoir Area should focus on the two snail host species. The use of molluscicides should be encouraged.

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Conflict of Interest

All the authors hereby declare that they do not have any possible conflicts of interest.

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