

Urogenital Schistosomiasis Transmission and Human Water Contact Activities in Owena Reservoir/Dam, Ondo East Local Government Area, Ondo State, Nigeria

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Abstract: *Background:* This study on urogenital schistosomiasis transmission and the roles played by human water contact activities was carried out in selected three communities viz Owena, Kajola and Baiken, bordering Owena Reservoir/Dam in Ondo East Local Government Area, Ondo State, Nigeria for a period of twenty four months. *Objective:* To ascertain the effects of human water contact activities on urogenital schistosomiasis transmission. *Materials and Methods:* Each site was observed for water contact activities once every month for twenty-four months. Observation was made at each site in February (dry season), May (early rainy season), August (rainy season) and November (early dry season). During this period, records were taken about individuals entering and leaving the water. Various types of human water contact activities were grouped on the basis of general purpose of contact. With regards to degree of body exposure and mean duration of contacts; using canoe, fetching water, washing household utensils, sorting fish and washing exposed limbs, all involved exposure of only parts of the lower limbs (foot and leg) and or the upper limbs (hand and forearm) for a brief period of time grouped as partial contact activities. Water contact activities consist of washing clothes and fish nets, processing food products (such as cassava and palm oil) may involve exposure of most parts of the lower and/or the upper limbs for a longer period. Swimming and bathing commonly involve total exposure for a very long time and were designated as complete contacts. *Results:* General pattern of human water contact activities in the study revealed 34,686 (61.6%) domestic, 15,897 (28.2%) economic, 5,732 (10.2%) recreational and 15 (0.03%) religious activities. Frequency of these activities varied significantly ($p < 0.05$) among stations and seasons but comparable from one year to the other. School children (5-19 years age group) spent more time on exposure than adults who spent more time on partial and limited exposure. As a result, the exposure index was significantly ($p < 0.001$) age dependent and followed the same pattern as duration of contact. Site containing most infected *Bulinus globosus* snails was site 4 (KAJ 1) at Kajola community with snail infection rate of 9.2% and the same site 4 (KAJ 1) had the highest relative index of exposure (15,063.80) as well as level of total duration (14,215) of contact in minutes. *Conclusion:* Site 4 (KAJ 1) at Kajola community was the transmission site in Owena Reservoir/Dam, Ondo East Local Government Area, Ondo State, Nigeria.

Keywords: Urogenital Schistosomiasis, *Bulinus globosus*, Human Water Contact, Snail Infection, Owena Reservoir/Dam, Nigeria

1. Introduction

Schistosomiasis, a water-based parasitic infection caused by

blood-dwelling trematode worms of genus *Schistosoma*, remains an important public health problem globally with approximately 779 million estimated to be at risk [3, 10, 18, 23] and perhaps the most important disease associated with man-

made lake and irrigation projects in tropical countries [5, 9, 18]. It has been reported that the disease is endemic in 23 of the 36 states in Nigeria [9]. Ondo State is one of the states where schistosomiasis occurs. However, epidemiological information of the disease in the state, especially in three communities bordering Owena Reservoir/Dam, is still very scanty. Information on urogenital schistosomiasis transmission and human water contact patterns in Ondo State is scanty despite widespread distribution in some of its neighboring states [19].

Urogenital schistosomiasis is highly endemic in three communities (Owena, Kajola and Baiken) of Ondo State, Nigeria [20]. 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 cercariae-infected water bodies [20].

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

Ondo State is drained by Owena River and while prevalence of the infection has been reported from various communities along some tributaries of the river, there is no information on detailed transmission studies along Owena River itself [8, 17]. It cannot be overemphasized that no sustainable schistosomiasis control can be achieved for Ondo State until a clear picture of the status and contribution of Owena River and Owena Reservoir to overall transmission in the state is elucidated. This is the hallmark of this investigation.

2. Materials and Methods

2.1. The Study Area

The study was carried out in Owena Reservoir/Dam and its adjoining three randomly selected communities (Owena, Kajola and Baiken) which are rural to semi-urban settlements in Ondo East Local Government Area, Ondo State (Figure 1) and lies between latitudes $7^{\circ}00' - 7^{\circ}30'N$ and longitudes $5^{\circ}00' - 5^{\circ}30'E$. Further illustrations are presented in the map of Owena showing Owena Reservoir, Owena Dam and the eight sampling sites of Owena, Kajola and Baiken communities (Figure 2). According to the National Population Commission (2006), the population of Owena community is approximately 9,000. The inhabitants are predominantly peasant farmers, petty traders, oil mill workers, fishermen and teachers.

Each site was observed for water contact activities once every month for twenty-four months (August 2013 – July 2015). Observation was made at each site in February (dry season), May (early rainy season), August (rainy season) and November

(early dry season). The observation was for period of six hours 07:00 – 13:00 GMT (07:00am – 01:00pm) in February to August; 13:00 – 19:00GMT (01:00pm – 07:00pm) in May and November. During this period, records were taken about individuals entering and leaving the water. Such records included sex, age, types of contact (i.e. activities performed), proportion of body immersed (exposure – degree of contact) and time spent (duration of contact which is the difference between time entered water and time out of water). The various types of human water contact activities were grouped on the basis of the general purpose of contact. Hence, domestic contact activities comprise washing clothes and utensils, fetching water, processing food products such as cassava, palm oil. Economic contacts include watching fishnets, sorting fish, using canoe. Personal contact consisted of washing exposed limbs. Recreational contacts consisted of swimming and bathing.

With regards to the degree of body exposure and mean duration of contacts; using canoe, fetching water, washing household utensils, sorting fish and washing exposed limbs, all involved exposure of only parts of the lower limbs (foot and leg) and/or the upper limbs (hand and forearm) for a brief period of time grouped as partial contact activities. Water contact activities consist of washing clothes and fish nets, processing food products (such as cassava and palm oil) may involve exposure of most parts of the lower and/or the upper limbs for a longer period. Swimming and bathing commonly involve total exposure for a very long time and were designated as complete contacts.

2.2. Snail Sampling

Each of the eight sites was sampled once monthly for twenty-four months from August 2013 to July 2015 [11]. Sampling on each site involved 30 passes of kitchen scoops and a manual search for 30 person-minutes [12, 22]. The scoop was attached to a metal of about 2.5m long. Sampling was carried out in each of the eight sites from five designated spots. The kitchen scoop used for snail sampling was thrown from one point of river bank to the other through semi-circular form.

Thirty scoops (ten in each area) were made in each of the eight sites and searching was done for 30 men per minute, ten minutes in each area [11, 14, 16, 17]. All the snails collected were placed in pre-labelled plastic containers with decaying leaves, transported to a laboratory in Ile-Ife, Osun State, Nigeria. The water used to shed cercariae was collected from each of the eight sites. On arrival (within 24 hours) to the 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 [4, 6]. Using the concept-length for discoid snails, snail size was measured with a fine vernier caliper. The snails were then grouped into <3mm, 3mm-5.9mm, 6mm-9mm size classes. Data collected each month was recorded.

2.3. Examination of Snails for *Schistosoma* Infection

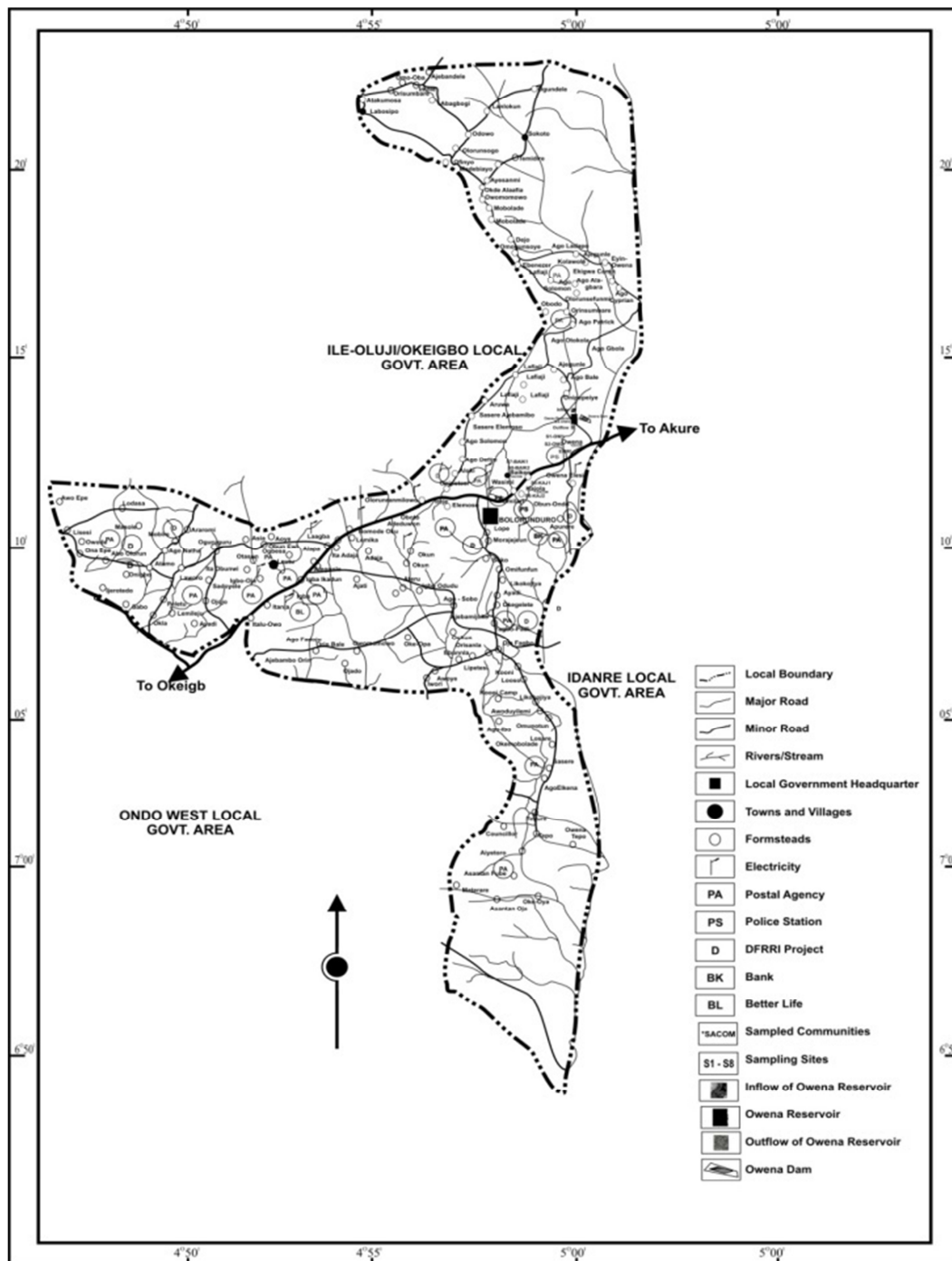
Examination of snails for *Schistosoma* infection was

carried by crushing method using a device [2]. Each of the snails was placed on a slide covered with another slide and minor pressure applied on the top slide to gently crush the snail. Some drops of dechlorinated water was 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. Cercariae were identified to genus level. However, only snails shedding *Schistosomacercariae* were recorded as infected. Other data

about size, species, date of collection and site of collection of infected snails were recorded.

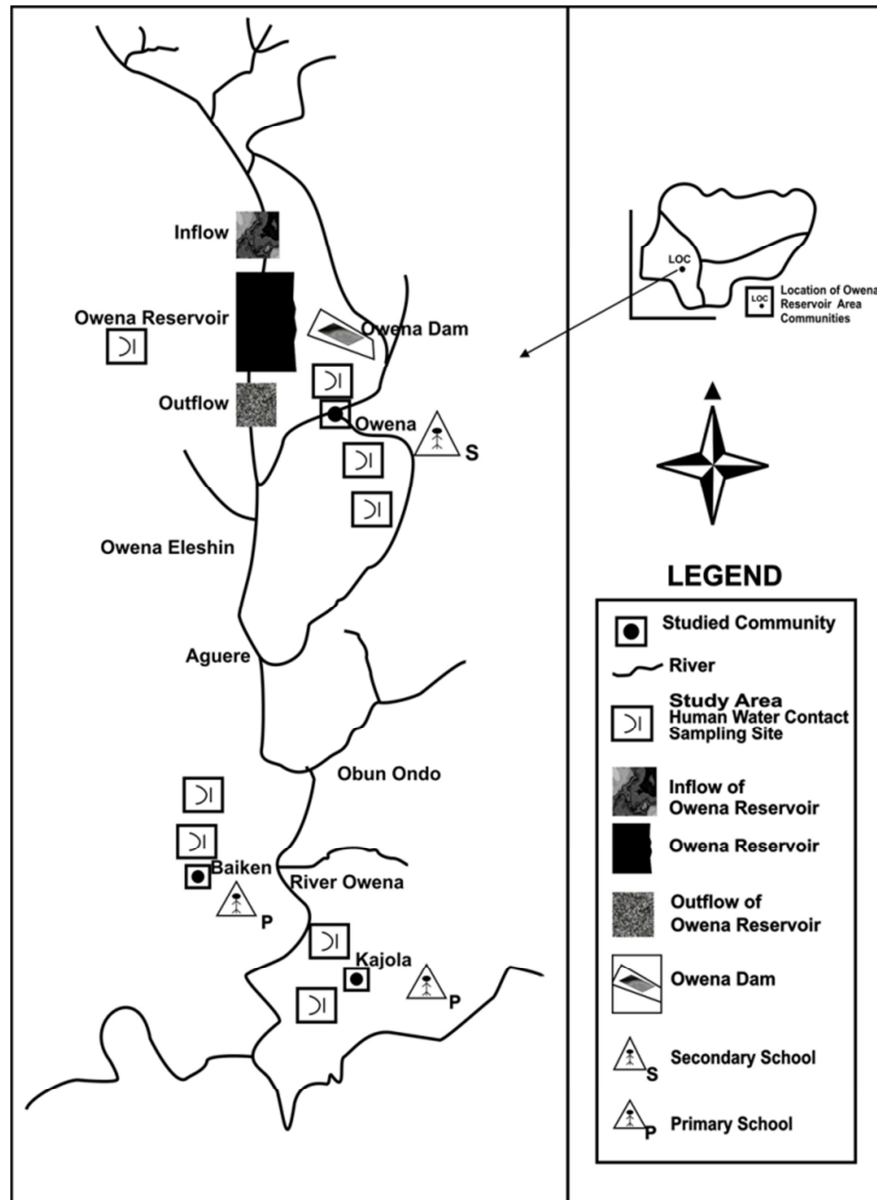
2.4. Statistical Analysis

For snail counts and water contact observations, the 2-score data of distribution pattern was determined by the Kolmogorov-Smirnov test for normality, the normal probability plots and/or the Shapiro-Wilk test for normality [24].



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

Figure 1. Map of Ondo East Local Government Area, Ondo State, Nigeria, showing Owena Reservoir Area, the three sampled communities (Owena, Baiken, and Kajola), Owena Dam, Owena River and the eight sampling sites.



Source: Adapted from Map of Ondo East L. G. A., Ondo State, (Planners, Arch Street Human Water Contact Patterns Observation)

Figure 2. Map of Owena showing Owena Reservoir, Owena Dam, Owena River and the eight sampling sites of Owena, Baiken, and Kajola communities.

3. Results

3.1. General Patterns of Water Contact in Owena Reservoir Area

Human water contact activities in the eight sites covered a total of 60,175 minutes in which 9 primary water contact activities involving 2,013 exposures for a total duration of 56,330 minutes were recorded (Table 1).

The primary activities recorded include washing (clothes, domestic utensils, farm tools, exposed limbs), swimming, bathing, playing, fetching (water), food processing (processing cassava, palm oil milling), fishing, sorting fish and ablution/baptism. A breakdown of 56,330 minutes exposure showed that 14,186 (25.2%) were spent on

washings; 2,737 (4.9%) on swimming; 2,017 (3.6%) on bathing; 978 (1.7%) on playing; 1,002 (1.8%) on fetching; 19,498 (34.6%) on food processing; 10,590 (18.8%) on fishing; 5,307 (9.4%) on sorting fish and 15 (0.0%) on ablution/baptism.

It means that 34,686 minutes were spent on domestic (i.e. fetching, processing food, washing clothes and utensil). Out of the 56,330 minutes of total exposure, 34,686 (61.6%) were spent on domestic (fetching water, food processing, washing; 5,732 (10.2%) on recreational activities (bathing and swimming); 15,897 (28.2%) on economic activities (i.e. fishing, sorting fish) and 15 (0.03%) on personal/religious activities (i.e. ablution/baptism). With regards to the total exposure of 2,013 contacts, 1183 (58.8%) were on domestic, 437 (21.7%) on economic and 39 (19.5%) on recreational, and 1 (0.1%) on personal activities (Table 2).

Table 1. The Relative index exposure of different types of water contact activities recorded during different observations at eight human water contact sites in Owena Reservoir (August 2013 to July 2015).

Activity	Year	Owena					Kajola				
		Duration (minutes)				Relative Index of Exposure	Duration (minutes)				Relative Index of Exposure
		Total contact	Minimum	Maximum	Total		Total contact	Minimum	Maximum	Total	
Washing	2013	67	2	90	1445	10.05	33	2	62	782	4.95
	2014	164	2	97	3589	24.60	70	5	105	1660	10.50
	2015	102	4	70	2211	15.30	34	6	90	763	5.10
	Total	333	2	97	7245	49.95	137	2	105	3205	20.55
Swimming	2013	18	4	30	346	16.20	10	14	25	198	9.00
	2014	34	10	20	498	30.60	21	10	20	313	18.90
	2015	19	11	19	293	17.10	11	10	25	184	9.90
	Total	71	4	30	1137	63.90	42	10	25	695	37.80
Bathing	2013	15	5	19	217	3.00	9	10	18	145	1.80
	2014	32	10	15	369	6.40	22	10	16	262	4.40
	2015	19	10	18	261	3.80	12	2	20	156	2.40
	Total	66	5	19	847	13.20	43	2	20	563	8.60
Playing	2013	12	4	7	134	1.20	6	5	56	84	0.60
	2014	23	3	10	96	2.30	14	4	7	80	1.40
	2015	17	3	19	322	1.70	10	5	19	70	1.00
	Total	52	3	19	552	5.20	30	4	56	234	3.00

Activity	Year	Baiken				
		Duration (minutes)				Relative Index of Exposure
		Total contact	Minimum	Maximum	Total	
Washing	2013	41	2	65	940	6.15
	2014	81	3	75	1731	12.15
	2015	48	7	70	1065	7.20
	Total	170	2	75	3736	21.15
Swimming	2013	12	10	66	272	10.80
	2014	23	10	21	348	20.70
	2015	16	12	25	285	14.40
	Total	51	10	66	905	45.90
Bathing	2013	10	10	18	141	2.00
	2014	21	10	15	239	4.20
	2015	17	10	16	227	3.40
	Total	48	10	18	607	9.60
Playing	2013	6	4	7	32	0.60
	2014	15	3	10	90	1.50
	2015	13	4	7	70	1.30
	Total	34	3	10	192	3.40

Table 1. Continued.

Activity	Year	Owena					Kajola				
		Duration (minutes)				Relative Index of Exposure	Duration (minutes)				Relative Index of Exposure
		Total contact	Minimum	Maximum	Total		Total contact	Minimum	Maximum	Total	
Ablution /Baptism	2013	0	0	0	0	0	1	15	15	15	0.10
	2014	0	0	0	0	0	0	0	0	0	0
	2015	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	1	15	15	15	0.10

Activity	Year	Baiken				
		Duration (minutes)				Relative Index of Exposure
		Total contact	Minimum	Maximum	Total	
Ablution /Baptism	2013	0	0	0	0	0
	2014	0	0	0	0	0
	2015	0	0	0	0	0
	Total	0	0	0	0	0

Source: Peletu *et al.*– Field monitoring of water contact activities at Owena Reservoir Area: Owena, Kajola and Baiken communities, Ondo State, Nigeria (August 2013 – July 2015)

Table 2. The pattern of domestic, recreational, economic and personal contact activities by total contact and the duration of contact (August 2013 to July 2015).

	Activities	Total Contact (Exposure) (Minutes)	Percentage (Total Contact) (Minutes) (%)	Total Duration (Minutes)	Percentage (Total Duration) (%)
Domestic	Washing	640	31.79	14,186	25.18
	Fetching	195	9.69	1,002	1.78
	Food Processing	348	17.29	19,498	34.61
	Total	1,183	58.77	34,686	61.57
Recreational	Swimming	164	8.15	2,737	4.86
	Bathing	157	7.80	2,017	3.58
	Playing	116	5.76	978	1.74
	Total	437	21.71	5,732	10.18
Economic	Fishing	215	10.68	10,590	18.80
	Sorting Fish	177	8.79	5,307	9.42
	Total	392	19.47	15,897	28.22
Personal	Ablution /Baptism	1	0.05	15	0.03
	Total	1	0.05	15	0.03
Grand Total		2,013	100.00	56,330	100.00

Source: Peletuet *al* – Field monitoring of water contact activities at Owena Reservoir Area: Owena, Kajola and Baiken communities, Ondo State, Nigeria (August 2013 – July 2015)

3.2. Variation of Water Contact Behavior by Age and Sex

Water contact pattern in the three communities according to sex and age is presented in Table 3. For both males and females, the number of people visiting the lake increased from the youngest age (0-4 years) to peak in the 15-19 years age bracket before declining gradually to lower levels in the older age groups. Also, the number of contacts was higher among females compared to males, from the youngest age group to 15-19 years age group from where number of contacts among males surpassed that of females.

Some of the activities were sex dependent, for example, females often bath, wash household utensils, fetching water, wash clothes and fishnet more often than their male counterparts. Water contact behaviors in the sampling sites were clearly age and sex-related [19]. The males, on their part often engage in economic activities such as fishing, use of canoe and sorting fish. Generally, the males significantly ($p < 0.001$) made more frequent contact with the lake than females. However, duration of female contact patterns was highly age dependent.

Children in age group 0-22 dominated in playing, swimming, bathing (recreation contacts) than adult in the age group of 30-51. Some of these activities, especially canoe paddling requires a shorter period than washing clothes that demanded exposures of much longer period of time. Hence, the duration of contact for females was significantly ($p < 0.05$) higher than that for the males.

The pattern of contact was very highly age dependent. Children in 0-19 years age group spent more time on domestic and recreational contact activities while middle aged adults in the age group 20-51 engaged more in the personal and economic activities. Besides, children (5-19 years age group) also spent more time on complete exposure than adults who spent more time on partial and limited exposure. As a result, the exposure index was significantly ($p < 0.001$) age dependent and followed the same pattern as duration of contact (Table 3).

Table 3. Variation of Water Contact Behavior by Age and Sex in all communities combined.

Age Group	Sex		Total
	Male	Female	
0-4	23	37	60
5-9	101	158	259
10-14	148	317	465
15-19	205	233	438
20-24	145	52	197
25-29	126	82	208
30-34	105	99	204
35-39	31	30	61
40-44	51	35	86
45-49	12	11	23
50-51	2	10	12
Total	949	1064	2013

Source: Peletuet *al* – Field monitoring of water contact activities at Owena Reservoir Area: Owena, Kajola and Baiken communities, Ondo State, Nigeria (August 2013 – July 2015)

3.3. Pattern of Frequency of Limited and Complete Exposures as Related to *Schistosomahaematobium* Infection

The combined frequency of limited and complete exposure accounted for 75.6% total duration and 84.3% of total relative index of exposure indicating that the relative index of exposure is very important in explaining that the infection of urogenital schistosomiasis (due to *Schistosomahaematobium*) depends more on duration of exposure than on the frequency of exposure. The site containing most infected snails was site 4 at Kajola community where snail infection rate was 9.2%. In contrast, the site with the least number of infected snails was site 8 (Owena Embankment). Also, relative index of exposure (15,063.8) was also highest at site 4 as well as the level of total duration (14,215) of contact in minutes. Frequency of different types of primary water contact activities was sex dependent. Female dominated washing, food processing (cassava and palm oil milling, fetching water, while males dominated the rest water contact activities).

Table 4. Water contact characteristics and the percentage distribution of *Bulinus globosus* infection at the eight water contact sites in Owena Reservoir (August 2013 – July 2015).

Site	Total Contacts	Total Duration	Relative Exposure	<i>B. globosus</i>		<i>B. globosus</i>	
				Number Collected	Number Infected	% of Number collected	% of Number infected
OW 1	335	6,420	785.0	554	11	13.0	1.9
OW 2	335	11,894	632.4	567	15	13.34	2.6
OW 3	307	5,421	930.4	555	12	2.16	2.1
KAJ 1	234	14,215	15,63.8	607	53	13.3	9.2
KAJ 2	238	8,894	1218.8	688	6	16.2	0.8
BAIK 1	264	5,931	435.0	511	13	12.0	2.5
BAIK 2	265	9,021	1245.0	491	24	0.6	4.9
OW 4	32	525	161.4	315	2	7.4	0.6
TOTAL	2013	57,391	5,8152.2	4258	136	100	3.19

Source: Peletu *et al.* – Field monitoring of water contact activities at Owena Reservoir Area: Owena, Kajola and Baiken communities, Ondo State, Nigeria (August 2013 – July 2015)

3.4. Snail Related Studies

3.4.1. Checklist of Snail Species Found in Owena Reservoir

During the twenty-four months (August 2013 – July 2015) period of study, a total of seven snail species, representing two sub-classes, three families and five genera, were identified in Owena Reservoir. The snail species were *Bulinus globosus*, *Bulinustruncatus*, *Bulinus forskalii*, *Biomphalaria Pfeifferi*, *Melanoidestherculata*, *Potadoma freethi* and *Pila ovata*.

3.4.2. Variation in Snail Density Within the Eight Sampled Sites

A total of 25,482 snails, comprising 4,258 (16.7%) *Bulinus globosus*; 213 (0.8%) *Bulinustruncatus*; 4,040 (15.9%) *Bulinus forskalii*; 4,770 (18.7%) *Biomphalaria Pfeifferi*; 6,024 (23.6%) *Melanoidestherculata*; 1,730 (6.8%) *Potadoma freethi*; and 4,447 (17.5%) *Pila ovata* were collected in a total of twenty-four monthly site visits (Table 5).

Table 5. The total number of each of seven snail species collected in a twenty-four monthly site visits (August 2013 – July 2015).

Sites	<i>Bulinus globosus</i>	<i>Bulinustruncatus</i>	<i>Bulinus forskalii</i>	<i>Biomphalaria Pfeifferi</i>	<i>Melanoidestherculata</i>	<i>Potadoma freethi</i>	<i>Pila ovata</i>	Total
Owena								
Site 1	554	62	396	599	771	557	433	3372
Site 2	567	46	425	485	623	784	713	3643
Site 3	555	17	552	630	676	65	983	3478
Kajola								
Site 4	607	11	645	739	955	101	953	4011
Site 5	688	16	570	534	890	76	656	3430
Baiken								
Site 6	511	16	544	558	670	92	345	2736
Site 7	461	17	487	544	664	15	109	2297
Embankment / Dam Owena								
Site 8	315	28	421	681	775	40	255	2515
Total	4258	213	4040	4770	6024	1730	4447	25482

Source: Peletu *et al.* – Field snail sampling at Owena Reservoir Area: Owena, Kajola and Baiken communities, Ondo State, Nigeria (August 2013 – July 2015)

3.5. Site Distribution of Infection Rate of *Bulinus globosus*

The site distribution of infection rates in small (3 to 5.9mm) and large (6 to 9+mm) *Bulinus globosus* are summarized in Table 6. Out of a total of 4,258 *Bulinus globosus* collected over the period of twenty-four months (August 2013– July 2015), 1,096 (representing 25.7%) were small and 3,162 (representing 74.3%) were large. Out of 1,096 small *Bulinus* snails collected, 430 (39.2%) were collected from sites 1-3 in Owena community, 334 (30.5%) from sites 4 and 5 in Kajola community, 252 (23.0%) from sites 6 and 7 in

Baiken community and 80 (7.3%) from the embankment site of Owena Dam.

For the 3,162 large (6 to 9+mm) *Bulinus globosus* snails collected, 1,199 (38%) came from sites 1 to 3 in Owena community, 970 (30.7%) from sites 4 and 5 in Kajola community, 756 (24.0%) from sites 6 and 7 in Baiken community and 327 (7.5%) from the embankment. The relative abundance of the combined small and large snails was relatively comparable between Owena and Kajola communities but significantly different ($p < 0.05$) from Baiken community.

Overall, the most densely populated were Sites 1, 2 and 3 (30.7%) in Owena community and the least populated - 237 (7.5%) was the embankment. The overall infection rate among *Bulinus globosus* was 136 (3.2%) out of a total of 4,258 specimens collected i.e. 136 of *Bulinus globosus* were infected with *Schistosoma* out of 4,258 collected. These comprised of 6 (0.6%) of 1,096 small snails, 130 (4.1%) of

3,162 large snails collected in site 4 (KAJ1) in Kajolacommunity, while the infected large ones were picked from all the eight sites, except that the highest infection rate - 47 (10.1%) was recorded also in site 4 (KAJ1) in Kajola community, and the least infection rate - 2 (0.8) in the embankment site. The relative distribution of infection rates was significantly different ($p < 0.05$) among the sites (Table 6).

Table 6. The relative abundance and rates of *Schistosoma* infection (cercariae- shedding pattern of small (3 to 5.9mm) and large (6 to 9+mm) among *Bulinus globosus* collected in a total of twenty – four monthly site visit in Owena Reservoir area (August 2013 – July 2015).

Sites	Small snails (3 to 5.9mm)			Large snails (6 to 9+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	80	0	0	237	2	0.8	317	2	0.6
Total	1096	6	0.6	3162	130	4.1	4258	136	3.2

Peletu – Field snail sampling for *Schistosoma* infection at Owena Reservoir Area: Owena, Kajola and Baiken communities, Ondo State, Nigeria (August 2013 – April 2015)

4. Discussion

The infection was also sex dependent [19]. The prevalence rate of infections among males was 43.59% in 2014 and 71.86% in 2015, and for females, it was 37.03% in 2014 and 57.0% in 2015. This is because more males took part in more complete water contact activities such as swimming, bathing, with higher duration of contact, than the females in the communities. Those in 11-15 years old age group got themselves involved in swimming, bathing than other groups.

Most of the females were not always allowed to swim in the river, with the ignorant belief that the only source of water supply in the communities could be contaminated if women under menstruation wash or bath in the river. This implies that, the age group 11-15 years contributes in no small measure, to potential environmental contaminations, one of whose consequences is the transmission of urogenital schistosomiasis in the study area. The same observations were made in Oyan River Reservoir/Dam, Ogun State, Nigeria [10, 13, 15] and in Aponmu-Lona River Basin, Idanre, Ondo State, Nigeria [19].

With regards to the pattern of seasonality and focality of the intermediate host snail, *Schistosoma haematobium* transmission in the study area, only *Bulinus truncatus* was recorded as the known intermediate host of *Schistosoma haematobium* in Nigeria which agreed with the findings of [1, 3, 7, 10, 19, 23]. The overall infection

rate of *Bulinus globosus* was 3.2%.

5. Conclusion

Our findings from the study revealed that water contact activities exposed Owena, Kajola and Baiken communities to urogenital schistosomiasis infection. This study would help to design and plan sustainable intervention strategies against *Schistosoma haematobium* and its urogenital schistosomiasis infection. It is recommended that health education on transmission of urogenital schistosomiasis should be focused on mass sensitization, to emphasize the role commonly played by water contact activities of snail host. Contamination habits such as urination and defecation in the water bodies should be discouraged. People should avoid wading into infected water bodies indiscriminately.

Conflict of Interest

All the authors do not have any possible conflicts of interest.

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