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Application of Geographic Information System (GIS) in the assessment of human water contact patterns in relation to schistosomiasis infection in five rural communities in Osun State, Southwest Nigeria

S. O. Oladejo¹, O. A. Morenikeji² and A. T. Salami³

¹Osun State College of Education, Ila-Orangun, Osun State, Nigeria

²Department of Zoology, University of Ibadan, Oyo State, Nigeria.

³Institute of Ecology and Environmental Studies, Obafemi Awolowo University, Ile-Ife, Nigeria.

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ABSTRACT: A survey of human water contact patterns in relation to schistosomiasis infection was carried out in five rural communities around Erinle/ Owalla Reservoir, Osun State in South West Nigeria. Six sites were surveyed for two sessions between May 2008 – June 2010. Coordinates of relevant sampling points were located and plotted in a Geographic Information System (using Arcview 3.20 GIS software). A base map of the study area was generated using Landsat ETM₊ and Landsat TM (1986) imagery. Human water contact points were overlaid on the base map produced from the generated map. The highest water contact was recorded among 12 – 13 age bracket, which was also the age group that had the highest intensity of infection, before decreasing to lower stables. The intensity was higher among children involved in bathing and washing clothes than those carrying out other activities. This age and activity- related exposure in Oba- Ile, Oba- Oke, Ile, Ore and Eko- Ende communities suggest that both age and exposures play important roles in the local transmission of the disease.

Keywords: Schistosomiasis, Geographic Information System (GIS), Water Contact, Behavioural Knowledge, Reservoir, SouthWestern Nigeria.

Introduction.

Schistosomiasis is one of the most important neglected tropical diseases with a global spread of over 200million people in 74 countries infected while more than 600million are at risk of infection world wide, (Okpala *et al.*, 2004; Ofoezie, 2002; Oladejo and Ofoezie, 2006.) *Schistosoma haematobium* is endemic in 52 African and Mediterranean countries including Nigeria, (Adeyeba and Ojeaga). The transmission takes place only in fresh water bodies harbouring appropriate snail intermediate hosts. Transmission is enhanced by human-water contact in such water bodies (Okpala *et al.*, 2004). The purpose of water contact study is to observe who in the population visits the natural water bodies, why such visits are made, the site(s) of exposure that was involved (Ofoezie, 2002; Oladejo and Ofoezie, 2006, and Steinmann, P. *et al.* 2006.) The epidemiology of schistosomiasis is rapidly changing and new approaches are required to promote prevention and control towards sustainable environmental management. Therefore water contact is an imperative to compliment other studies for better understanding of the local epidemiological pattern.

Remote Sensing (RS) and Geographical Information System (GIS) are new innovative methods that are rapidly developing to complete international disease control strategies. These technologies have capabilities that are suitably adapted for identification, and mapping of disease vectors and their habitats, surveillance and monitoring of

water and vector-borne diseases, environmental health analysis of disease policies and planning of health programs in an area (Herbreteau, *et al.* 2005)

Materials and Methods

Study Area

This study took place in five rural communities Oba- Ile, Oba- Oke and Ilie in Olorunda Local Government Area; Ore in Odo-Otin Local Government and Eko- Ende in Ifelodun Local Government Area.(Fig 1). Observations of human water contact patterns were made at six water contact sites once every month for 12 hours (0700 hour – 1900 hour) local time, for 24 months June 2008 – May 2010). Two of the sites (S1 and S2) were located at Ilie; two sites (S3 and S4) were located at Oba- Ile; while sites S5 and S6 are from Ore. All the sites were linked to the villages by footpaths and surrounded by farm lands. A total of 269 hours were used in all the contact sites. The various types of contacts are categorized as, washing utensils, swimming, fishing, bathing and fetching and bathing and washing and parts of the body exposed.(Fig 2) Urine samples were collected from 435 school children (primary and secondary) between ages 9- 15+ years from four schools within the hour of 10: 00am and 2:00pm which is the peak of cercarian egg excretion in urinary schistosomiasis. Each child was given a clean mouthed plastic containers into which he/ she emptied his/ her bladder taken to the University of Ibadan, Zoology Department, PG laboratory, preserved in the refrigerator. A 10ml sub- sample was withdrawn and poured into 25ml- universal plastic bottles with a groove at the bottom centrifuged later allowed to settle by gravity in bottle. For each sample, the sediment was then thoroughly mixed and 1ml was measured and examined under a microscope at X40 magnification for presence and number of *S.haematobium* eggs.

Statistical Analysis

The difference in the prevalence of the infection between groups was determined using chi- square (X^2) test while that of intensity was assessed using one way analysis of variance (One way ANOVA). The relationship between the prevalence and age was determined using correlation as the statistical tool. All the analysis were performed on SPSS Version- 15 Software.

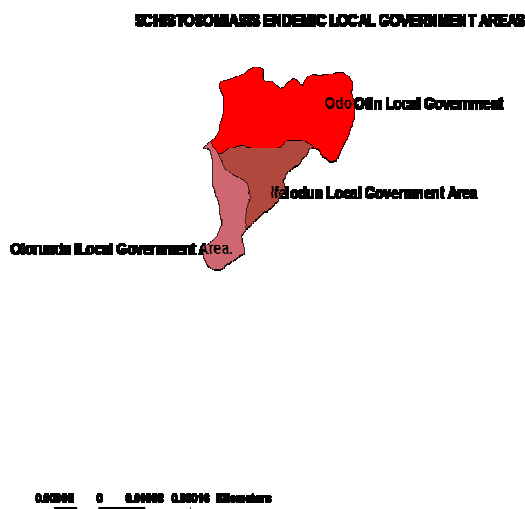


Fig 1 Map of the study Area.

Results and Discussion

General pattern of water contact in Erinle Reservoir.

Water contact was observed in six sites with a total of 1196 contacts, a breakdown of the contacts showed that fetching 726 (60.7%), fishing 207 (17.3%), washing utensils 128 (10.7%) and swimming 125 (10.5%) Table 2.

Human Water Contact By Sites

The relative proximity of the communities and purpose of contacts appear to be important in the pattern of water contact in the communities, as the nearest sites were particularly favoured for domestic utensils exclusively at site S1 which is the nearest to that village while in Oba Ile sites S4 is noted for fetching water and washing utensils, also in Ore sites 5 and 6 all the are noted for all the activities. (Table 2). Generally all the six sites were used for bathing and swimming especially as people return from markets, and farms, thus both frequency and duration of contacts were higher in sites S1 and S2 in Ilie communities. Also in sites 5 and S6 all the activities were found to be prominent (Table 2).

Table 1: Age and sex-related patterns of human contacts in Ilie, Oba-Ile and Ore Communities, Osun State. South West Nigeria

	Fetching		Fishing		Swimming		Washing Utensils		Total
	M	F	M	F	M	F	M	F	
0-4	-	-	10	2	-	-	-	-	12
5-9	22	40	10	4	4	2	4	4	90
10-14	44	72	24	32	10	3	4	20	299
15-19	30	35	10	12	20	14	4	8	123
20-29	20	15	2	2	32	20	4	10	105
30-39	1	3	6	2	12	27	1	2	34
40-49	-	-	-	-	2	-	-	-	2
Total	117	163	62	54	80	46	16	44	1196

Table 2 Number and Duration of Water Contacts at Ilie. Oba-Ile, and Ore Communities. Osun State, South West, Nigeria.

Types of contact	S I T E S						Total by contact types	% of contact by activity	Minimum contact duration in(min)	Maximum contact duration in (min)
	S1	S2	S3	S4	S5	S6				
Fetching	204	72	220	84	52	94	726	60.7%	2	15
Fishing	91	84	13	07	10	12	207	17.3%	35	142
Washing Utensils	24	42	30	09	07	16	128	10.7%	32	45
Swimming	42	62	04	03	04	10	125	10.5%	20	42
Total	361	260	267	103	73	132	1196	100%		

Infection Pattern by Community

The pattern of infection among the school children examined are as follows Oba- Oke 64 (62.5%), Oba-Ile 104 (57.7), Ilie 60 (53.3%), Ore 71 (59.2) and Eko-Ende 136 (66.2%) primary and secondary schools Table 3 below.

Table 3: Infection Pattern by Communities,Osun State,Nigeria.

Community	Number Examined	Number Infected	Prevalence(%)
Oba- Oke	64	40	62.5
Oba-Ile	104	60	57.7
Ilie	60	32	53.3
Ore	71	42	59.2
Eko-Ende	136	90	66.2
Total			

Table 4: Intensity by age in the five communities

AGE	LOW	MODERATE	HEAVY	TOTAL
<=9	6	5	7	18
10-11	13	6	4	23
12-13	29	40	39	108
14-15	15	10	8	33
15+	5	10	11	26
TOTAL	68	81	69	208
%	32.6	38.9	33.1	47.8

Landcover/Landuse and human contact pattern

The change in the LC/LU P pattern showed a change in the classified Images of LandsatTM1986 and Landsat ETM+ 2000 which changed the occupational pattern of some people to fishing thus favours contact with the infected water body.(Table 4)

The increase in the wetland by 84.55% is a clear evidence that a vast area of farmland and forest area has been changed to wetland thus increasing the flooded area creating a favourable condition for breeding of fresh water snail which is the intermediate host for schistosomiasis

Table 5: LC/LU Changes Between LandsatTM1986 and LandsatETM+2000Surface area (m2)

	Landsat ET+2000	Landsat TM 1986	Change in LU Surface Area	% Change of LU
FLD	20.2	43.7	23.3	53.4
HVF	30.2	21.7	9.5	31.4
LTF	49.5	80.3	30.8	62.3
SLT	23.0	42.0	42.9	18.0
STRB	39.9	40.0	0.1	2.5
WTB	30.1	4.5	25.6	84.6
STRB	56.9	5.4	51.5	90.5

Farmland.(FLD) Heavy Forest,(HVF),Light Forest(Light Forest),Settlement(STL),Shrub(STRB),WaterBody(WTB) AND Wetland(WTL)

The findings of this study revealed that infection pattern was highly age dependent with peak prevalence and intensity among children in the 10-14 years age brackets. These children also fall within the group that make the most intense and frequent contact with the reservoir. Thus there is a strong age and activity related exposure in the three communities suggesting that both age and exposure play important roles in the local transmission of the disease. These findings agree with earlier report from the area (Adewumi *et al*, 1993, Oladejo and Ofoezie, 2006) and from some other parts of Nigeria (Okpala, 1957; Awogun 1985, and Edungbola *et al*, 1988 Ofoezie 1991, Akogun O. B. and Akogun M. K. ; Ejindu *et al*, 1999 Abolarinwa 1999;) and elsewhere (Dalton and Pole, 1978). This study has shown strong positive correlation between water contact and infection patterns.

Conclusion

The result obtained in this study clearly showed that frequency of contacts with infected water body dictated by domestic water needs and proximity of schools to the water bodies is a major factor in acquisition of infection. The ecological changes and its effects brought by the land use patterns has a far reaching effect on the life pattern of the people of the five communities therefore this work forms a complementary baseline data for stakeholders in sustainable environmental management in the control of schistosomiasis.

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