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A COMPREHENSIVE MAPPING OF URINARY SCHISTOSOMIASIS USING GEOGRAPHIC INFORMATION SYSTEMS (GIS) IN KANO STATE, NIGERIA

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ABSTRACT
This study was conducted between July 2005- August 2007 using Geographic information Systems (GIS) to integrate the demographic, parasitologic and site location data of 132 towns/villages, in the 44 Local Government Areas of Kano state. A total of 6600 urine samples ware examined for S. haematobium infection. Of these number 2820(42.7%) were infected. Out of the 44 Local Government Areas of Kano State, Nigeria, the highest prevalence rate of 64.0% was observed in Kura Local Government Area and the least 18.0% was observed in D/Tofa Local Government Area.Males were observed to have a higher prevalence rate (48.0%) than the Females (29.7%). High micro-haematuria value was observed in 36.3% of the infected individuals with males having the highest values (91.5%).. The implication of these findings with a view to proper planning and control management of the disease is discussed

Keywords: Mapping, Urinary Schistosomiasis, GIS, S. haematobium

INTRODUCTION

Schistosomiasis is one of the World Health Organisation (WHO) great neglected diseases. It is the second most prevalent tropical disease with 200 million people infected and over 500 million people at risk (Lengeler *et. al.,* 2002). The great majority (80-85%) of schistosomiasis is found in sub- sharan Africa (Bergquist, 2002).

According it Werf, *et al,.* (2003), the disease often receives less attention by the health authorities even though a large number of infections were highlighted.

Schistosoma haematobium infection has been reported in Nigeria with varying intensity and prevalence rates. The disease is endemic in Nigeria (Agi, 1995).

Urinary schistosomiasis is characterized by blood in urine, pubic pain (LAP) micturation or difficult and frequent urination. The blood loss can lead to anaemia (iron deficiency). Larger percentage of infected persons especially children who are moderately to heavily infected experience urinary tract damage that can lead to blockage of the urinary tract and bladder cancer (WHO, 1998).

Penetration of the skin by cercariae may easily cause itching and dermatitis. The acute form of the intestinal schistosomiasis is characterized by fever, abdominal pain, diarrhea, headache, myalgia, and anorexia. This may be mis-diagnosed as typhoid fever. Chronic intestinal schistosomiasis presents as dysentery. Urogenital schistosomiasis (*S. haematobium)* infection is characterized by terminal haematuria (Ekpo, 2000).

In *S. haematobium* infections, the common late complains is an irreversible obstructive uropathy that may progress to uraemia. Calculus formation and secondary infections are common. Various changes occur in the bladder, including calcification, ulceration and Papilloma formation (Eldryd *et al* 2004).

A Geographical information system (GIS) is a computer- based system for imputing, storing, accessing, analyzing and presentation of spatially reference data from various sources in the form of maps. The GIS can therefore create a link between spatial data and their related descriptive information. A GIS is a combination of hardware (computers digitizing table, scanner, GPS (Global Positioning System), plotter, printer and so on) and specific software (Isabelle *et al*., 1995).

Geographical Information System (GIS) are increasingly being use in epidemiological and ecological studies of schistosomiasis. Most studies, many of them using GIS in combination with remote sensing techniques, have been carried out at the regional level (Isabelle, *et al.,* 1995).

According to Kitron *et al.,* (1994), GIS, should form an integral part of surveillance system. It is one of the few tools meeting the needs of monitoring the distribution of a disease. Since early 1994, GIS for health are being implemented, in countries for example Botswana, Kenya and Senegal.

Aims and Objectives

- To develop research data that could be linked to the maps and associate these data base with digitized maps.
- To establish the prevalence of urinary schistosomiasis in Kano State, Nigeria.

MATERIALS AND METHODS

Study Area

Kano State has an estimated of land area of 43,070 Km^2 and estimated population of 9,383,682 million people according to 2006 census. Kano state is situated between longitude 10^0 25 N and 13^0 53 N and latitude 7^0 10 E and 10^0 35 E. with an altitude range from 400m-800m above the sea level.

The main vegetation type of Kano is Sudan savannah and it has two major seasons: the dry season, which is between October to May (8 months dry) and the wet season, which is between June to September (4 months wet). The mean annual rainfall is averagely 870mm, with two main rivers, several reservoirs, earth dams, temporary pools that are scattered all over the state. The main tribes are Hausa and Fulani who are mainly farmers, traders and minor hand crafters. The state has 44 local government Areas.

Sample Sites and Data Collection:

The study was conducted in all the 44 local LGAs of Kano state. In each Local Government area, the sample site was obtained by dividing the LGA into 3 health districts and one sample town/village was selected from each district. The selection was made taking into cognizance, its proximity to fresh water body and or nearness to irrigation sites, to ensure spatial heterogenecity.

Clearance was sought for with the Kano state ministry for local government, for the purpose of the study. The 44 local government councils were directed and detailed to over see the conduct of the study as it affects their subjects. An awareness campaign was conducted at each site on the causes of the disease, and the main purpose of the study.

A questionnaire designed to collect data on Name, Age, Sex, Water supply, Contact and history of haematuria, was distributed to each of the randomly selected subjects (mostly translated to Hausa) and the responses collected at the same time. One hundred and fifty 150 questionnaires were distributed in each LGA.

Urine collection and Analysis

After responding to the questionnaire, a clean urine bottle was given to each subject and asked to produce his/her own urine. At sites, collection was done between the hours of 11am-2pm corresponding to the peak out put period for eggs in urine (Udonsi, 1990). Fifty urine samples were collected in each of the three sample sites per Local Government Area.

An indirect technique, which included the observation of gross haematuria from the urine of persons, was used on every sample. Secondly, a reagent strip soaked in a reactive agent (Comb-9), was used to examine for the presence of micro-haematuria (Lwambo *et al*., 1999).

Global Positioning Systems/Geographical information Systems (GIS)

The geographical location of each sampled area was recorded in the field by means of a hand held global positioning system (GPS) (Garmin 12xL version.2.0, Garmin corporation, USA) and spatial data were displayed and integrated using Arc View (v3.3 ESRI, C.A USA). These composed together with Parasitological data were used to classify the prevalence rate in the state as low, moderate and high prevalence to a color code. These coding is based on the prevalence rate, which is classified as low (less than 20%), moderate (20-50%) and (more than 50%) (Brooker *et al*., 2005). The spatial location of each LGA and its prevalence rate were displayed together with patterns of distribution of infection

Data Analysis

The raw data obtained at each town/village, Local Government Area and the state, was analyzed, using computer base software Programme SPSS 12.0 (statistical package for social sciences). In addition, statistical analysis was employed in some cases to test for the significance of age and Sex related prevalence and other tested phenomena's or parameters. P values less than 0.05% which was considered as significant.

The Global positioning systems (GPS), data was converted to an Easting and Northing, and integrated to an image using Geographic Information Systems (GIS), (Arc View V3.3 ESRI, CA USA) to produce maps, which is color-coded according to the infection prevalence per site and the spatial pattern of distribution

RESULTS

One hundred and thirty two towns/ villages in 44 Local Government Areas of Kano state, Nigeria were studied for urinary schistosomiasis. Of the 6600 persons examined, 2820(42.7%) comprising of 2256 (47.9%) males and 564 (29.7%) females were found positive for *S. haematobium* infection (Table 1&2). There was a significant difference ($p<0.005$) in prevalence between sexes.

The prevalence of urinary schistosomiasis increased with age and shows a peak among the 11-13 years age groups (Figure 1). The *S. haematobium* infection prevalence was recorded in all the 44 LGAs. The highest (64.0%) prevalence was indicated in Kura LGA while D/Tofa had the least (18.0%) among others. Distribution of micro haematuria values showed that high micro-haematuria values were observed among 36.30% of the infected individuals. Males had higher micro-haematuria value (41.5%) than females which that (13.2%) (Table 3). The coordinates of the sample areas was linked with the prevalence rate of *S. haematobium* infection. The prevalence rate was recorded as low, moderate and high. Figure 2 shows the mapping of the disease, by LGA, indicted by the coded color.

Table1. The Distribution of Urinary schistosomiasis by Local Government area, Kano State, Nigeria

S/n	LGA	Number Examined	Number Positive	%
1.	Ajingi	150	66	44.00
2.	Albasu	150	58	38.66
3.	Bagwai	150	80	53.33
4.	Bebeji	150	77	51.33
5.	Bichi	150	74	49.33
6	Bunkure	150	70	46.66
7.	Dala	150	58	38.66
8.	Danbatta	150	81	54.00
9.	D/Kudu	150	61	40.66
10.	D/Tofa	150	27	18.00
11.	Doguwa	150	58	38.66
12.	Fagge	150	49	32.66
13.	Gabasawa	150	72	48.00
14.	Garko	150	82	54.66
15.	G/malam	150	75	50.00
16.	Gaya	150	73	48.66
17.	Gezawa	150	77	51.33
18.	Gwale	150	47	31.33
19.	Gwarzo	150	60	40.00
20.	Kabo	150	65	43.33
21.	Karaye	150	44	29.33
22.	Kibiya	150	50	33.33
23	Kiru	150	57	38.00
24.	KMC	150	56	37.33
25.	Kumbotso	150	46	30.66
26.	Kunchi	150	64	42.66
27.	Kura	150	96	64.00
28.	Madobi	150	65	43.33
29.	Makoda	150	71	47.33
30.	Minjibir	150	81	54.00
31.	Nassarawa	150	58	38.66
32.	Rano	150	68	45.33
33.	R/Gado	150	60	40.00
34.	Rogo	150	66	44.00
35.	Shanono	150	70	46.66
36.	Sumaila	150	60	40.00
37.	Takai	150	81	54.00
38.	Tarauni	150	45	30.00
39.	Tofa	150	48	32.00
40.	Tsanyawa	150	76	50.66
41.	T/Wada	150	35	23.33
42.	Ungogo	150	55	36.66
43.	Warawa	150	75	50.00
44.	Wudil	150	83	55.33
	Overall	**6600**	**2820**	**42.72**

Table 2: Distribution of *S. haematobium* Infection According to sex in Kano State, Nigeria

Sex	Number Examined	Number Positive	Rate (%)
Male	4703	2256	47.96
Female	1897	564	29.73
Overall	**6600**	**2820**	**42.72**

Table 3. Sex -related distribution of Haematuria Value in *S. haematobium* infection in Kano State, Nigeria.

		Haematuria Value			
SEX	**NE**	**P1 (5-10 Ery/µl)**	**P2 (50 Ery/µl)**	**P3 (250 Ery/µl)**	**Total**
Male	4703	641	678	937	2256
Female	1897	279	199	86	654
Total	**6600**	**920**	**877**	**1023**	**2820**

Key:
NE: Number Examined, NP: Positive (P1, P2, P3), Ery/µl: Erythrocyte/Micro litre of Urine

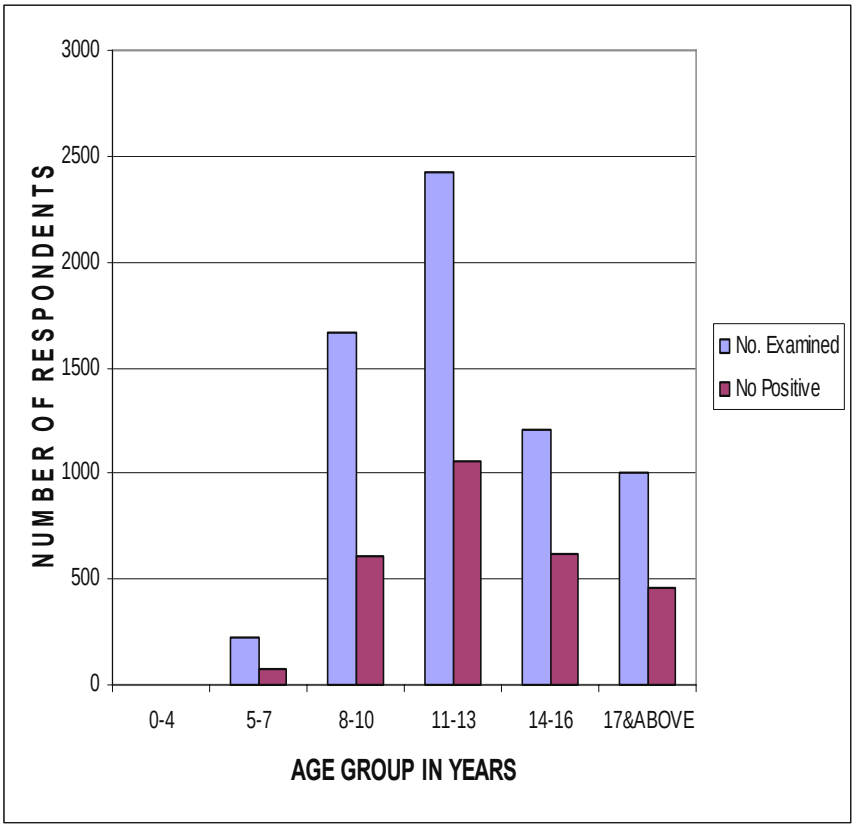

Figure 1: **Distribution of *S. haematobium* infection according to age group in Kano state, Nigeria.**

DISCUSSION

Urinary tract infection due to *S. haematobium* is more easily diagnosed, by indirect techniques, using reagent strip to detect the presence of blood in urine, as there is a very strong correlation between infection and the presence of blood in the urine. Bergquist *et al.,* (2005) validated this correlation at the community and district level and suggest it scale up, to national level so that control programs could be extended from community directed treatment to national.

In the present study, the occurrence of urinary schistosomiasis was indicated in all the 44 LGAs of Kano State, and the overall prevalence of 42.7% obtained shows that the state is endemic for *S. haematobium* infection. The result agrees with the finding of Awogun (1985), that urinary schistosomiasis is common in Nigeria. The highest prevalence observed in Kura LGA of among the 44 LGA S may be because Kura LGA is the most prominent LGA in terms of dry season, irrigation schemes and a lot new and old irrigations projects of Federal government are located in the LGA. The recently completed Imawa irrigation project of additional 2200 hectares is another additional risk factor. Similar observations made in Milola, Tanzania and Kebbi, Nigeria as reported by Hatz, *et al.,* (1999), and Daniel*, et al.,* (2001), respectively.

From the results obtained, there is a noticeable variation in the distribution pattern of the disease, with some having higher prevalence rates, than others among the 44 LGAs of Kano state. This may be related to availability or otherwise of portable drinking water and the people's relative dependence on dry season farming in these areas. Areas close to the bodies of water or irrigation canals are more exposed, therefore more vulnerable to *S. haematobium* infection. The migration of people from infected area to other places with low prevalence in search of jobs (dry farming) also plays a major role in the transmission of the disease in wider range. Similar finding have been reported by Ekejindu *et al.* (1999).

The prevalence of *S.haematobium* infection in relation to sex in Kano,Nigeria showed that, Males (47.96%) were infected higher than the females (29.73%). This corresponds and relates to the work of Lwambo *et al.,* (1999). The age related occurance of *S. haematobium* infection in this study showed that infection rate increases with age peaking at 11-13 years and then decreases slowly. This is in line with the report by TDR (2002). The prevalence map of *Schistosoma haematobium* produced using GIS in this study has indicated that, the endemicity for urinary schistosomiasis is high in about one quarter of the LGAs. The GIS map obtained showed that, there is clear vision of the area that requires active and rapid intervention according to the prevalence rates per LGA.

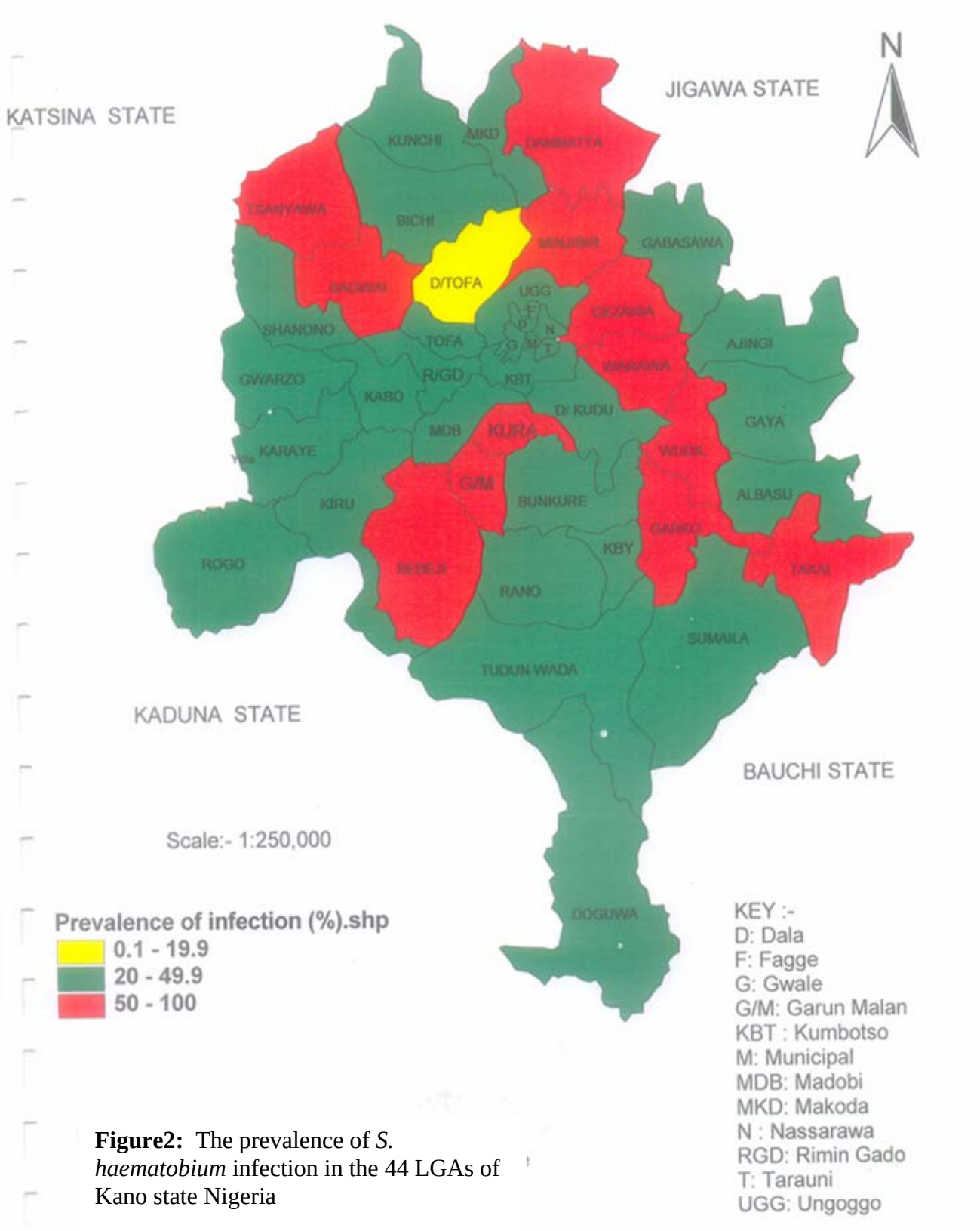

Figure2: The prevalence of *S. haematobium* infection in the 44 LGAs of Kano state Nigeria

CONCLUSION

This study confirmed that urinary schistosomiasis is prevalent in all the 44 Local Government Areas of Kano state, Nigeria. The mean prevalence of 40.2% due to *S. haematobium* infection in Kano state, obtained during the study, has strongly suggested the public health importance of urinary schistosomiasis in Kano state.

The study also provides relevant information for designing a plan of action for the selective integrated and targeting control of urinary schistosomiasis in local government areas, and communities where infection rate higher than 50% is recorded.

The GIS map produced contains information on the prevalence of urinary schistosomiasis in Kano state which could be use to visualize information for a particular environment or

or area where the infection occurred together with the determinant factors available. This information, at any point in time is retrievable and updatable.

Finally, the prevalence *S. haematobium* infection together with the Geographical location data of the area mapped can be use as an index for assessing the community or statewide prevalence of *S. haematobium* infection in Kano state, Nigeria.

Recommendations

Urinary schistosomiasis is endemic in most of the local government areas of Kano state and the introduction of this new technology (GIS) to asses the prevalence of the disease at this critical time is a very significant milestone toward *S. haematobium* infection control.To this end, the following are our recommendations:

- In all LGAs where prevalence rate is more than 50%, mass Chemotherapy at school and community level shall be instituted in the most effected locations.
- Health and related authorities should appropriately adopt the use of GIS tool in order to get tool for standardizing programmes surveillance and monitoring indicators across the nation.

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REFERENCES

Agi, P.I (1995) Vesical Schistosomiasisat Odau village in Ahoada, Local Government Area, Rivers state, Nigeria. *West Africa Journal of Medicine 14*(10); 6-10.

Awogun, IA (1985).The bionomics and population dynamics of the intermediate hosts of human Schistosomiasis in Illorin, Kwara State, Nigeria. PhD. Thesis. Liver pool, UK.

Bergquits, NR. (2002).Schistosomiasis: From risk assessment to control. *Trend in parasitology. 18*:309-314.

Bergquist, NR, Leonardo, LR, Mitchell, GF, (2005). Vaccine linked Chemotherapy; Can Schistosomiasis control benefit from an integrated approach? *Trend in parasitology 23(3):*112-117

Daniel, A.A ,Adamu, T, Abubakar, U and Dakul, D.A (2001). Preliminary Studies on schistosomiasis in Zuru emirate of Kebbi State, Nigeria. The *Nig. J. Parasitol 22 (1 & 2)* 65-74

Ekejindu, IM, Onyali, I.O, Ozumba, NA and IBE, C.C (1999). Prevalence and intensity of Urinary schistosomiasis in Agulu, Anambra State and the impact of health education on knowledge and practices in relation to disease transmission. *Nig. Journal Parasitol 20*:71-76.

Ekpo, MD, (2000). *Pathology: A complete text for Africa* (Tissue parasites). Published by Ibadan university press P211-212.

Eldryd, P, Richard, G. David, M., Geoffrey, G (2004).*Principles of Medicine in* Africa 3rd. edition. Cambridge University press. 411-425.

Hatz, C., Savioli L., Mayombana C., Dhunpath, Kisumku, UM, and Tanner, M (1990). Measurement of Schistosomiasis related morbidity at community level in area of different emdemicity. *Bulletin of the World Health Organization* 68:777-787.

Isabelle, N., Rumisha, DW, Pilatwe, KRK, ALI, H.I, MokweeTsinyana S.S, Syalla, A. H. and Talla, I (1995). Six GIS management tools for the control of tropical disease. Application: in Botswana, Senegal and Morocco. *J. Trop. Med. 58*: 221-227.

Kitron, U., Pener, H., Costin, C *et al* (1994). Geographic Information system in malaria surveillance: Mosquito breeding and impartial case in Israel 1992. *AM J. Trop. Med Hyg 50(5)* 550-556.

Lengeler, C., Utzinger, J., Tanner (2002). Questionnaires for rapid surveying of schistosomiasis in Sub Saharan Africa. *Bulletin of the world health organization 80*:235-242.

Lwambo, NJS, Siza, JE. Brooker, S, Bundy, DAP and Guyyat, H, (1999). Pattern of concurrent infection with hookworm and Schistosomiasis in School children in Tanzania. *Trans. Royal Soc. of Trop. Med. And Hyg,* 93, 497-502.

TDR, (2002). Schistosomiasis. *WHO/TDR*. Last up date January 28, 2002. Geneva.

Udonsi, J.K (1990), Human community ecology of urinary schistomiasis in relation to snail vector bionomics in the Igwun river Nigeria. *Trop. Med. Parasitol.,* 41,131-135

Werf, MJ, Vlas, SJ, Brooker, S. and Breooker,S (2003). Quantification of clinical morbidity caused by Schistosome infection in Sub Saharan Africa. *Acta Tropica 86:* 125-139.

WHO, (1998). Guidelines for the evaluation of Soil transmitted Helminthiasis and Schistosomiasis at community level, a guide for managers of control program *WHO/CTD/ SIP*/98.1