



doi: <http://dx.doi.org/10.48198/NJPAS/19.B07>

PREVALENCE AND INTENSITY OF URINARY SCHISTOSOMIASIS AMONG RESIDENTS ALONG RIVER BENUE, ADAMAWA STATE, NIGERIA

Page | 3577

*¹M.B. Yaro, ²R.S. Naphtali, and ²E. B. Alo

¹Department of Biology, School of Sciences, Adamawa State College of Education, Hong, Hong Local Government Area, Adamawa State, Nigeria.

²Department of Zoology, School of Life Sciences, Modibbo, Adama University of Technology, Yola. Adamawa state Nigeria.

ABSTRACT

In Nigeria, infection caused by *Schistosoma haematobium* has been known to be endemic especially among residence along Rivers. This study was a cross-sectional that involved 1,404 participants in ten (10) communities across five Local Government Areas (LGA) in question, they were randomly selected from July to September 2016 and from February to April 2017. Urine samples collected were examined using sedimentation technique while intensity was ascertained as eggs/10mls of urine and values were expressed as Mean±SD. Data on demography were obtained by structured questionnaires and was computed using SPSS version 22. Out of the overall prevalence and intensity of Urinary schistosomiasis 23.2% and 513±0.05 eggs/10mls of urine that were recorded, Kabawa had (12.4% and 80±0.02) prevalence and intensity of urinary schistosomiasis and lowest in Kangle (12.3% and 24±0.82 eggs/10ml) with significance association between intensity of urinary schistosomiasis and community ($p<0.05$). However, Gender related prevalence and intensity revealed 25.5% and 289±4.66 eggs/10ml as the highest while, 20.8% and 206±4.49 eggs/10ml were recorded as the lowest among males and females respectively. Furthermore, prevalence and intensity by age shows that, participants within age bracket 5-14 years old had the highest prevalence and intensity of urinary schistosomiasis (36.6%) and (142±0.005 eggs/10ml) respectively. While, low prevalence and intensity urinary schistosomiasis was recorded among age group 45-54years old 9.0% with (42±0.040 eggs/10mls). Subjects fetching from River/Streams had high prevalence and intensity of schistosomiasis compare to borehole fetchers 13.8% and 241±0.302 egg/10ml of urine, 31.8%, 46±0.080 egg/10ml of urine and respectively. Occupational related prevalence and intensity was highest among Fishers with 35.0% and 188±0.012 egg/10ml of urine while, lowest prevalence and intensity were recorded among Business men 4.8%, and 36±0.020 egg/10ml of urine among Civil servants. In conclusion, this study has shown moderate prevalence and intensity of urinary schistosomiasis, therefore, chemotherapy and Health Education should be advocated from time to time across the study area.

Keywords: Prevalence, Intensity, Urinary Schistosomiasis and River-Benue

Introduction

Schistosomiasis remains one of the most prevalent neglected tropical diseases especially in Nigeria

which has the greatest number of infected people worldwide (Salwa *et al.*, 2016). The intensity had

Corresponding Author: Yaro, M. B.

Department of Biology, School of Sciences, Adamawa State College of Education, Hong, Nigeria

Phone: +2347032526064 Email: gmyarobirdling@yahoo.com

high morbidity among Children, Adolescents and Young Adults (Hotez *et al.*, 2009). Thus, the negative Impacts on School and the debilitation cause by untreated infections demoralize both social and economic development in endemic Area (Vanderwerf *et al.*, 2003)

Schistosomiasis is an acute and chronic parasitic disease caused by blood flukes (trematode worms) of the genus *Schistosoma*. Estimates show that at least 206.4 million people required preventive treatment in 2016. Preventive treatment which should be repeated over a number of years, will reduce and prevent morbidity. Urinary schistosomiasis transmission has been reported from 78 countries. However, preventive chemotherapy for schistosomiasis, where people and communities are targeted for large-scale treatment, is only required in 52 endemic countries with moderate-to-high transmission, with estimated 101 million persons at risk and 26 million people infected (WHO, 2018). According to Chitsulo *et al.* (2010), transmissions and contact activities varies between the communities in many areas. Mostata *et al.* (2009) reported that, urinary schistosomiasis had the risk of causing haematuria, dysuria nutritional deficiencies, lesion of the bladder, kidney failure and elevated risk of bladder cancer and in children, growth retardations are well established. Finally, the work capacity of rural inhabitants has drastically reduced because of the weakness caused by the parasites. It is estimated that over 240 million people are infected, with about 700 million people worldwide at risk of infection.

According to Ivoke, *et al.* (2014) the prevalence of infection was significantly higher among male participants compared to females and this is consistent with previous reports in Nigeria. The presence of large body of water across the state and construction of dam seems to increase the human contact and thus increase the risk of schistosomiasis. Despite such problems schistosomiasis has to be studied among residents along River Benue.

Accordin to Hotez and Kamth (2009), Schistosomes are transmitted through snail intermediate host while some snail that serves as intermediate host of shistosome and *fasciola* are as follows: *Bulinus* spp (*Schistosoma intercalatum*, and *S. haematobium*), *Oncomelania* spp (*S. japonicum*), *Biomphalaria* spp (*S. mansoni*), *Lymnaea* spp (*Fasciola hepatica*) and *Segmentina* spp (*F. buski*).

Materials and Methods

The study was conducted in Adamawa State which is located in the north eastern part of Nigeria. It lies between latitude 7^o and 11^oN of the equator and between longitude 11^o and 14^o east of Greenwich Meridian. It shares boundary with Taraba State to the South and with Gombe State to the West, it also shares boundary with Borno State to Northwest and international boundary with Cameroun republic to the East. The State covers a land mass of about 38.741 square kilometers, having mountainous land with River Benue, Gongola and Yadzaram running from the North to the South (Adebayo and Tukur, 1999). The total population of the State according to (National Population Census, 2006) was 3, 178,950 with 1, 607,270 males and 1, 572,680 females.

Study Site

The study was carried out in 10 communities selected across 5 LGAs along River Benue in Adamawa State. The selection was based on the population and the proximity of the community to the river Benue shore, which includes Fofure (Ribadu and Dulo), Girei (Labondo and Kangle), Demsa (Zuran and Kwale), Numan (Bandawa and Kanti) and Lamurde (Kabawa and Hoki).

Population of the Study

Population of the study was randomly selected from communities along river Benue which includes children and adults, males and females of different occupations across ten communities of the study Area. Children who could not control

their bowel and urine were not enrolled into the study this was the screening criteria for sample collections. All adult participants were given consent form, Parents and guardians verbal consent on behalf of their children and wards. Children over 12 years of age were given consent form as well. One thousand four hundred and four (1,404) volunteers were randomly selected across the LGAs.

Sampling and Sample Collection

A well labeled specimens bottles were given to One thousand four hundred and four (1,404) participants, and they were instructed on how to collect their urine samples without contamination, the samples were immediately preserved with 1% household bleach (Ladan *et al.*, 2011) and was conveyed to Agape Medical laboratory and Diagnosis Yola and Institute of Infectious Disease for Poverty (IIDP) Laboratory Modibbo Adama University of Technology, Yola, for Macroscopy and Microscopy. Basically, sedimentation technique was adopted for the isolation of terminal spine ova of *S. haematobium* (Cheesbrough, 2006). Each participant was given a structured demographic questionnaire as regard to information about name, sex, age, location, educational qualification.

Ethical Clearance of the Study

The present study was carried out according to the guidelines and permission of Adamawa State Ministry of Health, Yola and the Village heads of communities involved. While seeking the consent from the research participants in each village, the objectives and procedures of the study were clearly explained to them in the local language, thus, written informed consents forms were given to all the adult participants and guardians/parents of the children before starting the survey. All the infected individuals were treated with a single dose of 40 mg/kg body weight of praziquantel under the supervision of a satisfied medical practitioner.

Data Analysis

Data were analyzed with SPSS, version 22. Simple percentage, Chi-square test and mean \pm SD were used to analyze the intensity, differences, association of the findings. $p < 0.05$ was considered as significant while, $p > 0.05$ as insignificant.

RESULTS

The prevalence and intensity of urinary schistosomiasis by gender across the community shown in table 1 revealed that, out of 10 community sampled, 23.2% and 513 \pm 0.05 eggs/10mls prevalence and intensity were recorded, however, among the communities, Ribado had the highest prevalence of 30.0% with intensity of 72 \pm 0.12 eggs/10ml of urine. With this breakdown, Kabawa had 23.5% prevalence with high intensity of 80 \pm 0.02 eggs/10mls of urine, while lowest prevalence and intensity of urinary schistosomiasis were recorded in Hoki 15.7% and Kangle 24 \pm 0.82 eggs/10mls of urine, this signifies association between prevalence and intensity of urinary schistosomiasis amongst the community in question ($p < 0.05$). It has also been showed that, males had the highest prevalence and intensity of infection than their female counterpart irrespective of the community with 25.5%, 289 \pm 4.66 eggs/10mls of urine and 20.8%, 206 \pm 4.49 eggs/10mls of urine with no statistical difference ($p > 0.05$). Prevalence and intensity by age bracket showed 36.6% and 142 \pm 0.005 eggs/10mls of urine among age bracket 5-14 years old, with lowest prevalence and intensity among age group 45-54 (9.0% and 42 \pm 0.040 eggs/10mls of urine). However, Chi-square analysis indicates significant difference between prevalence and intensity in relation to age group ($p < 0.05$).

Tables 2, presented many varieties of predisposing factors surrounding the participants which prone them to urinary schistosomiasis, this includes; Occupation, Source of water, Season of the year, Gender differences and their school background, The prevalence and occurrence of urinary

schistosomiasis in relation to the participants' source of water has revealed that, out of 362 subjects that drink from Borehole, 13.8 and 46 ± 0.080 eggs/10mls of urine were recorded, those drinking from wells had 112(21.3%) and 226 ± 0.981 eggs/10mls of urine, while participants that patronized Rivers and Streams as source of water had the highest prevalence and intensity of 164(31.8%) and 46 ± 0.302 eggs/10mls of urine.

This finding has showed association between prevalence and intensity in relation to source of drinking water ($P < 0.05$). High prevalence was observed in wet season 28.8% with intensity of 204 ± 0.221 while, highest intensity 254 ± 0.032 eggs/10mls of urine was observed in dry season with 17.7% prevalence, and there was significance relationship between urinary schistosomiasis infections and season ($p < 0.05$).

Table 1: Distribution and Intensity of Urinary Schistosomiasis in relation to Location, Gender and Age in the study Area

S/No	Location	No. Examined	Prevalence (%)	P. value	Eggs/10mls Mean intensity	P. value	Gender			
							Male		Female	
						Prevalence (%)	Intensity	Prevalence (%)	Intensity	
1	Dolo	120(8.5)	35(29.2)	0.03	31 ± 0.34	0.88	21(17.5)	25 ± 0.66	14(11.7)	13 ± 0.52
2	Ribado	120(8.5)	36(30.0)	0.01	72 ± 0.12	0.03*	18(15.0)	39 ± 0.52	18(15.0)	33 ± 0.35
3	Labondo	240(17.1)	58(21.6)	0.21	38 ± 0.91	0.07	19(7.9)	27 ± 0.55	39(16.3)	11 ± 0.05
4	Kangle	180(12.8)	39(21.6)	0.00	24 ± 0.82	0.06	27(15.0)	15 ± 0.34	12(6.7)	9 ± 0.28
5	Zuran	96(6.8)	25(26.0)	0.12	52 ± 0.23	0.12	10(10.4)	29 ± 0.19	15(15.6)	23 ± 0.49
6	Kwale	96(6.8)	26(27.0)	0.22	77 ± 0.44	0.25	13(13.5)	35 ± 0.20	13(13.5)	42 ± 0.31
7	Bandawa	174(12.4)	38(21.8)	0.06	51 ± 0.33	0.01*	14(8.0)	27 ± 0.12	24(13.8)	24 ± 1.02
8	Kanti	174(12.4)	29(16.7)	0.01	29 ± 0.94	0.06	20(11.5)	13 ± 0.63	9(5.2)	16 ± 0.23
9	Kabawa	102(12.4)	24(23.5)	0.03	80 ± 0.02	0.18	11(10.8)	54 ± 0.59	13(12.7)	26 ± 0.34
10	Hokij	102(12.4)	16(15.7)	0.11	34 ± 0.35	0.20	11(10.8)	25 ± 0.14	5(4.9)	9 ± 0.29
	Total	1404(100)	326(23.2)		513 ± 0.05		164(11.7)	289 ± 4.66	162(11.5)	206 ± 4.49
1	5-14	344(24.5)	126(36.6)	0.02	142 ± 0.005	0.02*	87(25.3)	90 ± 1.020	39(11.3)	52 ± 0.440
2	15-24	320(22.8)	95(29.7)	0.11	100 ± 0.045	0.07	66(20.6)	71 ± 0.234	29(9.1)	29 ± 0.431
3	25-34	268(19.9)	43(16.0)	0.17	94 ± 0.0311	0.13	23(8.6)	52 ± 0.933	20(7.5)	42 ± 0.341
4	35-44	158(11.3)	19(12.0)	0.43	59 ± 0.981	0.11	6(3.8)	43 ± 0.600	13(8.2)	16 ± 0.001
5	45-54	119(8.5)	18(9.0)	0.22	42 ± 0.040	0.19	8(6.7)	25 ± 0.414	10(8.4)	18 ± 0.231
6	55 & above	115(8.2)	25(21.7)	0.50	73 ± 0.027	0.15	17(14.8)	50 ± 0.544	8(6.9)	23 ± 0.074
	Total	1404(100)	326(23.2)		513 ± 0.05		207(14.7)	331 ± 4.66	119(8.5)	180 ± 4.49

*Significant ($p < 0.05$)

Table 2: Prevalence and Intensity of Urinary Schistosomiasis by Predisposing factors in the Study Area

S/No	Predisposition Factors	No. Examined	Prevalence (%)	P. value	Eggs/10mls Mean intensity	P. value	Gender			
							Male		Female	
						Prevalence (%)	Intensity	Prevalence (%)	Intensity	
	Source of water									
1	Borehole	362(25.8)	50(13.8)	1.04	46±0.080	0.12	27(7.5)	21±0.620	23(6.4)	25±1.200
2	Well	526(37.5)	112(21.3)	0.9	226±0.981	0.32	50(9.5)	105±1.022	62(11.8)	121±0.321
3	River/ Stream	516(36.8)	164(31.8)	0.04*	241±0.302	0.11	98(19.9)	150±0.120	66(12.8)	91±0.021
	Total	1404(100)	326(23.2)		513±0.05		175(12.5)	276±4.66	151(10.8)	237±4.49
	Season									
1	Wet	702(50.0)	202(28.8)	1.07	204±0.221	0.23	99(14.1)	122±0.321	103(14.7)	82±0.320
2	Dry	702(50.0)	124(17.7)	0.08	254±0.032	0.210	77(10.9)	143±0.001	47(6.7)	111±0.121
	Total	1404(100)	326(23.2)		513±0.05		176(12.5)	265±0.231	150(10.7)	193±1.001
	Occupation									
1	Farming	253(18.4)	61(23.6)	.03*	114±1.200	0.012	38(15.0)	32±0.020	23(9.1)	82±0.022
2	C/Servant	184(13.1)	30(16.4)	0.11	36±0.020	1.021	18(9.8)	12±0.012	12(6.5)	24±0.330
3	Student	335(23.9)	128(38.2)	0.07	85±0.001	0.340	65(19.4)	65±0.020	63(18.8)	15±0.001
4	Business	292(20.8)	14(4.8)	0.01*	90±0.321	0.111	5(1.7)	41±0.021	9(3.1)	49±0.001
5	H/wife	135(9.6)	23(17.0)	0.10	0±0.00	0.0	0.00	0±0.00	23(17.0)	10±0.120
6	Fishing	200(14.2)	70(35.0)	0.55	188±0.012	0.943	58(29.0)	143±1.002	12(6.0)	40±0.012
	Total	1404(100)	326(23.2)		513±0.05		184(13.1)	293±0.003	142(10.1)	220±0.001

*Significant (p<0.05)

DISCUSSION

Out of the overall prevalence and intensity of urinary schistosomiasis 23.2% and 513±0.05 eggs/10ml of urine that were recorded in this study, 30.0% prevalence of urinary schistosomiasis were recorded in Ribadu and intensity of 72±0.12 eggs/10mls of urine. While, Kabawa had the high intensity with 80±0.02 eggs/10mls of urine and 12.4% prevalence with less in Kangle 24±0.82 eggs/10mls of urine with 21.6% prevalence urinary schistosomiasis, with statistically significant difference (p<0.05). Gender related prevalence and intensity showed 185(25.5%) and 289±4.66 eggs/10ml of urine among male with 141(20.8%) and 206±4.49 eggs/10ml of urine. This report is in disagreement with that of Olalubi *et al.* (2013) who recorded high intensity of *S. haematobium* among females than males. These differences may be attributed to the facts that, males engaged intensively in water contact related occupation

than female in the present study Area, this is also in contrast with the work of (Kabaterine *et al.*, 2004 and Turrock *et al.*, 2009) who recorded very low prevalence and intensity of *S. haematobium* in their studies. Meanwhile, this could be as a result of geographical differences and high water contact activities by the subjects in the study Areas, meanwhile, this is in consonance with the research carried out by (Biu *et al.*, 2009; Shashie *et al.*, 2015 and Salwa *et al.*, 2016) who in their findings shown high prevalence of *S. haematobium* infection among males than females and contrary with the work of (Tohon *et al.*, 2008; Samei *et al.*, 2010; Ladan *et al.*, 2011) who reported high infection of urinary schistosomiasis among females than males.

Prevalence and intensity with respect to age is highest among age bracket 5-14 with 36.6%, and 128±0.033 eggs/10mls of urine and lowest among age bracket 45-54 years old with 9.0% and 42±0.005 eggs/10mls of urine, this finding is

in concordance with the work of (Hottez *et al.*, 2009) who reported high urinary schistosomiasis incidence among School-age children, Adolescents and young Adults, and also in line with the work of (Olalubi *et al.*, 2013) who reported age group ≤ 8 , between 8-11 and 12-15 years old with intensity of 301 ± 0.03 , 201 ± 0.23 and 103 ± 0.22 respectively. Analysis has further shown that, males and females have relatively equivalent percentage of infections with 25.5% and 20.8% respectively and Chi-square indicated no statistically significant difference ($p > 0.05$). The prevalence and intensity of urinary schistosomiasis with respect to sources of water indicate that, subjects fetching from River/Stream and from Borehole have the highest and the lowest infection with and 31.8% and 241 ± 0.302 eggs/10mls of urine and 13.8% and 46 ± 0.080 eggs/10mls of urine, and there was significant statistical difference ($p < 0.05$), this is in line with the previous work conducted in Kano State by Salwa, *et al.* (2016) who reported 16.7% prevalence among those that depend on Streams and River water as their only sources of water. It is also in accordance with the report of (Kiran *et al.*, 2016) who recorded highest and lowest *S. haematobium* infection among those that fetch from Streams and Boreholes as 60.0% and 17.6% respectively. Seasonal prevalence and predisposition factor play important roles in urinary schistosomiasis in which low prevalence of 17.7%, with high intensity 254 ± 0.032 eggs/10mls of urine while high prevalence 28.8% and low intensity 202 ± 0.221 eggs/10mls of urine and reported in wet season. Prevalence and Intensity of urinary schistosomiasis was recorded to be moderately low in terms of occupation with 35.0% and 188 ± 0.012 eggs/10mls of urine among fishers. Meanwhile, highest prevalence was among students 38.3% with intensity of 85 ± 0.001 eggs/10mls of urine, while, lowest prevalence and intensity were recorded among Business men 4.8% and 36 ± 0.020 eggs/10mls of urine C/servants

respectively and it has revealed significant statistical differences ($p < 0.05$), this finding was in accordance with the work of (Ololubi *et al.*, 2013) who noted highest prevalence of urinary schistosomiasis among students than any other occupations, but disagreed with that of Dennis, *et al.* (2013) who reported highest prevalence of urinary schistosomiasis among farmers (36.2%) and lowest among Artisans, this disparity could be associated with the facts that most of the students in the present study attend Day Schools which might have given them more chances to frequently visit streams and rivers for fishing and recreational purposes.

Conclusion

This study that was conducted among residence along River Benue Adamawa State, and has presented moderate prevalence and intensity of urinary schistosomiasis compare to other report in some places, meanwhile, predisposition factors like; community geographical differences, occupation, gender, water source and age were considered to be the major determinant factors for the infection.

Recommendation

With the reports portrayed in the results, treatment of the community residence especially the fishermen and school-aged children with praziquantel at least once a year, until the prevalence of the infection falls below a level of public health importance should be advocated.

Acknowledgements

The Authors really acknowledged the generous cooperation of Adamawa State Ministry of Health Yola, Zoology Department, University of Technology, Yola, community heads of the study area, research assistance, and all the participants for their commitment, willingness and support during the field work.

Conflict of Interest

There was no any conflict of interest associated to this research, and it was sponsored by Nigerian Tertiary Education Trust Fund (TETfund).

REFERENCES

Adebayo, A and Tukur, L. (1999). Adamawa State in Map.

Biu, A.A., Kol, H.B. and Agbado, E.T. (2009). Prevalence of *Schistosoma haematobium* infection in School Aged Children of Konduga Local Government Area, North Eastern Nigeria. *International Journal of Biomedical and Health Sciences*, 5: 181-184.

Chitsulo, L., Engels, D., Monlresor, A. and Savioli, L. (2010). Global status of schistosomiasis and its control, *Acta tropical Journal*, 7(3):41-51.

Cheesbrough, M. (2006). District Laboratory Practice, Second Edition. Part 1, Cambridge University Press.233-236.

Dennis, O.U., Celestine, O.E., Onwuliri, F.O.U., Osuala., Ikechukwu, N.S., Dozie, F.N., Opara and Ucheamaka, C.N. (2013). Endemicity of Schistosomiasis in some parts of Anambara State. *Academic Journal of Medical Laboratory and Diagnosis*, 4(5) 54-61.

Hotez, P.J. and Kamth, A. (2009). Neglected Tropical Diseases in Sub-saharan Africa: Review of their Prevalence, Distribution, and Disease Burden. *PLOS Neglected Tropical Disease*. 3: 412-414.

Hotez, P.J, Asojo O.A, Adesina AM. (2012). Nigeria "Ground Zero" for the high prevalence neglected tropical diseases. *PLOS. Neglected Tropical Diseases*. 6(5):54-59.

Kiran, S., Dalhatu, M. and Jindra, S. (2016). Current Status of Schistosomiasis in Sokoto, Nigeria. *Journal of Parasite Epidemiology and Control*, 4(3): 239-244.

Mostata, M.H., Sheweita, S.A. and Oconnar, P.S. (2009). Relationship between Schistosomiasis and Bladder Cancer. *Clinical microbial Journal*, 12(4): 97-111.

Ladan, M.U., Abubakar, U., Abubakar, K., Bunza, M.D.A., Nasiru, M. and Ladan, M.J. (2011). Gender and Age Specific Prevalence of Urinary Schistosomiasis in Selected Villages Near a Dam site in Gusau Local Government Area. Zamfara State, Nigeria. *Nigerian Journal of Parasitology*, 32; 57-61.

National Population Commission (NPC) (2006)

Olulabi, A., Oluwasogo, Olukunle, B. and Fagbemi. (2013). Prevalence and Risk Factors of *Schistosoma haematobium* Infections among Primary School Children in Igbokuta Village, Ikorodu North Local Government, Lagos State. *IOSR Journal of Nursing and Health Science*2(6): 62-68.

Kabatereine, N.B., Brooker, S., Tokahebwa, E.M., Kazbwe, F., Onapa, A.W. (2005). Epidemiology and Geography of *Schistosoma mansoni* in Uganda, Implication for Planning Control. *Journal of Tropical Medicine International for Health*. 9: 372-380.

Samie, A., Nchachi, D.J., Obi, C.L. and Igumbor, E.O. (2010). Prevalence and Temporal Distribution of *Schistosoma haematobium* infections in the Vhembe District, Limpopo Province, South Africa. *African Journal of Biotechnology*, 42(9) 7157-7164.

Sturrock, H.J.W., Picon, D., Sabasio, A., Oguttu, D. and Robenson, E. (2009). Integrated Mapping of Neglected Tropical Disease;

Epidemiological Findings of and Control Implications for for Northern Bahr-el-Ghazal State. Southern Sudan. *PLOS Neglected Tropical Disease* 3(2): 537-543.

Page | 3584

Shashie, G., Agersew, A., Sisay, G., Zeleke, M. and Berhanu, E. (2015). Prevalence of Urinary Schistosomiasis and Associated Risk Factors among Abobo Primary Children in Gambella Regional State, Southwestern Ethiopia: A cross Sectional Study. *Journal of Parasite and Vector* 8:215 Doi 10.1186/s13071-015-0822-5.

Salwa, D., Hesham M., Jamaiah, I., Awatif, M. A., Abdulhamid, A., Hany, S. *et al.* (2016). Prevalence and Risk Factors of Schistosomiasis among Hausa Communities in Kano State, Nigeria. *Revista Instituto of Medicina Tropico Sao Paulo*, 5(7): 112-132

Tohon, Z.B., Mainassara, H.B., Garba, A., Mahamane, A.E., Bosque-Oliva, E., Ibrahim M.L. *et al.* (2008). Controlling Schistosomiasis: Significant decrease of Anaemia Prevalence one Year After a single Dose of Praziquantel in Nigerian School Children. *PLOS Neglected Tropical Disease* 2: e241. Doi:10.1371/Journal.Pntd.0000241.

Vanderwerf, M.J., De Vlas, S.J., Brooker, S., Looman, C.W., Nagelkerke, N.J. *et al.* (2003). Quantification of Clinical Morbidity Associated with Schistosome infection in Sub-Saharan Africa. *Acta Tropical Journal*. 86(1): 125-139

WHO. (2018) Global Burden Disease Estimate Index, Geneva