

(RESEARCH ARTICLE)



Haematobium infection and the predisposing factors in Fufore LGA of Adamawa State

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Abstract

Background & Objectives: Schistosomiasis, is a major health problem in the rural areas of developing countries where there is high water contact activities with fresh water bodies, poor hygienic practices and no portal drinking water. It ranks the second after Malaria with socio-economic and public health importance in the tropics and subtropical regions. To provide information on the prevalence and predisposing factors of Haematobium infection among School-aged children in relation to their age and gender in Fufore LGA.

Methods: A cross sectional study was carried out to determine the prevalence of urinary Schistosomiasis and the predisposing factors in Fofure LGA of Adamawa State between October and November 2022 where five Schools were sampled for the study. 300 Students between the ages 0-15 years were randomly selected and grouped into three age groups (0-5, 6-10 and 11-15) respectively. Urine samples were obtained from the students and transferred to New Boshang Hospital Medical Laboratory for parasitological examination. Each were also issued a structured questionnaire so as to obtain their demographic characteristics and to determine the possible risk factors associated with this infection in the case of study.

Results: Out of the total 300 Students examined, 113(37.7%) were positive for *Schistosoma haematobium* and the Males (43.9%) had significantly higher prevalence ($P < 0.05$) than the Females (30.2%). In respect to age, the age group 11-15 (51.5%) were significantly more infected ($P < 0.05$) than the younger age groups 0-5 (8.2%) and 6-10 (36.6%) examined. Haematobium infection was observed to be higher in children whose parents were irrigation farmers/fishermen 173(57.7%) than those whose parents are not. Students whose household monthly income is below N30, 000 were more infected. Those that used well 97(32.3) and streams 123(41.0%) as source of drinking water showed high prevalence than those who use borehole. Students whose water contact activities were for farming/ fishing 201(67.7%) were significantly more infected with haematobium infection ($P < 0.05$) than those without ant water contact activity.

Interpretation and Conclusion: From the result of the study, it's clear that poverty, ignorance, socio-cultural practice, poor hygienic practices, inadequate toiletry facility are some of the predisposing factors associated with this infection in the study area. Intervention by the relevant authorities are needed to curtail the transmission of this infection. These interventions includes; massive health education, provision of portable drinking water and provision of good sanitary/ toilet facility.

Keywords: Adamawa State; Fufore; School-aged; Haematobium infection; Predisposing factors

1. Introduction

Schistosomiasis (Bilharziasis) which is also known as snail fever is a waterborne disease caused by parasites of the genus *Schistosoma*, a digenic trematode that resides in the blood vessels of man and other livestock (Steinmann *et al.*,

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2006) and (Moore, 2010). These blood flukes are among the helminthes infection that causes considerable morbidity and mortality (WHO, 2010). Schistosomiasis after malaria, is the second most important tropical disease and one of the main occupational hazards encountered in rural farming populations and the most prevalent among water-based parasitic infections (CDC, 2016). Many freshwater snails are of medical and veterinary importance serving as intermediate hosts of different helminthic parasites of humans and animals (Abaje *et al.*, 2012 & Abdulhamid *et al.*, 2018). Majority of the snail intermediate hosts for human Schistosomiasis belong to three genera *Biomphalaria*, *Bulinus* and *Oncomelania* (Agi, and Okafor, 2005). The genera *Biomphalaria* and *Bulinus* are the intermediate hosts of *Schistosoma mansoni* and *Schistosoma haematobium* in Nigeria, respectively. The aquatic snail hosts of *Schistosoma* occur in shallow water near the shores of lakes, ponds, marshes, streams and irrigation channels. The development and management of dams has numerous social and economic benefits such as irrigation, power generation, fishing, transportation and tourism (Owojori *et al.*, 2006). However, it creates new biotopes which are conducive for breeding of these fresh water snails. The transmission of these infections takes place only in places where fresh water snail intermediate hosts are present, and where there is contact between the population and the infested water (Sanu *et al.*, 2020).

This disease have been given less concern therefore, are classified under the neglected tropical diseases (NTD) Federal Ministry of Health (FMOH, 2012-2017). It is prevalent in 78 countries of the world and affects an estimated 236.6 million people (WHO, 2021). Nigeria is currently the most affected country in the world and more than a decade ago, 29 million people were affected and 101 million others are at the risk of being infected. The disease is endemic in Nigeria and has been reported from all the six (6) geopolitical zones according to the Nigerian master plan for NTDs (2012-2017), out of the 37 states in Nigeria.

Schistosomiasis is most prevalent in rural and pre-urban areas where ponds, rivers, streams, ditches and inland lakes form major sources of water for domestic use and where urination and defecation are done indiscriminately (WHO, 1999). Farmers and fishermen are predominantly affected as it's an occupational hazard, this is compounded by poor sanitary practices, open urination and defecation in ponds, rivers and streams which are used for water-related activities. Introduction of irrigated Agricultural Schemes have been associated with introduction of Schistosomiasis in various parts of Africa (Audibert and Etard, 1998, De Clerq *et al.*, 2000, Ofоеjie, 2002, Hunter, 2003 and Odaibo *et al.*, 2004).

Most parasitological survey of common parasitic infections in Nigeria have been confined mostly to rural area, where poor sanitation and hygiene as well as a general ignorance of the disease, provide optimal environment for the transmission (Damen *et al.*, 2010), some of the risk factors like human migration, infrastructural development projects, agriculture, hydro-electricity, and road projects continue to extend the disease to new areas as these projects increase the natural habitats whereby creates conducive environment for breeding of the snail intermediate hosts. Thus, there is a continued increase in the prevalence, as well as the pattern of distribution of the scourge globally (Carter Center and WHO, 2016).

2. Material and methods

2.1. Study area

Fufore is a town and headquarter of Fufore Local Government Area of Adamawa State, Nigeria. Fufore LGA is located at 9° 13'N and 12° 39'E. The LGA have an average daily temperature of 34 °C, average humidity of 18% and average wind speed of 10 km/ h and contains seven lakes with two most popular within the territory; the Lake Bagale and Shaffa jauole lakes. As of 2006, it has a population of 209,460 peoples (NPC, 2006) with the majority of its people being members of the Hausa and Fulani ethnic groups. It has a total land mass of about 3,666 km² (Tukur and Musa, 2009). The area is regarded as low lying with about 80% of the entire area being at less than 300m above sea level, while the remaining 20% are hills and mountains. The area is drained by a series of rivers and streams such as River Benue which takes its source from the republic of Cameroon, River Faro and Ine which all encourage arable cropping, livestock rearing and fishing (Fadama II, 2008). The area experiences distinct dry and wet seasons with temperature and humidity varying with season. The wet season is between April and October with average annual rainfall of 750 to 1000mm. The dry season period is between November and March and characterized by dry, dusty and hazy north – east trade winds that blow over the area from Sahara desert. Temperatures are relatively high almost all the year round. The temperature of the area ranges from 30 °C to 42 °C with cold dry winds that reduce the temperatures to about 15 °C during Harmattan period with the hottest months being April and May, with mean average temperature of 34 °C (Adebayo, 1999). The major occupation of the indigenous people of Fufore LGA is farming (crops such as; Rice, beans, Soyabean, Millet and Sorghum) and cattle rearing.

The study was carried out among School children between the age ranges of 0 to 15 from the five major Schools. The Local Government authority, principals/ headmasters and the students were informed about the purpose and benefit of the study. Informed consent were issued. During the sample collection, the students were offered a structured questionnaire and a well labelled screw capped universal container containing age, sex, School and ethnic group.

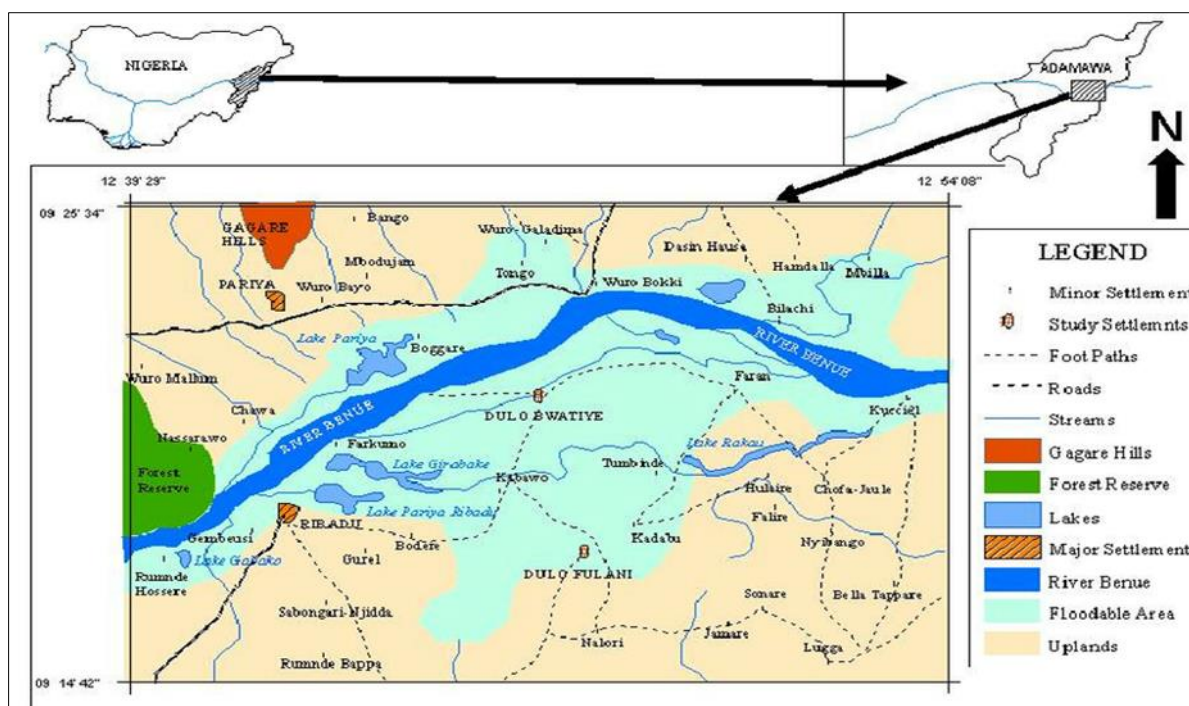


Figure 1 Map of the study area (Tukur and Musa, 2009)

2.2. Ethical clearance

Ethical clearance was obtained from the Local Government director Ministry of Education and the School authorities gave approval for this study.

2.3. Urine sample collection

The students were randomly selected from the five Schools of the study area. A total of 300 urine samples were collected from the students in clean sterile sample containers. The urine samples were placed in a thermo box containing cold packs and transferred to New Boshang Hospital medical laboratory, Yola for examination.

2.4. Examination of urine sample

5mls of the urine sample was been poured into test tubes and spun in a general purpose centrifuge for 5 minutes each at 1500rpm. Two layers were formed, the upper layer called supernatant and the down layer called debris. The upper layer was discarded while the debris were collected and placed on a glass slide using pasture pipette, covered with a cover slip and examine under a microscope using X10 objective lens. The *Schistosoma Haematobium* eggs recovered were recorded duly.

2.5. Data analysis

The data obtained during the study was analyzed using Statistical Package for Social Sciences (SPSS) version 24. The prevalence of parasites were presented in the form of descriptive statistics while the relationship between various variables and the occurrence of parasites was determined using chi square test at 95% confidence level ($P < 0.05$).

3. Results

Three hundred School children were examined for Urinary Schistosomiasis. Result revealed that 37.7% of the total Student's population were infected with Urinary Schistosomiasis.

Table 1. Shows that, out of the 300 urine samples examined, 164 were Males and 72(43.9%) were positive, while 136 were Females in which 41(30.2%) were positive. The Males (43.9%) were more infected than the Females (30.2%) and there was a significant difference at $P < 0.05$. Of the 300 samples examined in regard to age, 61 were within the age 0-5 and 5(8.2%) were infected, 101 were within the age 6-10 and 37(36.6%) were infected, 138 were within the age 11-15 and 71(51.5%) were infected. The age group 11-15 (51.5%) were more infected than the other age group and there was significant difference in the infected rate at $P < 0.05$ (Table 2).

Table 3. Summarizes the result for the demographic characteristics of the study subjects and their response to the study questions.

3.1. Parents/ guardians occupation

The respondents whose parents/ guardians are farmers were 173(57.7%) out of the 300 respondents. Those whose Parents/ guardians are businessmen/ women were 36(12.0%) out of the 300 respondents. Those that said their parents/ guardians are healthcare personnel were 14(4.7%), while those that their parents/ guardians have other occupation were 77(25.7%) out of the 300 respondents.

3.2. Source of drinking water

Those that use pond as their source of drinking were 13(4.3% out) of the 300 respondents, those that use stream as source of drinking water were 97(32.3%), those that uses well as their source of drinking water were 123(41.0%), while those that uses borehole as their source of drinking water were 67(22.0%) out of the 300 respondents.

3.3. Water contact activities

Out of the 300 respondents, those whose water contact activity is for bathing/ swimming were 87(29.05%) out the 300 respondents, those that said is for farming/ fishing were 201(67.0%), while those whose water contact activity is for domestic purposes were 12(4.0%) out of the 300 respondents.

3.4. Ever experienced painful urination

Those that said they've ever experience painful urination were 171(57.0%), while those never experience were 129(43.0%) out of the 300 respondents.

3.5. Ever observed blood in your urine

Those that said they've have never observed blood in their urine were 75(25.0%) out of the 300 respondents, those that have observed but not frequently were 128(42.7%), while those that frequently observed blood in their urine were 97(32.3%) out of the 300 respondents.

Table 1 Prevalence of Haematobium in relation to Gender of the respondents in the study area

Gender	Number examined	Number positive	Prevalence (%)
Male	164	72	43.9%
Female	136	41	30.2%
Total	300	113	37.7%

P-value: $X^2 = 5.991$, $df = 1$, $P = 0.014$

Table 2 Prevalence of Haematobium in relation to Age of the respondents in the study area

Age group (Years)	Number examined	Number positive (%)	Prevalence (%)
0-5	61	5	8.2%
6-10	101	37	36.6%
11-15	138	71	51.5%
Total	300	113	37.7%

P-value: $X^2 = 33.775$, $df = 2$, $P = 0.000$

Table 3 Demographic and other characteristics of the study subjects and their response to the study questions

Questions	Options	Response (Frequency)	Percent (%)
Parent/ guardian occupation	Farmer	173	57.7
	Businessman/ woman	36	12.0
	Healthcare personnel	14	4.7
	Others	77	25.7
	Total	300	100
Household Monthly income	10,000-15,000	19	6.3
	16,000-20,000	83	27.7
	21,000-30,000	117	39.0
	31,000-40,000	81	27.0
	Total	300	100
Numbers in household	3-5	79	26.3
	6-8	188	62.7
	9-11	33	11.0
	Total	300	100
Source of drinking water	Pond	13	4.3
	Stream	97	32.3
	Well	123	41.0
	Borehole	67	22.3
	Total	300	100
Water contact activities	Bathing/ swimming	87	29.0
	Farming/ fishing	201	67.0
	Domestic use	12	4.0
Ever experienced painful urination	Yes	171	57.0
	No	129	43.0
	Total	300	100
Ever observed blood in urine	Not at all	75	25.0
	Not frequent	128	42.7
	Frequent	97	32.3
	Total	300	100

4. Discursion

The result of this research showed a prevalence of (37.7%) which is higher than the result reported by Ameh, *et al.* (2015) who work on the prevalence of urinary Schistosomiasis and got (5.02%). There is however, a similarity on the inference of the prevalence in relation to age and gender. The findings are consistent with studies done elsewhere within the State and Nigeria at large as seen in that of Habiba and Jabbo, (2013) who got the prevalence of (34.4%) in Mayobelwa LGA of Adamawa State. Also, that of Birma, *et al.* (2017) who reported 48% in the infection rate in their work done Urinary Schistosomiasis in the communities of Kiri Lake, Shelleg LGA. Adamawa State. Naphtali, *et al.* (2017)

also reported 34.7% rate of infection in their work carried out on *Schistosoma haematobium* among primary School Children in Girei LGA of Adamawa State. Schistosome infection poses serious threats to the hopes and aspiration of Nomadic Fulanis and the entire inhabitants of Fufore Local Government Area for a healthy living which would prevent them from taking proper care of their animals and carry out some of their domestic activities to burst the economy of the area, State and the country at large. Fishing, irrigation farming, dams created during construction and building of mud houses by the inhabitants, swimming/ bathing, use of waters from streams for domestic uses could be attributed to the prevalence of Urinary Schistosomiasis in Fufore. Some of the urine samples observed to be heavily laden during the examine suggest that the prevailing environmental conditions favors the snail intermediate host and support the transmission of this infection among the inhabitant in Fufore LGA. The high increase in the prevalence rate of Urinary Schistosomiasis recorded in this study than that recorded by Ameh, *et al.* (2015) is not surprising as it is a parasite that is common in an environment containing fresh water bodies and where there is high fishing and irrigation farming activities which is observed to be increasing on daily bases in Fufore as, it is their major occupation.

The higher prevalence observed in the Male gender could be due to the fact that, they are the ones that mostly indulge more in contact water activities such as fishing, irrigation farming and do mostly visit these water bodies for bathing and swimming than the Females and by so doing an infective stage of the *Schistosoma haematobium* parasite may be picked from these fresh water bodies during any of these water contact activities as also reported by Naphtali, *et al.* (2017), Chessed, *et al.* (2017) and Ameh, *et al.* (2015).

The age group 11-15 was observed to be more infected 51.1% followed by the age group 6-10 (36.6%) than the age group 0-5 at prevalence rate of 8.2%. This could be due to the fact that, the age group 11-15 are less confined by parents/ guardians hence more likely to visit water bodies for recreational activities than the younger age group. Furthermore, the age group 11-15 appears to be more adventurous in terms of fishing, swimming, Snail hunting and washing of clothes. All these corresponds with the report of Chessed, *et al.* (2017), Naphtali, *et al.* (2017), Habib, *et al.* (2021), Shashie, *et al.* (2015) and Biu, *et al.* (2009) who reported the age group 11 and above to be more infected than the younger age group in their work.

Recommendation

As this study revealed the endemicity of urinary Schistosomiasis among School Children and the risk factors associated with this infection in Fufore LGA of Adamawa State, Nigeria. For the prevention and control of these infection in the case of study, the following are recommended to curtail the effect of this infection and further transmission among the inhabitants in the case of study:

- Massive health education in the area so as to enlighten the people on the imminent dangers posed by these parasites especially in the case of multiple infection by an individual.
- Immediate treatment of the infected children to avoid further spray of these infection.
- Massive intervention in the case of study through provision of good toiletry and sanitary facilities so as to discourage the indiscriminate urination and defecation to avoid polluting the environment.
- Provision of potable drinking water.

5. Conclusion

This study evaluated the prevalence of haematobium infection and the predisposing factors in Fufore LGA in relation to the age and gender of the respondents. The Schools sampled made it easier and possible to carry out the research, the structured questionnaire offered during the research aid in the collection of the demographic characteristics and examination of associated risk factors of this infection the case of study. The rate of haematobium infection discovered is highly associated to unprotected water contact activities such as; irrigation farming, fishing and swimming in fresh water bodies. Poverty in the other hand, is the greatest driven force which brings about poor nutritional and hygienic practice among the inhabitants and thereby, expose them to the risk of the infection. This study have revealed the endemicity of urinary Schistosomiasis in Fufore LGA and because of that, the inhabitants are brought to knowledge about the infection, the health risk and the possible means of contacting this infection and furthermore, the information gathered during the research will be resourceful in planning the prevention and control measured. Massive intervention in the study area will help in reducing the effect and further transmission of the infection.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors have not experience any conflict of interest during and after the research.

Statement of ethical approval

Ethical approval was obtained from all relevant bodies before the research was carried out and the authors have adhered to the accepted ethical standards throughout the research.

Statement of informed consent

Informed consent letter was obtained from individuals involved in this research after they are educated on how the research will be carried out and the importance of the research to them, their community and the country at large.

References

- [1] Abdulhamid A, Usman AI and Adamu T. (2018). Schistosomiasis among schoolchildren living in endemic communities around Kwanar Areh Dam, Katsina State, Nigeria. International Journal of Science and Research (manuscript accepted for publication).
- [2] Abaje IB, Ati OF and Iguisi EO. (2012). Recent Trends and Fluctuations of Annual Rainfall in the Sudano-Sahelian ecological zone of Nigeria: Risks and opportunities. Journal of Sustainable Society, 1(2):44-51.
- [3] Adamawa State Ministry of Information (2008). Adamawa State Diary. Adamawa State Press Limited Yola, Adamawa State: 1-3.
- [4] Adebayo A.A. (1999) Vegetation and forest in: Adebayo A.A. and Tukur A.L. (eds), Adamawa State in Maps, psaraclete publishers Yola Nigeria.
- [5] Agi PI and Okafor EJ. (2005). Epidemiology of Schistosoma haematobium in Odau community in the Niger Delta area. Journal of Applied Sciences and Environmental Management, 9(3):37-43.
- [6] Ameh, V, Qadeer, M.A, Asher, R, Nganjiwa, J.I. (2015). A study on urinary Schistosomiasis amongst the inhabitants of Fufore Local Government Area of Adamawa State, Nigeria. IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS) e-ISSN: 2278-3008, p-ISSN:2319-7676. Volume 10, Issue 4 Ver. I (Jul - Aug. 2015), PP 91-95
- [7] Audibert, M. and J. Etard, (1998). Impact of Schistosomiasis in Rice output and farm inputs in Mali, J. Afr. Econ., 7 (2), 1998, 18. (8)
- [8] Arora, DR and Arora, B. (2008). Medical parasitology CBS, Publisher, New Delhi.pp 15-177.
- [9] Birma, JS; Chessed, G; Shadrach, PA; Nganjiwa, JI; Yako, AB; Vandi, P; Laurat, T. (2017). Urinary Schistosomiasis in Communities around Kiri Lake, Shelleng Local Government Area, Adamawa State. J. Appl. Sci. Environ. Manage. Feb. 2017 Vol. 21 (1) 128-134
- [10] Biu AA, Kol HB and Agbado ET. (2009). Prevalence of Schistosoma haematobium infection in School age children of Konduga Local Government Area. North Eastern Nigeria. International Journal of Biomedical and Health Science. 5: 181-184
- [11] Cheesbrough. M (2002). Clinical features and pathology of Schistosoma. Medical Laboratory manual for tropical Countries (second edition). 1:331. Cambridge University Press.
- [12] Damen, JG, Lar, P, Mbaawuga, EM and Nyary, BW. (2010). A comparative study on the prevalence of intestinal helminthes in de-wormed and non-dewormed students in rural area of North-central Nigeria. Laboratory Medicine, 41: 585 – 589.

- [13] De Clerq, D., Verracruyse, J., Sene, M., Seck, I., Sall, CS. M., Ly, A. and VR, South gate, (2000). The effects of irrigated agriculture on transmission of urinary Schistosomiasis in the Middle and upper valleys of the Senegal Basin, *Annals of Tropical Medicine and Parasitology*, 6(94), 2000, 581 -590. (8)
- [14] Fadama II, (2008): The journey so far in Fufore Local Government Area Adamawa State. pp 1-3.
- [15] Federal Ministry of Health (2012). Nigeria master plan for neglected tropical disease (NTDs) (2013–2017): 22 March 2012. [cited. 2016 Feb 10]. Available from: [http:// docplayer.net/2404435-Nigeria-master-plan-for-neglected-tropical-diseasesntds-2013-2017.html](http://docplayer.net/2404435-Nigeria-master-plan-for-neglected-tropical-diseasesntds-2013-2017.html)
- [16] Habib MR, Lv S, Rollinson D, Zou XN. (2021). Inversion and dispersal of Biomphalaria Species: Increased Vigilance needed to prevent the introduction and spread of Schistosomiasis. *Front Med* 8:614797
- [17] Ballah H.J and Jabbo A.A, (2013). Survey of urinary Schistosomiasis among School-aged children in the rural communities of Mayo-belwa local Government area, Adamawa State, Nigeria. *Journal of National Sciences Research*, 3(4):73-77.
- [18] Hunter, J. M. (2003). Inherited burden of disease: agricultural dams and the persistence of bloody urine (*S. haematobium*) in the upper East Region of Ghana, 1957-1997, *Soc. Sci. Med.*, 56 (2), 2003. 219-234. (8)
- [19] Moore J. (2010). Intermediate host behavior. *Encyclopedia of Animal Behavior* pg. 658-662. ISBN 9780080453378
- [20] National Population Commission (2006): Legal notice on publication of the details of the breakdown of the national and state provisional totals 2006 Census pgB179.
- [21] Naphtali RS, Yaro MB, Arubi M. (2017). Prevalence of *Schistosoma haematobium* among Primary School Children in Girei Local Government Area, Adamawa State. *IOSR Journal of Nursing and Health Science (IOSR-JNHS)* e-ISSN: 2320–1959.p- ISSN: 2320–1940.
- [22] Odaibo, AB., Adewumi, C., Olorumola, FO., Ademoyin, CO., Olofintoye, LK., Akinwumi, TA., Adetula, MO., Awe, CO. and Akinyemi, F. (2004). Preliminary studies in the prevalence and distribution of urinary Schistosomiasis in Ondo state, Nigeria, *African Journal of Medical Sciences*, 33(3), 2004, 219-224. (8)
- [23] Ofoeje, IE. (2003). Human Health and sustainable water resources development in Nigeria: Schistosomiasis in other lakes, *Natural Resource Forum*, 26, 2002, 150-160. (8)
- [24] Owojori OJ, Asaolu SO and Ofoeze EI. (2006). Ecology of freshwater Snails in Opa Reservoir and Research farm ponds at Obafemi Awolowo University Ile-Ife, Nigeria. *Journal of Applied Sciences*, 6(15): 3004-3015.
- [25] Sanu KM, Istifanus WA, Musa MS and Mao PS (2020).The diversity of fresh water snail fauna in Kiri dam, Adamawa State, North Eastern Nigeria, *GSC Biological and Pharmaceutical Sciences*, 11(02): 099–104.
- [26] Shashie D, 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. A cross sectional study. *Journal of parasite and vector* 8:215 Doi 10.1186/s13071-015-0822-5.
- [27] Steinmann P, Keiser J, Bos R, Tanner M, Utzinger J. (2006). Schistosomiasis and water resources development: systematic review, meta-analysis, and estimates of people at risk. *Lancet Infect Dis.*2006;6(7): 411–425.PMID:16790382
- [28] Tukur AL, Musa AA and Mubi AM. (2009). Assessment of changes in land cover along the lower reaches of River Gongola, North East Nigeria: *Global Journal of Environmental Sciences* Vol.5 No. 2, pg 77-81
- [29] WHO, (1999). Epidemiology and control of Schistosomiasis, Report of WHO Expert committee. Technical report series 728, 1999, 11-38. (8)
- [30] WHO (2021). Prevention and control of Schistosomiasis and soil-transmitted helminthiasis: report of a WHO expert committee. *WHO Tec. Rep. Ser.*, 912:1-57
- [31] World Health Organization (2010). Working to overcome the global impact of neglected tropical diseases: first WHO report on neglected tropical diseases Geneva: WHO; 2010.
- [32] Carter Center & WHO (2016). *Schistosomiasis: number of people treated worldwide in 2013*. *Weekly Epidemiological Record*. 2015;5 (90):25–32. 12. WHO/UNICEF. Mid-upper arm circumference (MUAC) measuring tape. 2009;13 (2):1–2. 13. *The Carter Center. Waging peace, fighting disease. Building hope Nigeria.*

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