



## Urogenital Schistosomiasis Study in a Rural Community, North West Nigeria

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### Authors' contributions

*This work was carried out in collaboration between both authors. Author MUI designed the study, wrote the first draft of the manuscript and co-ordinated the research; He also helped with sample collection and laboratory analysis; Author UHB performed statistical analysis and literature search. Both authors read the final manuscript.*

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### ABSTRACT

**Background:** Bilharzia is a parasitic disease caused by the trematode worms (schistosomes). It is the most important and prevalent of water-borne parasitic disease. Schistosomiasis affects between 200 million and 300 million people in 77 countries throughout the world and is a significant cause of disease in areas of endemic infections especially among children.

**Aims:** The study was aimed to determine the prevalence and intensity of urinary schistosomiasis among people in Goronyo and taloka communities in Sokoto State, Nigeria.

**Study Design:** Investigative study.

**Place and duration of study:** The samples were collected from Goronyo and Taloka communities of Goronyo local government Area of Sokoto State between October and December, 2020.

**Methodology:** 300 water samples were obtained from domestic water sources. 175 of the samples were collected from river, 77 from borehole and 48 from well. Samples were investigated for the presence of parasites using standard parasitological techniques. Samples were subjected to macroscopy, filtration, centrifugation and microscopy.

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**Results:** Findings reveals total prevalence of 37%. The prevalence in Taloka was higher (47%) than Goronyo (27%)( $P < 0.05$ ). Males were found to be more infected (52%) than their females counterparts (12%). The age group 16-20 had the highest prevalence rate of 45% compared to age group 5-10 (34%). Fishermen had the highest prevalence rate of 71% while civil servants is least (14%).

**Conclusion:** Findings revealed that the source of water in the study area constitute an epidemiological threat to public health. However, inhabitants of the communities should boil or treat water before consumption while we solicit for government intervention so that the control of the infestation can be achieved through the integration of complementary strategies such as disease surveillance, chemotherapy, health education, alternative water supplies and public sanitation in the study area.

**Keywords:** Endemic; parasites; urogenital; Schistosomiasis; urine.

## 1. INTRODUCTION

Bilharzia is a parasitic disease caused by the trematode worms (schistosomes). It is the most important and prevalent of water-borne parasitic disease [1,2] Schistosomiasis affects between 200 million and 300 million people in 77 countries throughout the world and is a significant cause of disease in areas of endemic infections [2]. In Egypt, approximately 20% of the population is affected; prevalent rates in some villages have been estimated to be 85% [1].

The parasite was first observed in Cairo in 1851, by Theodor Bilharz in the blood of mesenteric veins of a young man on autopsy. After the name of its discoverer, it was named *Bilharzia*. The name was changed subsequently to schistosoma [1].

The name Schistosoma is derived from the appearance of the adult male the body of which has a longitudinal genital groove or canal, which serve as a receptacle for the female during copulation. It appears as though the body of the male is split longitudinally to produce this canal, hence the name schistosoma [1].

There are 19 species of schistosomes of which human infection with 10 species have been confirmed [2]. Five species of trematode parasite are responsible for the major forms of human schistosomiasis. In 1996 intestinal schistosomiasis caused by *Schistosoma mansoni* was reported from 52 countries in Africa, the eastern Mediterranean, the Caribbean and South America [3]. Oriental, asiatic or intestinal schistosomiasis caused by the *S. japonicum* group of the parasite (including *S. mekongi* in the MekongMekong Mekong river basin) was reported to be endemic in 11 countries of south east Asia and the Western

pacific region [3]. Another form of intestinal schistosomiasis caused by *S. intercalatum* was reported from 10 central African countries. Urinary (vesical) schistosomiasis caused by *S. haematobium* was reported to be endemic in 54 countries in Africa and the eastern Mediterranean [3].

The various species of Schistosomes show specie specific variations in their choice of a snail intermediate host; *S. mansoni* is transmitted by snail of the genus Biomphalaria; *S. haematobium* by bulinid snail while *S. japonicum* is transmitted by amphibious oncomelania snails [3].

Schistosomiasis is widespread among the poor population of third world countries in Africa and Asia, who live in conditions that favour transmission and who have no access to proper health care or effective preventive measures. The prevalence and morbidity of the infection is particularly linked to agriculture and water development scheme, plus the African lakes and rivers [4]. Infection is prevalent in school age children, in special occupational groups (fishermen, irrigation workers and farmers), in females and other groups using infected water for their domestic purposes [4].

Haematuria (blood in urine) and Proteinuria (excess protein in urine) are strongly indicative of urinary schistosomiasis [3]. In endemic areas up to 80% of infected people present with Haematuria, in those infected with more than 50 eggs per 10ml of urine, 98-100% has Haematuria [4].

However, infection must be confirmed in the laboratory either by microscopic techniques that detect the characteristic ova in urine or by immunodiagnostic technique that detect circulating antibodies [3] or parasite antigen in

different host body fluid. A highly sensitive PCR (Polymerase chain reaction) method has been developed for the detection of schistosome [2].

In chronically infected patients with negative urine examinations diagnosis can be made by biopsy of bladder mucosa [4,5].

Until the 1970s, foudin a trivalent antimony preparation and potassium antimony tartrate were the only treatment available and the cure involve suffering more intense than that caused by the disease itself [3]. Metrifonate has been used for the treatment of *S.haematobium*. But it has some severe human neurological side effects. Currently, medical management relies on Praziquantel (Biltricide, Bayer AG, Germany).

Although there have been important local success in Nigeria, Senegal, Zimbabwe, India and other parts of the world in the control and substantial decrease in morbidity and mortality, schistosomiasis continue to spread to new geographical areas. This is mainly as a result of environmental changes resulting from development of water source and the growth and migration of population which facilitates the disease [5,6]. The control of schistosomiasis require an integrated approach and has the following four cardinal points [3] as stipulated by the WHO expert committee on schistosomiasis control namely; Reduction of water contact, Snail control, Mass chemotherapy and Health education.

Furthermore, there have been report of resistance to praziquantel, the main stay of Medical and veterinary treatment since the mid-70s [7,8].

## 2. MATERIALS AND METHODS

### 2.1 Study Area

Sokoto state is located at the extreme Northwest of Nigeria between longitude  $4^{\circ}8$  E and  $6^{\circ}54$  and between latitude  $12^{\circ}$ N and  $13^{\circ}58$  N. the state share borders with the republic of Niger to the North, Kebbi state to the west and southeast and Zamfara state to the east. The state covers a total land area of about 32,000 square km. Based on the 2006 census the state has a population of 3,696,999.

Sokoto state is located within the illumedden basin which is surrounded to the east and south by the Precambrian basement complex. The state is drained by the Sokoto and Rima rivers and their

tributaries, most of which rise from the southeast. They all flow westwards to join the Rima and later River Niger to the west. These rivers and their tributaries form one of the most extensive Fadama areas in Nigeria [8,9].

The study was conducted in Goronyo local government. Its headquarters are in the town of Goronyo, it has an area of  $1,704$  km<sup>2</sup> and a population of 182,296 at the 2006 census. The local government is the location of the Goronyo Dam, upstream of Goronyo town to the east.

### 2.2 Study Population

The study population is individuals aged between 5-20 years living in the communities.

### 2.3 Inclusion and Exclusion Criteria

The study was limited to people in Goronyo and Taloka village (a km from the main town). The research was restricted to the age range (5-20years) because it has been found that this age group harbour the highest prevalence rate and intensity of infection. The participants below 5 years and above 20 years of age were excluded from the study.

### 2.4 Research Hypothesis

The research hypothesis is that urinary schistosomiasis will be higher in the community due to presence of the large dam as compared to other communities who lack water bodies.

**Alternate hypothesis:** There will be high prevalence of urinary schistosomiasis due to the community dependence on the water bodies for their daily activities.

**Null hypothesis:** There will be low prevalence of urinary schistosomiasis.

### 2.5 Sample Collection and Analysis

A letter of introduction was presented to the village heads involved in order to permit the collection of urine samples from their people. The permission was granted, individuals were randomly selected with regards to age and sex without bias. Clean and sterile universal urine containers were given to each of these people to collect samples of urine one after the other and about 10mls for the investigation at midday. The essential data of the people such as age, sex and name of the community, sample number,

water conduct activity and time of collection were noted on the containers and laboratory request form with the same information given was accompanied to the laboratory for the investigation not later than two hours [10].

## 2.6 Methods

1. The sample numbers serially was carefully recorded to correspond with their names to avoid mixing up the groups.
2. 10mls of the urine was collected in a clean dry container and f 4 drops of 10% formal formol saline were added to preserve parasite morphology.
3. The samples were carefully placed to avoid breakage.
4. All subjects involved were strictly advised to wash their hands before going back to their respective duties.
5. Urine samples were prevented from faecal contamination and other source of contamination by instructing subjects how to collect urine aseptically.
6. Urine samples were processed within two hours of its collection.
7. Appearance of the urine was reported, in moderate to heavy infection, the urine will usually contain blood and appear red or brown and cloudy
8. The well mixed urine sample was centrifuged at 3000rpm for 2-4 minutes to sediment the *Schistosoma Schistosoma* eggs (centrifuging at greater level was avoided to prevent hatching of the eggs).
9. The supernatant fluid was discarded and the sediment transferred to a glass slide

and covered with a cover glass, the entire sediment was examined under x10 objective with the condenser iris closed sufficiently to give good contrast.

10. The number of eggs was counted and the number reported /10 mls of urine, if more than 50 eggs are present, there would not be need to continue counting and will be reported as 50 eggs/10mls. Such counts indicate heavy infection [11].

Samples were transported to the laboratory in suitable containers to avoid breakage and leakage of urine. Urine was examined quantitatively after centrifuging. Eggs are not shed at a steady rate during the day and quantitative egg counts are useful for determining the degree of infestation and response to therapy. Therefore, 24 hour urine collection is recommended for microscopy [12].

An increased number of eggs is excreted around midday and microscopic examination of a centrifuged urine specimen collected at this time usually reveal light infections, examination of an increased quantities of urine is sometimes required [10].

*Schistosoma haematobium* eggs are commonly found in the urine of infected individuals when examined microscopically after centrifuging within 2-4 minutes at 2000rpm 200 revolution per minute and then the sediments are examined under 10x and 40x objectives of the light microscope [13].



**Fig. 1. Egg of *S.haematobium*.**

Source: [www.medicine.cmu.ac.th](http://www.medicine.cmu.ac.th)

## 2.7 Statistical Analysis

The results obtained were analyzed using SPSS version 20 and proportions were evaluated by the chi-square test. The level of significance was 0.05.

## 3. RESULTS

The overall prevalence of urinary schistosomiasis in the study area was 37%. Out of the 300 urine samples analyzed, 111 were found to have varying number of ova of *Schistosoma haematobium*. The total Prevalence of infection ranges from 47% in Taloka to 27% in Goronyo as seen in table 1.

Age specific distribution (Table 2) shows that the least prevalence of infection is seen in the age group of 5-10 (34%) while the highest prevalence and intensity occurred in the age group of 16-20 years (45%).

Table 3 shows the prevalence of *Schistosoma haematobium* infection in relation to gender. Males 52% were significantly more infected than the females 12%. This is in line with many studies carried out across the country.

Prevalence of urinary schistosomiasis in relation to water contact pattern of the people is shown on Table 4. The peak prevalence was seen among people whose families depend largely on streams or river as their main source of water for domestic use (57%) while the least is recorded in those using borehole (6%) and families who use well as a source of domestic water had (12%).

Relationship between occupation and prevalence is shown in Table 5. People who are fishermen had the highest prevalence rate (71%) followed by farmers (33%). The lowest prevalence rate was seen in people who are civil servants (14%).

**Table 1. Urogenital schistosomiasis study in relation to the location of community it was analysed but gave the same results as shown below**

Location	No. Examined	No. Positive	% Positive
Taloka	150	71	47
Goronyo	150	40	27

**Table 2. Urogenital schistosomiasis study in relation to age in the community**

Age group (yrs)	No. Exam	No. positive	%Positive
5-10	99	34	34
11-15	179	67	37
16-20	22	10	45

The P-value is 0.8028 and pearson chi-square value is 0.4393

**Table 3. Urogenital schistosomiasis study in relation to gender of people in the community**

	No. Examined	No. Positive	%Positive
Male	186	97	52
Female	114	14	12

The p-value is 8.026 and the pearson chi-square value is 24.35

**Table 4. Urogenital schistosomiasis study in relation to water contact activity (source of domestic water)**

Source of water	No. Examined	No. Positive	%Positive
River	175	99	57
Borehole	48	3	6
Well	77	9	12

The p-value is 2,444 and the pearson chi-square value is 35.054

**Table 5. Urogenital schistosomiasis study in relation to occupational status of parents**

Parent occupation	No. Examined	No. Positive	%Positive
Civil servant	57	8	14
Farmer	58	19	33
Fishermen	85	60	71
Irrigation	62	18	29
Others (taxi, welder, traders)	38	6	16

*The P-value is 1.693 and the pearson chi-square value is 27.35*

#### 4. DISCUSSION

The results from this study have demonstrated the presence of urinary schistosomiasis in the study area. The overall prevalence of 37% has shown that the disease is endemic in the study area. The prevalence observed in this study is higher than the national Nigerian average of 13% [14]. This high prevalence and intensity can be attributed to the presence of stream in the area, which has made the inhabitant to engage in such activities like fishing, irrigation, agriculture and swimming which are predisposing factor to infections. The results are comparable to other findings from several endemic regions in Nigeria [14,15] and some endemic countries like Senegal, Madagascar and Tanzania [16,17]. However, the results obtained here is in contrast with the findings of Akinneye et al. [18] and Damen et al. [19].

The higher prevalence rate observed in Taloka (47%) as compared to Goronyo (27%) can be attributed to the fact that Taloka village is built along the stream while Goronyo is about 500 metres away from the river. Therefore the inhabitant of Taloka will be expected to make much more contact with the infected river water.(The same number of samples were collected from each location. Taloka has more positive samples and the reason is given below) A closer survey has shown that the river is the main source of water for Taloka; only in a few household does one find well. On the other hand there is borehole and overhead tanks in Goronyo even though the supply of water is not constant. In many other part of the world, schistosomiasis has been associated with lack of portable water supply [3].

The age related prevalence showed a slight increase in age group of 11-15 followed by 16-20 . The peak prevalence and intensity was observed in the age group of 16-20(45) while the least was observed in the age group of 5-10 years (34%). The age group of 5-10 had a prevalence rate of 34%. This can be attributed to the fact that water contact activity in the study area tends to be high as they grow older and when level of maturity is attained. The variation in ages turned out to be statistically insignificant (0.8028) [15,20].

Gender distribution shows higher prevalence in males (52%) than in females (12%). This is due to the fact that the study area being a predominantly Islamic community, males enjoy

quite a greater freedom of movement as compared to their female counterparts. This tends to expose them to the infected water body. This is in agreement with a similar work reported by Deribe et al.. in South Dafaur. Males are more adventurous and therefore engage more in such activities like swimming. The variation in relation to gender tends to be statistically not significant (P-value 8.026). [10,21,22].

Morbidity [The rate of disease (*Schistosomiasis*) in the population]- in relation to water contact activities, considered here in terms of the source of domestic water supply, shows that subjects from homes where the major source of water is the river were significantly more infected with a prevalent rate of 57%. These are followed by those families largely dependent on well water (13%). The least morbidity is recorded among those using borehole (6%). There is no pipe borne water supply in the two communities. The reasons for these variations are obvious; as people fetching water from the river become exposed to infection. Even in homes with wells, they tend to dry during the dry season when the water table is low and there will be no source of water apart from the stream. Exposure of subjects from homes using borehole is least, thus the lower infection rate [7,23].

Prevalence in relation to the occupational status of the subjects showed that the high prevalence was recorded among people who are fishermen (71%) followed by farmers (33%), irrigation (29%), other groups of occupation (16%) while civil servants are least (14%).. The high prevalence among fishermen may be attributed to the fact that male subjects are mostly involved in fishing. [24]. Therefore those whose occupation involves contact with water (e.g. irrigation, fishing and farming) are more exposed to infected water and therefore become more vulnerable to infection [25,26]. However, statistical analysis has shown that the difference among the different occupational status were statistically insignificant (P- value 1.693).

#### 5. CONCLUSION

The results obtained in this study shows that the prevalence rate of urinary schistosomiasis in the study area is 37%. Males were more infected (52%) while the highest prevalence in the age group was observed in 16-20 years (45%). Fishermen had the highest prevalent rate of 72% compared to other occupational status. The prevalence of infection in the study area could be

due to exposure of the people to the contaminated water bodies.

## 6. RECOMMENDATION

The high prevalence of urinary schistosomiasis recorded in this study suggest a high epidemicity, high risk of transmission and development of complication among the people in the communities.

At the time of the study there was no control programme on the disease in the area. Therefore, if not reversed the situation can affect the standard of education in the area. This could be as a result of anaemia, learning difficult and cognitive impairment in the infected children (WHO, 2006). Similarly the productivity of the study area may also decrease. Therefore, enlightenment programme and periodic treatment of young individuals are very essential. A snail survey should also be carried out and appropriate control measures applied.

Most importantly, government should provide safe and portable drinking water for the growing population of the area.

## CONSENT

It's not applicable.

## ETHICAL APPROVAL

It's not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Arora DR, Arora B. Medical parasitology, 2<sup>nd</sup> edition, CBS publishers, New Delhi, India; 2006.
2. Southgate BA, Yacoub A. 'The epidemiology of schistosomiasis in the later stage of a control programme based on chemotherapy: The Basrah study 3. Antibody distribution and use of age catalytic models and log-probit analysis in seroepidemiology'. *Trans R Soc Trop Med Hyg.* 1987;81:468-75.
3. World Health Organization. [database on the internet]. Schistosomiasis retrieved on the oct.20<sup>th</sup>; 2007. Available: <http://who.int/mediacentre/factsheets/fs115/en/print.html>
4. Schistosomiasis control initiative. Schistosomiasis; high risk groups. Retrieved on June 14<sup>th</sup>; 2007. Available: [http://www.Schisto.org/schistosomiasis/high\\_risk\\_groups.htm](http://www.Schisto.org/schistosomiasis/high_risk_groups.htm)
5. Patzet J, Graczyk T, Geller N. 'Effect of environmental change on emerging parasitic disease'. *Int J parasitol.* 2000;30:1395-405.
6. Bishop HG, Omenesa HO, Raji HM. Prevalence of urinary Schistosomiasis among pupils attending primary schools in Bomo village, Zaria-Nigeria. *Inter J Res Eng Sci.* 2015;3(5):2320-9364.
7. King CH. 'Disease in Schistosomiasis haematobia' In: Mahmoud AAF, ed. *Schistosomiasis.* London, Imperial College Press. 2001;265-95.
8. Houmsou RS, Agere H, Wama BE, Bingbeng JB, Amuta EU, Kela SL. Urinary Schistosomiasis among children in Murbai and Surbai Communities of Ardo-Kola Local Government Area, Taraba State, Nigeria. *J Trop Med.* 2016;2(7):134-142. Available: <http://dx.doi.org/10.1155/2016/9831265>
9. Chen X, Wang L, Cai J, Zhou X, Zheng J, Guo J, Wu X, Engels D, Minggang C. 'Schistosomiasis control in China; the impact of a 10 year World Bank Loan Project (1992-2001)'. *Bulletin of the WHO* 2005; 85; 43-48.
10. Jude CA, Anthony NO, Bertran EBN, Chukwu JU, Nwosu DC, Njokwu-Tony RF et al. 'Endemicity of vesical schistosomiasis in the ebonyi Benue River Valley, Southeastern Nigeria' *Inter J Environ Health.* 2003;206(3):205-10.
11. Cheesbrough M. *District laboratory practice in tropical countries.* Cambridge university press, UK. 2006;1:122-9.
12. Okpala HO, Nwobu GO, Agba MI, Okor JO. 'Prevalence of schistosomiasis in Wurukum, Makurdi Local Government area of Benue state Nigeria'. *J Med Lab Sci.* 2003;12(2):47-50.
13. Okwori AEJ, Sidy M, Ngwali YB, Obiekezie SO, Makut MD, Chollom SC, Okeke IO, Adikwu. Prevalence of Schistosomiasis among Primary School Children in Nasarawa State Toto, North Central Nigeria. *J Infect Dis.* 2012;1:1-13.
14. Ezhim M, Oti V, Goriya K, Gloria Z, Dlama J. Prevalence of urinary Schistosomiasis



- among primary school children in a Northern Nigerian population. *Inter J Adv Res.* 2015;3(11):511–519.
15. Babamale OA, Kolawole OH, Abdulganiyu K, Abdulkareem OA, Ugbomoiko US. Urogenital Schistosomiasis among School children and the Associated Risk Factors in Selected Rural Communities of Kwara State, Nigeria. *Journal of Tropical Medicine.* 2018;6. Article ID: 6913918. Available:<https://doi.org/10.1155/2018/6913918>
  16. Mtethiwa AHN, Bakuza J, Nkwengulila G. "Prevalence and Intensity of Schistosomiasis in Communities around Water Reservoirs in Malawi," *Journal of Tropical Diseases.* 2015;04:01. View at Publisher. View at Google Scholar.
  17. Rasoamanahaja CF, Rahetilahy AM, Ranjatoarivony B, et al. "Baseline prevalence and intensity of schistosomiasis at sentinel sites in Madagascar: Informing a national control strategy," *Parasites and Vectors.* 2016;9:1. Article no: 1337. View at Publisher. View at Google Scholar. View at Scopus.
  18. Akinneye JO, Fasidi MM, Afolabi OJ, Adesina FP. Prevalence of Urinary Schistosomiasis among Secondary School Students in Ifedore Local Government, Ondo State, Nigeria. *International journal of tropical disease.* 2018;1(1). DOI: 10.23937/ijtd-2017/1710004.
  19. Damen JG, Kopkuk ED, Lugos MD. Prevalence of Urinary Schistosomiasis among Irrigation Farmers in North Central Nigeria. *Journal of Medical and Health Sciences.* 2018;7(3):1-4.
  20. Amuta EU, Houmsou RS. Prevalence, intensity of infection and risk factors of urinary schistosomiasis in pre-school and school aged children in Guma Local Government Area, Nigeria. *Asian Pac J Trop Med.* 2014;7:34-9.
  21. Dawaki S, Mahyoub Al-Mekhlafi HM, Ithoi I, Ibrahim J, Abdulsalam AM, Ahmed A, et al. Prevalence and risk factors of Schistosomiasis among Hausa communities in Kano State, Nigeria. *Rev. Inst. Med. Trop. Sao Paulo.* 2016;58:54. Available:<http://dx.doi.org/10.1590/S1678-9946201658054>
  22. Deribe K, Eldaw A, Hadziabduli S, et al. "High prevalence of urinary schistosomiasis in two communities in South Darfur: Implication for interventions," *Parasites and Vectors.* 2011;4:1. Article no:14. View at Publisher · View at Google Scholar · View at Scopus
  23. Xu J, Yu Q, Tchuenté LT, Bergquist R, Sacko M, Utzinger J, et al.. Enhancing collaboration between China and African countries for schistosomiasis control. *Lancet Infect Dis.* 2016;16:376-83.
  24. Mafiana CF, Ekpo UF, Ojo DA.'Urinary Schistosomiasis in preschool children in settlement around Oyan Reservoir in Ogun State, Nigeria: implicatioin for control'. *Trop Med inter Health* 2003;8(1):78-82.
  25. Adamu T, Abubakar U, Danga C. Schistosomiasis in wurno district of Sokoto state, Nigeria'. *Nig J Parasitol.* 2001;24:33-41
  26. Utzinger J, Berquist R, Shu-Hua X, Singer BH, Tanner M.' Sustainable Schistosomiasis control –the way forward' *Lancet.* 2003;362:1932-34.

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