Current status of schistosomiasis in Sokoto, Nigeria

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A R T I C L E  I N F O

Article history:
Received 7 December 2015
Received in revised form 19 August 2016
Accepted 20 August 2016
Available online 23 August 2016

Keywords:
Schistosomiasis
S. mansoni
S. haematobium
Snail
Bladder cancer
Neglected tropical diseases

A B S T R A C T

The study was conducted in poor communities, where most of the population is dependent on river and well for their everyday activities. In this study 5 years–15 years aged children were sampled for schistosomiasis (Urinary and intestinal), using of urine and stool samples. The stool samples were analyzed using kato-katz thick faecal smear technique while the urine samples were analyzed by filtration technique. The overall prevalence of urinary schistosomiasis (Schistosoma haematobium) was 60.8% (228 positive cases in 375 samples), and for intestinal schistosomiasis (Schistosoma mansoni) was 2.93% (11 positive in 375 samples). The order of infection based on social status (occupation of pupil's parents) was farmers > fishermen > traders > civil servants > others. The prevalence of infection based on pupil's water contact activities such as farming associated 84.87% urinary schistosomiasis, followed by swimming (78.21%). Occurrence of urinary schistosomiasis based on source of pupil's drinking water; highest infection was reported among those that drink dam water (75.24%) while least infection was occurred whose drinking water was from bore-whole (17.64%). Prevalence of urinary schistosomiasis in the studied area is therefore very high and family status, means of water contact and availability of drinking water dependent. Therefore there is urgent need to adapt preventive measures, provision of safe drinking water as well as control programmes for vector snails, immediately.

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1. Introduction

Schistosomiasis (Bilharziasis as “the infection was first described by the German physician Theodor Bilharz”) is a water borne parasitic disease caused by Schistosoma, the digenic trematode found in the blood vessels of man and livestock. About up to 252 million individuals might be affected worldwide with the disease (Utzinger et al., 2015).

The six species of Schistosoma that cause disease worldwide, include Schistosoma haematobium, S. mansoni, S. japonicum, S. intercalatum, S. mekongi and S. guineensis (Uko et al., 1993; Agi and Okafor, 2005), each having a well-defined distribution which is important in diagnosis. Among which three SPP S. haematobium, S. mansoni and S. japonicum account for >95% of all human cases of schistosomiasis found in the world (Mutapi et al., 2003). In Nigeria, three species (spp.) are pathogenic to man, these are: S. haematobium, S. mansoni and S. intercalatum.

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http://dx.doi.org/10.1016/j.parepi.2016.08.003
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The disease caused by *S. haematobium* characterized by bloody urine, lesions and calcification of bladder, kidney failure and bladder cancer in children (Butterworth, 1997; Norberg, 2004), and is the major cause of female genital schistosomiasis (FGS), which is a risk factor for transmission of sexually transmitted diseases including HIV (TDR, 1996; Raven and Johnson, 2002); while the *S. mansoni* infection is characterized by bleeding from gastro – oesophageal region, splenomegaly, persistent bloody diarrhoea, pain, growth retardation, delayed sexual maturity and chronic dermatitis (Norberg, 2004; WHO, 1998).

The life cycle of schistosomes requires the presence of fresh water snails, of species of *Bulinus, Biomphalaria, Planorbis, Oncomelania, Lymnaea* and *Indoplanorbis* (Tierney et al., 2005). Human and other animals get infection due to cercarial penetration through skin, when comes in contact with water infested with cercaria larva of schistosomes.

Though the disease kills few people, its clinical effects, prevalence and association with agriculture and water development projects, movement of population and increase in population density makes it a problem of great public health importance (Steinmann et al., 2006).

Globally, the disease is in the increase in both prevalence and incidence because of:

Expansion of Irrigated Agriculture which provide habitats for vector snails, the construction of hydro-electricity generating sites, lack of good sanitary habits and lack of safe water for the growing population (Tierney et al., 2005).

Schistosomiasis is a very locally transmitted disease due to the aforementioned life cycle and it need for contact with freshwater intermediate hosts. Both intestinal and urinogenital schistosomiasis occur in Nigeria. Previous research has documented prevalence rates between 14.2% and 91.4% (Nnoruka, 2000; Ozumba et al., 1989; Houmsou et al., 2012; Nwabuez and Oapara, 2007; Umar et al., 2008; Kabiru et al., 2013).

In study area, there is insufficient knowledge of factors associated with schistosomiasis transmission; poor sanitary habits, and insufficient safe and potable water, which give rise to chances to create more transmission foci. The present study was conducted to have knowledge of current prevalence rate of disease among habitants.

2. Materials and methods

2.1. Study area

The study was conducted in two districts of Sokoto State viz. Sokoto metropolis and Hamma Ali, Sokoto town is located on latitude 13°02′N and longitude 05°13′E in the upper north western part of Nigeria, covering about 677 km². The area generally experience high temperature throughout the year, the rainy season lasts from June to September each year (Topographic Sheet, 1990).

The water supply in the town is mainly from water board pipes, bore holes and wells. Sewage disposal is by pit latrine within the compound and refuse disposal is by open dumping system outside the house and subsequent burning (Topographic Sheet, 1990).

2.2. The study population

The study was carried out between May 2012 and March 2014. From the localities three primary schools were randomly selected, since the disease occur mostly in school aged children and it is easy to get required number of samples at such places. Stool and urine samples were collected from 125 pupils in each school. All the children examined in this study were aged between 7 and 13 years attending primary school at the time of investigation. The study was carried out to determine the proportion of children capable of excreting schistosomes eggs that are potentially high enough to contribute in the transmission process.

2.3. Sample collection

Urine and stool sample were collected mainly from school aged children because of their high risk of schistosomiasis infection. The infection status of this group gives a reliable reflection of the general situation of the diseases in an area (Mafiana and Adesanya, 1999; Akogun and Obadih, 2000).

Three schools were randomly selected. From each selected school, 125 children were randomly screened for intestinal and urinary schistosomiasis giving a total number of 375 samples each for urine and stool. For each child examined, a questionnaire (parasitological screening record) aimed at determining the water contact activity, parental occupation and source of drinking water was recorded.

Urine samples were collected between the hours of 10:00 am–2:00 pm and stool sample were collected in the morning since eggs output from infected persons riches peak value around that time of the day (Grist et al., 1998; Rubin and Faber, 1999).

Clean labeled specimen bottles were used for the collection of urine samples small and clean, small plastic cups with cover were used for stool collection. Care was taken to number the containers. Specimen bottles and plastic cups were numbered accordingly, such that they correspond with numbers of the subject, on the questionnaire record. Stool samples were preserved with 10% formalin solution while urine samples were preserved with 1% domestic bleach (Ladan et al., 2011). The samples were taken to the Parasitology laboratory, Department of Biological Sciences, Usmanu Danfodiyo University Sokoto and examined for *Schistosoma* infection.
2.4. Urine analysis

Urine samples were analyzed according to Adeoye and Akabo (1996) using standard filtration technique. A 5.5 cm Whatman's filter paper was inserted in the filtration unit. After shaking the urine sample, 10 ml of it was withdrawn with a syringe and injected into filtration unit. After filtration, the filter paper was carefully removed using a pair of forceps and placed on a clean sheet of paper and stained with one or two drops of iodine and 50% ninhydrin solution. The stained filter paper was allowed to dry for about 15 min after which it was placed on a clean glass slide and observed systematically under the microscope at ×10 and ×40 magnification. All the eggs were counted and the result was recorded and expressed as number of eggs per 10 ml of urine.

2.5. Stool analysis

Stool analysis was carried out using the Kato-Katz thick faecal smear technique as described by Adeoye and Akabo (1996). The stool samples were sieved using a plastic sieve of 0.75 mm pore size. A clean template was placed on a clean glass-slide with the help of a spatula; the sieved stool was filled in the hole on template. The template was then removed leaving a plug of stool (about 50 mg) on the glass-slide one or two drops of iodine and 50% ninhydrin solution was added on the plug of stool and covered by cover slip, the whole preparation on the slide was then observed at lower magnification of ×10 and ×40 the result was systematically recorded and expressed as number of eggs per 50 mg of stool.

2.6. Statistical analysis

The data was analyzed using analysis of variance (ANOVA) and chi-square to find out the similarities and differences between population and frequency. Histogram and tables were drawn. P value used was under 0.01.

3. Results

Out of 375 samples of urine and stool, 228 were found infected with *Schistosoma haematobium* (urinary schistosomiasis) which gives a prevalence of 60.80% and 11 were infected with *Schistosoma mansoni* (intestinal schistosomiasis) which show an infection rate of 2.93%.

3.1. Prevalence of urinary schistosomiasis by occupation of pupils parents in the study area

The prevalence of the infection based on occupation of the pupils parents was recorded. It was observed that children of farmers had a higher prevalence with 71.50%. This is followed by children of fishermen with 52.00%, and then those from Business (small scales traders) parents with 45.71%. Similarly children of civil servants had a prevalence of 45.00% while others (those without specific jobs) had the least prevalence rate 40.00%. Parasite load among children of farmers, fishermen, businessmen, civil servants and others are 50.69, 43.00, 25.00, 30.76 and 27.77 eggs per 10 ml of urine respectively. Chi square analysis showed high significant variation \( (P < 0.01) \) in occupation related prevalence as shown in Table 1.

3.2. Prevalence of urinary schistosomiasis by water contact activities of pupils in the study area

The prevalence of the infection by water contact activities was recorded. It was observed that children who were involved in farming, swimming, and fishing had the prevalence of 84.87%, 78.21% and 52.17% respectively. Similarly, those who contact river and dam water for bathing, fetching and washing had prevalence of 29.03%, 28.57% and 22.85% respectively. Parasite load observed in relation to water contact activities for those involved in farming, fishing, swimming, bathing, fetching and washing were 54.45, 33.30, 35.44, 38.09, 26.30 and 20.00 eggs per 10 ml of urine respectively. However, chi square analysis showed high significant variation \( (P < 0.01) \) between the prevalence of infection and water contact activities as shown in Table 2.

| Occupation of pupils parents | No. examined | No. positive | Prevalence (%) | Parasite load per 10 ml of urine |
|-----------------------------|--------------|--------------|----------------|---------------------------------|
| Farmers                     | 200          | 143          | 71.50          | 50.69++                        |
| Fishermen                   | 100          | 52           | 52.00          | 43.00+                         |
| Civil Servant               | 20           | 9            | 45.00          | 25.00+                         |
| Traders                     | 35           | 16           | 45.71          | 30.76+                         |
| Others                      | 20           | 8            | 40.00          | 27.77+                         |
| Total                       | 375          | 228          | 60.80          | 43.85++                        |

The chi square is: \( (\chi^2 = 11.90; df = 4; P < 0.01) \). Key- + = light infection, ++ = moderate infection and +++ = high level of infection.
3.3. Prevalence of urinary schistosomiasis by source of drinking water of pupils in the study area

Prevalence of the infection based on the sources of drinking water of studied children indicated that, those pupils whose source of drinking water were dams, ponds and rivers had the highest prevalence of 75.24%, 70.00% and 60.00% respectively. Pupils that drink water from wells and boreholes had the least prevalence of 49.24% and 17.64%, respectively. Pupils that drink water from rivers, ponds and dams had the highest parasite load of 61.22, 39.68 and 41.66 eggs per 10 ml. of urine respectively, while those pupil that drink water from well and borehole had the least parasite load of 18.46 and 16.66 eggs/10 ml of urine respectively. However, there was a high significant variation ($P < 0.01$) between prevalence of infection and the sources of drinking water as shown in Table 3.

3.4. Prevalence of intestinal schistosomiasis by water contact activities, occupation of parents and source of water supply of pupils in the study area

The prevalence of $S. mansoni$ by water contact activities of pupils in the study area is shown in Table 4. It is clear that pupils that are involved with fishing and farming had the highest prevalence of 9.30% and 5.00% respectively while in case of contact with water for bathing and fetching purposes caused least infection 1.47%. The prevalence in relation to occupation of parents of the studied children showed that, those whose parents were civil servants had least prevalence (1.98%) while highest prevalence (11.00%) was recorded among children of fishermen. The prevalence in relation to source of drinking water indicated that children who depend largely on Dams as source of water they drink had the highest prevalence (3.89%) and well (1.92%), had the least prevalence. In all the cases the chi square showed no significant variation ($P > 0.01$).

4. Discussion

It is clear from the result that urinary Schistosomiasis is highly prevalent in the study area; however intestinal schistosomiasis is low, which can be due to the fact that intestinal schistosomiasis is transmitted by Biomphalaria sps. of snails whose presence is very low in northern Nigerian regions while high prevalence of urinary schistosomiasis may be attributed to high occurrence of vector snails of Bulinus sps. in the local water bodies of northern Nigeria (Pukuma and Musa, 2007).

The high prevalence of urinary Schistosomiasis in the area may be due to the fact that most of population especially those living in the rural areas are dependent on untreated water from natural water bodies for their everyday water need, from where they may get infection, since schistosomiasis is a water-based disease and the frequent contact of the population with freshwater may lead to high infection rates and constant re-infection.

Provision of safe drinking water for inhabitants and mass chemotherapy for infected population should be done as immediate action, but due to lack of funds from government, its implementation is not possible. An effective way to reduce incidence of this disease is to control/reduce vector snail population and delink life cycle of the fluke, but most of the synthetic molluscicidal compounds are contact poison, they have to be mixed in the water in which the snails live; in this environment where a large number of human population is dependent on dam and river water for their everyday water need; use of such molluscicides is not justifiable; though many researchers have investigated many effective plant molluscicides and have ensured their safety on non-target

### Table 2
Prevalence of urinary schistosomiasis by water contact activities of pupils in the study area.

| Water contact activity | No. examined | No. positive | Prevalence (%) | Parasite load per 10 ml of urine |
|------------------------|--------------|--------------|----------------|---------------------------------|
| Farming                | 119          | 101          | 84.87          | 54.45++                         |
| Fishing                | 23           | 12           | 52.17          | 33.30++                         |
| Swimming               | 101          | 79           | 78.21          | 35.44+                          |
| Bathing                | 62           | 18           | 29.03          | 38.00+                          |
| Fetching water         | 35           | 10           | 28.57          | 26.30+                          |
| Washing                | 35           | 8            | 22.83          | 20.00+                          |
| Total                  | 375          | 228          | 60.80          | 43.85++                         |

The chi square is: ($\chi^2 = 50.94; \text{df} = 5; P < 0.01$). Key- + = light infection, ++ = moderate infection and +++ = high level of infection.

### Table 3
Prevalence of urinary schistosomiasis by source of drinking water of pupils in the study area.

| Source of water supply | No. examined | No. positive | Prevalence (%) | Parasite load per 10 ml of urine |
|------------------------|--------------|--------------|----------------|---------------------------------|
| River                  | 35           | 21           | 60.00          | 61.22++                         |
| Well                   | 132          | 65           | 49.24          | 18.46+                          |
| Pond                   | 90           | 63           | 70.00          | 39.68+                          |
| Dam                    | 101          | 76           | 75.24          | 41.66++                         |
| Borehole               | 17           | 3            | 17.64          | 16.66+                          |
| Total                  | 375          | 228          | 60.80          | 43.85++                         |

The square is: ($\chi^2 = 56.30; \text{df} = 4; P < 0.01$). Key- + = light infection, ++ = moderate infection and +++ = high level of infection.
animals too (Singh and Singh, 1997; Singh et al., 1998; Singh and Singh, 2000), but practical application of such study is not possible until government intervention.

The adult *S. haematobium* commonly invade the venous plexus around the urinary bladder, the eggs are released by the adult worms cause chronic granulomatous inflammation and irritation in mucosal and submucosal lining of urinary bladder. Chronic granulomatous inflammation and irritation subsequently lead to the development of squamous metaplasia of the transitional epithelium (Barsoum, 2003). Schistosomiasis associated urinary bladder cancer with positive schistosomal eggs tends to occur at a relatively young age with a high tendency towards bladder muscle invasion, compared to non-schistosomal associated cancer in western countries (El-Bolkainy et al., 1981). In a previous study carried out in Sokoto and nearby Local Government areas, 85.5% cancer causes were reported from farmers and fishermen and 65.1% squamous cell carcinoma showed histological evidence of chronic urinary schistosomiasis (Mungadi and Malami, 2007).

Prevalence of the urinary schistosomiasis infection based on water contact behavior has been reported by various authors (Pukuma and Musa, 2007; Uwaezuoke et al., 2007; Adamu et al., 2001) previously; their findings are in line with the present study which indicated that high prevalence rate of the infection occurs in those, whose water contact activities was farming/irrigation, swimming and fishing. This may be due to the prolonged exposure of body to infected water thus giving more chances to cercarial penetration through skin; in the act of swimming and fishing the whole body remain in contact with water; providing more surface area for penetration of larval stages through skin. The rest of water contact activities had low prevalence which are bathing, fetching and washing.

Different source of water supply used for domestic purpose was observed in the study area. The highest infection rate was seen among people who depend largely on dams, rivers and ponds for water source. This could be attributed to the preference shown by snail hosts for slow flowing rivers, or stagnant bodies of water. Because these snails harbor schistosome parasites and contributing to high infection rate among the people coming in contact with such water bodies. A similar conclusion had been made by Bello et al. (2003) and simple control measures like provision of safe drinking water from borehole, well etc., have been recommended for the control of schistosomiasis. However, prevalence of infection was also been observed in people who used water from boreholes, wells and other safe means those (others) who used pure water, swan water, tap water etc. probably they acquired the infection by other contact activities with infested water in their area.

Prevalence of infection based on sources of drinking water has indicated that those who largely depend on dams and ponds as their sources of drinking water had the high rate of Urinary schistosomiasis infection. It has being observed during this study, that the snail vectors are more abundant during the dry season. It can be concluded that in the study area during dry hot seasons, temperature reach up to 48–50 °C; which cause overwhelming heat and children near natural water bodies had an opportunity to reduce that heat with water recreational activities and hence got and transmit more infection.

The result obtained in this study, however imposes a heavy burden upon the health and well-being of individuals, children who are persistently exposed to infection are likely to be debilitated. The information above mentioned coupled with the view that children play leading role in the spread of urinary and intestinal schistosomiasis; prompt intervention and care in the study area is urgently needed. Therefore, health education and the treatment of infected persons are suggested as first line of measure. However, long term integrated control measures and improving safe water access to the community; as well as elimination of intermediate host is imperative. As such there are urgent needs for the State Government Authority, Local Governments as well as nongovernmental organizations to formalize and establish feasible control programmes in the area.

5. Limitation of the study

This study is a community based research so we, examined a single urine and stool sample per individual. Due to low sensitivity of employed diagnostic technique, it is very likely that the true prevalence of schistosomiasis is considerably higher than the reported prevalence. We must mention here that due to large size of population we collected samples from schools, where there is at least, some degree of literacy; but in some poor settlements where children don’t even go to school; they play around in sand and water and live in poor hygienic conditions the prevalence will be much more higher than this reporting.

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.parepi.2016.08.003.
