

Research Article

The Transmission Patterns of Schistosomiasis in Khartoum State, Sudan

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Abstract

Schistosomiasis is a neglected tropical disease which affects the poor of the poorest and is targeted for elimination. The current study aims to update the transmission patterns of the disease in important settings in Khartoum State along the White Nile. A wide range of activities was observed to take place in the bank of the White Nile and inside the river throughout the day, including recreation activities, economic activities and social activities. 986 participants were examined for schistosomiasis. The overall prevalence was 39.9%. Snail hosts of both *S. mansoni* (*Biomphalaria* spp) and *S. haematobium* (*Bulinus* spp) were reported in irrigation canals and along the shores of the White Nile. Khartoum State Ministry of Health decided to eliminate the disease via comprehensive integrated strategy. Mass distribution of praziquantel is indicated and its success will rely on the use of community-directed intervention.

In conclusion the overall prevalence of schistosomiasis is high in the White Nile River and is closely associated with various water contact activities. We strongly recommend the inclusion of the White Nile and the main Nile River in the elimination strategy of Khartoum State.

BACKGROUND

Schistosomiasis being one of the neglected tropical diseases (NTDs) affects poor and marginalized populations living in settings where poverty is widespread and where resources or access to livelihood opportunities are scarce. Schistosomiasis can lead to significant ill-health and economic burden [1,2]. Schistosomiasis in the Sudan started as far back as 2600 B.C. and had been brought by Ancient Egyptian raids and trade missions [3]. In Khartoum Province (now Khartoum State) boys from Goz Rumeila villages along the White Nile and at El Ghorashi Dairy farm were examined and found to be infected with urinary schistosomiasis [4,5]. Within the whole of the Sudan there has been over the last 30 years, a serious increase in the endemicity of schistosomiasis as a result of population movements and a failure of the control measures which have been employed [6].

Khartoum State has the highest population in Sudan

according to 2010 national census which is about 7,380,158 citizens. The state has seven localities of which 5 are endemic for schistosomiasis (Figure 1). Within the state there are numerous agricultural projects using irrigation systems represented by networks of canals, in addition to the White Nile and main Nile shores.

This study aims to map the transmission patterns of schistosomiasis and to identify social and environmental determinants of the disease in neglected sites along the White Nile and two irrigation schemes to be part of the elimination strategy.

MATERIAL AND METHODS

Type of the study

This is a cross-sectional study.

Study area: shores of the White Nile namely Murada Fish

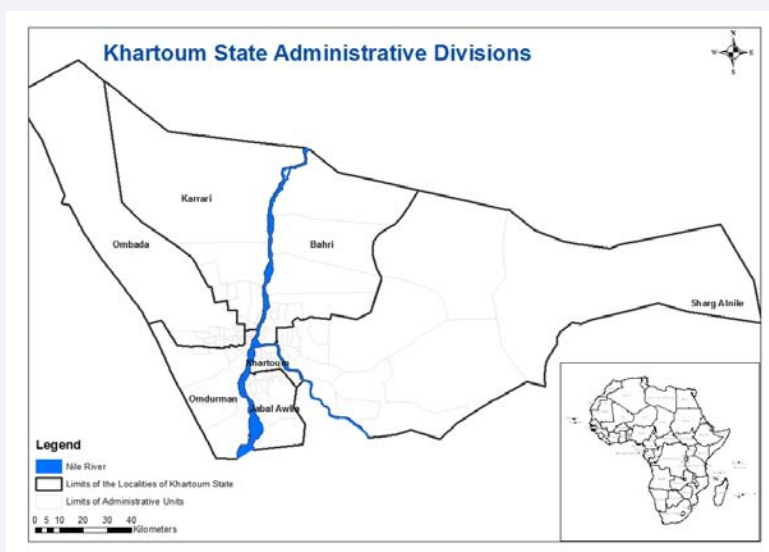


Figure 1 Administrative divisions of Khartoum State.

market, Mogran Forest, Wad alagali, Jabel Awlia Dam, recreational sites and Soba and Silate irrigation schemes.

Target population

Fishermen, animal breeders Agricultural workers, car washers, school children and other recreational activities.

Ethical considerations: the attached ethical clearance certificate was obtained from Ahfad University for Women. Signed consents forms were obtained from targeted subjects.

Laboratory diagnosis

Urine samples were tested using the CCA assays for diagnosis of *S. mansoni* obtained from Rapid Diagnostics (Pretoria, South Africa) were performed at ambient temperature, following the manufacturer's instructions. Briefly, one drop of urine was added to the well of the test cassette and allowed to be absorbed entirely into the specimen pad within the well. Then one drop of buffer (provided with the kit) was added. Results were read 20 minutes after adding the buffer. Results were determined by two persons and confirmed by the principal investigator as negative, trace (weak band) or positive (strong band) [7]. Each urine sample was examined by centrifugation at 3500 rpm for *S. haematobium* eggs [8]. Subjects were weighed using a calibrated weighing scale and a single dose of 40 mg/kg praziquantel was administered [9].

Snail survey

The eastern shores of the white Nile from the fish market at Murada up to Jabel Awlia Dam and selected sites in irrigation canals at Soba and Silate irrigation schemes were examined for infestation with *Bulinus truncatus* and *Biomphalaria* intermediate hosts of *S. haematobium* and *S. mansoni* respectively, concentrating on contact sites using a dip net scoop on the basis of 1 m an hour [10].

Qualitative research methods

The research employed purposive sampling technique that targets urban population who happened to be by the White Nile

bank at the moment of the visits to the area; and who are identified to be involved in water related behavior. Observation was one of the main tools of participatory strategy and was implemented by the researchers to explore the process of: What went on the side of the White Nile as the team members were collecting urine sample from the target groups. Data unfolded through observation was then supported by in - depth discussion (focus group discussions) as to help understand why the identified target groups area conducting the water related activities. Participatory observation was conducted with tea sellers and other street vendors who were happened to be around at the moment of conducting the study.

RESULTS

The results of the cross - sectional survey is shown in the Table (1). The overall prevalence of schistosomiasis was 39.9% with 393 participants infected out of 986 examined in 18 sites (11 schools + 07 sites). 23.1% of the persons examined (n = 986) *S. mansoni*, *S. haematobium* affected 13.2% and 3.5% were infected by both *S. mansoni* and *S. haematobium*. Out of the 598 school children examined, 306 were infected (51.2%). The prevalence was lower (24.5%) in the working/recreational areas where 93 cases of infection were diagnosed out of 388 participants examined 23.7% of the persons examined (n = 986) harbored *S. mansoni* *S. haematobium* affected 13.2% and 3.5% were infected by both *S. mansoni* and *S. haematobium*.

Snail survey

Along the White Nile shore snails were found in discrete sites mainly in semi stagnant water with vegetation or trapped water. In irrigation canals snails are found along the margins of the canals in slowly running water. As results of recent treatment of the study sites with molluscicide (Bayluscide) very few snails were found.

Table (3) summarizes the prevalence of schistosomiasis distribution by sex. Schistosomiasis was more prevalent in males than females with respectively 50.4% and 15.4%. A statistical

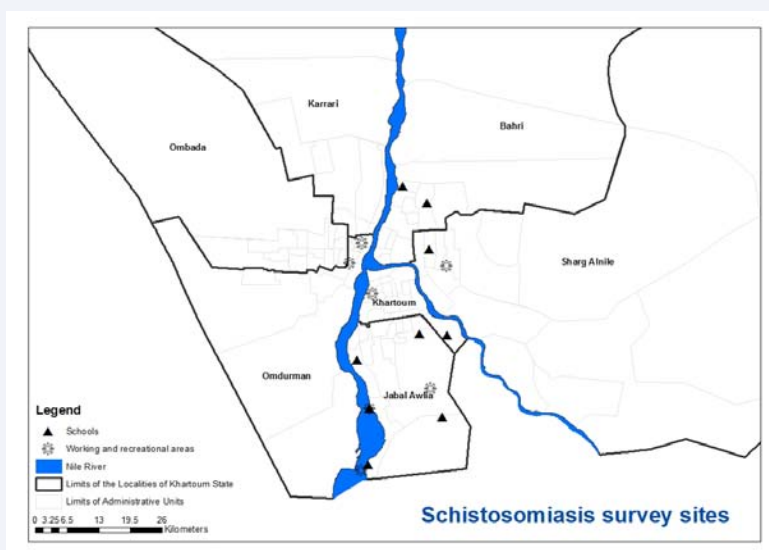


Figure 2 Survey sites (School and working place).

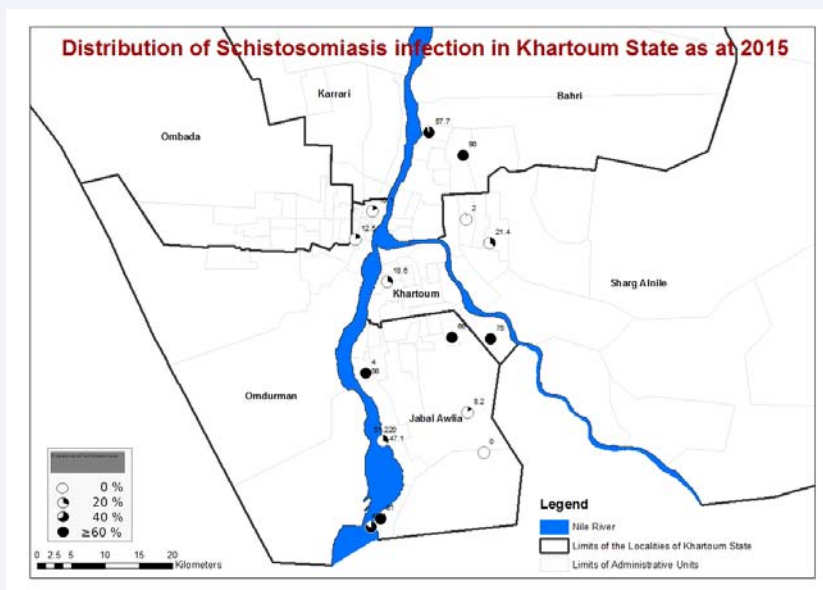


Figure 3 Prevalence of Schistosomiasis in Khartoum State.

significant association was found between the sex of the participants and the prevalence of the disease with a chi - square of 101.384 and a p - value of 0.000.

Water contact activities

A wide range of activities was observed to take place in the bank of the White Nile and inside the river throughout the day, including recreation activities, economic activities and social activities. As for age, the data were unfortunately not collected for the working participants whose were in the age group of 30 to 65 and school children were between 6 and 17 years old.

Recreation activities

School students constituted a significant category of those

who are involved in the risk behavior. Preferable time of the day was mid - day after the school day, till four o'clock. For many of this category bathing in the Nile water constitute a substitute for scarcity of water back home. Many of these categories are of low income background and lack of the main services back home is the motive behind targeting the Nile water for bathing before going home. Some of them are even equipped with bathing detergent for the purpose of the activity which is done in groups. Bathing takes place near the bank of the river and the secondary school groups do not stay for a long time in water (average of half an hour).

Economic activities

Another pattern constitutes tea sellers and street vendors



Figure 4 Fish handlers in White Nile.

Table 1: Prevalence of Schistosomiasis in Khartoum State.

Variable	Survey site		Total
	School	Working/ Recreational area	
Total examined	598	388	986
All infections	306	93	399
Prevalence all forms	51.2	24.5	40.5
<i>S. mansoni</i>	151	83	234
Prevalence <i>S. mansoni</i>	25.3	21.4	23.7
<i>S. haematobium</i>	124	6	130
Prevalence <i>S. haematobium</i>	20.7	1.5	13.2
Mixed (<i>S. mansoni</i> and <i>S. haematobium</i>)	31	4	35
Prevalence mixed form	5.2	1.0	3.5

Table 2: Results of snail survey in November 2015.

Study site	Bulinus	Biomphalaria
Soba irrigation scheme		
No. examined	47	42
% positive	0	1
Mugran forest		
No. examined	31	5
% positive	0	0
Jabal Awlia Dam		
No. examined	122	20
% positive	1	0

who target the Nile water for different activities including fetching water or cleaning the dishes. The activity varies in the duration through which it takes place with an average of (15 minutes). Tea sellers use the Nile water for making tea as well. For both tea sellers and street vendors the age group includes both gender, but women and young girls represent the majority in this group. For this group parts of the body such as the hands and legs are immersed in water and the main location is along the bank of the White Nile.

A relevant pattern for this category is the carpet and cars' cleaners. Both are using Nile water for their income generating activities. The category composed only of male children, adolescent and adults whose ages range 12-45. They use water near the bank of the river making use of their hands and legs to carry out the job and spend as much time as they need (between 1-3 hrs) in the bank of the river.

Socialization

This pattern constitutes all categories males and females starting from age 11. Groups, pairs or individuals spend the time by the bank of the river socializing. Pattern relevant to water risk behavior includes immersing the feet in water while having conversations during taking a cup of tea or so. The time for conducting this activity varies and depends on the individual's leisure time assigned for entertainment. Tea and food sellers are playing important roles in serving this category and some of the target groups in this category revealed that they come to the location.

DISCUSSION

Besides mapping and identifying geographical areas to be targeted for Community Directed Intervention (CDI), consideration of local socio - cultural, economic and political factors is essential for the success of elimination programs as these factors will influence the application and acceptance of intervention strategies [11]. Patterns of transmission of schistosomiasis are widely associated with water related behavior. In places where there is little or no safe water and sanitation; where health care is scarce or non - existent water related behavior of the population counts in explaining patterns of transmission of schistosomiasis [11]. In Sudan, agricultural labourers from Egypt, Nigeria and western Sudan have played a significant role in the spread of schistosomiasis and the change in the patterns and type of Schistosomiasis in the Gezira Irrigation Scheme [12,13]. The population of Khartoum State has increased tremendously during the last 10 years. People from different states of Sudan settled to work in Khartoum State. This resulted in changes in the patterns of transmission of schistosomiasis and type of infection reported in this study. WHO Expert Committees stressed the importance and feasibility of reducing morbidity

Table 3: Prevalence of Schistosomiasis according to gender.

Variable	Positive	%	Negative	%	Total	Chi-square	p-value
Student							
Female	39	22.3	136	77.7	175		
Male	237	60.3	156	39.7	393		
Total	276	48.6	292	51.4	568		
Workers							
Female	4	3.8	100	96.2	104		
Male	89	31.3	195	68.7	284		
Total	93	24.0	295	76.0	388		
Sample							
Female	43	15.4	236	84.6	279		
Male	356	50.4	351	49.6	707	101.384	0.000
Total	399	40.5	587	59.5	986		

due to schistosomiasis via control programs and recommended the use of operational components, such as safe water supply, sanitation, environmental management, snail control and health education, along with chemotherapy, in an integrated manner [14] Recent study among school children in the White Nile River basin showed is high prevalence rate and is closely associated with various water contact activities [15].

The implementation of strategic elimination plan for Khartoum State should be conducted by primary health care settings with the involvement of the community. It is important to upgrade and equip the centers and improve surveillance and diagnostic methods. Interruption of transmission to achieve elimination would require mapping and identifying areas to be targeted for CDI. Mapping of snail habitat water, sanitation, and health promotion.

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