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Prevalence and Intensity of Infection of Schistosomiasis in Two Endemic Areas in Sudan

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Abstract: *Schistosomiasis is considered as the second parasitic disease responsible for morbidity and mortality. The disease in prevalent in several tropical and subtropical regions with sub-Saharan Africa being among the highest endemic areas. In Sudan, the disease has been determined since the early twentieth century and it's prevalence has been increasing with the extension of irrigated agricultural schemes all over the country. This study aimed to determine the prevalence of intestinal and urinary schistosomiasis in two areas in Sudan: Alkalkla area in Khartoum State near the White Nile and Halfa Algadida, Kassala State, near Atbara River. This cross sectional laboratory based study was conducted between March to October 2011. Seven-hundreds and seventy stool specimens and 770 urine specimens were collected from 720 inhabitants of the both study areas and 50 healthy controls. Samples were investigated by Kato-Katz method and sedimentation technique for stool and urine samples, respectively. The intensity of infection was determined for each subject. The results obtained showed an overall prevalence of 14.5% for Shistosoma. mansoni and 0.4% for Schistosoma. haematobium. Moreover, S. mansoni was found only in Halfa and S. haematobium was found only in Khartoum. The intensity of infection was variable among the study subjects and several factors were found associated with the positive cases including sources of drinking water, history of water contact, level of education and the knowledge about the disease. The study concluded that reduction of water contact and knowledge about the disease are positively acting towards the reduction of disease prevalence in endemic areas.*

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I. Introduction

Among human parasitic diseases, schistosomiasis, (sometimes called bilharziasis), caused by blood flukes, (*Schistosomes)* is considered as the most important parasitic infection after malaria in the tropics and subtropics. There are around 200 million infected individuals in more than 74 endemic countries with more than 600 million individuals being at risk [1]. Half of the confirmed cases are found in Africa with those inhabiting agricultural and rural areas being susceptible to the infection [1]. Severe complications of the disease are observed in 20 million of the infected patients [2]. The annual estimates of schistosomiasis mortality is around 200,000 deaths [3].

The disease has two clinical forms, urinary and intestinal schistosomiasis, caused by *Schistosoma* haematobium for the former and *S. mansoni*, *S. intercalatum* and *S. japonicum* for the later [4]. Schistosomiasis occurs when the individual's skin contacts fresh water which is contaminated by *Schistosoma* eggs as *Schistosoma* parasites can penetrate the skin.

In Sudan, the disease existence returns to 2600 BC, and became most prevalent with the expansion of irrigated agriculture [5]. Moreover, interaction with neighboring African countries and the continuous population movement across the boarders from areas that have high disease burden had led to the increase of transmission and endemicity of the disease [6]. The first infection of *S. haematobium* was reported by Balfour, among school children in Khartoum in the early twentieth century[7]. Since then, the disease was reported from different parts all over the country, including the Northern State, Kordofan, Darfur, Gadaref, Kassala,, White Nile, Gezira and Wadi Halfa [8.9.10.11.12.] and even in several parts of Khartoum [13]. Moreover, the distribution and prevalence of the two types of schistosomiasis are still increasing due to the increased development of water resource and the interaction of population during different life activities[13, 14, 15].

II. Materials and Methods

Study area: The study was performed in Khartoum, the largest city and the capital of Sudan, in villages beside the White Nile (Figure 1: A) and New Halfa city in the eastern Sudan, in villages beside Atbara River (Figure 1: B).

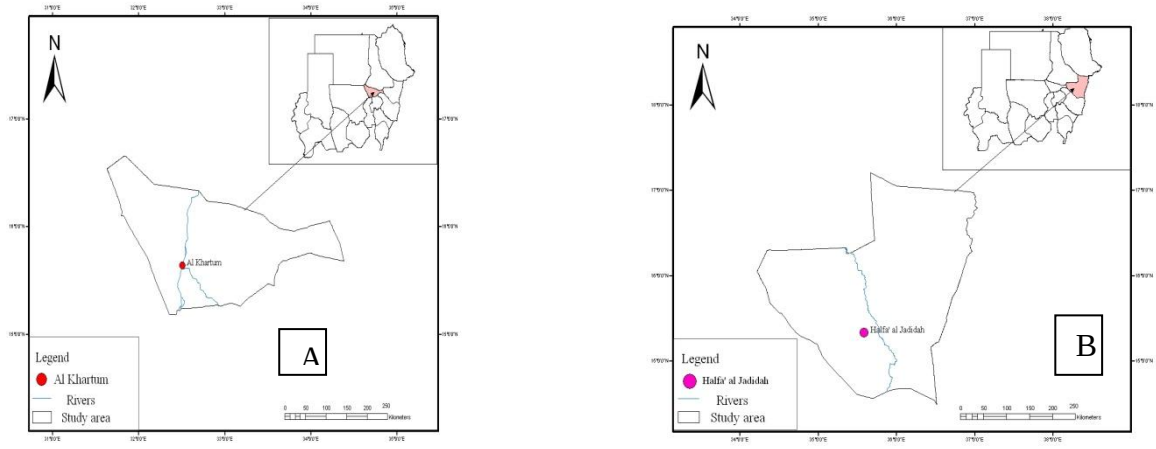

Fig 1: A map of A: Khartoum city, B: New Halfa city, Source: Remote Sensing Authority (2012)

Study design: This was a laboratory based cross sectional study.

Study population: The study populations included in this study were the school children in El kalakla area in Khartoum State and the inhabitants of Al Qadesia, Tiba, Tabark allah, Al Gamhoria and Alwehda villages in New Halfa. males and females with different ages and occupations, with symptoms of schistosomiasis were recruited. Seven hundred and twenty (n=720) stool samples and 720 urine samples were collected to detect *S. mansoni* and *S. haematobium* eggs, respectively. Moreover, 50 stool and 50 urine samples were collected as control.

Stool specimens were investigated by wet mount preparation [16] and Kato-Katz [17] whereas urine samples were investigated by sedimentation technique following centrifugation [18].

Ethical clearance was approved by the ethical committee of Ministry of Health, Kassala. Moreover, the informed consent was obtained from study subjects or their guardians. Designed and previously prepared questionnaire was used for data collection.

Data was analyzed using Statistical Package of Social Sciences (SPSS) for windows, version 15 and the p value of less than 0.05 was considered statistically significant.

III. Results

General characteristics of the studied population: The age of the study subjects included in the present study ranges between 4-85 years, mean age was 23 years. Males were 475 (61.7%) and females were 295 (38.3%) with M:F ratio of 1.6. Study subjects (720) were from endemic area in addition to 50 healthy controls. Within these surveyed population, 200 were from El Kalakla in Khartoum state and 520 were from different villages in New Halfa scheme, New Halfa city and 50 negative non endemic controls from Khartoum city.

Overall prevalence of *S. mansoni* infection

One hundred and twelve (n=112) stool samples out of the 770 (14.5%) were positive by both wet mount and Kato-Katz concentration method. The worm load was found to be between (0-960) eggs per gram of stool. Regarding gender, 46 (41.1% of the positive cases and 6.0 % of the total study population) were males while 66 (58.9% of the positive cases and 8.6% of the total study population) were females. The relation between gender and infection was highly significant (p = 0.000).

Prevalence of *S. mansoni* infection according to age

The surveyed populations were categorized into five age groups: (4-12), (13-19), (20-45), (46-60) and (61-85) year. The frequency of each age group was 332 (43.1%), 145 (18.8%), 183 (23.8%), 60 (7.8%) and 50 (6.5%) of the total population respectively (table 1). The positive cases within each age group were 69 (20.8%

of age group population, 8.96% of total subjects), 21 (14.5% of age group population, 2.7% of total subjects), 18 (9.8% of age group population, 2.34% of total subjects), 3(5% of age group population, 0.39% of total subjects) and 1(2% of age group population, 0.13 of total subjects) respectively (figure 1). The relation between age groups and an infection was highly significant (p=0.000).

Table 1: Frequency of age-groups

Age-groups	Frequency	Percentage (%)
4-12 Year	332	43.1
13-19 Year	145	18.8
20-45 Year	183	23.8
46-60 Year	60	7.8
61-85 Year	50	6.5
Total	770	100.0

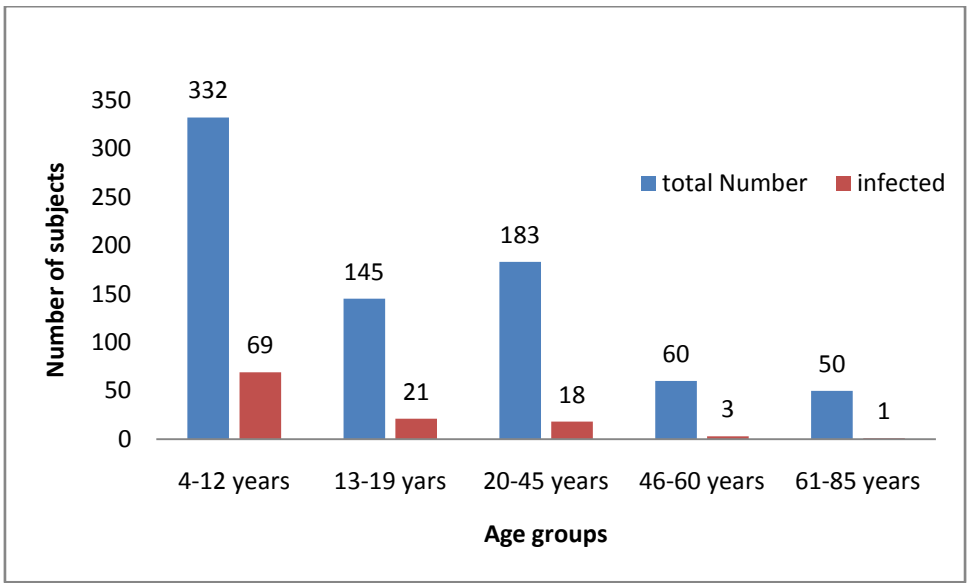

Figure 1: Prevalence of *S. mansoni* among age groups

Determination of intensity of infection

The intensity of infection was determined according to the following criteria:

Mild	≤ 50 eggs per gram of stool
Moderate	51- 200 eggs per gram of stool
Severe	201-300 eggs per gram of stool
Hyper infection	≥ 400 eggs per gram of stool

The intensity of *S. mansoni* infection was compared to age-groups. Results are shown in Table (2). The relation between intensity of an infection and age-groups was insignificant.

Table 2: Intensity of *S. mansoni* infection according to age-groups

	Intensity of *S. mansoni*				
Age-groups	Mild infection	Moderate infection	Severe infection	Hyper infection	Total
4-12 Year	23	36	8	2	69
13-19 Year	11	9	1	0	21
20-45 Year	9	8	1	0	18
46-60 Year	0	2	0	1	3
61-85 Year	0	1	0	0	1
Total	43	56	10	3	112

Overall prevalence of *S. mansoni* infection according to the presence of latrines in houses

Out of the 770 surveyed populations, 348 (45.2%) had latrines in their houses, among those, 16 (4.6%) were found to be positive for *S. mansoni*, 422 (54.8%) had no latrines in houses, among those, 96 (22.7%) were found to be positive (figure 2). The relation between infection and presence of latrines in houses was significant (p = 0.000).

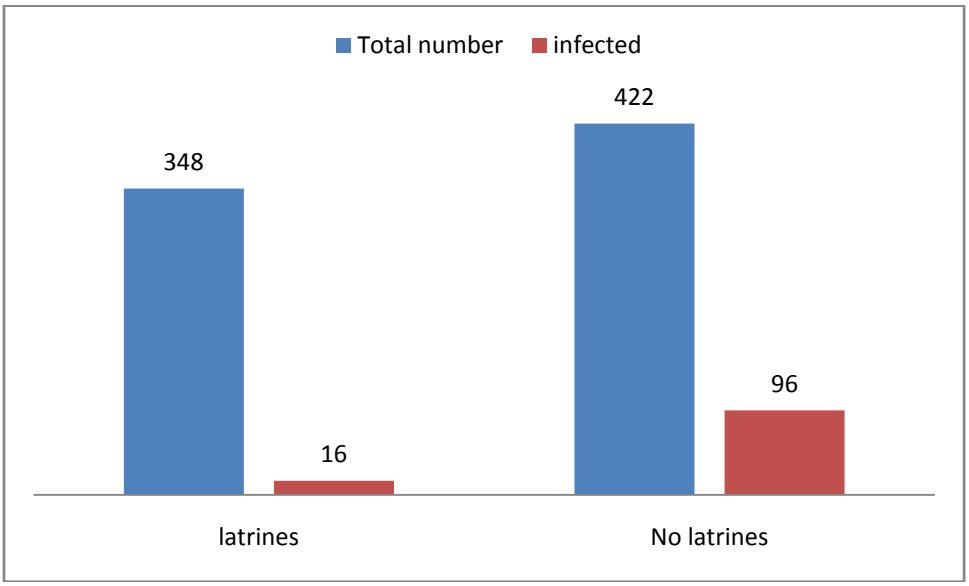

Figure 2: Prevalence of *S. mansoni* infection according to the presence of latrines in houses

Overall prevalence of *S. mansoni* infection according to source of drinking water

Out of the 770 surveyed populations, 272 (35.32%) were drinking from pipes, among those, 10 (3.7%) were found to be positive for *S. mansoni*, 468 (60.78%) were drinking from canals, among those, 102 (21.8%) were found to be positive and 30 (3.90%) were drinking from donkey cars, among those no one was positive. The relation between infection and source of drinking water was significant (p=0.000).

Overall prevalence of *S. mansoni* according to history of water contact

Out of the 770 surveyed populations, 588 (76.36%) had history of water contact, among those, 102 (17.3%) were positive for *S. mansoni*, 182 (23.64%) had no history of water contact, among those, 10 (5.5%) were positive (figure 3). The relation between infection and history to water contact was significant (p=0.000).

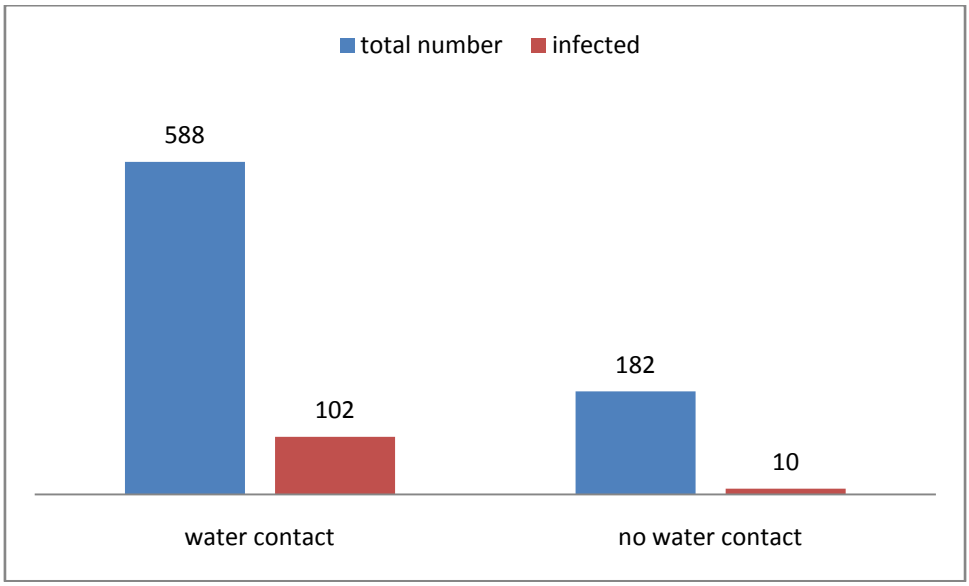

Figure 3: Prevalence of *S. mansoni* infection according to history of water contact

Overall prevalence of *S. mansoni* according to knowledgement (information) about an infection
Out of the 770 surveyed populations, 579 (75.2 %) had knowledge about an infection, among those, 68 (11.7%) were found to be positive for *S. mansoni*, 191 (24.8 %) had no Knowledge about an infection, among those, 44 (23%) were found positive (figure 3). The relation between infection and knowledge about an infection was significant (p=0.000).

Overall prevalence of *S. mansoni* according to the level of education
Out of the 770 surveyed populations, 644 (83.6%) had low level of education, among those, all the 112 (17.4%) positive were observed, whereas 60 (7.8%) had medium level of education and 66 (8.6%) had high education level, among those no positive cases were registered (table 3). The relation between infection and education level was significant (p=0.000).

Table 3: Overall prevalence of *S. mansoni* according to level of education

		Education level			
		Low	Medium	High	Total
S.mansoni	Positive	112	0	0	112
	Negative	532	60	66	658
Total		644	60	66	770

Overall prevalence of *S. haematobium*
For detection of *S. haematobium* eggs, 770 urine samples were collected from patients and controls, Within these samples, only 3(0.4%) from El Kalakla area were found positive by sedimentation technique.

IV. Discussion

Schistosomiasis is one of the most important water-associated diseases. It is far more prevalent in irrigated agricultural schemes than other places. The endemic areas are always characterized by irrigation systems and man-made reservoirs that lead to the spread of the infection. The extensive use of human feces for fertilization of gardens and fields crops may greatly increases the chances of infecting the snails. The distribution of infection across populations of rural and suburban areas is strongly associated with the human water contact patterns, snail populations and cercarial density.

The results from the present study in New Halfa Scheme (for *S. mansoni*) and Al Kalakla areas in Khartoum State (for *S. h\Aaematobium*) showed that from 770 collected stool and urine samples, the overall prevalence was 14.5% and 0.4% respectively. This reveals that several factors could be responsible for the

transmission of the disease in these areas: the social behavior, non hygienic community practices, improper disposal of human waste and lack of health care and education.

Moreover, the results of this study indicated that the severity of schistosomiasis is proportionally correlated with the intensity of water contact. In fact, the absence of piped water in the house and daily repeated contact with canal water (for drinking, washing and other activities) presumably infected, were the greatest risk factors for development of severe infections.

The current study compared between direct wet mount and Kato-Katz concentration, two techniques that can be used for diagnosis of intestinal schistosomiasis (*S. mansoni*). The mean eggs count was 17 eggs per gram of stool by the Kato-Katz technique. The wet preparation is not considered as a quantitative method for egg count. Although it is distinguishable by being quick and simple method and requires small amounts of sample but it is not efficient in detecting mild and chronic infections. Examination of stool samples by Kato-Katz smears is the recommended standard method for the field diagnosis of intestinal schistosomiasis as declared by the World Health Organization (WHO) [3].

Within population and age groups, infection relates to patterns of water contact and host immunity. In this study, the infection prevalence was concentrated particularly upon the age-groups (4-12 years). The high prevalence rate of schistosomiasis in the primary school may be largely due to its location, as it is boarded by small flowing water/stream with vegetation. In addition to the fact that school children are the most susceptible age group to schistosomiasis (mostly between 4-12 years). A recent study in Zimbabwe demonstrated that *schistosomes* collected from snails inhabiting long non-connected rivers, possess major genetic diversity, which is proportionally correlated with geographic separation [19]. On the other hand, Brouwer et. al.,[20] found that *Schistosomes* from infected persons of a certain area may share similar genotypes.

Disease patterns associated with gender are variable, considering behavioral, professional and cultural factors. The rate of infection among males (6.0%) was less than among females (8.6%). Woolhouse et al., (1991)[21], concluded that the age and gender factors are related to the frequency and behavior of water contacts. Most reports showed that males are more susceptible than females due to their attitude towards water contact. These findings disagree with the present study in which schistosomiasis prevalence and intensity are higher in females than in males. However, On the contrary, studies carried out in Ghana and Nigeria showed similar results of higher prevalence of urinary schistosomiasis among females compared with males [22, 23].

Regarding history of water contact, a significant association between percentage of infection and history of water contact was observed in this study. This comes into agreement with previous study from Kenya [24].

Regarding personal hygiene and access to safe and clean water, a recent review concluded that people who have access to safe water and sufficient sanitation have much lower prevalence of *Schistosomiasis* [25]. Moreover, a recent study from Congo Republic revealed that *S. mansoni* infection is significantly associated with age, educational level and water activities linked with direct fresh water resources such as rivers and streams [26]. In addition, a recent Nigerian study proved that factors highly associated with the KAP (knowledge, attitude and practices) on schistosomiasis among the studied populations were age, gender and level of education [27], which are all agree with the results of this study.

V. Conclusion

S. mansoni is quite prevalent in New Halfa but there is no *S. haematobium* while in Khartoum, there are few cases of *S. haematobium* and no *S. mansoni*. Moreover, infection with *S. mansoni* was more prevalent in young children and is significantly high among females compared with males. In addition, while more epidemiological studies are needed to determine the prevalence rate of intestinal parasitic co-infections in Sudan, health education can significantly reduce the disease prevalence.

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