



## Prevalence Rate of Intestinal Schistosomiasis with Interaction of Other Factors in New Halfa City-Eastern Sudan

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### ABSTRACT

This study was conducted to determine the prevalence of intestinal schistosomiasis in New Halfa city in Eastern Sudan. Cross-sectional study was carried out during the period March 2011 to October 2011. A total number of 770 surveyed population (age between 4-85 years old, mean age was  $23 \pm 19$  years) were investigated in this study. Faecal specimens, clinical, parasitological and epidemiological data were obtained and recorded. One hundred twelve out of 770 (14.5%) faecal specimens were positive for *Schistosoma mansoni* (46 (6.0 %) were males and 66 (8.6%) were females) when examined by direct wet mount and Kato-Katz technique. The study also showed that the prevalence of schistosomiasis was high among the age group between 4-12 year. This study compared the infection in treated and untreated groups, the prevalence of infection among the previously treated group found to be (5.2%) and the untreated group showed relatively lower prevalence. The study also showed that out of 770 surveyed population, 88 (11.4%), 103 (13.4%), 183 (23.8%) and 1 (0.1%) were positive for *Hymenolepis nana*, *Giardia lamblia*, *Entamoeba histolytica* and *Taenia saginata* respectively. Using direct wet mount technique, 21 (19.0%) of the positive cases of *S. mansoni* showed no co- infections compared to 91 (81.0%) with co-infections included *H. nana*, *G. lamblia*, and *E. histolytica* detected in 22 (20.0%), 26 (23.0%) and 43 (38.0%) cases respectively. The co-infection within all studied population were (3.0%), (3.0%) and (6.0%) also respectively. This study indicates that the area under investigation is endemic for *S. mansoni* and *S. mansoni* co-infection.

### المستخلص:

أجريت هذه الدراسة لتحديد إنتشار البلهارسيا المعوية في مدينة حلفا الجديدة في شرق السودان. الدراسة المستعرضة نفذت أثناء الفترة بين مارس 2011م إلي أكتوبر 2011م وكان مجموع عدد السكان الذين تم إشراكهم في الدراسة (770) مواطن وكانت أعمارهم ما بين 4-85 عاماً. وكان متوسط العمر 23 سنة. أخذت عينات من الفسحة كما تم الحصول علي البيانات السريرية، الطفيلية و الوبائية وتم تسجيلها. بلغت إصابات البلهارسيا (*Schistosoma mansoni*) في البراز بواسطة التحضير الرطب و استخدام تقنية كاتو

في 112 عينة من أصل 770 (14.5%). أظهرت الدراسة أن معدل إنتشار البلهارسيا المعوية اعلى وسط المجموعة العمرية بين 4-12 عاماً. الدراسة قارنت العدوى في المجموعة التي عولجت والتي لم تعالج، الإنتشار اعلى وسط التي عولجت. أيضاً أظهرت الدراسة أن 88 (11.4%) من أصل 770، 103 (13.4%)، 183 (23.8%) و 1 (0.1%) مصابين بعدوى الديدان القزمية، القارديا، الأميبا المحللة للنسيج والديدان الشريطية على التوالي. وعند استخدام التحضير الرطب وجد أن 21 (19.0%) من إصابات البلهارسيا (*S.mansoni*) غير مصابين بعدوى مشتركة مقارنة ب 91 (81.0%) عدوى مشتركة من الديدان القزمية، القارديا والأميبا المحللة للنسيج حددت في 22 (20.0%)، 26 (23.0%) و 43 (38.0%) علي التوالي. والعدوى المشتركة خلال كل المواطنين (3.0%)، (3.0%) و (6.0%) على التوالي.

تلخص هذه الدراسة أن المنطقة تحت الدراسة موبوءة بالبلهارسيا (*S.mansoni*) والعدوى المشتركة للبلهارسيا.

**KEYWORDS:** *S. mansoni*, Direct wet mount technique, Kato technique, Epidemiological data, Co-infections.

## INTRODUCTION

Schistosomiasis is sometimes referred to as bilharzias, bilharziasis, or snail fever, a parasitic disease caused by blood flukes (trematodes) of the genus *Schistosoma*. An estimated 700 million people are at risk of infection in 76 endemic countries. Although, transmission is interrupted in some countries, more than 207 million people are infected with schistosomiasis; 85% of them live in Africa. After malaria, and intestinal helminthiasis, schistosomiasis is the third most devastating tropical disease in the world<sup>(1)</sup>. Schistosomiasis was discovered by Theodore Bilharz, German surgeon working in Cairo, who first identified the etiological agent, *Schistosoma hematobium* in 1851<sup>(2)</sup>. Schistosomiasis is characterized by focal epidemiology and over dispersed population distribution, with higher infection rates in children than in adults. Complex immune mechanisms lead to the slow acquisition of immune resistance, though innate factors also play a part. Acute schistosomiasis,

a feverish syndrome is mostly seen in travelers after primary infection. Chronic schistosomal disease affects mainly individuals with longstanding infections in poor rural area<sup>(3)</sup>. Immunopathological reactions against *Schistosoma* eggs trapped in the tissues lead to intestinal disease, hepatosplenic inflammation, and liver fibrosis<sup>(3)</sup>. Praziquantel is the drug of choice for treatment of the disease. Vaccines are not yet available. Great advances have been made in the control of the disease by interruption of the parasites lifecycle<sup>(3)</sup>. The standard diagnostic method is by microscopic demonstration of eggs in the faecal specimen and Kato-Katz technique for determining the intensity of infection. In areas of the Sudan, infections with *Schistosoma mansoni* remain a deliberating problem for the affected communities and considered to be one of the major public health problems after malaria. Schistosomiasis is now endemic in all states of the Sudan except Red Sea. The World Bank in

1997 estimated that the minimum population at risk in the Sudan is 24 million while 5 million are infected. During the last two years, parasitological surveys were carried out in some irrigation schemes (prevalence were found to be Kinana 80%, Gunaid 60%, Assalya 50% and Sennar 37%)<sup>(4)</sup>. The first three cases of bilharzias were reported by Balfour in 1903 who reported in the following year that 73 pupils of school children in Khartoum were infected with bilharziasis. World Health Organization (WHO) Country Office in Sudan is directed to purchasing supplies and equipments, to strengthen the diagnostic capabilities of the program<sup>(4)</sup>. By the end of 2004, all plan items were requested. To upgrade and update the database of the program, surveys were conducted among school pupils to detect the prevalence rate of the disease in Khartoum, Gazira, Sennar, and Blue Nile states. The surveys were followed by mass treatment of the school pupils according to the results. There are constraints include, weak capacity of the program at national and state levels, week epidemiological surveillance of disease, weak basic services in the endemic areas, especially safe drinking water, proper surveys on soil-transmitted helminths are lacking and lack of transportation facilities for field supervision, particularly at the state level<sup>(4)</sup>. Lessons learned from region and in Sudan show significant reduction in the overall prevalence and in the intensity of infection following introduction of mass chemotherapy. Access to safe water and sanitation and improved hygiene are also important to control schistosomiasis and soil-transmitted helminths. Steps taken so far, in integration of the epidemiological surveillance of the

disease within the integrated package of communicable diseases, are, although still weak, expected to yield good result in the near future<sup>(4)</sup>. The common package for the control of both schistosomiasis and soil-transmitted helminths with regular treatment of high risk groups, particularly school children, will continue in 2005. More funding is needed to secure the purchase of praziquantel. Active surveillance needs to be strengthened as part of the integrated approach and diagnostic capabilities will be upgraded<sup>(4)</sup>. The main objective of this study was to determine the prevalence of intestinal schistosomiasis in New Halfa city in Eastern Sudan.

## **MATERIALS and METHODS**

### **Study area**

The study was performed in five different villages (Tiba, Tabark Allah, AlQadesia, AlGamhoria and AlWehda) in New Halfa city in the Eastern Sudan in Kassala State where the Khashm El Girba Dam provides a reliable source for the irrigation scheme intended to convert the nomads of the area to farmers of cotton and sugar, during the period from March to October 2011.

### **General characteristics of the studied population and ethical clearance**

The study was conducted among 770 population with age range between 4-85 years old and average age of  $23 \pm 19$  years, 475 of them were males (61.7%) and 295 were females (38.3%). 150 of the participants from Tiba village, 150 from Al Gamhoria village, 200 from Al Wehda village, 160 from Tabark Allah village and 110 from Al Qadesia village in New Halfa city. 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. Ethical clearance for this study was obtained from Ministry of Health-Kassala State Department of Preventive Medicine Office of the anti-bilharzia and intestinal worms New Halfa city.

### Sampling

In this study a total of 770 questionnaires were administered. And a total of 770 stool samples collected, from among those that filled the questionnaire.

### Design of questionnaire

The design of questionnaire considers simple investigative questions or indicators, which include gender, age, observation of blood and mucus in the stool, visit to water bodies (risk factor), history to previous infection and previous treatment, presence of latrines in the houses, source of drinking water and a simple knowledge on the sign and symptom of the diseases and also employs the activities that put an individual at the risk of infection.

### Parasitological investigations

#### 1-Direct wet preparation

For detection of *S. mansoni* in faecal specimens, 770 samples were examined by direct wet mount preparation as described by (WHO, 1993). Three slides were prepared for each stool specimen.

#### 2- Kato-Katz technique

Kato-Katz technique was used for the quantitative assessment of eggs in 1 gram of stool as described by (WHO, 1993). The intensity of infection was

obtained by counting the number of *S. mansoni* eggs per gram (epg) of stool. Results were expressed as ( $\leq 50$  epg) presented as mild infection, (51-200 epg) as moderate infection, (201-300 epg) as severe infection and ( $\geq 400$  epg) as hyper infection. All surveyed populations were screened for other intestinal parasites like *Entamoeba histolytica*, *Giardia lamblia* and *Hymenolepis nana* using direct wet preparation.

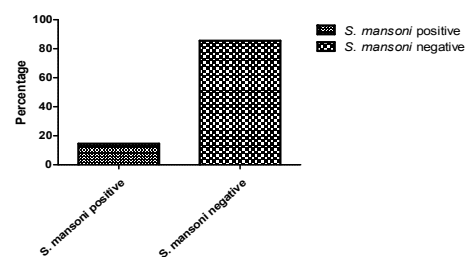
### Statistical analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) under windows, version 15.0. Chi square test statistical analysis was performed and the p values of less than 0.05 were considered statistically significant. Data were presented in tables and graphs using PRISM 5 programme (Graph Pad Software, Inc., Jolla, USA) and Excel after analysis using SPSS.

### RESULTS:

Overall prevalence of *S. mansoni* infection using wet preparation Among 770 faecal samples, 112 (14.5%) were found positive by direct wet mount and 659 (85.6%) samples were negative (Figure 1).

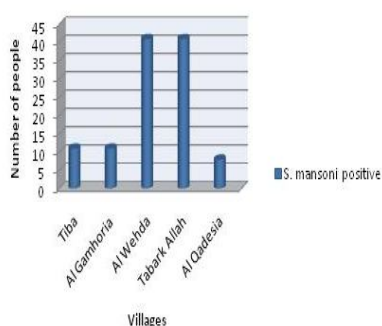
Figure 1: Overall prevalence of *S. mansoni* in the study area using direct wet mount technique



The prevalence of infection in each village was as follow: from Tiba 150 stool samples were collected, 11

(1.43%) were found positive, from AlGamhoria 150 were collected, 11 (1.43%) were positive, from Al Wehda 200 were collected, 41 (5.32%) were positive, from Tabark Allah 160 were collected, 41 (5.32%) were positive and from Al Qadesia 110 were collected, 8 (1.04%) were positive (Figure 2).

**Figure 2:** Prevalence of *S. mansoni* infection according to different villages using Kato-Katz technique



Seven hundred seventy stool samples were examined by Kato technique to detect *S. mansoni* infection. Results showed 112 stool samples (14.5%) were positive and worm load was found to be between (0-960) ages per gram of stool (Table 1). Within these 43 (38.4%) were mild infection, 56 (50.0%) were moderate infection, 10 (8.9%) were severe infection and 3 (2.7%) were hyper infection. The two methods direct wet mount and Kato technique showed highly significant differences (p=0.000).

#### Prevalence according to gender by direct wet mount technique

From the hundred twelve positive cases, 46 (6.0 %) were males and 66 (8.6%) were females. The differences in prevalence according to gender found to be significant (p=0.000).

Table 1: Kato-Katz technique (number of eggs/1gram

Number of eggs/1 gram of stool	Frequency	Percentage
0	658	85.5
24	6	0.8
48	37	4.8
72	15	1.9
96	21	2.7
120	8	1.0
144	8	1.0
168	1	0.1
192	3	0.4
216	2	0.3
240	4	0.5
336	1	0.1
360	1	0.1
384	2	0.3
480	1	0.1
720	1	0.1
960	1	0.1

#### Prevalence of *S. mansoni* according to age-groups

The positive cases within each age group were 69 (8.96%), 21 (2.7%), 18 (2.34%), 3 (0.39%) and 1 (0.13) respectively (Figure 3). The differences in prevalence according to age groups was highly significant (p=0.000)

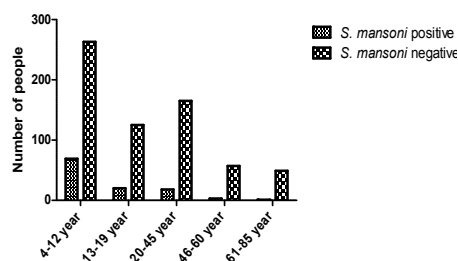


Figure 3: Prevalence of *S. mansoni* according to age-groups.

#### Overall prevalence of *S. mansoni* according to history of previous infection by wet preparation

Out of 770 surveyed populations, 256 (33.25%) were previously infected with *S. mansoni*. Among those, 43 (5.6%) were found to be positive for *S. mansoni*. Among the other group without history of previous infection,



514 (66.8%), 69 (9.0%) were positive. The relation between these two groups was insignificant ( $p=0.211$ ).

### Overall prevalence of *S. mansoni* according to duration of previous infection

Out of 203 (26.36%) previously infected for (1-12 month), 36 (4.67%) were found to be positive for *S. mansoni* by wet preparation, 20 (2.60%) of previously infected for (13-24 month), 3 (0.39%) were positive, 12 (1.56%) of previously infected for (25-36 month), 1 (0.13%) was found to be positive and 21 (2.72%) of previously infected for (more than 37 month), 3 (0.38%) were positive. The relation between recent infection and the duration of previous infection was insignificant ( $p=0.829$ ).

### Overall prevalence of *S. mansoni* according to last dose of previous treatment

Out of 770 surveyed populations, 201 (26.10%) were previously treated with praziquantel during (1-12 month), among those, 34 (4.42%) were found to be positive for *S. mansoni* by wet preparation, 20 (2.60%) were treated during (13-24 month), among those, 3 (0.39%) were found to be positive, 11 (1.43%) were treated during (25-36 month), among those, 1 (0.13%) was found to be positive and 21 (2.72%) were treated during (more than 37 month), among those, 3 (0.38%) were found to be positive. The relation between infection and last dose of treatment was insignificant ( $p=0.905$ ).

### Prevalence of *S. mansoni* among population with mucus and blood in their stool

Out of 770 surveyed populations, 85 (11.04%) had mucus and blood in their stool samples, among those, 18

(2.34%) were found to be positive for *S. mansoni* by wet preparation and among 685 (88.97%) who had no mucus and blood in their stool, 94 (12.21%) were found to be positive. The relation between infection and presence of mucus and blood in stool was insignificant ( $p=0.066$ ).

### Prevalence of *S. mansoni* according to presence of latrines in the houses by wet preparation

Out of 770 surveyed populations, 348 (45.19%) had latrines in their houses, among those, 16 (2.08%) were found to be positive for *S. mansoni* and from the 422 (54.81%) with no latrines in their houses, 96 (12.47%) were found to be positive. The relation between infection and latrines in the houses was significant ( $p=0.000$ ).

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

Out of 770 surveyed populations, 272 (35.32%) were drinking from pipe, among those, 10 (1.30%) were found to be positive for *S. mansoni* by wet preparation, 468 (60.78%) were drinking from canal, among those, 102 (13.25%) were found to be positive and 30 (3.90%) were drinking from donkey car, among them no one was positive (Figure 4). The relation between infection and source of drinking water was significant ( $p=0.000$ ).

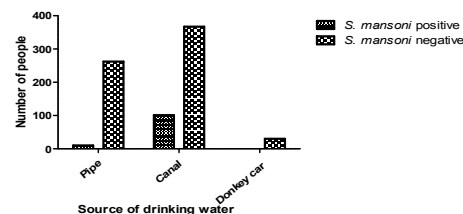


Figure 4: Prevalence of *S. mansoni* according to source of drinking water

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

Out of 770 surveyed populations, 588 (76.36%) had history of water contact, among those, 102 (13.25%) were found to be positive for *S. mansoni* by wet preparation, 182 (23.64%) with no history of water contact, among them, 10 (1.30%) were found to be positive. The relation between infection and history of water contact was significant ( $p=0.000$ ).

### Overall prevalence of *S. mansoni* according to the tribe

770 surveyed populations from 42 different tribes, from Tama 91 (11.8%) were found to be positive for *S. mansoni*, from Bany Aamir 11 (1.4%) were found to be positive, from Foor 3 (0.4%) were found to be positive, from Barno 2 (0.3%) were found to be positive, from Misaria 2 (0.3%) were found to be positive, from Zagawa 2 (0.3%) were found to be positive and from Masaleet 1 (0.1%) was found to be positive. The relation between infection and tribes was significant ( $p=0.002$ ).

### Prevalence of other parasites in the study area by wet preparation

Out of 770 surveyed populations, 88 (11.4%) samples were found to be positive for *H. nana*, 103 (13.4%) samples were found to be positive for *G. lamblia*, 183 (23.8%) samples were found to be positive for *E. histolytica* and 1 (0.1%) sample was found to be positive for *T. saginata* (Figure 5).

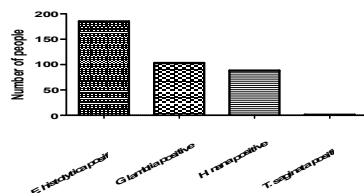


Figure5: Prevalence of other parasites in the study area

### Other infections associated with *S. mansoni* using direct wet mount technique

Twenty one (19.0%) of the positive cases of *S. mansoni* showed no associated infections but the other 91(81.0%) positive cases showed other co-infections included *H. nana* , *G. lamblia*, and *E. histolytica*. They were detected in 22 (20.0%), 26 (23.0%) and 43 (38.0%) cases respectively and within all studied populations percentage were (3.0%), (3.0%) and (6.0%) respectively (Figure 6).

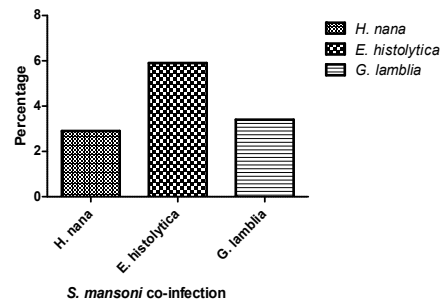


Figure 6: Prevalence of *S. mansoni* co-infections in the study area

### Overall prevalence of *S. mansoni* comparing to prevalence of *S. mansoni* co-infections in the study area by direct wet mount

Overall prevalence of *S. mansoni* was 14.5% while overall prevalence of *S. mansoni* co-infections was 11.8%.

## DISCUSSION

Schistosomiasis is one of the water-associated diseases. It is far more prevalent in irrigation agricultural schemes than in other places. The endemic areas always characterized by man-made reservoirs and irrigation system that have contributed to the spread of the infection. Snail populations, cercarial density and patterns of human water contact show strong variations resulting in a focal distribution of infection within

countries, regions and villages<sup>(5)</sup>. The results obtained from this study showed that overall prevalence of *S. mansoni* was 14.5%. This reveals that several factors such as the social behavior, non hygienic community practices, and improper disposal of human waste could be responsible for the transmission of the disease in these areas<sup>(5)</sup>. For detection of *S. mansoni*, each stool sample was examined using direct wet mount by three slides preparation and Kato technique. The two methods were showed highly significant differences ( $p=0.000$ ). Examination of stool samples by Kato-Katz smears is the standard method recommended by the World Health Organization (WHO) for the field diagnosis of intestinal schistosomiasis<sup>(5)</sup>. Therefore, Kato technique must be used routinely for stool examinations in laboratories and field work especially for *S. mansoni* because of highly relative sensitivity and ability to detect very mild infections. Moreover, all the eggs of co-infections (*H. nana*, *Taenia* species, *G. lamblia* and *E. histolytica*) detected in this study with *S. mansoni* were seen by these two methods. The high prevalence rate of schistosomiasis in the primary school may be largely due to its location, as it is bordered by small flowing water/stream with vegetations. In addition to the fact that school children are the most susceptible age group to schistosomiasis (mostly between 4-12 year). The study showed that the prevalence of schistosomiasis was high among the age group between 4-12 year; these findings agree with the results obtained by World Health Organization Country Office in Sudan, surveys were conducted among school pupils to detect the prevalence rate of schistosomiasis in Khartoum, Gezira, Sinnar and Blue Nile states. The

surveys were followed by mass treatment of the school pupils or treatment of infected pupils according to the results. A recent study in Zimbabwe was demonstrated that Schistosomes derived from snail in long non-connected river systems showed substantial genetic diversity, with genetic distance increasing with geographic separation. Brouwer and others<sup>(8)</sup> have shown that *Schistosomes* found among Zimbabwean school children living in the same area can be clustered into a series of related groups that share similar genotypes. Sex related patterns vary in relation to behavioral, professional and cultural factors. Schistosomiasis was more prevalent and intense in boys than in girls and in older children. The age and gender factors are well known and are associated with the number and type of water contacts. It has been shown that boys are more exposed than girls because they take more baths<sup>(9,10)</sup>, and that the level of infection increases with age because schistosomiasis is a chronic infection and children have repeated exposures<sup>(11)</sup>, these findings disagree with the results obtained from the present study, as the rate of infection within males (6.0%) was to be seen less than within females (8.6%), it has been shown that females are more exposed than males. This study compared the infection in treated and untreated groups, the prevalence of infection among the previously treated group found to be (5.2%) and the untreated group showed relatively lower prevalence. The appearance of infection may be either due to ineffectiveness of the treatment or reinfection. The results obtained from this present study showed the prevalence was high among population with no latrines in their houses, these findings agree with Abou-Zeid *et al.*<sup>(12)</sup>. The prevalence of *S. mansoni*



co-infections reported in this study indicated a serious problem and the impact of this phenomenon on the control of the single infection needs further investigation.

## CONCLUSIONS

Prevalence of *S.mansoni* in the study area was 14.5%. Disease is significantly high among females compared with males; females face the highest risk because of domestic and occupational contact with fresh water. Co-infection with *S.mansoni* and other protozoal and helminthic infections is common in the study area.

## RECOMMENDATIONS

From this paper and the results obtained, the following recommendations can be drawn: 1- Health education to reduce water contacts. 2-Co-infections in the study area are common. 3- More epidemiological studies are needed to determine the prevalence rate of co-infections in Sudan. 4-The impact of co-infection on disease outcome and immunity to single infection is needed. 5-Control of activities should be considered in the study area to reduce infection with schistosomiasis and other intestinal parasitic infection.

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