



## PREVALENCE AND ASSOCIATED FACTORS OF SCHISTOSOMIASIS AMONG PRIMARY SCHOOLCHILDREN IN AL–MAHWEET GOVERNORATE, YEMEN

DOI: 10.7904/2068–4738–VII(13)–24

Gawad M. A. ALWABR

Sana'a Community College, Sana'a–YEMEN,  
\*Corresponding author: Email: [alwabr2000@yahoo.com](mailto:alwabr2000@yahoo.com)

**Abstract.** Schistosomiasis is among the mainly prevalent suffering of human who live in areas of poverty in the developing world. Epidemiological surveys indicated that schistosomiasis is widely distributed in Yemen. Two main forms of human schistosomiasis exist in Yemen. Urinary schistosomiasis caused by *Schistosoma haematobium* infection and intestinal schistosomiasis caused by *Schistosoma mansoni* infection. This cross–sectional inquiry aims to appreciate the prevalence and corresponding risk factors of schistosomiasis included in primary schoolchildren in Al–Mahweet governorate, Yemen. Urine and faecal specimenes (samples) were collected from 196 primary school children. Urine samples were examined using sedimentation method for presence of *Schistosoma haematobium* eggs. While faecal samples were examined using Kato Katz techniques for the presence of *Schistosoma mansoni*. Structured questionnaires were administered to the subjects of the target population in order to determine infection in relation to associated factors. Overall, 30.1 % of study participants were found to be positive for schistosomiasis; 35.7 % were infected with *Schistosoma mansoni* and 24.5 % were infected with *Schistosoma haematobium*. The relation between the prevalence of schistosomiasis infection and the factors of age and gender were not statistically significance ( $P= 0.183$  and  $0.560$ ) respectively. The highest rate (61 %) of schistosomiasis infection, were recorded among the schoolchildren who using streams as a main source of water. The urban area of Al–Mahweet governorate had a lower prevalence of schistosomiasis infection (11.9 %), as compared to schoolchildren from rural area (29.4 %). Other multivariate analysis confirmed that schoolchildren fathers' education status ( $P= 0.007$ ), sanitary facilities ( $P= 0.001$ ) and place of residence ( $P= 0.001$ ) were the key factors significantly associated with schistosomiasis infection among these children. This study reveals that schistosomiasis infection is still highly prevalent in Al–Mahweet governorate, Yemen. This study recommended that, beside periodic drug distribution, a comprehensive intervention strategy should be designed and be implemented to reduce schistosomiasis prevalence.

**Keyword:** Schistosomiasis, School children, Al–Mahweet governorate, Prevalence, Yemen.

### Introduction

Despite progress in control, *schistosomiasis* remains endemic in 76 countries, with an estimated 200 million people infected, of whom 120 million are symptomatic and 20 million have severe disease [GOSELLE, *et al.*, 2010; ANTO, *et al.*, 2013; HAILE, *et al.*, 2012]. Eight hundred million people worldwide are at risk of this infection [SADY, *et al.*, 2013; GRIMES, *et al.*, 2014, YUSUF, *et al.*, 2015].

It is the most important water–borne disease and presents the greatest risk to health in rural areas in developing countries [BOLAJI, *et al.*, 2014].

In Yemen schistosomiasis is the second most common health disease after malaria, with 2–3 million people infected [RAJA'A, *et al.*, 2000; AL–SHAMIRI, *et al.*, 2011].

There are two main forms of human schistosomiasis exist in Yemen.

Urinary schistosomiasis caused by *Schistosoma haematobium* infection and intestinal schistosomiasis caused by *Schistosoma mansoni* infection [ABDULRAB, *et al.*, 2013].

It affects populations where substandard conditions of living are predominant i.e. poor sanitation, insufficient safe water supply and low standard hygiene is practiced [RAJA'A, *et al.*, 2001].

Among the Middle East countries, Yemen has the highest percentage of people living in poverty where more than 50% of the population of nearly 25 million



people lives below the poverty line [SADY, *et al.*, 2013].

The geographical distribution of the various *Schistosoma* species depends on the availability of a suitable snail host [AbdElRahman, *et al.*, 2010].

Also there are various physical and chemical factors collectively have an effect on the abundance of snails under natural conditions [IHUOMA and JUDE, 2004].

Primary schoolchildren are particularly vulnerable to schistosomiasis because of their habitat of playing in water, where they may contract the infection. As such, they are the ideal target group to investigate the prevalence of schistosomiasis and the data collected from this age group can be used to assess not only whether schistosomiasis threatens the health of schoolchildren, but can also be used as reference for evaluating the need for community intervention [NWORIE, *et al.*, 2012].

Children who practice swimming are particularly at risk because of their prolonged and complete body exposure, as well as their lower levels of acquired immunity. [BARAKAT, *et al.*, 2014; AL-SHAMIRI *et al.*, 2011; BUTNARIU and CAUNI, 2013].

Hence, aims of present study were to assimilated prevalence and distribution of schistosomiasis and to identify associated key factors of this disease among schoolchildren after two years of running the programme of active control and prevention of *Schistosoma* surveillances in Al-Mahweet governorate areas.

## **Material and methods**

### **Study area**

The study was conducted in the Al-Mahweet governorate areas, west Sana'a city the capital of Yemen.

The present study formed part of an evaluation of a school-based deworming project, and was carried out in randomly selected schools of Al-Mahweet governorate areas.

### **Study population**

The study population included children attending grade one to nine in six primary schools in Al-Mahweet governorate areas.

In the period from March to April, 2012, the schools were randomly selected by balloting from the list of schools in towns and villages of Al-Mahweet governorate areas.

The schools involved in the study were, (Al-Khansa and 26-September schools located in urban of Al-Mahweet city), (Belqes and Mohammed Aldorah schools located in rural of Shebam-Kaokaban), Abla school located in rural of Al-Taweela and 26-September school located in rural of Al-Rogom.

The age of selected children ranged between 9 and 17 years. 196 schoolchildren (91 females and 105 males) were selected from the selected schools.

### **Data collection**

After obtaining written consent from the parent of the children, semi-structured interview questionnaires were administered to the study subjects to identify risk factors associated with schistosomiasis.

The questionnaire was consisted variables including demographic information, socioeconomic status, previous history of schistosomiasis treatment, sanitary facilities, sources of water, lastly if they have had symptoms of schistosomiasis before.

The interview was conducted in an empty classroom and the answers recorded as 'yes', 'no' or 'don't know'.

### **Parasitological sample collection and examination**

Following the questionnaire, children who were volunteer to participate in the study were given orientation on how to handle and submit their urine and stool samples. Thereafter, after doing some exercise, the children were given plastic sheet and applicator stick to bring their fresh urine and stool samples.

Urine samples were collected using wide-mouthed, screw-cap plastic containers.

Subjects were instructed to produce mid-stream or terminal urine sample.

The names, sexes and ages of the subjects were entered against the appropriate number on epidemiological field form on submission of the samples.



Each sample container was labeled appropriately.

The subjects ID, the schools' name and the town or community were written on them. The containers were then neatly packed into thick bags and sent to the laboratory for analysis.

Sedimentation method of urine analysis was used for the analysis. The samples were neatly arranged on the laboratory bench for analysis. They were allowed to settle for 20 minutes then the supernatant urine was decanted carefully so as not to disturb the deposit, leaving behind about 10 mL. The deposit was then suspended in the remaining urine by shaking vigorously and the suspension poured into labeled 10 mL centrifuge tubes corresponding to the respondents ID number of the urine container.

The standard centrifugation method as described by Cheesbrough (2006) was employed. The contents were spun in centrifuge for 2 minutes. Pasteur's pipette was then used to remove all but a few drops of urine above the supernatant.

With the pipette, the supernatant was mixed with the remaining urine and suspension transferred to a microscopic slide, covered with coverslide, observed under the light microscope with an X40 magnification for *Schistosoma haematobium* eggs [CHEESBROUGH, 2006]. The process was repeated for same sample till an egg was found or sample depleted.

Faecal samples were obtained from selected schoolchildren using a wide mouth plastic specimen bottles labeled with the laboratory identification number assigned to each child. The samples were processed within an hour of collection.

*Schistosoma mansoni* infection was determined. The Kato Katz technique [KATZ, *et al.*, 1972; WHO, 1991], was used to prepare stool smears on slides for microscopic examination.

#### Data Analysis

The data obtained were entered into MS Excel and analyzed using SPSS software version 11.5. Prevalence rates were reported in percentages and 95% confidence intervals. Chi-square ( $\chi^2$ ) was used to evaluate significant association among the study variables.

A P-Value less than 0.05 was considered statistically significant

#### Results and discussion

The overall prevalence of schistosomiasis infection was (30.1 %).

*Schistosoma mansoni* eggs were identified in 70 (35.7 %) stool samples, whereas *Schistosoma haematobium* eggs were identified in 48 (24.5 %) urine samples. 62 (31.6 %) of male and only 8 (4.1 %) of female, were infected with, *Schistosoma mansoni*, while 41 (20.9 %) of male and only 7 (3.6 %) of female, were infected with, *Schistosoma haematobium*. (Table 1).

**Table 1.**

Incidence of intestinal and urinary schistosomiasis according to sex and age groups of the sample.

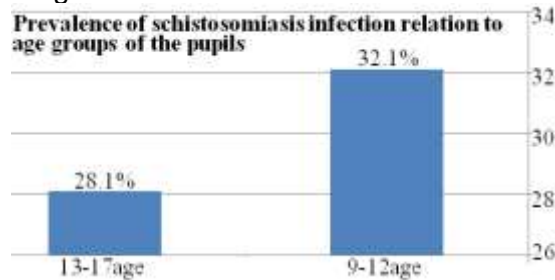
Factor	<i>Schistosoma mansoni</i> Infected (%) n= 196	<i>Schistosoma haematobium</i> Infected (%) n= 196	Average of total samples infected n= 392
<b>Gender:</b>			
Male	62 (31.6)	41(20.9)	103 (26.3%)
Female	8 (4.1)	7 (3.6)	15 (3.8%)
Total	70 (35.7)	48 (24.5)	118 (30.1%)
<b>Age group:</b>			
9–12 years	40 (20.4)	23 (11.7)	63 (16.1%)
13–17 years	30 (15.3)	25 (12.8)	55 (14%)
Total	70 (35.7)	48 (24.5)	118 (30.1%)

And 40 (20.4 %) of the age group of 9–12, and 30 (15.3 %) of the age group of 13–17, were infected with, *Schistosoma mansoni*, while 23 (11.7 %) of the age group of 9–12, and 25 (12.8 %) of the age group of 13–17, were infected with, *Schistosoma haematobium*.

Figure 1 shows the prevalence of schistosomiasis infection in relation to age groups of the schoolchildren, which, 32.1 % of the infected children were in the age group of 9–12, while 28.1 % of the infected children, were in the age group of 13–17.



Prevalence of schistosomiasis infection based on schools location, ranged from 11.9%–36.4%.



**Figure 1.** Prevalence of schistosomiasis infection in relation to age group of the sample n= 196

The highest prevalence of the infection (36.4%), were in Al-Rogom area schools as and a rural location, while the lowest prevalence (11.9%), were in Al-Mahweet city schools as an urban location (Table 2).

**Table 2.**

Prevalence of schistosomiasis based on school location.

Location	No. examined	No. infected	% infected
<b>Urban:</b>			
Al-Mahweet city	49	14	11.9
<b>Rural:</b>			
Shebam-Kaokab	48	28	23.7
Alrogom	49	43	36.4
Altawela	50	33	28.0
Total	196	118	100%

**Risk factors associated with schistosomiasis infection**

Table 3 shows that, the risk factors of (place of residence, fathers' education and sanitary facilities), were significantly associated with schistosomiasis infection ( $p > 0.05$ ).

**Table 3.**

Risk factors associated with schistosomiasis infection.

Risk factors	Infected (%)	Not infected (%)	Total	X <sup>2</sup>	p-value
<b>Place of residence:</b>					
Al-Mahweet City	14 (11.9)	35 (44.9)	49	38.204	0.001
Shebam-Kaokaban	28 (23.7)	20 (25.6)	48		
Al-Rogom	43 (36.4)	6 (7.7)	49		
Al-Tawela	33 (28.0)	17 (21.8)	50		
Total	118 (100)	78 (100)	196		
<b>Fathers' education:</b>					
Illiterate	16 (13.6)	6 (7.7)	22	14.028	0.007
Literate	34 (28.8)	12 (15.4)	46		
Primary school	21 (17.8)	11 (14.1)	32		
Secondary	24 (20.3)	16 (20.5)	40		
University	23 (19.5)	33 (42.3)	56		
Total	118 (100)	78 (100)	196		
<b>Presence of electric power:</b>					
Yes	83 (70.3)	60 (76.9)	143	1.290	0.166
No	35 (29.7)	18 (23.1)	53		
Total	118 (100)	78 (100)	196		
<b>Source of water:</b>					
Pond	4 (3.4)	7 (9)	11	2.523	0.471
Dams	9 (7.6)	5 (6.4)	14		
Stream	72 (61)	38 (48.7)	110		
Well	33 (28)	28 (35.9)	61		
Total	118 (100)	78 (100)	196		
<b>Sanitary facilities:</b>					
Sewage system	15 (12.7)	28 (35.9)	43	25.929	0.001
Closed pit	26 (22)	27 (34.6)	53		
Open pit	52 (44.1)	14 (18)	66		
Others	25 (21.2)	9 (11.5)	34		
Total	118 (100)	78 (100)	196		
<b>Pre schistosomiasis treatment:</b>					
Yes	93 (78.8)	54 (69.2)	147	2.045	0.153
No	25 (21.2)	24 (30.8)	49		
Total	118 (100)	78 (100)	196		

While, risk factors of (presence of electric power, source of water and pre

schistosomiasis treatment), were not significantly associated with the infection



( $p > 0.05$ ).

The present study is aimed to assess the prevalence and associated risk factors of schistosomiasis infection in school children of Al-Mahweet governorate.

Overall prevalence of schistosomiasis infection was 30.1 %.

This result is similar to findings of previous study conducted in Yemen, indicated that the overall, 31.8 % of the test persons were found to be positive for schistosomiasis.

However, it is higher than other studies in Yemen [SADY, *et al.*, 2013].

Study conducted in Al-Mahweet town and rural areas, reported that prevalence rates of schistosomiasis were 27 % [RAJA'A, *et al.*, 2001].

Other study conducted in Taiz Governorate, Yemen, reported that the overall, 24.8 % of test persons were indicated to be positive for schistosomiasis [ABDULRAB, *et al.*, 2013].

Another study conducted in Sahar district, Sa'dah governorate, Yemen, for estimated prevalence rates of schistosomiasis among third-year schoolchildren after 4 schistosomiasis control campaigns, reported that the total average prevalence of schistosomiasis infection was low (3.4 %) [RAJA'A and MUBARAK, 2006].

This could be due to effects of the deworming programs.

However, it is lower than the prevalence rate reported by study conducted in the Assahul valley of lbb governorates in Yemen, reported that the overall schistosomiasis infection rate of 37 % [RAJA'A, *et al.*, 2000].

The observed infection prevalence variation in this study from other localities might be due the difference in water contact behavior of the schoolchildren, environmental sanitation and socioeconomic status, ecological distribution of snails, local endemicity and sample size.

Overall prevalence of *Schistosoma mansoni* infection was 35.7 %.

This result is similar to the findings of previous study conducted in the Assahul valley of lbb governorates in

Yemen, reported that the overall *Schistosoma mansoni* prevalence was 35 % [RAJA'A, *et al.*, 2000].

However, it is higher than to the findings of previous studies from different part of Yemen.

Study conducted in Al-Mahweet town and rural areas, reported that the prevalence rates of *Schistosoma mansoni* were 22 % [RAJA'A, *et al.*, 2001].

Other study conducted in Yemen, reported that the overall, 9.3 % were infected with *Schistosoma mansoni* [SADY, *et al.*, 2013].

Another study conducted in Taiz Governorate, Yemen, reported that the *Schistosoma mansoni* prevalence in the study population was 31 % [ABDULRAB, *et al.*, 2013]. Study conducted in Sahar district, Sa'dah governorate, Yemen, for estimated prevalence rates of Schistosomiasis among third-year schoolchildren after 4 Schistosomiasis control campaigns, reported that the prevalence of *Schistosoma mansoni* infection was 2.3 % [RAJA'A and MUBARAK, 2006].

Also it is higher than to the findings of previous studies from different countries.

Study conducted in Northern Ethiopia, reported that the overall prevalence of *Schistosoma mansoni* in the schoolchildren was 23.9 % [ASSEFA, *et al.*, 2013].

Other study conducted in Southern Ethiopia, reported that the prevalence of *Schistosoma mansoni* was 12 % [MITIKU, *et al.*, 2010].

Study conducted in Kaduna State, Nigeria, reported that the overall prevalence of *Schistosoma mansoni* was (20.3 %) of the study population were positive [ALHASSAN, *et al.*, 2013].

However, it is lower than the prevalence rate reported in North Western Tanzania reported that the prevalence of *Schistosoma mansoni* was 64.3 % [MAZIGO, *et al.*, 2010].

Other study conducted in southern Ethiopia, by Terefe and collab. reported that the overall infection rates of *Schistosoma mansoni* was 73.7 % [TEREFE, *et al.*, 2011].



Overall prevalence of *Schistosoma haematobium* infection was 24.5 %. This result is similar to the findings of previous study conducted in Yemen, reported that the overall, 23.8 % were infected with *Schistosoma haematobium* [SADY, et al., 2013].

However, it is higher than the prevalence rate reported by the study conducted in Al-Mahweet town and rural areas, Yemen, reported that the prevalence rates of *Schistosoma haematobium* were 7 % [RAJA'A, et al., 2001].

Other study conducted in Taiz Governorate, Yemen, reported that the prevalence of *Schistosoma haematobium* was 18.6 % [ABDULRAB et al., 2013].

Another study conducted in Sahar district, Sa'dah governorate, Yemen, for estimated prevalence rates of Schistosomiasis among third-year schoolchildren after 4 Schistosomiasis control campaigns, reported that the prevalence of *Schistosoma haematobium* infection was low (5.6 %–3.3 %) [RAJA'A and MUBARAK, 2006].

Also it is higher than the prevalence rate reported by the studies conducted in different countries.

Study conducted in Nasarawa State, Nigeria, reported that (16.3 %) of the urine samples collected were positive for *Schistosoma haematobium* [REUBEN, et al., 2013].

Study conducted in Maiduguri, reported that the overall incidence of *Schistosoma haematobium* was (14.5 %) [JOSEPH, et al., 2010].

However, it is lower than the prevalence rate reported by the studies conducted in different countries.

Study conducted in Ghana, by Tetteh-Quarcoo, and collab., reported that the Prevalence of *Schistosoma haematobium* infection was 30.7 % [TETTEH-QUARCOO, et al., 2013].

Other study conducted in South Africa, reported that the Prevalence of *Schistosoma haematobium* infection was 73.2 % [MEENTS and BOYLES, 2010].

Another study conducted in northern Nigeria, reported that the Prevalence of *Schistosoma haematobium* infection was 41.6 % of the urine sampled examined [SARKINFADA, et al., 2009].

This study results also showed that, the highest prevalence of schistosomiasis infection (32.1 %) was in children with ages ranging from 9–12 years followed by those with ages ranging from 13–17 years (28.1 %).

This finding is in agreement with reports by study conducted in the Assahul valley of Ibb governorates in Yemen, reported that the highest prevalence of schistosomiasis infection (37 %) was in children with ages ranging from 9–13 years [RAJA'A, et al., 2000].

However, this study finding is in disagreement with reports of many investigators in different localities of Yemen.

Study conducted in Al-Mahweet town and rural areas, reported that the highest prevalence of schistosomiasis infection (37 %) was in children with ages ranging from 14–18 years followed by those with ages ranging from 9–13 years (30 %) [RAJA'A, et al., 2001].

Other study conducted in Yemen, reported that prevalence of schistosomiasis was meaningfully higher among children aged >10 years assimilated to those aged < 10 years [SADY, et al., 2013].

Also it is disagreement with reports of studies conducted in different countries.

Study conducted in Northern Ethiopia, reported that the highest (31.2 %) prevalence of schistosomiasis was recorded in children with ages ranging from 10–14 years followed by those aged 5–9 (11.4 %) and 15–19 (9.8 %) years [ASSEFA, et al., 2013].

This might be due to higher rate of water contact among those children with ages ranging from 9–12 years, while the least infection in the age groups 13–17 years might due to low outdoor water contact activities and the development of age-acquired immunity to re-infection.

In relation with gender this study results showed that the infected males were (26.3 %) while the infected females were (3.8 %).

The high rate of infected male might due to the fact that male is more in



contact with water through swimming activities than female.

This study finding is in agreement with reports of many investigators in different localities of Yemen.

Study conducted in Al-Mahweet town and rural areas, reported that the infected males were (33 %) while the infected females were (9 %) [RAJA'A, *et al.*, 2001].

Other study conducted in the Assahul valley of Ibb governorates in Yemen, reported that the infected males were (43 %) while the infected females were (9 %) [RAJA'A, *et al.*, 2000].

Also it is in agreement with reports of studies conducted in different countries.

Study conducted in Northern Ethiopia, reported that the higher prevalence was detected in male children (30.71 %) than in females (14.12 %) [ASSEFA, *et al.*, 2013]. However it is in disagreement with reports of studies conducted in different countries.

Study conducted in Lagos State, Nigeria, reported that the frequency of infection was higher among the female pupils (61 %) compared to the male counterpart (39 %) [OLUWASOGO and FAGBEMI, 2013; BARBAT, *et al.*, 2013; BUTU *et al.*, 2015].

Other study conducted in Southwest Nigeria, reported that no statistically significant difference in infection between male (48.6 %) and female pupils (47.6 %) [BABATUNDE, *et al.*, 2013].

This study findings showed that was no significantly associated with schistosomiasis infected and previous history of schistosomiasis treatment ( $P$ -value= 0.153).

Children who were treated before were at higher risk of infection (78.8 %), than those who were not treated (21.2 %).

This might due to the treatment by ineffective drugs could not reduce the output of eggs in the infected individuals.

Also might due to the intervention implementing with chemotherapy only, neglecting the other components of the comprehensive control program.

In relation to the education status of children's fathers, this study finding showed that the relation between

schistosomiasis infection and the children's fathers education status was significantly associated ( $P$ = 0.007).

This finding agrees with study conducted in Yemen, reported that the children fathers education status was significantly associated with schistosomiasis infected ( $P$ = 0.008) [SADY, *et al.*, 2013; RODINO *et al.*, 2014].

However, this study finding is in disagreement with reports of many investigators in different localities of Yemen.

Study conducted in Al-Mahweet town and rural areas, reported that the relation between the prevalence of schistosomiasis and children fathers education status had no significantly associated [RAJA'A, *et al.*, 2001].

Other study conducted in the Assahul valley of Ibb governorates in Yemen, reported that the relation between the prevalence of schistosomiasis and children fathers education status had no significantly associated ( $P$ = 0.146) [RAJA'A, *et al.*, 2000].

In relation to source of water supply for household use, this study results showed that the highest prevalence rate schistosomiasis infection was recorded among the students who using streams as their main source of water (61 %).

There was no significant relationship ( $P$ = 0.471) between schistosomiasis infection and sources of water supply.

Therefore, the recorded cases of infection among students using these sources of water supply may be as a result of contamination of these water sources with cercariae.

This explain that the incidence of schistosomiasis infection in pupils was higher in Al-Rogom schools (36.4 %), due to spread of streams in this location more than other locations.

This study results also showed that the students from the urban area of Al-Mahweet governorate had a lower prevalence of schistosomiasis infection (11.9 %), as compared to students from Al-Mahweet governorate rural area, which the average of infection rate was (29.4 %).



This finding is in agreement with previous study conducted in Al-Mahweet town and rural areas, reported that the prevalence of schistosomiasis from the urban area were, lower than (16 %) the prevalence of schistosomiasis from the rural area were (39 %) [RAJA'A, *et al.*, 2001].

The high of the schistosomiasis infection in the rural areas of Al-Mahweet governorate are attributed to ignorance, poor living condition, inadequate sanitation, water contact activity with snail infected streams and ponds.

Also, parents' occupation of most of the Al-Mahweet governorate rural area students are farming.

Therefore, the students actively engaged in these activities which expose them to schistosomiasis which serves as a major risk factor for schistosomiasis infection.

### Conclusions

There is a relatively high prevalence of schistosomiasis infection among primary school students in Al-Mahweet governorate.

It is therefore indispensable that a comprehensive epidemiological survey of schistosomiasis in Al-Mahweet governorate, Yemen at large in order to further identify high risk communities for successful design and implementation of control programme.

The problems of lack of portable water supply in Al-Mahweet governorate and its environs put the children at high risk of exposure to schistosomiasis.

There is need for start intervention by local government and concerned organizations to step up measures in improving water supplies in these areas.

Massive screening to identify the infected individuals and treat them in order to reduce transmission of the infection is imperative.

Health education programmes on the associated risk factors and the dangers posed by the disease need to be carried out.

Besides periodic drug distribution, a comprehensive intervention strategy should be designed and be implemented to reduce schistosomiasis prevalence.

### References

1. AbdElRahman, M.; AbuGedeiri, Y.B.; AbdElRahim, A.E.; Magzoub, M.; ElSharief, O.AO; Musa, S.E., Prevalence of Intestinal Schistosomiasis in New Halfa scheme, *Eastern Sudan. Khartoum Medical Journal*, **2010**, 3(2), p. 448–451.
2. Abdulrab, A.; Salem, A.; Algobati, F.; Saleh, S.; Shibani, K.; Albutighi, R., Effect of School Based Treatment on the Prevalence of Schistosomiasis in Endemic Area in Yemen, *Iranian Journal of Parasitol*, **2013**, 8(2), p. 219–226.
3. Alhassan, A.; Luka, S.A.; Balarabe, M.L.; Kogi, E., Prevalence and Selected Risk Factors of Intestinal Schistosomiasis among Primary School Children in Birnin-Gwari Local Government Area, Kaduna State, Nigeria, *International Journal of Applied Biological Research (IJABR)*, **2013**, 5(1), p. 72–81.
4. Al-Shamiri, A.H.; Al-Taj, M.A.; Ahmed, A.S., Prevalence and co-infections of Schistosomiasis/hepatitis B and C viruses among school children in an endemic areas in Taiz, Yemen, *Asian Pacific Journal of Tropical Medicine*, **2011**, p. 404–408. doi:10.1016/S1995–7645(11)60113–2.
5. Anto, F.; Asoala, V.; Adjuik, M.; Anyorigiya, T.; Oduro, A.; Akazili, J.; Akweongo, P.; Ayivor, P.; Bimi, L.; Hodgson, A., Water Contact Activities and Prevalence of Schistosomiasis Infection among School-age Children in Communities along an Irrigation Scheme in Rural Northern Ghana, *Journal of Bacteriol & Parasitol*, **2013**, 4(4), p. 1–6.
6. Assefa, A.; Dejenie, T.; Tomass, Z., Infection prevalence of *Schistosoma mansoni* and associated risk factors among schoolchildren in suburbs of Mekelle city, Tigray, Northern Ethiopia, *Momona Ethiopian Journal of Science (MEJS)*, **2013**, 5(1), p. 174–188.
7. Babatunde, T.A.; Asaolu, S.O.; Sowemimo, O.A., Urinary Schistosomiasis among pre-school and school aged children in two peri-urban communities in Southwest Nigeria, *Journal of Parasitology and Vector Biology*, **2013**, 5(7), p. 96–101.





8. Barakat, R.; El Morshedy, H.; Farghaly, A., Human Schistosomiasis in the Middle East and North Africa Region, M.A. McDowell and S. Rafati (eds.), Neglected Tropical Diseases—Middle East and North Africa, *Neglected Tropical Diseases*, **2014**. DOI 10.1007/978-3-7091-1613-5\_2, ©Springer-Verlag Wien.
9. Barbat, C.; Rodino, S.; Petrache, P.; Butu, M.; Butnariu, M. Microencapsulation of the allelochemical compounds and study of their release from different products. *Digest Journal of Nanomaterials and Biostructures*, **2013**, 8 (3), p: 945–953.
10. Bolaji, O.S.; Adeyeba, O.A.; Ojurongbe, O.; Ukaga, C.N.; Ojo, J.A., Epidemiological Studies on Urinary Schistosomiasis in Osun State, Nigeria, *International Journal for Pharmaceutical Research Scholars (IJPRS)*, **2014**, 3(1–1), p. 655–662.
11. Butnariu, M.; Caunii, A. Design management of functional foods for quality of life improvement. *Annals of agricultural and environmental medicine*, **2013**, 20(4), p. 736–741.
12. Butu, A.; Rodino, S.; Golea, D.; Butu, M.; Butnariu, M.; Negoescu, C; Dinu-Pirvu, C.E. Liposomal nanodelivery system for proteasome inhibitor anticancer drug bortezomib, *Farmacia*. **2015**, 63(2), p. 224–229.
13. Cheesbrough, M., District laboratory practice in Tropical Countries, part 2, second edition, Cambridge University Press, **2006**.
14. Gosellen, O.; Anegebe, D.; Imandehg, N.; Dakuld, A.; Onwuliria, C.F.; Abba, O.J.; Udeh O.E.; Abelau A.M., *Schistosoma mansoni* Infections Amongst School Children in Jos, Nigeria, *Science World Journal*, **2010**, 5(1), p. 42–45.
15. Grimes, J.E.T.; Croll, D.; Harrison, W.E.; Utzinger, J.; Freeman, M.C.; Templeton, M.R., The Relationship between Water, Sanitation and Schistosomiasis: A *Systematic Review and Meta-analysis*, *Journal of PLOS Neglected Tropical Diseases*, **2014**, 8(12), p. 1–12.
16. Haile, S.; Golassa, L.; Mekonnen, Z., Prevalence of *Schistosoma mansoni* and effectiveness of Praziquantel in school children in Finchaa valley, Ethiopia, *Journal of Parasitology and Vector Biology*, **2012**, 4(3), p. 25–30.
17. Ihuoma, A.J.; Jude, A., Prevalence of Urinary Schistosomiasis in Ozuitem, Bende Local Government area of Abia State, Nigeria, *Animal Research International*, **2004**, 1(2), p. 77–80.
18. Joseph, M.B.; Gaji, B.; Muhammad, T.; Baba M.M.; Thilza, I.B., Incidence of Schistosomiasis in Primary School Pupils with Particular Reference to *S. haematobium* in Maiduguri, *Journal of Researcher*, **2010**, 2(3), p. 31–36.
19. Katz, N.; Chaves, A.; Pellegrino, J., A simple device for quantitative stool thicksmear technique in *Schistosomiasis mansoni*, *Revista do Instituto de Medicina Tropical de São Paulo*, **1972**, 14(6), p. 397–400.
20. Mazigo, H.D.; Waihenya, R.; Mkoji, G.M.; Zinga M.; Ambrose E.E.; Jahanpour, O.F.; Bahemana, E.; Mnyone, L.L.; Kweka, E.Y.A.J.; Lwambo, N.J.S., Intestinal Schistosomiasis: prevalence, Knowledge, Attitude and Practices Among School Children in an Endemic Area of North Western Tanzania, *Journal of Rural and Tropical Public Health*, **2010**, 9, p. 53–60.
21. Meents, E.F.; Boyles, T.H., *Schistosoma haematobium* prevalence in school children in the rural Eastern Cape Province, South Africa, *The Southern African journal of epidemiology & infection*, **2010**, 25(4), p. 28–29.
22. Mitiku, H.; Legesse, M.; Teklemariam, Z.; Erko, B., Transmission of *Schistosoma mansoni* in Tikur Wuha area, Southern Ethiopia, *Ethiopian Journal of Health Development*, **2010**, 24(3), p. 180–184.
23. Nworie, O.; Nya, O.; Anyim, C.; Okoli, C.S.; Okonkwo, E.C., Prevalence of Urinary Schistosomiasis among Primary School Children in Afikpo North Local Government Area of Ebonyi State, *Annals of Biological Research*, **2012**, 3(8), p. 3894–3897.
24. Oluwasogo, O.A.; Fagbemi, O.B., Prevalence and risk factors of *Schistosoma haematobium* infections among primary school children in Igbokuta Village, Ikorodu North Local Government, Lagos State, *IOSR Journal of Nursing and Health Science (IOSR-JNHS)*, **2013**, 2(6), p. 62–68.
25. Raja'a, Y.A.; Assiragi, H.M.; Abu Luhom, A.A.; Mohammed, A.B.S.; Albahr, M.H.; Ashaddadi, M.A.; Al Muflihi,



- AR.N., *Schistosomes* infection rate in relation to environmental factors in school children, *Saudi Medical Journal*, **2000**, 21(7), p. 635–638.
26. Raja'a, Y.A.; Mubarak, J.S., Intestinal parasitosis and nutritional status in schoolchildren of Sahar district, Yemen, *Eastern Mediterranean Health Journal*, **2006**, 12(2), p.189–194.
27. Raja'a, Y.A.; Sulaiman, S.M.; Mubarak, J.S.; El-Bakri, M.M.; Al-Adimi, W.H.; El-Nabihi, M.T.; El-Dhobri, M.A.; Raja'a, J.A., Some aspects in the control of schistosomosis and soil-transmitted helminthosis in Yemeni children, *Saudi Medical Journal*, **2001**, 22(5), p. 428–432.
28. Reuben, R.C.; Tanimu, H.; Musa, J.A., Epidemiology of Urinary Schistosomiasis Among Secondary School Students in Lafia, Nasarawa State, Nigeria, *Journal of Biology, Agriculture and Healthcare*, **2013**, 3(2), p. 73–82.
29. Rodino, S.; Butu, M.; Negoescu, C.; Caunii, A.; Cristina, R.T.; Butnariu M. Spectrophotometric method for quantitative determination of nystatin antifungal agent in pharmaceutical formulations. *Digest Journal of Nanomaterials and Biostructures*, **2014**, 9 (3), p. 1215–1222.
30. Sady, H.; Al-Mekhlafi, H.M.; Mahdy, M.A.K.; Lim Y.A.L.; Mahmud, R.; Surin, J., Prevalence and Associated Factors of Schistosomiasis among Children in Yemen: Implications for an Effective Control Programme, *Journal of PLOS Neglected Tropical Diseases*, **2013**, 7(8), p. 1–10.
31. Sarkinfada, F.; Oyebanji, A.A.; Sadiq, I. Ab.; Ilyasu, Z., Urinary schistosomiasis in the Danjarima community in Kano, Nigeria, *Journal of infection in developing countries*, **2009**, 3(6), p. 452–457.
32. Terefe, A.; Shimelis, T.; Mengistu, M.; Hailu, A.; Erko, B., *Schistosomiasis mansoni* and soil-transmitted helminthiasis in Bushulo village, southern Ethiopia, *Ethiopian Journal of Health Development*, **2011**, 25(1), p. 46–50.
33. Tetteh-Quarcoop, P.B.; Attah, S.K.; Donkor, E.S.; Nyako, M., Urinary Schistosomiasis in Children—Still a Concern in Part of the Ghanaian Capital City, *Open Journal of Medical Microbiology*, **2013**, 3(3), p. 151–158.
34. WHO, Basic Laboratory Methods in Medical Parasitology, *Organization World Health Organization, Geneva*. **1991**.
35. Yusuf, A.ISA.; Modu, A.M.; Naphtali, R.S.A., Study on Schistosomiasis in Three Communities along Lake Alau, Konduga Local Government Area, Borno State, Nigeria, *The International Journal Of Science & Technoledge*, **2015**, 3(2), p. 73–79.

Received: March 3, 2016

Article in Press: April 23, 2016

Accepted: Last modified on: May 20, 2016

