Contents lists available at ScienceDirect

Asian Pacific Journal of Tropical Medicine

journal homepage:www.elsevier.com/locate/apjtm

Document heading doi:

Prevalence and co-infections of schistosomiasis/hepatitis B and C viruses among school children in an endemic areas in Taiz, Yemen

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ARTICLE INFO

Article history:
Received 14 January 2011
Received in revised form 27 February 2011
Accepted 15 March 2011
Available online 20 May 2011

Keywords:
Schistosomosis
Intensity
Hepatitis B and C virus
School children
Yemen

ABSTRACT

Objective: To determine the disease prevalence and its relationship with hepatitis B and C viruses among school children in five endemic areas by schistosomiasis. **Methods:** During June 2007 and March 2009, 1 484 school children aged between 5 – 16 years participated in the current study from 32 basic schools in five districts (Al-Dhabab, Hedran, Warazan, Al-Barh and Al-Shmaytin) in Taiz Governorate, Republic of Yemen. Out of school children who participated in the study; 1 406 stool samples, 1 484 urine samples and 214 blood samples were collected and examined. **Results:** *Schistosoma mansoni (S. mansoni)* was found in all the studied areas except Al-Barh. However, *Schistosoma haematobium (S. haematobium)* was recorded only in Al-Shmaytin and Al-Barh. Both *S. mansoni* and *S. haematobium* were observed in Al-Shmaytin district. The overall prevalence was 20.76% for *S. mansoni* and 7.41% for *S. haematobium*. The prevalence rate of infection among males was higher than females, shwing no significant differences. Rate of light, moderate and heavy infections in the case of *S. mansoni* were 41.78%, 25.34% and 32.87% respectively. Whereas, for *S. hematobium* it was 50.90% for light infection and 49.09% for heavy infection. Regarding to the prevalence of viral hepatitis among infected school children with schistosomiasis, it could be noticed that hepatitis B virus was higher than the prevalence of hepatitis C virus. But, the presence of HBsAg and anti-HCV was not associated with *Schistosoma* infection. **Conclusions:** Schistosomiasis infection is an important public health problem in Taiz Governorate, Republic of Yemen. There was a correlation between *S. haematobium* and hepatitis B, but no association between *S. mansoni* infections and hepatitis B and C viruses.

1. Introduction

Schistosomiasis remains one of the most important parasitic diseases in the tropics and subtropics regions, and constitutes a major public health problem [1,2]. Schistosomiasis is endemic in Yemen, with 2-3 million people infected [3]. It is the second most prevalent tropical disease after malaria and is one of the most important public health problems in Yemen [4]. Both urinary and intestinal schistosomiasis are known to be endemic in Yemen. Environmental factors and the expansion of agricultural facilities, with the associated improvement in irrigation systems and construction of dams, have generated the optimal environment for the fresh-water snails, *Biomphalaria arabica* and *B. truncates*, which are the intermediate hosts for *Schistosoma haematobium* (*S. haematobium*) and *Schistosoma mansoni*(*S. mansoni*), respectively [2]. The study on the intermediate hosts of schistosomes in Taiz Governorate was recorded two snail species namely *Bulinus beccarii* and *Biomphalaria pfeifferi* [5]. The transmission of schistosomiasis takes place only in the place where fresh water snail vector is present and where there is contact between the population and infested water. Children who practice swimming are particularly at high risk, because of their prolonged and complete body exposure. These endemic areas are often characterized by low socioeconomic conditions and poor sanitary facilities, erroneous habits of the people as regards urination and defecation in canal water, and the exposure to this polluted water by bathing, swimming, washing utensils and clothes, walking bare-foot during irrigation in agriculture or fishing[6].

The two diseases schistosomiasis and viral hepatitis are often associated in developing countries and both lead to chronic liver inflammation [7]. A lack of association between *S. mansoni* and *S. haematobium* infection and hepatitis B

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has also been reported in Egypt. Hepatitis C virus (HCV) has been implicated in some studies as a factor influencing the severity of schistosomiasis [8,9].

The aim of this study is to determine the prevalence of intestinal and urinary schistosomiasis among school children in water-contact areas and attempt to determine the incidence of hepatitis B and C viruses among infected children with schistosomiasis.

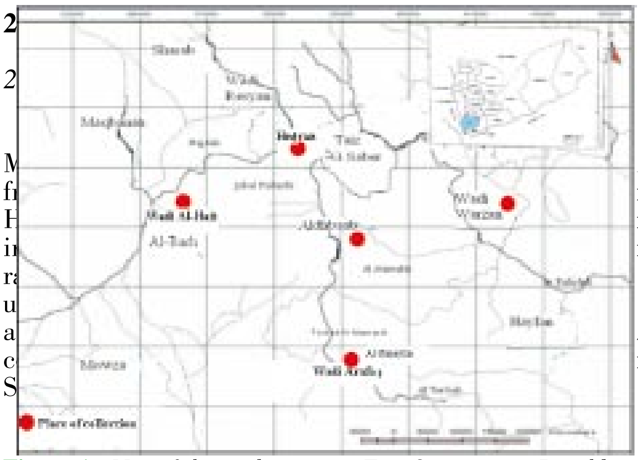

Figure 1. Map of the study areas in Taiz Governorate, Republic of Yemen

2. Materials and methods

2.1. Study area and population

The study was carried out at the period of July 2007 to March 2009, in five endemic areas which chosen randomly from different regions at Taiz Governorate (Al-Dhabab, Hedran, Warazan, Al-Barh and Al-Shmaytin), as shown in Figure 1. These are agricultural areas, depending on rain, streams and groundwater for irrigation and domestic use. A total of 245-400 school children aged between 5 and 16 years in each ecologically homogenous area was considered adequate to evaluate prevalence and intensity of Schistosoma infection in a disease-endemic area.

2.2. Samples collection and examination

Out of 1 484 school children who participated in the study; 1 406 stool samples, 1 484 urine samples and 214 blood samples were collected and examined. Stool, urine and blood samples were collected from each child for examination. Personal and behavioural information from each child were collected in the questionnaire forms. Information collected includes age, sex, water source and attitude towards water contact patterns. Each child was given two clean, dry screw-capped containers carrying the same identification numbers and were instructed on when and how to collect the samples.

One stool sample of each child was evaluated by the Kato-Katz technique. Two Kato-Katz thick smears were prepared for each stool sample. Individual egg output of *S. mansoni* was expressed as eggs per gram (e.p.g.) of faeces (arithmetic mean of all eggs counts multiplied by 24) [10]. Three infection categories were considered: light 1-99 e.p.g.), moderate (100-399 e.p.g.) and heavy (⩾400 e.p.g.) [11]. For urine examination, 10 mL of each urine sample were filtered for *S. haematobium* eggs applying Millipore filtration technique. The filters were placed on a microscope slide, a drop of Lugol's iodine was added and the slides were examined under a microscope. The number of *S. haematobium* eggs per slide were counted and recorded for each individual separately. Infections were categorized as light (1- 49 eggs/10 mL urine) or heavy (⩾50 eggs/10 mL urine) [12,13]. Each child with schistosomiasis was treated with single oral dose of Praziquantel (40 mg/ kg) according to body weight.

Serology for hepatitis B and C markers was performed on subjects-based random sample of 214 school children of endemic areas for schistosomiasis (with and without schistosomiasis). HBV surface antigen (HBsAg) and HCV antibody determination in human serum were tested.

2.3. Statistical analysis

The data were statistically analyzed using SPSS software program version 15.0. *Chi*-squared test was used for the analytic assessment. The differences were considered to be significant when the *P*-value obtained was less than 0.05.

3. Results

The total number of school children selected for this study was 1 484 of both sexes; 1 406 stool samples and 1 484 urine samples were collected and examined. Exception Al-Barh district, *S. mansoni* was recorded at all studied districts, with prevalence rate of infection ranging from 20.90% (at Warazan area) to 28.82% (at Hedran area), while S. haematobium was recorded at Al-Barh and Al-Shmaytin areas, with the prevalence rate of 19.45% and 8.51%, respectively (Table 1).

Out of the 1406 stool samples examined, 292 were positive for *S. mansoni* infection, with the overall prevalence rate of 20.76%. Although the prevalence rate of infection in males was higher (21.91%) than in females (18.00%), but this difference was statistically not significant (χ^2=2.695, P>0.05), (Table 2). With exception of the 5-7 age group, the rate of infection was higher in males than females, among all age groups (Table 2). This table showed that the prevalence rate of *S. mansoni* infection was increased towards the age increasing of children, but there was no statistically significant correlation (χ^2=6.047, P>0.05).

Table 2 showed the prevalence of urinary schistosomiasis among 1 484 school children examined. *S. haematobium* eggs were identified in 110 urine samples (7.41%). The prevalence of infection in males (7.94%) was slightly higher than in females (6.25%). However, this difference was not statistically significant (χ^2=1.329, P>0.05). Though, the prevalence rate of infection was significantly high between male and female in the age group of 5-7 (χ^2=10.553, P<0.001) and 11-13 (χ^2=8.519, P<0.01) (Table 2).

Regarding the prevalence of infection with *S. haematobium* among school children examined in different age groups, it was observed that the incidence of infection varied from one age group to another, but there were no statistical differences (Table 2).

According to the Kato-Katz technique, a Kato-Katz thick smear was prepared for each sample to determine the intensity of infection for *S. mansoni*, expressed as eggs per gram of stool (e.pg). Table 3 showed the intensity of *S. mansoni* infection in four studied areas. Out of 292 infected children, 122 (41.78%) of the students presented with light infections, 74 (25.34%) moderate infections and 96 (32.87%) were heavily infected. On the other hand, *S. haematobium* infection was detected in Al-Bbarh and Al-Shmaytin districts only. Out of 110 infected children with *S. haematobium*, there were 56 (50.90%) with light intensity infection and 54 (49.09%) with heavy intensity (Table 4).

In attempt to determine the relationship between schistosomiasis and hepatitis B and C viruses, 214 (12.27%) serum samples were examined. The distribution of hepatitis B among noninfected school children with *S. mansoni* was higher (10.42%) than the infected school children (4.40%).This difference was statistically, not significant (χ^2=2.445, P>0.05), (Table 5). This table demonstrated that the prevalence of HBsAg among school children with urinary schistosomiasis was higher (17.14%) compared to

Table 1

Prevalence of infection with *Schistosoma mansoni* and *S. haematobium* among school children examined in the 5 districts in Taiz Governorate, Yemen.

District	Stool		Urine	
	No. examined	*S. mansoni* (*n*, %)	No. examined	*S. haematobium* (*n* %)
Al-Dhabab	330	78(23.63)	192	0(0.00)
Hedran	340	98(28.82)	322	0(0.00)
Warazam	244	51(20.90)	193	0(0.00)
Al-Barh	215	0(0.00)	401	78(19.45)
Al-Shmaytin	277	65(23.46)	376	32(8.51)
Total	1 406	292(20.76)	1484	110(7.41)

Table 2

Prevalence of *S. mansoni* and *S. haematobium* infection among School Children examined, according to age and sex, in Taiz Governorate, Yemen.

Age group (years)	*S. mansoni*					*S. haematobiam*				
	Male	Female	Total	χ^2	*P*-Value	Male	Female	Total	χ^2	*P*-Value
5-7	13.43(18/134)	19.31(17/88)	15.78(35/222)	1.385	0.239	1.84(3/163)	11.36(10/88)	5.18(13/251)	10.553	<0.001
8-10	22.0(88/400)	16.58(33/199)	20.20(121/599)	2.419	0.119	9.29(38/409)	7.31(16/219)	8.59(54/628)	6.715	0.398
11-13	23.71(97/409)	20.00(23/115)	22.90(120/524)	6.702	0.402	8.25(33/400)	1.36(2/147)	6.39(35/547)	8.519	<0.01
14-16	28.84(15/52)	11.11(1/9)	26.23(16/61)	1.247	0.264	14.58(7/48)	10(1/10)	13.79(8/58)	0.146	0.702
Total	21.91(218/995)	18.00(74/411)	20.76(292/1 406)	2.695	0.101	7.94(81/1020)	6.25(29/464)	7.41(110/1484)	1.329	0.249
X^2	7.872	0.975	6.047			12.267	10.582	7.372		
P-value	<0.05	0.807	0.109			<0.05	<0.05	0.061		

Table 3

Intensity of *S. mansoni* infection, according to district.

District	Positive cases	Intensity (eggs per gram of faeces)					
		Light (1-99 eggs /1 g)		Moderate(100-399 eggs /1 gm)		Heavy(>400 eggs /1 gm)	
Al-Dhabab	78	28	35.89	22	28.20	28	35.89
Hedran	98	42	42.85	24	24.48	32	32.65
Al-Shmaytin	65	24	36.92	18	27.69	23	35.38
Warazan	51	28	54.90	10	19.60	13	25.49
Total	292	122	41.78	74	25.34	96	32.87

Table 4

Intensity of *S. haematobium* infection, according to district.

District	Positive cases	Intensity (eggs per 10 mL urine)			
		Light(1-49 eggs / 10 mL)	Heavy(≥50 eggs / 10 mL)	Light(1-49 eggs / 10 mL)	Heavy(≥50 eggs / 10 mL)
Al-Barh	78	41	51.94	37	48.05
Al-Shmaytin	32	15	45.16	17	54.83
Total	110	56	50.90	54	49.09

Table 5

The relationship between HBsAg & HCV status and *Schistosoma* infection in selected school children in Taiz Governorate, Yemen.

Schistosoma	infection	HCV				HbsAg			
		HBsAg-ve	HbsAg+ve	χ^2	*P* value	HCV-ve	HCV+ve	χ^2	*P* value
S. mansome	-ve(*n*=96)	98.95(95/96)	1.04(1/96)	0.001	0.970	89.58(86/96)	10.42(10/96)	2.445	0.118
	+ve(*n*=91)	98.90(90/91)	1.10%(1/91)			95.60(87/91)	4.40(4/91)		
S. haematobium	-ve(*n*=125)	98.40(123/125)	1.60(2/125)	0.353	0.552	94.40(118/125)	5.60(7/125)	6.798	<0.01
	+ve(*n*=70)	97.14(68/70)	2.86(2/70)			82.85(58/70)	17.14(12/70)		

that of in noninfected school children (5.60%), with high significant difference (χ^2=6.798, P< 0.01).

Table 5 showed the prevalence of hepatitis C among infected and noninfected school children with schistosomiasis, there was no association between Schistosoma infections and hepatitis C virus. In relation to district, there was a significant difference between the prevalence of hepatitis B and schistosomiasis infections (χ^2=11.379, P<0.05), with high prevalence in Al-Barh district (22.22%), (Table 6).

Table 6
The relation between schistosomiasis infection and hepatitis B and C viruses according to district (*n*, %).

istrict	No. examined	HBsAg positive	HCV positive
Al-Dhabab	22	0(0.00)	0(0.00)
Hedran	13	2(13.38)	0(0.00)
Shmaytin	61	3(4.91)	1(2.00)
Al-Barh	45	10(22.22)	2(4.44)
χ^2		11.379	1.991
P- value		<0.050	0.574

4. Discussion

In the current study, the overall prevalence rate of schistosomiasis infection among school children aged 5 to 16 years was 20.76% and 7.41% for *S. mansoni* and *S. haematobium*, respectively. Although the presence of schistosomiasis in Yemen has been well documented, few epidemiological studies have been carried out. Our results show that the prevalence rate of *S. mansoni* infection was ranged from 20.90% (at Warazan area) to 28.82% (at Hedran area), while the prevalence rate of *S. haematobium* infection was higher in Al-Barh area (19.45%) than Al-Shmaytin area (8.51%). The higher Schistosomes infection rate of prevalence reaching 37% among school children in Assahul valley of Ibb Governorate and 27% among children in Al-Mahweet Governorate [14,15]. The low rate of infection in this study may be attributed to the schistosomiasis control campaigns in the previous years in the area. The campaigns comprised health education, case finding and treatment in school children and mollusciciding. In Assahul valley of Ibb Governorate, the *S. mansoni* prevalence was recorded in 35% and *S. haematobium* in 5% [14]. A higher prevalence of urinary schistosomiasis (21.4%) was recorded among school children in Abyan and Taiz Governorates[16]. Whereas, a lower prevalence (3.3% and 2.3%) was observed in Sahar district, Sa'dah Governorate for *S. haematobium* and *S. mansoni*, respectively [17].

The present study showed that *S. mansoni* was more prevalent than *S. haematobium* which is similar to the findings of other authors [14]. This may be attributed to that the distribution of Biomphelaria snails (the intermediate host for *S. mansoni*) is more than the distribution of Bulinus snails (the intermediate host for *S. haematobium*).

The close figures of infection in males and females indicating to the similar water contact behaviour in both sexes. Higher prevalence and intensity of *S. haematobium* infection in boys has been seen in other countries such as Tanzania and Nigeria [18-19]. Whereas, in Madiduguri the incidence was 15.0% and high within the group 12-15 years old [20]. On the other hand, the results of this study were in disagreement with other results that showed in Ghana that the prevalence of schistosomiasis was higher among the female children (64%) than their male counterparts (21.8%) [21].

Infection intensity was influenced by exposure and susceptibility [10]. Host exposure varies with the duration and type of water contact. Individual and host susceptibility depends on whether the individual was predisposed to become infected because of immunological or genetic factors. There are other factors which also should be considered, such as host nutritional status and the possible presence of concurrent infections both of which might affect the host's susceptibility [19]. Accordingly, the higher prevalence in this study and intensity of infection in males must therefore be due to males being more exposed, more susceptible to infection or some combination of these two factors.

The current study shows that the prevalence of hepatitis B and C among infected school children with *S. haematobium* was higher in Al-Barh than Al-Shmaytin district .There was a significant difference between the prevalence of hepatitis B and schistosomiasis infections according to districts, with high prevalence in Al-Barh area (22.22%).

In hospital-based studies, the carrier rate of HBV in patients with hepatosplenic schistosomiasis was higher than in the controls, whereas in field-based studies an association between these organisms was not found [9,22]. In this field-based study, neither the presence of HBsAg nor the presence of anti-HCV antibodies was associated with *S. mansoni* infection status or intensity of *S. mansoni* egg excretion. Studies that addressed the association/interaction of *S. mansoni* with HBV/HCV infections are varied and at times conflicting. In elsewhere, other results were failed to find such a correlation between *S. mansoni* infection and both HCV and hepatitis B virus [23]. In Egyptian patients, found no association between *S. mansoni* and hepatitis C virus infection. The results of a large-scale community-based study in Ethiopia revealed that neither *S. mansoni* infection nor intensity of egg excretion was associated with markers of HBV or HCV infection[22]. Some studies from Egypt have reported higher prevalence of HBsAg among subjects with schistosomiasis and schistosomal periportal fibrosis and subjects with co-infection had increased risk of hepatocellular carcinoma [8]. Furthermore, subjects with co-infection had significantly more advanced liver disease and exhibited higher titers of HCV RNA [24].

On the other hand, other studies reported no association of HBV/HCV infection with either *S. mansoni* infection or with periportal fibrosis [25]. In addition, the high frequencies of HCV infections observed among Egyptian subjects with a history of schistosomiasis were largely considered to be related to possible iatrogenic transmissions that may have resulted from the use of poorly sterilized equipment during parenteral anti-schistosomal treatment campaigns [27,28]. A similar phenomenon has been observed in Japan where intravenous treatment for schistosomiasis has also facilitated the spread of HCV infection [29]. The authors recommended more work is needed to find the relationship between schistosomiasis and hepatitis viral infection. Snail control by using suitable methods and the water sources should be treated.

There was high prevalence of schistosomiasis in the school children, both, in males and females. There was a correlation between *S. haematobium* and hepatitis B, and no association between the hepatitis of B and C viruses and *Schistosoma* infection.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgements

The authors acknowledge the staff members of Applied Microbiology Department, Faculty of Applied Science, Taiz University and schistosomiasis control programme in Taiz Governorate for their invaluable help. Thanks are extended to the headmasters and teachers of all schools visited for their great help. The authors declare that they have no grant foundation for the manuscript.

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