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RESEARCH ARTICLE

URINARY SCHISTOSOMIASIS AMONG SCHOOL-AGE CHILDREN IN SELECTED RURAL COMMUNITIES IN HADHRAMOUT GOVERNORATE, YEMEN

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Abstract

Background: Urinary schistosomiasis is a potentially life-threatening public health issue in some areas of Yemen, particularly in Hadhramout rural communities. It is considered as one of the most common neglected tropical parasitic diseases. This study aimed to investigate the prevalence of urinary schistosomiasis and associated risk factors among school-age males and females in selected rural communities of Hadhramout, Yemen.
Methods: A total of 450 students participated in this cross-sectional study. Urine samples were collected, then examined for haematuria and *Schistosoma haematobium* (*S. haematobium*) eggs using urine dipsticks and filtration technique respectively. To assess knowledge and practices regarding the transmission of urinary schistosomiasis, a pre-tested questionnaire was employed.
Results: An overall (66)14.7% of participants tested positive for *S. haematobium*, and of those, 54 (12.0%) developed haematuria with a statistically significant difference (p=0.001). A total of 35(53.0% eggs/10 ml urine) had heavy intensity of infection, with a significant difference (p=0.001) between the different communities visited: high in Al-Dhulaya'a (18.2 eggs/10 ml urine) and low in Yabaith (6.1 eggs/10 ml urine). *S. haematobium* infection showed significantly higher (p=0.002) in males (13.8%) than females (0.9%), and increased with age of participants. Multivariate logistic analysis of risk factors were significantly associated with the prevalence of urinary schistosomiasis such as swimming activities (p=0.016), washing clothes (p=0.14), time spent in infested areas more than 15 minutes (p=0.012), habits of defecation/urination in open water sources (p=0.44), self-reported symptoms suggestive of the disease (p=0.03), participants with a history of illness (p=0.014), lack of awareness of schistosomiasis (p=0.050), and no prior treatment with praziquantel (p=0.001).
Conclusions: Urinary schistosomiasis remains highly prevalent among schoolchildren in rural communities in Hadhramout. The study highlights the urgent need to implement preventive measures, safe drinking water supply, proper sanitation, and vector control programs in order to reduce transmission and morbidity caused by schistosomiasis.
Keywords: Intensity, prevalence, risk factors, rural communities, *Schistosoma haematobium*, school children, urinary schistosomiasis.

INTRODUCTION

Schistosomiasis is one of the two most prevalent parasite illnesses in the world, and has been documented to spread into 78 countries[1]. Schistosomiasis and helminth-related illnesses afflict an estimated 2 billion people globally[2]. Seven hundred million people worldwide live-in endemic areas[3]. A trematode parasite is the causative agent can infect an individual in contact with contaminated freshwater; snails serve as intermediary hosts. The trematode enters the human body through unbroken skin during its second larval stage. The larvae travel across multiple tissue layers as they move through developmental phases. As adults, the worms unite into couples and while living in different parts of the abdominal cavity's veins, start to lay eggs. These locations seem to be specific for each schistosome

species. *Schistosoma haematobium* (*S. haematobium*), *S. japonicum*, and *S. mansoni* are the three primary Schistosoma species that infect the human being[4].

In the instance of *S. haematobium*, the eggs pass through the urinary tract's mucosal layers to end up in the urine, where they may contaminate water sources and carry on the parasite's life cycle. Eggs are central in the pathogenesis and diagnosis. A worm-pair is estimated to persist for two to five years if untreated, though they may live longer[5]. School-age children are typically the ones with high rates of both prevalence and intensity of *S. haematobium* infection, which increases the morbidity and mortality rate of those individuals affected. Most *S. haematobium* infections are asymptomatic; therefore, those living in rural areas where poverty and inadequate sanitation seldom visit healthcare facilities, only after complications have developed[6].

Yemen is reported to have an epidemic region for both urinary and intestinal schistosomiasis (*S. haematobium* and *S. mansoni*), two of the trematode Schistosoma species that are known to infect humans[7]. Nonetheless, schistosomiasis is endemic in Yemen and is focally dispersed throughout the nation, with some villages having a prevalence of 23.8%[8]. Although earlier studies reported the endemicity of schistosomiasis in Yemen, there is a limit of new records on the endemicity of schistosomiasis in many parts of the country especially in the rural area.

In Hadhramout coast, agriculture in rural areas mostly depends on rainfall stored in water tanks, subterranean wells and streams for irrigation and residential use. The widespread use of surface conventional irrigation systems, which cover sizable agricultural areas, facilitates the breeding of snails. In the studied areas, population of snails belonging to several genera were found in various water sources. People continuously in direct contact with warer for playing and swimming in the water pools during the day or washing utensils, clean their clothes, and motorcycles and cars. Therefore, in our knowledge, this is the first study aimed to investigate and screening the epidemiological prevalence of urinary schistosomiasis and the associated risk factors among school aged pupils in selected rural communities of Hadhramout Governorate.

MATERIALS AND METHODS

Study design

A cross-sectional study was carried out in four rural areas endemic for urinary schistosomiasis in Hadhramout coast, Yemen. Data were collected whithin one year from November 2022 to October 2023 to investigate the infection among students of primary and secondary schools.

Study area

This study was conducted in some rural communities at Hadhramout coast region: Ar Raydah Wa Qusayar directorate, Al-Dhalayah directorate, Yabaath directorate and Daw'an directorate. Hadhramout represents 36% of whole area of Yemen, 74030 Km² with a population of 1.611.000, located in the south-eastern of Yemen (Figure 1).

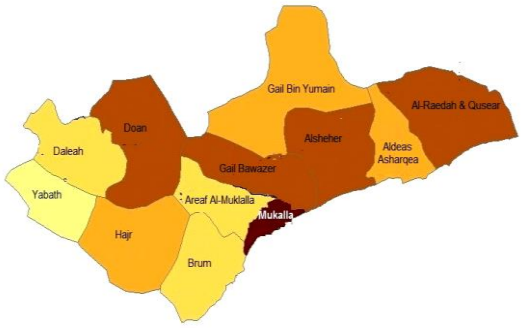

Figure 1: Geographic map of Hadhramout coast regions.

Study population

The study focused on school aged pupils of primary and secondary schools of the four rural communities at Hadhramout coast of different age groups and both males and females were involved.

Study inclusion and exclusion criteria

The study included children between the ages of 7 and 24 who were present on the day of data collection and whose parents were given a written informed consent for their participation.

Children who had taken praziquantel, an anti-schistosoma medication before or during the study's data collection were excluded.

Sample size

Non-probability, simple random sampling (convenience sampling) was used, so that maximal participation ensured, with 450 participants.

Pre-survey procedures

During a pre-survey visit to the rural communities in the study region, leaders of the directorate's health office, heads of the directorate, managers of primary schools, and teachers who helped organizing the participants were all consulted and discussed.

The students and their parents were recruited and the purpose and implication of the research was explained. Research ethical approval was taken from the Ethical Research Committee at the faculty of medicine and health sciences University of Aden. A brief questionnaire was distributed to parents and students and with the help of research assistant explained the way to answer the questions.

Samples collection

Urine samples were collected from each student, between 10 am and 2 pm when maximum eggs excretion occurs into 100 mL clean containers with wide mouth and screwcap[9], then examined for the presence of *S. haematobium* eggs by filtration method[10]. To determine the worm burden, egg counts were taken and recorded as eggs per ml. of urine for each positive sample and the intensity of infections was graded as heavy, moderate or light according to the criteria proposed by the WHO[11]. For quality control, the consistency of the microscopic readings was verified according to WHO guidelines. A discrepancy of up to 10% for egg counts was taken as normal, but if the discrepancy was larger, the reasons were identified and corrected.

Data analysis

Statistical Package for Social Sciences (SPSS) version 20 (SPSS Inc, Chicago, IL, USA) was used for data analysis. The association between different variables and outcome of *Schistosoma* infection was calculated and compared using Pearson Chi-square ($\chi 2$) test. Binary and multiple regression tests (crude odds ratio/adjusted odds ratio) was used to detect independent predictors of *Schistosomiasis.* The level of statistical significance was set at p-value < 0.05.

RESULTS

General characteristics of study population

In this study, 450 volunteers between the ages of 7 and 19 years old; 341(77.6%) were males and 109 (22.4%) females. The general characteristics of the participants and their parentsare shown in (Table 1).

Table 1: General characteristics of participants (N= 450).

Characteristics	No. (%)
Age groups (Years)	
7-11	172 (38.2)
11-15	233 (51.8)
15-19	45 (10.0)
Sex	
Male	341 (75.8)
Female	109 (24.2)
Residency	
Al Raydah Wa Qusay`ir	200 (44.4)
Doa'an	150 (33.3)
Al-Dhulaya'a	50 (11.1)
Yabaith	50 (11.1)
Educational level of fathers	
Illiterate	90 (20)
Primary	239 (53.1)
Secondary	84 (18.7)
University	37 (8.2)
Educational level of mother	
Illiterate	214 (47.6)
Primary	229 (50.9)
Secondary	4 (0.9)
University	3(0.7)
Father's occupation	
Government employees	70 (15.6)
Farmer	118 (26.2)
Trader	89 (19.8)
Others	173 (38.4)
Mother's occupation	
Housewife	450 (100)
Household size (Persons)	
3 – 5	226 (50.2)
5 – 9	154 (34.2)
More than 9	70 (15.6)
Monthly income (YER)	
Less than 50000	44 (9.8)
50000-100000	329 (73.1)
100000-150000	51 (11.3)
More than 150000	26 (5.8)
Health status	
Pipe water supply	294 (65.3)
Presence of toilet in house	364 (80.9)

YER, Yemen Rial; (US$1=YER 1400)

Overall, more than half of the fathers had primary education and about 26.2% of them were farmers while 15.6% were government employee. On the other hand, almost half the mothers 47.6% had no formal education and were not working (housewives). Moreover, more than half 73.1% of the families had low household monthly income (YER 50,000-100,000). Most of the houses had piped water supply and toilet 65.3%, 80.9% respectively.

Prevalence and distribution of urinary schistosomiasis

The overall prevalence of urinary schistosomiasis was 14.7%, and low intensity of infection was 47.0 eggs/10 ml of urine. With regards to theintensity of infections, 53.0% of *S. haematobium* infection was heavy intensities. The eggs load was high in Al-Dhulaya'a and Al Raydah Wa Qusay`ir 18.2% and 16.7% respectively, and low in Yabaith 6.1%. The prevalence of urinary schistosomiasis wassignificant (χ^2=39.151; p=0.001), while the intensity was insignificant (χ^2= 0.149; p=0.985) as presented in (Table 2).

Risk factors associated with urinary schistosomiasis

Results of univariate and multivariate analysis for the association of urinary schistosomiasis with demographic, socioeconomic, environmental and behavioral risk factors are shown in (Tables 3).Urinary schistosomiasis was substantially more common in participants aged 11-15 years and 15-19 years with statistically significant prevalence (OR=3.015; 95%CI=1.542-5.897) and (OR=3.441; 95% CI=1.344-8.814), (p=0.001 and 0.010) respectively. Similarly, the prevalence of urinary schistosomiasis was significantly higher among male participants when compared to females (OR=5.239; 95%CI=1.857-14.777; p=0.002), and those from families with low household size 3-5 persons and 5-9 persons (OR=4.519; 95%CI=1.351-15.119; p=0.014) and (OR=4.000; 95%CI=1.161-13.776; p=0.028).

Moreover, participants were seen swimming in the open water sources (OR=2.929; 95%CI=1.224-7.010; p=0.016), those who washing clothes in water sources (OR=0.489; 95%CI=0.299-0.873; p=0.014) had higher prevalence of urinary schistosomiasis. Furthermore, the results showed that the prevalence of infection was significantly higher among participants had duration activities more than 15 minutes in water (OR=4.600; 95%CI=1.4031-5.078; p=0.012), and those had habits of defecation/urination in open water sources (OR=1.763; 95% CI=1.014-3.064; p=0.044).

Interestingly, such variable regarding self-reported symptoms suggestive of the disease (OR=0.601; 95%CI=0.219-0.725; p=0.003), those participants with past disease history (OR=4.519; 95%CI=1.351-15.119; p=0.014), those without treatment praziquantel drug (OR=2.758; 95%CI=1.499-5.076; p=0.001), and unawareness of infection (OR=2.124; 95%CI=0.977-4.618; p=0.050) had significantly higher prevalence of urinary schistosomiasis. Moreover, it was found haematuria (OR=24.400; 95% CI=12.396-48.030; p=0.001), showed strong significant association with higher prevalence of urinary schistosomiasis. The multivariate logistic regression analysis retains two risk factors that were statistically significant with urinary schistosomiasis (Table 4). The likelihood that a participants would have urinary schistosomiasis

increased by 3.015 times (95% CI=1.060-8.575; *p*=0.039) when they swimmer in open water sources. Comparing male individuals to female participants, the odds of contracting urinary schistosomiasis were considerably greater (AOR=7.670; 95% CI=1.486-39.589; *p*=0.015).

DISCUSSION

The present study reported that the prevalence rate of urinary schistosomiasis among school aged pupils in rural communities of Hadhramout coast was 14.7%. This low prevalence is consistent with other previous studies carried out in Yemen 7.41%[7], 23.8%[8], and 27%[13], and other studies carried out in Zimbabwe 8.5%[14], Angola 30.2%[15], Sudan 3.8%[16], and 3.7%[17], Eswatini 16%[18], Tanzania 6.9%[19], and Gambia 10.2%[20]. A higher prevalence of schistosomiasis 58.9% was reported among in Amran province/Yemen[21]. Other studies showed high prevalence of urinary schistosomiasis in Nigeria 37.7%[22] and 67.3%[23], South Africa 37.5%[24], Ethiopia 31.6%[25], and 34.2%[26], Ghana 52.9%[27], Cameroon 37.0%[28], Mozambique 38.4%[29], Mali 51.2%[30], and Angola 47.3%[31]. This variation of prevalence rates between countries is due to the socioeconomic status and the local environmental conditions of the communities where the schools are located may be responsible for these variations. In addition, the different degrees of exposures of the children to infested places of water might also have accounted for the variation in prevalence, and the inhabitants of these communities depend on natural bodies of water such as streams, and ponds for their daily domestic chores. It is plausible that these water sources may have been infected with schistosome parasites, therefore serving as actual source of infection[32].

The high frequency of urinary schistosomiasis in this study could be explained by the study areas' high levels of water contact, especially in Al Raydah Wa Qusay`ir and Al-Dhulaya'a directorates. In all four communities, children were often found playing, swimming, washing their cloths, utensils, livestock and sheep, cars and motorcycle, and doing other domestic activities in the streams and ponds. Additionally, since schistosomiasis is a water-based disease and frequent contact with freshwater can result in high infection rates and ongoing re-infection, the majority of people, especially those living in rural areas, rely on untreated water from natural water sources for their daily needs may lead to high infection rates and constant re-infection.

The findings of the current study showed that almost *S. haematobium* infection was of heavy intensity 53.0% eggs/10 ml of urine when compared to similar studies 14.9% eggs/10 ml[33,34], 49.09 eggs/10 ml[7], 20.3% eggs/10 ml urine[15], and 37.1 eggs/10 ml[19]. This percentage of heavy infections is alarmingly high especially considering the fact that clinical manifestations of infection are associated with the intensity of infection. But lower than reported in other studies 149 eggs/10 ml urine[35], 127.9 eggs/10 ml of urine[36,37]. Many factors, including variations in season transmission and types of water contact, frequency of water contact, and density of infected snail in the water sources, particularly during the hot hours of the day, could be the cause of this variation in infection intensity[38]. Also, this high rate of egg excretion might be due to the age group studied because children from 7 to 25 years old are the most important egg shedders[38,39].

In this study, the infected children hadinfection of *S. haematobium*, with Al Raydah Wa Qusay`ir and Al-Dhulaya'a provinces having the highest prevalence 4.9% followed by Doa'an province 3.3%, whereas the prevalence was lower in Yabaith 1.6%. So, the prevalence and severity of illness differed greatly between communities, with Yabaith province having the lowest prevalence. This is consistent with prior observations in Yemen's governorates of Taiz, Ibb, Dhamar, Sana'a, and Hodiedah[7,8], and is most likely related to changes in disease transmission force[37,40].

It is well known surveillance and control measures were either intermittent or discontinued in Hadhramout's rural epidemic areas. As a result, schistosomiasis is expected to spread more widely. The epidemic areas of the Hadhramout coast are experiencing serious water depletion, forcing people to rely on open water sources such as streams, unprotected pools, and tanks to obtain drinking and domestic water. Furthermore, the government has built hundreds of dams for agricultural irrigation and groundwater recharge across the country. The present study showed that school children aged 11-15 years had a higher risk of contracting urinary schistosomiasis than other groups. This is in agreement with previous reports[41-44]. This could be explained by children excessive mobility at this age, which increases their exposure to contaminated water when they play, swim, fetch water for the home, or assist with agricultural tasks[8]. Similar to other studies, the prevalence of schistosomiasis is high among children in age group 11-15 years.

Table 2: Prevalence and intensity of urinary schistosomiasis in the selected study communities.

Locations	Examined No.	Infected No.(%)	Intensity of urinary schistosomiasis (ep10 ml)*	
			Parasite load less than 50 eggs per 10 ml of urine (%)	Parasite load more than 50 eggs per 10 ml of urine (%)
Overall	450	66 (14.7)	31 (47.0)	35 (53.0)
Al Raydah Wa Qusay`ir	200	22 (4.9)	11 (16.7)	11 (16.7)
Doa'an	150	15 (3.3)	7 (10.6)	8 (12.1)
Al-Dhulaya'a	50	22 (4.9)	10 (15.2)	12 (18.2)
Yabaith	50	7 (1.6)	3 (4.5)	4 (6.1)
χ^2=39.151; *p*-value=0.001*			χ^2=0.149; *p*-value=0.985	

*Significant association (*p*-value < 0.05) *According to WHO (2002). Ep 10 ml, Number of eggs per 10 ml of urine

Table 3: Univariate analysis of epidemiological factors for urinary schistosomiasis in the study area.

Variable	No. Examined	No. Positive (%)	No. Negative (%)	Odd ratio	CI (95%)	*p*-value
Gender						
Male	341	62 (13.8)	279 (62.0)	5.239	1.857-14.777	0.002*
Female	109	4 (0.9)	105 (23.3)	1	1	
Age groups (Years)						
7 - 11	172	16 (3.6)	156 (34.7)	1	1	
11 - 15	233	39 (8.7)	194(43.1)	3.015	1.542-5.897	0.001*
15 – 19	45	11 (2.4)	34 (7.6)	3.441	1.344-8.814	0.010*
Father's occupation						
Farmer	118	15 (3.3)	103 (22.9)	0.199	0.162-3.971	0.786
Trader	89	10 (2.2)	79 (17.6)	0.304	0.135-3.603	0.666
Government worker	70	6 (1.3)	64 (14.2)	0.484	0.092-2.889	0.451
Others	173	35 (7.8)	138 (30.7)	1.440	0.304-6.818	0.645
Mother's occupation						
Housewife	450	66 (14.7)	384 (85.3)	1	1	
Household size (Persons)						
3 – 5	226	39 (8.7)	187 (41.7)	4.519	1.351-15.119	0.014*
5 – 9	154	24 (5.4)	130 (29.0)	4.000	1.161-13.776	0.028*
More than 9	70	3 (0.7)	65 (14.5)	1	1	
Monthly income (YER)						
Less than 50000	44	7 (1.6)	37 (8.2)	1.703	0.185-15.651	0.638
50000-100000	329	50 (11.1)	279 (62.0)	1.613	0.200-13.011	0.654
100000-150000	51	6 (1.3)	45 (10.0)	1.200	0.128-11.212	0.873
More than 150000	26	3 (0.7)	23 (5.1)	1.286	0.068-24.382	0.867
Farming						
Yes	164	27 (6.0)	137 (30.4)	1.248	0.732-2.127	0.415
No	286	39 (8.7)	247 (54.9)	1	1	
Swimming						
Yes	357	60 (13.3)	297 (66.0)	2.929	1.224-7.010	0.016*
No	93	6 (1.3)	87 (19.3)	1	1	
Washing clothes						
Yes	234	25 (5.6)	209 (46.4)	0.489	0.299-0.873	0.014*
No	216	41 (9.1)	175 (38.9)	1	1	
Frequency of water contact						
Daily	127	23 (5.1)	104 (23.1)	0.06	0.433-2.039	0.875
Weekly	222	31 (6.9)	191 (42.4)	0.31	0.331-1.438	0.322
Monthly	63	12 (2.7)	51 (11.3)	1	1	
Annual	38	0 (0)	38 (8.4)	1.00	0.000	0.998
Duration of activities						
More than 15 min	378	63 (14.0)	315 (7.0)	4.600	1.4031-5.078	0.012*
Less than 15 min	72	3 (14.7)	384 (85.3)	1	1	
Presence of latrines in the house						
Yes	445	65 (14.4)	380 (84.4)	1	1	
No	5	1 (0.2)	4 (0.9)	1.462	0.161-13.284	0.736
Presence of latrines in the school						
Yes	364	58 (12.9)	306 (68.0)	1	1	
No	86	8 (1.8)	78 (17.3)	0.459	0.248-1.180	0.123
Habits of defecation/urination in open water sources						
Yes	118	24 (5.3)	94 (20.9)	1.763	1.014-3.064	0.044*
No	332	42 (9.3)	290 (64.4)	1	1	
Self-reported symptoms suggestive of the disease						
Yes	187	16 (3.6)	171 (38.0)	0.601	0.219-0.725	0.003*
No	263	50 (11.1)	213 (47.3)	1	1	
Past disease history						
Yes	226	39 (8.7)	187 (41.7)	4.519	1.351-15.119	0.014*
No	154	24 (5.4)	130 (29.0)	1	1	
Awareness of infection						
Yes	95	8 (1.8)	87 (19.3)	1	1	
No	355	58 (12.9)	297 (66.0)	2.124	0.977-4.618	0.050*
Previous treatment with praziquantel						
Yes	187	15 (3.3)	172 (38.2)	1	1	
No	263	51 (11.3)	212 (47.1)	2.758	1.499-5.076	0.001*
Haematuria						
Yes	54	36 (8.0)	18 (4.0)	24.400	12.396-48.030	0.001*
No	396	30 (6.7)	366 (81.3)	1	1	

*Significant association (*p*-value < 0.05); CI, Confidence interval

Table 4: Multivariate analysis of epidemiological factors of urinary schistosomiasis among the infected participants.

Variables	Urinary schistosomiasis		
	Adjusted OR	95% CI	*p*-value
Gender (Male)	7.670	1.486-39.589	0.015*
Age group (11-15 years)	2.630	0.757-9.138	0.128
Age group (15-19 years)	7.694	0.670-88.367	0.101
Swimming	3.015	1.060-8.575	0.039*
Habits of defecation/urination in open water sources	1.837	0.596-5.662	0.289
Past disease history	50205968.76	0.000	0.999
Previous treatment with praziquantel	182241524.5	0.000	0.999
Haematuria	1048609224	0.000	1.00

*Significant association (*p*-value < 0.05); OR, Odds ratio. CI, Confidence interval

Low exposure may be the reason of the variation in the pattern of infection across persons of different age groups[44]. Findings of this study revealed that males had higher prevalence of urinary schistosomiasis 13.8% than the females 0.9% with statistically significant difference (p=0.002). However, we found that Al Raydah Wa Qusay`ir and Al-Dhulaya'a directorates had significantly higher intensity of urinary schistosomiasis than Doa'an and Yabaith. This may be related to male's propensity and routine water-related activities, such as swimming, bathing, playing, fishing, and irrigation farming. Because males stay longer in these bodies of water harboring cercariae, they are more likely to become infected with Schistosoma[45].

The higher prevalence reported in males in the study area was consistent with the previous reports showed males more infected than females[46,47,48]. However, the present finding contrasted with the previous reports[49,50,51] who reported higher prevalence of urinary schistosomiasis in females than males. They attributed their findings to variations in water contact activities among the residents of the different study areas where the females are more engaged in domestic activities[52].

The present study is the first to provide information about the predictor and risk factors associated with urinary schistosomiasis in Hadhramout coast. It is commonly known that urinary schistosomiasis and water contact are related. The current study found that swimming, clothes washing, duration of water activities more than 15 minutes, and habits of urination in open water sources were identified as significant risk factors for urinary schistosomiasis. Similar findings have been reported in previous studies among rural children and adolescents in different countries[35,43]. Pools, dams, streams, and water storage facilities could offer snails ideal breeding grounds and hence facilitate the ongoing spread of urinary schistosomiasis in these communities.

Washing/swimming, fishing, and frequent contact with freshwater sources (rivers, streams) are the main risk factors for *S. haematobium* infection. For socioeconomic factors, primary education of fathers was significantly associated with the infection. Other study showed 12-14 years age group had significantly associated with *S. haematobium* infection[53]. Swimming in rivers or playing in water was, however, a common practice among the children; this was also a commonly reported practice in previous studies[18,54-56].

Only 54(12.0%) of the 66 patients in this study who had *S. haematobium* eggs in their urine reported having haematuria. This highlights the value of routine schistosomiasis screening as an alternative to waiting for the symptoms in children. Comparable results were recorded in Zimbabwe[14] and Sudan[57]. As an alternative, it's possible that individuals in the chronic stages still had haematuria, that there was a considerable decrease in egg elimination in the urine, and even it may not be present at this stage[18].

This is because, in endemic communities, haematuria is a defining sign of urinary schistosomiasis, and its incidence has a positive correlation with the infection[58]. Previous studies found presence of blood in urine to correlate with presence of *S. haematobium* eggs, and it has been demonstrated as a good indicator of *S. haematobium* infection[20,58-60].

Limitations of the study

In the current study, a microscopic examination was done using a single urine filtration collected on a single day urineper individual, which might reduce the sensitivity of detecting light infection and result in lower all-over prevalence. Although some of the risk and environmental factors are considered here, we could not be able to collect intermediate hosts.

CONCLUSIONS

This study reveals that urinary schistosomiasis is still highly prevalent among school children in Hadhramout rural communities. These findings support the urgent need to implement preventive measures; safe drinking water supplies, proper sanitation, and vector control programs are imperative among these communities in order to reduce transmission and morbidity caused by *S. haematobium*.

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AUTHOR'S CONTRIBUTIONS

Bayousuf FF: writing original draft, methodology, and investigation. **Bin-Hameed EA:** conceptualized the study, interpreted the data, and approved the final manuscript. **Assakaf GM:** edited and reviewed the

manuscript. **Al-Bowri SS:** conceptualization and formal analysis. All authors revised the article and approved the final version.

DATA AVAILABILITY

The data will be available to anyone upon request from the corresponding author.

CONFLICT OF INTEREST

None to declare.

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