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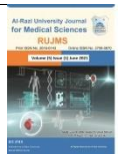

Hepatitis A Virus and *Helicobacter pylori* among Schoolchildren at Sana'a -Yemen: Seroprevalence and Risk Factors

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Abstract:

Background: Hepatitis A virus (HAV) and *Helicobacter pylori* (*H. pylori*) are very common diseases, especially in developing countries and both have a similar route of transmission and epidemiology. In Yemen, data is not available about these types of infections. **Aims:** Therefore, the current study aimed to assess the seroprevalence and risk factors of HAV and *H. pylori* infections among schoolchildren in Sana'a city, Yemen. A cross-sectional study was conducted from August to October 2022 among one hundred and eighty-seven (187) schoolchildren in Sana'a city- Yemen. A designed questionnaire was used to gather the required data. Also, the blood specimens were screened for HVA and *H. pylori* antibodies using a qualitative rapid test by cassette technique, and positive results were confirmed by ELISA technique. **Result:** Out of 187 studies screened, the seropositivity rate of HAV and *H. pylori* were 5(2.7%) and 23(12.3%), respectively. The higher rate of seroprevalence of HAV and *H. pylori* infections were detected among male students at 5.2% and 12.4%, respectively, in age groups of 5-8 and 9-12 years, respectively, and parents hold primary and secondary certificates (27.6%) and *H. pylori* (14.4%), respectively. Also, the seroprevalence of HAV and *H. pylori* was higher observed among students who drank untreated water, rarely bought foods from mobile vendors, sometimes ate foods outside of the home, didn't have contact with flooding water, didn't have a history of hepatitis A and no one of their family infected by hepatitis A, had a history of a blood transfusion, and non-vaccinated and vaccinated study subjects, respectively. The positive results were confirmed by ELISA and revealed that the seropositivity rate of anti-HAV-IgM was 4.17% and anti-*H. pylori*-IgG (8.7%) and anti-*H. pylori*-IgM (100%). **Conclusion:** The high seroprevalence of these infections is a serious and life-threatening health condition in the community. Therefore, major efforts are still necessary to avoid both morbidity and mortality of susceptible individuals.

Keywords: ELISA, *H. pylori*, Hepatitis A (HAV), Schoolchildren, Seroprevalence, Sana'a, Yemen.

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Introduction

Helicobacter pylori (*H. pylori*) is frequently a pathogen prevalent all over the world and infects more than half of the population (50%) in both developed and developing countries. More than 80% of those infected with *H. pylori* are asymptomatic [1]. Signs and symptoms associated with *H. pylori* disease are primarily due to peptic ulcer illness and duodenal inflammation. Also, vomiting, nausea, and abdominal pain are other symptoms that may be attributed to other gastrointestinal diseases [2]. Additionally, the persistent infection among pregnant women by *H. pylori* results in decreasing blood platelet count, iron deficiency anemia, fetal malformation, and fetal growth retardation [3].

H. pylori infection is primarily acquired in childhood or adolescence that maybe result from outdoor activities and exposure to potential external sources [4]. Seroepidemiologic reports have documented that more than 90% and 50% of adults in developing and developed countries, respectively, are positive for serum antibodies against *H. pylori* [5].

The hepatitis A virus (HAV) has an extensive global distribution and is a common infectious etiology of acute hepatitis among children worldwide. It is responsible for up to 75% of all cases of viral hepatitis in the world. Symptoms of hepatitis A include a sudden onset of fever, nausea, vomiting, fatigue, malaise, poor appetite, abdominal pain, dark urine, and jaundice. Symptomatic illness is directly related to age; while children < 6 years of age are usually asymptomatic, older children and adults are likely to have a symptomatic illness and present with acute hepatic damage and jaundice [6,7].

Since transmission of *H. pylori* occurred by the fecal-oral route feco-oral and oral-oral routes and HAV is known to be a sensitive marker of feco-oral exposure, HAV infection could be associated with an increased risk of *H. pylori* acquisition. The association between these infections requires further investigation. Undeniably, similar age-specific frequency curves for *H. pylori* and HAV have been documented, suggesting a shared feco-oral transmission common for *H. pylori* and HAV [8].

Up to the present time, all reports of this association have been based on comparisons of seroprevalence. However, differences in immunological responses between *H. pylori* and HAV infections impact the interpretation of seropositivity. HAV antibodies are believed to persist indefinitely. Thus, HAV IgG seropositivity reflects prior exposure to infections, and someone who is seronegative has most likely never been infected. In contrast, the natural immune response to *H. pylori* infection does not confer lasting immunity. Thus *H. pylori* seropositivity may reflect a current or cleared infection, while seronegativity does not rule out prior infection. While HAV serostatus accurately measures lifetime exposure to the infection, *H. pylori* serostatus does not [9].

Yemen is one of the developing countries that are highly exposed to transmitting these types of infectious diseases as a result of the use of unsafe water, poor sanitary conditions, overcrowding conditions, inadequate personal hygienic practices, and low socioeconomic conditions [10-15].

Up to date, the previous studies carried out in Yemen were focused on the prevalence of *H. pylori* infections among schoolchildren and some studies also focused on determining the prevalence of the hepatitis A virus [16, 17,18]. Therefore, the present project aimed to determine the seroprevalence of HAV and *H. pylori* infections and risk factors among schoolchildren in Sana'a city, Yemen.

Materials and Methods

Study area and period

A cross-sectional study was conducted among primary school students in Sana'a city- Yemen during the period from August to October 2022.

Sample size

A total of one hundred and eighty-seven (187) blood specimens were randomly collected from asymptomatic students aged between 5-15 years who attended primary schools.

Data collection

A designed questionnaire was used to collect the required data such as gender, age, father's educational status, family size, source of drinking water, food buying habits at mobile vendors, eating food out of home, contact with flooding water, history of hepatitis A, hepatitis A cases in the family, infected previously by *H. pylori*, one of your family infected by *H. pylori,* hospitalizations, surgery, blood transfusion, and hepatitis A vaccinated. Also, clinical signs and symptoms such as yellowness of eyes, fever, weakness, headache, abdominal pain, heartburn,

regurgitation, heartburn, and regurgitation were obtained through face-face interviews. The questionnaire was constructed in Arabic and translated into English. The students voluntarily participated in this study. The age group was divided into a group that included; children (5-8 years), (9-12 years), and (13-15 years).

Inclusion and exclusion criteria

The students who/whose attending primary school signed informed consent and delivered blood specimens were included. In contrast, the students who refused to fill out the questionnaire and sign the informed consent were excluded.

Specimens collection and processing

About three mL of blood specimens were collected from each student under an aseptic condition by venipuncture and transferred into a tube containing anticoagulant. Samples were immediately transmitted to the serology laboratory at Al-Razi university where they were processed. Each specimen was centrifuged by centrifuge at 3500 rpm for 5 minutes. The plasma was transferred by micropipette to an Eppendorf tube and stored until serological examination.

Serological assay

Hepatitis A test

About 5 uL of prepared plasma was transferred to buffer solution (2 mL) and mixed well. Then, approximately 100 uL of the prepared solution was transferred by micropipette to the wells of the test kit to detect anti-HAV-IgM by using the rapid test of HEALGEN Cassette (Healgen Scientific Limited, USA). The test was conducted after between 10-15 minutes. The positive results for HAV detection were confirmed using an enzyme-linked immunosorbent assay (ELISA) (Cobas e 411 analyzer, Roche Diagnostics GmbH) using a commercially available kit for anti-HAV antibody (Cobas, Roche Diagnostics) at the Al-Gumhouri Teaching Hospital.

H. pylori test

About 100 uL of the prepared plasma was transferred by a micropipette to the wells of the test kit to detect *H. pylori* antibody by using the rapid test of SAFECARE *H. pylori* Ab Test Cassette (Safecare Bio-Tech Hangzhou Co., UK). The test was conducted after between 10-15 minutes. The positive results for *H. pylori* detection were confirmed using an enzyme-linked immunosorbent assay (ELISA) (Cobas e 411 analyzer, Roche Diagnostics GmbH) using a commercially available kit for anti-*H. pylori* antibody (Cobas, Roche Diagnostics) at the Al-Gumhouri Teaching Hospital.

Ethical statement

The ethical declaration of the present study was approved by the Yemen and Research Ethics Review Committee of Al-Razi University and permission to start data collection by the Education office belonging to Sana'a city. Further, participation was voluntary and the consent form signed by the investigator teams was obtained.

Statistical analysis

The data were statistically analyzed using the SPSS program (SPSS version 18.0). A significant difference between the variables was determined by *P*-value (<0.05) that was considered statistically significant.

Results

Socio-demographic characterization

There were 187 subjects enrolled in this study aged 5-15 years, with a mean age of 11.03 years. Most of the participants were males (51.9%) aged between 13-15 years (43.9%) whose parents have a university certificate (67.5%), and living with a family size between 3-5 individuals (61.5%). Also, it was found that the majority of specimens were collected from study subjects drinking treated water (94.7%), bought rarely foods from mobile vendors (73.9%), rarely eating out of home (50.3%), didn't contact with flood water (94.7%), didn't infect previously by hepatitis A (88.2%), didn't have their family hepatitis A (91.4%), completely didn't infect by *H. pylori* (100%), had their family history of *H. pylori* (68.4%), didn't have a history of hospitalizations (51.9%) didn't have a blood transfusion (96.3%), didn't vaccinate for hepatitis A (89.3%) summarized in Table (1).

Table 1. Scio-demographic characteristic of the subjected study

Variables	Categories	Examined No. (%)
Gender	Male	97(51.9)
	Female	90 (48.1)
Age (in years)	5-8	38(20.3)
	9-12	67(35.8)
	13-15	82(43.9)
Fathers' educational status	Illiterate	27(14.4)
	Primary	7(3.7)
	Secondary	27(14.4)
	Graduate	126(67.5)
Family size	3-5	115(61.5)
	6-8	61(32.6)
	≥9	11(5.9)
Source of drinking water	Treated water	177(94.7)
	Not treated	10(5.3)
Food buying habits at mobile vendors	Often	49(26.2)
	Rarely	138(73.8)
Eating food out home	Always	28(14.9)
	Sometimes	65(34.8)
	Rare	94(50.3)
Contact with flooding water	Yes	10(5.3)
	No	177(94.7)
History of hepatitis A	Yes	22(11.8)
	No	165(88.2)
Hepatitis A cases in the family	Yes	16(8.6)
	No	171(91.4)
Infected previously by *H. pylori*	Yes	0(0)
	No	187(100)
One of your family infected by *H. pylori*	Yes	128(68.4)
	No	59(31.6)
Hospitalizations	Yes	90(48.1)
	No	97(51.9)
Blood transfusion	Yes	7(3.7)
	No	180(96.3)
Hepatitis A vaccinated	Yes	20(10.7)
	No	167(89.3)

Seroprevalence of hepatitis A and *H. pylori* antibodies

The current study showed that the seropositivity of anti-HAV-IgM was 5(2.7%) recorded among participating schoolchildren. In similar, the prevalence rate of anti-*H. pylori*-IgM was 23(12.3%) reported among study subjects as figured in Fig. (1).

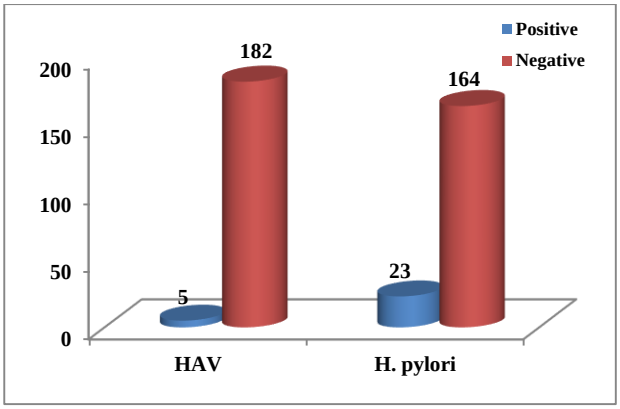

Figure 1. Seroprevalence of hepatitis A and *H. pylori* antibodies

The present finding revealed that HAV hepatitis A infection was only detected among male students (5.2%). In similar, the *H. pylori* infection was slightly higher found among male students at 12.4% when compared with female students (12.2%). In addition, the highest rate of anti-HAV and *H. pylori* positivity were observed among the age group of 5-8 and 9-12 years, respectively. Also, it was found that the student parents who hold a primary and secondary certificate had a high rate of HAV (27.6%) and *H. pylori* (14.4%) infections**.** Regarding family size, this result showed that a higher rate of HAV and *H. pylori* antibodies was recorded among family sizes of ≥9 (9.1%) and 3-7 (16.4%) individuals (Table 2).

Table 2. Frequency of hepatitis A and *H. pylori* infections among participants

Variables	Categories	Examined No. (%)	HAV No. (%)	*P*-value	*H. pylori* No. (%)	*P*-value
Gender	Male	97(51.9)	5(5.2)	0.029	12(12.4)	0.917
	Female	90 (48.1)	0(0)		11(12.2)	
Age group (in years)	5-8	38(20.3)	2(5.3)	0.917	2(5.3)	0.299
	9-12	67(35.8)	0(0)		10(14.9)	
	13-15	82(43.9)	3(3.6)		11(13.4)	
Parents' educational status	Illiterate	27(14.4)	2(7.4)	0.008	7(25.9)	0.042
	Primary	7(3.7)	2(27.6)		0(0)	
	Secondary	27(14.4)	0(0)		4(14.8)	
	Graduate	126(67.5)	1(0.8)		12 (9.5)	
Family size	3-5	115(61.5)	2(1.7)	0.219	12(10.4)	0.511
	6-8	61(32.6)	2(3.3)		10(16.4)	
	≥9	11(5.9)	1(9.1)		1(9.1)	

*Significant statistics at *P*-value <0.05.

Risk factors associated with hepatitis A virus and *H. pylori* infections

In the present study, the higher rates of HAV and *H. pylori* seropositivity were recorded among students who drank untreated water, rarely bought foods from mobile vendors, sometimes ate foods outside of the home, and didn't contact with flooding water. Similarly, a higher rate of seroprevalence of HAV infection was observed among students who didn't have a history of hepatitis A and no one in their family was infected by hepatitis A. In contrast, a higher rate of seroprevalence of *H. pylori* infection was found among subjects who had and family history of hepatitis A infection (Table 3). A similar result of both HAV and *H. pylori* infections were higher detected among students who didn't have and family history of *H. pylori* infection and didn't have a history of hospitalization. The study subjects who had a history of a blood transfusion showed a higher rate of HAV (21.2%) and *H. pylori* (14.3%) infections. Also, the higher rate of HAV and *H. pylori* infections were respectively presented among non-vaccinated and vaccinated study subjects (Table 3).

Regarding signs and symptoms of hepatitis A, a higher rate of HAV was found among participants who suffered from jaundice (80%), fever (25%), weakness (50%), and headache (42.8%) with statistical differences (P <0.05). While a higher rate of *H. pylori* infection was detected among subjects who had weakness signs with statistical differences (P <0.05) (Table 4).

The present work revealed that the highest rate of *H. pylori* seropositivity was observed among children who suffered from heartburn (28%), regurgitation (40%), and heartburn and regurgitation (42.85%) with statistical differences (P <0.05) as listed in Table (5).

Table 3. Frequency of hepatitis A and *H. pylori* according some risk factors

Variables	Categories	Examined No. (%)	HAV No. (%)	*P*-value	*H. pylori* No. (%)	*P*-value
Source of drinking	Treated water	177(94.7)	4(2.3)	0.176	21(11.9)	0.727
	Not treated	10(5.3)	1(10)		2(20)	
Food buying of mobile vendors	Often	49(26.2)	1(2.1)	0.173	6(12.2)	0.940
	Rarely	138(73.8)	4(2.9)		17(12.3)	
Eating food out of home	Always	28(14.9)	0(0)	0.858	2(7.1)	0.380
	Sometimes	65(34.8)	3(4.6)		14(21.5)	
	Rare	94(50.3)	2(2.1)		7(7.4)	
Contact with flooding water	Yes	10(5.3)	0(0)	0.592	0(0)	0.226
	No	177(94.7)	5(2.8)		23(13)	
History of hepatitis A	Yes	22(11.8)	0(0)	0.411	4(18.2)	0.374
	No	165(88.2)	5(3.0)		19(11.5)	
Hepatitis A cases in the family	Yes	16(8.6)	0(0)	0.491	2(12.5)	0.980
	No	171(91.4)	5(2.9)		21(12.3)	
Infected before by *H. pylori*	Yes	0(0)	0(0)	0.000	0(0)	0.597
	No	187(100)	5(2.7)		23(12.3)	
One of your family infected by *H. pylori*	Yes	128(68.4)	2(1.6)	0.018	14(10.9)	0406
	No	59(31.6)	3(5.1)		9(15.3)	
Hospitalizations	Yes	90(48.1)	0(0)	0.029	11(12.2)	0.975
	No	97(51.9)	5(5.2)		12(12.4)	
Blood transfusion	Yes	7(3.7)	3(21.2)	0.000	1(14.3)	0.986
	No	180(96.3)	2(1.1)		22(12.2)	
Hepatitis A vaccinated	Yes	20(10.7)	1(5)	0.498	5(25)	0.068
	No	167(89.3)	4(2.4)		18(10.8)	

*Significant statistics at P-value <0.05.

Table 4. Clinical signs and symptoms of hepatitis A associated with hepatitis A and *H. pylori* infections

Variables		Examined No. (%)	HAV No. (%)	*P*-value	*H. pylori* No. (%)	*P*-value
Jaundice	**Yes**	5(2.67)	4(80)	0.005	1(20)	0.066
	No	182(97.33)	1(20)		22(12.1)	
Fever	**Yes**	8(42.87)	2(25)	0.012	0(0)	0.128
	No	179(95.72)	3(1.7)		23(12.8)	
Weakness	**Yes**	4(2.13)	2(50)	0.000	2(50)	0.005
	No	183(97.7)	3(1.6)		21(11.47)	
Headache	**Yes**	7(3.8)	3(42.8)	0.000	0(0)	0.128
	No	180(96.2)	2(1.1)		23(12.77)	

*Significant statistics at *P*-value <0.05.

Table 5. Clinical signs and symptoms of *H. pylori* associated with hepatitis A and *H. pylori* infections

Variables		Examined No. (%)	HAV No. (%)	*P*-value	*H. pylori* No. (%)	*P*-value
Heartburn	**Yes**	25(13.37)	1(4.0)	**0.835**	7(28.0)	**0.000**
	No	162(86.63)	4(0)		18(9.87)	
Regurgitation	**Yes**	5(26.73)	1(20)	**0.835**	2(40.0)	**0.000**
	No	182(97.3)	4(0)		21(11.53)	
Heartburn and regurgitation	**Yes**	7(3.8)	0(0)	**0.692**	3(42.85)	**0.000**
	No	180(96.2)	5(0)		20(11.1)	

*Significant statistics at *P*-value <0.05.

Comparison between the Cassette and ELISA techniques

All the specimens that showed positive for HAV and *H. pylori* antibodies by rapid tests technique were confirmed by ELISA technique. It was found that positive specimens of anti-HAV were positive for anti-HAV-IgM (100%) and negative for IgG by ELISA. Also, this technique revealed that the anti-*H. pylori*-IgG and anti-*H. pylori*-IgM were 2 (8.7%) and 23(100%), respectively, (Table 6).

Table 6. Comparison between the Cassette and ELISA techniques

Subjected Test		Cassatt technique			ELISA technique		
		Examined	Positive No. (%)	Negative No. (%)	Positive cases No	Positive No. (%)	Negative No. (%)
HAV	**IgG**	**187**	N.A	N.A	**5**	0(0)	5(100)
	IgM		5(2.7)	182(97.3)		5(100)	0(0)
H. pylori	**IgG**	**187**	N.A	N.A	**23**	2(8.7)	21(91.3)
	IgM		23(12.3)	164(87.7)		23(100)	0(0)

N. A; Not applicable

Discussion

Acquisition of HAV and *H. pylori* infections is recognized early in life and most children have been infected by the time they reach late adolescence [19]. The findings of this project observed that seropositivity of anti-HAV-IgM was 2.7% recorded among schoolchildren participants. Also, the seroprevalence rate of anti-*H. pylori* IgM was 12.3% found in the same study subjects. In the previous studies, the seropositivity of HAV and *H. pylori* was 63% and 87%, respectively, found among the participating subjects [20]. Similarly, in 1986, the prevalence of HAV and *H. pylori* infections, respectively, were 80% and 70% among adults and 31% and 5% among children [21].

However, it was detected that HAV and *H. pylori* infections were 21.1% and 26%, respectively, among participating children. In addition, no significant

correlation between seroprevalences of *H. pylori* and HAV was detected [22]. Another study by Wu *et al*. [23] observed that the overall rate of *H. pylori* and HAV infection were 6% and 0.8%, respectively.

The high prevalence of infectious diseases in later years in Yemen resulted from the war in 2015 and so on. Also, these conflicts have been contributing significantly in increase poverty among the population, increasing costs the living requirements, and most families immigrating to other areas that are safe for them to live [24-30].

This result showed that hepatitis A infection was only detected among male students (5.2%) and no one of females infected with statistically significant differences (P = 0.029). Although, the male students had a slightly higher rate of *H. pylori* infection at 12.4% than female students (12.2%) with non-statistical significant differences (P = 0.975).

Similar studies were carried out on children subjects and found that the seropositivity rate of both *H. pylori* and HAV infections was higher among male participants than females [22, 23]. The high frequency of *H. pylori* infection among male students in Yemen had been documented well by some investigators [4,17, 31].

The high prevalence of both *H. pylori* and HAV infections that were observed among male subjects maybe referred to activities done by males outdoors for a long time in a day which make them more exposed to potential sources of most pathogenic microorganisms through contact with contaminated inanimate and eating foods prepared with poor sanitation conditions [17,32,33,34].

The present result observed that the HAV was 5.3% recorded among the age group of 5-8 years and 3.6% among the group aged 13-15 years (P = 0.917). Also, the age group of 9-12 years had a higher rate of *H. pylori* (14.9%), followed by 13.4% among the group aged 13-15 years, and 5.3% in age 5-8 years with non-statistical significant differences (P = 0.299). This finding is consent with previous reports that documented the high prevalence of *H. pylori* and HAV infection were among the old age group of study [9,22,35].

The low prevalence of antibodies at young ages raises concerns about the risk of outbreaks or epidemics at primary schools and about the possibility of members of this population becoming infected at older ages when the effects of the disease can be more serious [36].

In general, the infection rate of *H. pylori* increases with age, suggesting that acquisition usually occurs in early childhood in all countries. However, the infection rate of children in developing nations is higher than in industrialized nations, probably due to poor sanitary conditions, perhaps combined with lower antibiotics usage for unrelated pathologies [37]. In developing countries, the prevalence of infection peaks in the 20 to 30-year-old age group [38].

H. pylori and HAV, as indicated by a similar pattern of increase in seropositivity with age, may share a common mode of transmission, but changes in environmental conditions make this very difficult if not impossible to prove with seroepidemiological data [22].

This work found that the student parents who hold a primary certificate had a high rate of HAV infection (27.6%) while the student parents who were uneducated had a higher rate of *H. pylori* infection (14.4%) with statistically significant differences (P <0.05). A similar study by Wu *et al*. [23] noticed that the *H. pylori* and HAV infection rates were significantly higher in children whose parents had lower education levels.

However, several studies conducted in different regions of Yemen showed that children with low-education parents had a higher prevalence rate of pathogenic microorganisms [39-42]. Educational status plays an important role in increasing awareness about personal hygiene and reducing the transmission of disease [43-46].

Regarding family size, the students living with family size between 6-8 and equal or more than 9 individuals had a higher rate of hepatitis A infection (9.1%) and *H. pylori* (16.4%) with non-statistical significant differences (P > 0.05). Similar reports were observed in other parts of the world that the higher rates of HAV and *H. pylori* infections increased among children with an increasing number of family members [22,47,48]. It is known that crowded living conditions accelerate the spread of HAV and *H. pylori*. Diseases that are transmitted by person-to-person and fecal-oral routes spread rapidly, especially among people spending many hours together in institutions such as nursing homes, nurseries, and barracks [49].

However, the majority of students who drank untreated water showed positive for hepatitis A (10%) and *H. pylori* (20%) antibodies with non-statistical significant differences (P > 0.05). This result is in agreement with the report by Nassrolahei and Khalilian [8] who did not notice a significant relationship between the seropositivity of *H. pylori* and the source of water

supply. This finding reveals that the source of drinking water is not a vehicle for *H. pylori* transmission in individuals living in the areas under study.

Yemen is a developing country where over 90% of households lack the use of a safe water supply. They depend on obtaining water from surface rivers and water tanks which are available to everyone and more potentially contaminated by pathogenic microorganisms [50,51,52].

This finding revealed that the high rate of hepatitis A and *H. pylori* infections were recorded among students who rarely foods buying of mobile vendors with non-statistical significant differences ($P > 0.05$).

The highest rate of seroprevalence of *H. pylori* antibodies in this study was observed among students who drank untreated water, consuming of unwashed vegetables and fruits, and washed their hands after defecation with water and soap, and there was no statistically significant difference. The results of this study are supported by Abebaw *et al*. [47] and Mynepalli *et al*. [53].

The current result showed that a higher rate of hepatitis A and *H. pylori* infections were reported among students who sometimes eat out at home (4.6%) and (21.5%), respectively, and there were no significant differences ($P > 0.05$). These findings are consents with some reports carried out among children in Yemen [17, 31].

This result revealed that hepatitis A and *H. pylori* infections were only detected among students who didn't contact with flooding water with non-statistical significant differences ($P > 0.05$). A similar finding was reported by Kury *et al*. [54].

According to a history of hepatitis A, it was noticed that a high rate of hepatitis A infection was found among students who didn't infect previously (3%) while *H. pylori* were 18.2% only detected among students who were infected previously with non-statistical significant difference ($P > 0.05$).

This result showed that the high rate of hepatitis A seropositivity was only reported among students who didn't have a history of hepatitis A cases in their family and this is not in agreement with earlier reports [48].

However, *H. pylori* was detected among students in one of their families infected by hepatitis A at 12.5% with non-statistical significant differences ($P > 0.05$). This finding is consistent with the literature and it shows that hepatitis A infection is mostly asymptomatic in children [48].

In this finding, it was found that the hepatitis A and *H. pylori* infection was only detected among students who didn't infect previously by *H. pylori*.

However, it was observed that the higher rate of hepatitis A and *H. pylori* infections were 5.1% and 15.3%, respectively, reported among students who no one in their family was infected by *H. pylori* and there were only statistically significant differences documented between *H. pylori* infection and one of their family infected by *H. pylori* ($P = 0.018$). The hepatitis A and *H. pylori* infections are well known transmitting among though dirty hands when an infected person prepares food for family members [55].

It was observed in this study the seroprevalence rate of hepatitis A infection was only detected among students who didn't hospitalize ($P = 0.029$). Also, *H. pylori* was almost equally found among both students hospitalized and didn't with non-statistical significant differences ($P = 0.975$). The transmission of hepatitis A was proven among hospitalized individuals [56].

The current result found that the high rate of hepatitis A and *H. pylori* infection were recorded among students who had a history of a blood transfusion (21.2%; $P = 0.000$), and (14.3%; $P = 0.986$), respectively. The prevalence of hepatitis A was detected among blood donors [57].

Therefore, the infected individuals in this study are remaining high risk and threaten the community if they donate their blood to other people. For that reason, it is preferable to exclude individuals who had previously worked in medical waste collection in hospitals by donating blood to other people [42].

According to ELISA techniques, it was observed that ELISA technique had more sensitivity and specificity for anti-HAV-IgM, anti-HAV-IgG, anti-*H. pylori*-IgG, and anti-*H. pylori*-IgM detection. This finding was supported by some reports [58].

Yemen is one of the countries that use non-advance techniques such as rapid test cassettes, for hepatitis virus screening among blood donors. This technique giving more false-positive results is better for the diagnosis than those giving more false-negative results [59]. A false-positive can be followed by a more accurate and advanced method to confirm the infection (presence) unlike false negative results which may jeopardize human safety [60].

Conclusion

The higher rate of HAV and *H. pylori* seropositivity among schoolchildren is a serious and life-threatening health condition for Yemeni posterity. Some factors such as inadequate awareness, inadequate hygienic practices, unsafe drinking water, and absence of sanitary facilities could be contributing to the transmission of HAV and *H. pylori* infections.

From the present work, it can be recommended that adequate plans are crucial for improving education health awareness, hygiene practices, living conditions, lifestyle behaviors, supply of safe water, and sanitation system that could decrease the acquisition of HAV and *H. pylori* infections among schoolchildren in Yemen.

Conflict of interest

No conflict of interest is associated with this work.

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