**Original Research Article**

**Seroprevalence of *Helicobacter pylori* and Hepatitis A Virus among Orphanage Children at Sana’a –Yemen**

**Abstract**

**Background:** Helicobacter pylori (H. pylori) and hepatitis A virus (HAV) are common diseases in low-income countries and both have similar transmission routes including fecal-oral. **Aims:** This study was undertaken to assess the seropositivity pattern of H. pylori and HAV infections among orphanage children in Sana’a-Yemen. **Methods:** This is a cross-sectional study carried out among 200 orphaned children who lived at Ahmed's orphanage in Sana’a City, Yemen during the period from October 2022 to February 2023. The stool and blood specimens were collected and the required data were filled in pretested questionnaire. By using the immunochromatographic assay technique, the seropositivity of the HAV antibody was screened in blood plasma while the H. pylori antigen was detected in stool. The obtained results were analyzed using SPSS software. **Results:** Out of 200 participants; 2(1%) were positive for anti-HAV and 63(31.5%) for H. pylori antigen. The HAV and H. pylori infections, respectively, were significantly higher in the group aged 10-12 and 13-15 years, attending a primary and preparatory school, living with 3-5 individuals/room, their family infected with hepatitis A and H. pylori, and received a blood transfusion. The high risk of hepatitis A infection was in children who their family infected by HAV and received a blood transfusion while H. pylori was in subjects who had a history of hospitalizations and whose family infected by H. pylori. Age was the only factor significantly influencing the seroprevalence of H. pylori.The correlation between HAV and H. pylori infections was not significant.**Conclusion:**The high rate of H. pylori in the study area consider the life-threatening to orphaned individuals, whether in the short or long period. Therefore, health education, increase awareness, good personal hygiene, improved living conditions, and supply of safe water and food are useful factors in reducing the transmission of the disease in orphanage building.

**Keywords:***Helicobacter pylori*(H. pylori), Hepatitis A virus (HAV), Prevalence, Orphanage Sana'a, Yemen

**INTRODUCTION**

Helicobacter pylori (H. pylori) infection is currently recognized as a worldwide health problem and causes morbidity and mortality. Globally, H. pylori have infected about half of the total population (50%) and nearly one-third (32.3%) of all children, particularly in low-incoming nations 1,2,3**.**H. pylori is the main cause of peptic ulcer disease which progress to develop into gastric cancer. The signs and symptoms associated with H. pylori infection are abdominal pain, nausea, belching, bloating, and sometimes vomiting. Also, the complication resulting from persistent infection can lead to iron deficiency anemia, decreasing blood platelet count, mental deficiency, birth defects, and fetal stunted growth in pregnant women 4,5,6**.**

Hepatitis A virus (HAV) is considered one of the endemic infectious diseases worldwide and is usually asymptomatic in younger children(<6 years) and symptomatic in older children and adults. It infects the liver andcan range in severity from a mild illness to a severe illness. Internationally, it was estimated by the World Health Organization (WHO) that approximately 1.4 million new cases of HAV infection and about 100 thousand people die resulting from acute HAV infection are reported each year 7,8,9**.**

Some studies suggested their association between *H. pylori* and HAV in epidemiology, transmission routes, age-speciﬁc seroprevalence, and acquisition of infection. The high incidence of both *H. pylori* and HAV are reported in populations with low economic status, high density of living, low levels of education, poor hygiene practices, one of a family infected,unsafe water or foods, lack of drinking water, and poor sewage system 10,11,12,13.

The acquisition of *H. pylori* and HAV infectionsoccurred during childhood**suggesting another association between these types of infection 14,15,16**.Several reports documented the prevalence of HAV and H. pylori infections within the same study area in some countries 15,17,18**.**

Yemen is ranked as one of the poorest low-income countries in the world.According to recent reports, about 79% of the total population lives under the poverty line and approximately 65% of these individualsare classified as awfully poor 19.In addition, the majority of Yemenis are without clean drinking water, inadequate sanitation, absence of institutional stability, food insecurity, severe malnourishment, loss of livelihoods and income, inadequate hygienic practices,and inadequate access to healthcare services are factors contributingto increasingexposure to infectious diseases 20-28.

Up-to-date,most of thestudies conducted in Yemeninterested in the prevalence ofhepatitis A virus or *H. pylori*independently 29,30,31, and only one study hasdetermined hepatitis A virusand *H. pylori* infections among schoolchildren in Yemen 32. So, this study was intended to find out the seroprevalenceand association of *H. pylori* and HAV infections among orphanage children in Sana’a-Yemen.

**MATERIALS AND METHODS**

**Study design and period**

This is a cross-sectional study conducted at Ahmed's orphanage center which is located on Taiz Street belonging to Al-Sabeen District, Sana’a City, Yemen during the period from October 2022 to February 2023. The experimental analysis was performed at the Medical laboratory at Queen Arwa University (QAU).

**Sample size**

The sample size consisted of 200 orphan children aged between 7-15 years who lived in Ahmed's orphanage center in Sana'a City, Yemen. The random method was used for sample collection from study subjects.

**Data collection**

The questionnaire was designed to gather the required data from each study subject enrolled in this study. The questionnaire inquired about the age, educational level (either primary or preparatory school), number of children in the room, contact with flooding water, history of hepatitis A, history of H. pylori, family history of hepatitis A virus/ H. pylorus, hospitalizations, surgical operation, blood transfusion, source of drinking water, eating vegetables after washing, eating fruits after washing, washing hand after defecation, and vaccinated for hepatitis A. Moreover, clinical signs and symptoms such as jaundice, fever, weakness, headache, heartburn, regurgitation, heartburn, and regurgitation were gathered through face-face interviews. Questionnaires were filled out by the orphan children or investigators teams. The questionnaire was constructed in Arabic and translated into English.

**Inclusion and exclusion criteria**

The participants who lived in Ahmed's orphanage, signed informed consent, and delivered blood and stool specimens were included in this study. In contrast, the participants who didn’t resident in Ahmed'sorphanage, refuse to sign informed consent, and did not properly collect their blood and stool specimens were excluded

**Blood and stool specimens’ collection**

The blood specimens (3 mL) were collected from each subject and transferred into a tube containing an anticoagulant. In addition, the collection of stool specimens was performed by giving each participant a clean, dry, codded, and leak-proof container and instructing them on how to collect the specimens properly. The collected specimens were transported immediately to the medical laboratories at QAU for examination.

**Laboratory examination**

Seropositivity of HAVantibody in prepared plasma was determined by using the immunochromatographic assay(rapid test) of HEALGEN Cassette (Healgen Scientific Limited, USA) according to the manufacturer's instructions. Also, the detection of *H. pylori* stool antigen was performedby using the rapid test of SAFECARE *H. pylori* Ag Test Cassette (Safecare Bio-Tech Hangzhou Co., UK) based on the manufacturer's instructions.

**Ethical statement**

The protocol of the present study was approved by the Yemen and Research Ethics Review Committee of Queen Arwa University and permission to start data collection by the Administration of Orphanage. Further, the purpose and objectives of this work were explained briefly to all orphans’ children and administrative staff working in the orphanage before specimen collection.

**Statistical analysis**

All variables were categorical and presented as counts and percentages. The SPSS program (version 26) was used to determine the Chi-square test(χ2), Odds ratio (OR), and Confidence interval (CI 95%)**.**Pearson’s chi-square test was used to evaluate the relationship between H. pylori antigen and HAV seropositivity with risk factors. The comparison between the seroprevalence of H. pylori antigen and HAV was analyzed by Logistic regression. Also, the relationship between H. pylori and HAV with age was calculated by linear association. A significant difference between the proportions and the groups or variables was determined by and P-value (< 0.05 considered significant).

**RESULTS**

**Socio-demographic characterization**

A total of 200 orphan children participated in this study aged between 7-15 years with a mean age of 12.7 years. The majority of specimens were collected from study subjects aged 13-15 years (65%), attended a preparatory school (58%), lived in a room with children size between 9-12 individuals (27%), always contacted with flood water (97%), didn’t have a history of hepatitis A (92%) and *H. pylori*(92.5%), no casesin their family hepatitis A (94%) and *H. pylori*(83%), didn’t hospitalize 10(90%),surgical operation (83.5%), didn’t receive a blood transfusion (93%), and vaccinated against hepatitis A (91%) Table (1).

**Table 1.** Socio-demographic characterization of study participating in a study

| **Variables** | **Categories** | **Examined** | **Rate (%)** |
| --- | --- | --- | --- |
| **Age (in years)** | 7-9 | 8 | 4 |
| 10-12 | 62 | 31 |
| 13-15 | 130 | 65 |
| **Study level** | Primary | 84 | 42 |
| Preparatory | 116 | 58 |
| **Number of children in the room** | 3-5 | 62 | 31 |
| 6-8 | 44 | 22 |
| 9-12 | 94 | 27 |
| **Contact with flooding water** | Always | 194 | 97 |
| Sometimes | 6 | 3 |
| **History of hepatitis A** | Yes | 16 | 8 |
| No | 184 | 92 |
| **History of *H. pylori*** | Yes | 15 | 7.5 |
| No | 185 | 92.5 |
| **Hepatitis A cases in the family** | Yes | 12 | 6 |
| No | 188 | 94 |
| ***H. pylori* cases in the family** | Yes | 34 | 17 |
| No | 166 | 83 |
| **Hospitalizations** | Yes | 20 | 10 |
| No | 180 | 90 |
| **Surgical operation** | Yes | 33 | 16.5 |
| No | 167 | 83.5 |
| **Blood transfusion** | Yes | 14 | 7 |
| No | 186 | 93 |
| **Hepatitis A vaccinated** | Yes | 182 | 91 |
| No | 18 | 9 |

**Prevalence of hepatitis A antibody and *H. pylori* antigen**

This result revealed that the seropositivity rate of anti-HAV and *H. pylori* antigen, respectively, were 2(1.0%) and 63(31.5%) recorded among the orphan children (Fig.1).

**Figure 1.** Prevalence of HAV antibody and *H. pylori* antigen

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

The present result revealed that the prevalence rate of HAV antibody and *H. pylori* antigen was detected in the group aged 10-12 years (3.2%; *P* = 0.125) and13-15 years (40%; *P* = 0.000), respectively. attending a primary (2.4%; *P* = 0.096) and preparatory school (41.4%; *P* = 0.000) respectively. Also, the higher rate of anti-HAV and *H. pylori* antigen was found among children who lived in room content between 3-5 individuals (1.6% and 35.5%, respectively) and always contact with flooding water (1% and 31.9%, respectively) (Table 2).

However, the hepatitis A antibody was observed among children who had and their family history of hepatitis A at 12.5%, and 16.67%, respectively, (*P* = 0.000), and had (6.7%; *P* = 0.022) and their family didn’t have a history of *H. pylori* (5.9%; *P* = 0.522), non- hospitalized (1.1%; *P* = 0.638), and had a surgical operation (6.1%; *P* = 0.001). While the *H. pylori* was among participants didn’t have (33.7%; *P*= 0.023) and their family a history of hepatitis A infection (33%; *P*= 0.075), didn’t have a history of *H. pylori* (31.9%; *P* =0.677), *H. pylori* cases in their family (58.8%; *P* = 0.000), hospitalized (60% *P* = 0.004), and didn’t subject to surgical operation (32.9%; *P* = 0.328) as listed in the Table (2).

Furthermore, a higher rate of anti-HAV and *H. pylori* antigen, respectively, was found in participating respondents who received blood transfusion (14.28%; *P* = 0.000) and 30.6%; *P* = 0.345), drunk treated water (1.4%) and (34% *P* =0.204). The majority ofanti-HAV seropositivity was detected among individuals who eat unwashed vegetables (1.6%) and washed fruits (2.4%), washed their hand after defection (1.1%), and non-vaccinated for hepatitis A (1.11%; *P* = 0.657). Whereas *H. pylori* antigen was found among participants who eat washed vegetables (37.3%) and fruits (37.4%), didn’t wash their hand after defection (41.2%), and vaccinated for hepatitis A (33.5%; *P* = 0.051) as summarized in Table (2).

**Table 2.** Frequency of HAV antibody *H. pylori* antigen among study subjects

| **Variables** | **Categories** | **Examined No. (%)** | **Hepatitis A** | | ***P-*value** | ***H. pylori* antigen** | | ***P-*value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **+ve**  **n (%)** | **-ve**  **n (%)** | **+ve**  **n (%)** | **-ve**  **n (%)** |
| Age (in years) | 7-9 | 8 (4) | 0(0) | 8(100) | 0.125 | 0(0) | 8(100) | 0.000 |
| 10-12 | 62 (31) | 2(3.2) | 60(96.8) | 11(17.7) | 51(82.3) |
| 13-15 | 130 (65) | 0(0) | 130(100) | 52(40) | 78(60) |
| Educational level | Primary | 84 (42) | 2(2.4) | 82(97.6) | 0.096 | 15(17.9) | 69(82.1) | 0.000 |
| Preparatory | 116 (58) | 0(0) | 116(100) | 48(41.4) | 68(58.6) |
| Number of children in the room | 3-5 | 62 (31) | 1(1.6) | 61(98.4) | 0.795 | 22(35.5) | 40(64.5) | 0.477 |
| 6-8 | 44 (22) | 0(0) | 44(100) | 13(29.5) | 31(70.5) |
| 9-12 | 94 (27) | 1(1.1) | 93(98.9) | 28(29.9) | 66(70.1) |
| Contact with flooding water | Always | 194 (97) | 2(1) | 192(99) | 0.804 | 62(31.9) | 132(68.1) | 0.430 |
| Sometimes | 6 (3) | 0(0) | 6(100) | 1(16.7) | 5(83.3) |
| History of hepatitis A | Yes | 16 (8) | 2(12.5) | 14(87.5) | 0.000 | 1(6.3) | 15(93.7) | 0.023 |
| No | 184 (92) | 0(0) | 184(100) | 62(33.7) | 122(66.3) |
| Hepatitis A cases in the family | Yes | 12 (6) | 2(16.7) | 10(83.3) | 0.000 | 1(8.3) | 11(92.7) | 0.075 |
| No | 188 (94) | 0(0) | 188(100) | 62(33) | 126(67) |
| History of *H. pylori* | Yes | 15 (7.5) | 1(6.7) | 14(93.3) | 0.022 | 4(26.7) | 11(73.3) | 0.677 |
| No | 185 (92.5) | 1(0.5) | 184(99.5) | 59(31.9) | 126(68.1) |
| *H. pylori* cases in the family | Yes | 34 (17) | 2(5.9) | 32(94.1) | 0.522 | 20(58.8) | 14(41.2) | 0.000 |
| No | 166 (83) | 0(0) | 6(100) | 43(25.9) | 123(74.1) |
| Hospitalizations | Yes | 20 (10) | 0(0) | 20(100) | 0.638 | 12(60) | 8(40) | 0.004 |
| No | 180 (90) | 2(1.1) | 178(98.9) | 51(28.3) | 129(71.7) |
| Surgical operation | Yes | 33 (16.5) | 2(6.1) | 31(93.9) | 0.001 | 8(24.3) | 25(75.7) | 0.328 |
| No | 167 (83.5) | 0(0) | 167(100) | 55(32.9) | 112(67.1) |
| Blood transfusion | Yes | 14 (7) | 2(14.3) | 12(85.7) | 0.000 | 6(42.9) | 8(57.1) | 0.345 |
| No | 186 (93) | 0(0) | 186(100) | 57(30.6) | 129(69.4) |
| Source of drinking water | Treated | 147 (73.5) | 2(1.4) | 145(98.6) | 0.396 | 50(34) | 97(66) | 0.204 |
| Untreated | 53 (26.5) | 0(0) | 53(100) | 13(24.5) | 40(75.5) |
| Eating vegetables after washing | Yes | 125 (62.5) | 0(0) | 75(100) | 0.273 | 28(37.3) | 47(62.7) | 0.171 |
| No | 75 (37.5) | 2(1.6) | 123(98.4) | 35(28) | 90(72) |
| Eating fruits after washing | Yes | 117 (58.5) | 2(2.4) | 81(97.6) | 0.092 | 31(37.4) | 52(62.6) | 0.135 |
| No | 83 (41.5) | 0(0) | 117(100) | 32(27.4) | 85(72.6) |
| Washing hand after defecation | Yes | 183 (91.5) | 2(1.1) | 181(98.9) | 0.667 | 56(30.6) | 127(69.4) | 0.372 |
| No | 17 (8.5) | 0(0) | 17(100) | 7(41.2) | 10(58.8) |
| Hepatitis A vaccinated | Yes | 182 (91) | 0(0) | 182(100) | 0.657 | 61(33.5) | 121(66.5) | 0.051 |
| No | 18 (9) | 2(1.1) | 16(98.9) | 2(11.1) | 16(88.9) |

**Risk factors associated with *H. pylori*infection**

The current result showed that the detection of HAV antibody was only reported among participants who suffer from jaundice (25%; *P* = 0.000), fever (6.45%; *P* = 0.001), headache (1.26%; *P* = 0.466), and weakness (2.6%; *P* = 0.070). While most of the study subjects who didn’t suffered from eye jaundice (32.8%) and headache (33.3%) were positive for *H. pylori* antigen, as well as it, was detected among subjects who had a fever (38.7%) and weakness (34.2%) signs with non-statistical differences (*P*>0.05) as summarized in Table (3).

**Table 3.**Hepatitis A and *H. pylori* infection concerning signs and symptoms of hepatitis A

| **Variables** | | **Examined No. (%)** | **Hepatitis A** | | ***P*-value** | **H. pylori** | | ***P-*value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **+ve**  **n (%)** | **-ve**  **n (%)** | **+ve**  **n (%)** | **-ve**  **n (%)** |
| **Jaundice** | Yes | 8(4) | 2(25) | 6(75) | 0.000 | 0(0) | 8(100) | 0.051 |
| No | 192 (96) | 0(0) | 192(100) | 63(32.8) | 129(67.2) |
| **Fever** | Yes | 31 (15.5) | 2(6.5) | 29(93.5) | 0.001 | 12(38.7) | 19(61.3) | 0.350 |
| No | 169 (84.5) | 0(0) | 169(100) | 51(30.2) | 118(69.8) |
| **Headache** | Yes | 158 (97) | 2(1.3) | 156(98.7) | 0.466 | 49(31.) | 109(67) | 0.775 |
| No | 42 (21) | 0(0) | 42(100) | 14(33.3) | 28(66.7) |
| **Weakness** | Yes | 76 (38) | 2(2.6) | 74(97.4) | 0.070 | 26(34.2) | 50(65.8) | 0.521 |
| No | 124 (62) | 0(0) | 124(100) | 37(29.8) | 87(68.2) |

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

Regarding signs and symptoms of *H. pylori*, the HAV was only observed among participants who suffered from heartburn (3.3%), regurgitation 2(3.2%), and heartburn and regurgitation 2(5.4%) with statistical differences (*P* ˂0.05). In similar, the highest rate of *H. pylori* antigen was detected among children who suffered from heartburn (34.4%; *P* =0.557), regurgitation (38.7%; *P* =0.143), and heartburn and regurgitation (56.7%; *P* =0.000) as listed in Table (4).

**Table 4.**Hepatitis A and *H. pylori* infection concerning signs and symptoms of *H. pylori*

| **Variables** | | **Examined No. (%)** | **Hepatitis A** | | ***P-*value** | ***H. pylori*** | | ***P-*value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **+ve**  **n (%)** | **-ve**  **n (%)** | **+ve**  **n (%)** | **-ve**  **n (%)** |
| **Heartburn** | **Yes** | 61 (30.5) | 2(3.3) | 59(96.7) | 0.032 | 21(34.4) | 40(65.6) | 0.557 |
| **No** | 139 (69.5) | 0(0) | 139(100) | 42(30.2) | 97(69.8) |
| **Heartburn and regurgitation** | **Yes** | 62 (31) | 2(3.2) | 60(96.8) | 0.034 | 24(38.7) | 38(61.3) | 0.143 |
| **No** | 138 (69) | 0(0) | 138(100) | 39(28.3) | 99(71.7) |
| **Regurgitation** | **Yes** | 37 (18.5) | 2(5.4) | 35(94.6) | 0.003 | 21(56.7) | 16(43.3) | 0.000 |
| **No** | 163 (81.5) | 0(0) | 163(100) | 42(25.8) | 121(74.3) |

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

**Associations of risk factors with seropositivity of HAV antibody *H. pylori* antigen**

Table 5 shows the association between some risk factors and seropositivity of the HAV antibody H. pylori antigen. This result found that the high risk of hepatitis A infection was among children whose family had a history of HAV cases (OR = 19.800; 95% CI=10.824–36.220), followed by receiving blood transfusion (OR =16.500; 95% CI=9.535–28.552), and had a history of surgical operation (OR = 6.387; 95% CI=4.623–8.825). In addition, the high risk of H. pylori infection was noticed among subjects who had a history of hospitalizations (OR = 3.262; 95% CI=1.403–7.581) and H. pylori cases in the family (OR = 3.107; 95% CI=1.681–5.742).

The logistic regression analysis showed that age was the only factor influencing the seroprevalence of H. pylori significantly. Also, there was no significant correlation detected between the seropositivity of anti-HAV and H. pylori antigen in this study **(Table 6).**

**Table5.** The association between risk factorswith seropositivity of anti-HAV and *H. pylori*Ag

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **Hepatitis A virus** | | | ***H. pylori* Ag** | | |
| **OR** | **CI 95%** | **χ2** | **OR** | **CI 95%** | **χ2** |
| Educational level | 1.193 | 0.295–4.816 | 0.053 | 1.407 | 1.021–1.939 | 0.143 |
| Number of children in the room | N.A | N.A | 0.076 | N.A | N.A | 0.038 |
| Contact with flooding water | 1.031 | 1.002–10.57 | 0.018 | 1.021 | 0.976–1.069 | 0.056 |
| History of hepatitis A | 15.231 | N.A | 0.341 | 0.145 | 0.071–1.016 | -0.160 |
| Hepatitis A cases in the family | 19.800 | 10.824–36.220 | 0.398 | 0.198 | 0.023–1.498 | -0.126 |
| History of *H. pylori* | N.A | N.A | 0.353 |  | 1.059–1.191 | 0.015 |
| *H. pylori* cases in the family | 1.207 | 1.133–1.286 | -0.045 | 3.107 | 1.681–5.742 | -0.193 |
| Hospitalizations | 1.112 | 1.062–1.166 | -0.034 | 3.262 | 1.403–7.581 | 0.205 |
| Surgical operation | 6.387 | 4.623–8.825 | 0.226 | 0.696 | 0.333–1.456 | -0.069 |
| Blood transfusion | 16.500 | 9.535–28.552 | 0.366 | 1.631 | 0.591–4.503 | 0.067 |
| Source of drinking water | 1.366 | 1.255–1.485 | 0.060 | 1.121 | 0.950–1.323 | 0.090 |
| Eating vegetables after washing | 1.610 | 1.444–1.795 | 0.078 | 0.846 | 0.657–1.088 | -0.097 |
| Eating fruits after washing | 2.444 | 2.068–2.890 | -0.119 | -0.106 | 0.621–1.079 | -0.106 |
| Washing hand after defecation | 1.026 | 1.048–1.142 | 0.031 | 0.052 | 0.951–1.125 | 0.052 |
| Hepatitis A vaccinated | 1.100 | 1.053–1.150 | 0.032 | 0.138 | 1.017–1.182 | 0.138 |

**χ2**= Chi-square test.**OR** =odds ratio, **CI 95%** =confidence interval,**NA** = not applicable

**Table 6.**Logistic regression analysis of anti-HAVand *H. pylori* antigen

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | ***H. pylori* Ag** | | | |
| **Beta** | **Standard error** | ***P*- value** | **CI 95%** |
| **Age** | 0.612 | 0.058 | 0.027 | 0.015–0.244 |
| **Hepatitis A** | -0.267 | 0.329 | 0.417 | -0.912–0.381 |
| **Variables** | **Hepatitis A** | | | |
| **Beta** | **Standard error** | ***P*- value** | **CI 95%** |
| **Age** | -0.011 | 0.013 | 0.404 | 0.036–0.014 |
| ***H. pylori*** | -0.013 | 0.015 | 0.417 | 0.043–0.018 |
|  |  | **r=0.338\*\*** |  |  |

\*\*Regression tests, 95% CI=confidence interval, *P*-value <0.05,

**DISCUSSION**

The acquiring infections of HAV and H. pylori are commonly occurring early in the life of childhood and most of them become infected when they reach late adolescence33,34**.**The overall rate anti-HAV and H. pylori antigen were recorded among the orphan children at 1% and 31.5%, respectively. The result of this study is similar**to** the prevalence rate of HAV and H. pylori, respectively, was reported among children at 63% and 87% in Italy 35**,**20.5% and 7% in South Korea 36**,** 31% and 5% in Japan 17, 71.3% and 61.6% in Lebanon 18**,** 21.1% and 26% in Turkey37**,**6% and 0.8% in Taiwan15, and 2.7% and 12.3% in Sana’a 32**.**

The difference in prevalence rate may be referred to by some factors such as geographical distribution, size of the sample, study population, hygienic practices, environmental conditions, socioeconomic status, food consumption, and diagnostic techniques employed by the participants. Also, the study conducted in Orphanage revealed the decline in hepatitis B virus among study subjects 38and this may be due to the fact that the environment in which the orphans live, which separates them from the external environment, has contributed significantly to reducing the spread of pathogenic viruses.

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 live27, 39-45.

These data showed that the prevalence rate of HAV antibody was observed among the age group of 10-12 years (3.2%; P = 0.125) while H. pylori antigen was in the group aged 13-15 years (40%; P = 0.000). These results are in accordance with the results observed in the previous reports 32,36**.** Most of the previous reports which had indicated a relationship between the transmission routes for HAV and H. pylori revealed that the seroprevalence rates of HAV and H. pylori increased simultaneously with age36,37,46,47.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 48**.**In developing countries, the prevalence of infection peaks in the 20 to 30-year-old age group 49**.**

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 data37**.**The seropositivity rate of HAV was in this result only found among students who attended primary schools (2.4%). While a higher rate of H. pylori antigen was detected among the subjects who attended a preparatory school (41.4%) with a significant difference (P =0.000). However, several studies conducted in different regions of Yemen showed that children with low-education parents had a higher prevalence rate of pathogenic microorganisms 29,50-52.

Education is considered an important social determinant of health. Also, a strength of association between educational status and health has been recognized. The effect of education is creating better overall self-awareness of personal health and making healthcare more accessible. Well-educated persons have better health as reflected in the low levels of mortality, morbidity, and disability. Education helps promote health equity and sustain healthy lifestyles and positive choices, nurture relationships, and enhance personal, family, and community well-being 53**.**

However, a higher rate of anti-HAV and H. pylori antigen was recorded in this result among children who lived in room content between 3-5 individuals (1.6% and 35.5%, respectively). This result is in agreement with published studies documented that HAV and H. pylori infections were significantly increased among children with an increasing number of persons per room 37,54,55**.** Moreover, a study by **Bizri**et al.18indicated that the number of individuals per room was a signiﬁcant factor in increasing the prevalence of antibodies to H. pylori but not to HAV.

The present result revealed that participating respondents who were always in contact with flooding water had the highest rate of hepatitis A (1%) and H. pylori (31.9%) infections. On other hand, our result was in disagreement with the results of **Kury**et al**.**56 and**Edrees**et al.**32** who noticed the hepatitis A antibody and H. pylori antigen were only identified among children who didn’t have a history of contact with flooding.

However, the hepatitis A antibody was observed among children who had hepatitis A (12.5%) and hepatitis A cases in their family (16.67%) with significant difference (P < 0.05), non-hospitalized (1.1%; P = 0.638), and had a surgical operation (6.1%; P = 0.001). This result is in agreement with earlier reports 32,55**. Also,**the transmission of hepatitis A was proven among hospitalized individuals 57**.**

The present finding showed that H. pylori were among participants who didn’t have a history of H. pylori (31.9%; P =0.677),H. pylori cases in their family(58.82%; P = 0.000), and hospitalized (60% P = 0.004). This result is in agreement with the observations reported by **Pirinççioğlu**et al.55 and **Edrees**et al.**32**

Transmission of H. pylori infection mainly occurs from person to person within the family setting in developed countries as well as it can be acquired from the community in developing countries. Mothers play an important role in transmitting H. pylori infection to their children11**.**Evidence supporting this view comes from epidemiological studies showing that children with an infected mother have an increased risk of infection, and from studies comparing the genetic makeup of H. pylori strains present in the index child and his or her parents 11**.**

The current result showed the respondents receiving blood transfusion had a higher rate of anti-HAV (14.28%; P <0.05) and H. pylori antigen (30.6%; P >0.05). This result is in accordance with the result of **Edrees**et al.**32** where the rate of HAV and H. pylori infections are significantly more among children who had a history of a blood transfusion. Also, the prevalence rate of hepatitis A infection was found among blood donors 58**.**

The rate of HAV and H. pylori seropositivities were found in this project among subjects drunk from treated water with non-significant differences (P > 0.05). These findings are in apparent disagreement with the resultsof **Edrees**et al**.32**. Also, a report by**Nassrolahei and Khalilian**58 revealed there was a non-significant relationship between H. pyloriseropositivity and the source of drinking water. Moreover, transmission routes for H. pylori occur mainly oral–oral or fecal–oral route is most likely while the role of water as a transmission route for H. pylori remains unproven 11,60**.**

The seropositivity of HAV was detected among individuals who eat unwashed vegetables (1.6%), washed fruits (2.4%), and washed their hands after defection (1.1%). This result is concordant with the previous study 32. Infected persons are able to transmit hepatitis A infection through dirty hands during food preparation to family members 9.

Furthermore, H. pylori antigen was observed in this result among subjects who consumed washed vegetables (37.3%) and fruits (37.4%), and didn’t wash their hand after defection (41.2%)**.**In contrast, the previous results documented that a high rate of anti- H. pylori was reported among children who eat unwashed vegetables and fruits and washed their hands after defecation29, 54,61**.A study by**Moreno-Mesoneroet al**. 62detected intra-amoebic *H pylori* DNA in 55% of 20 samples of lettuce (*Lactuca sativa*) by using PMA-qPCR technique and viable intra-amoebic *H. pylori* cells in 25% of the samples using the DVC-FISH technique.**

The prevalence of pathogenic microorganism in vegetables in Yemen have been documented. So, these vegetables consider one of the main sources of disease transmission among persons’ consumers of unwashed vegetables 63**.** However, transmission routes of the H. pylori bacterium via the gastro-oral, oral-oral, or faecal-oral route remains unclear 11,60**.**

The study participants non-vaccinated for hepatitis A showed positive for HAV antibodies at1.11% and this is similar to findings by **Wu**et al**.**15 and Obyyahet al**. 51**.

Regarding signs and symptoms of hepatitis A infection, the detection of anti-HAV was only found among subjects who suffer from jaundice and fever with a significant difference (P <0.05) as well as headache and weakness with a non-significant difference (P >0.05). This result is in agreement with Obyyah et al**. 51**.

In similar, the highest rate of H. pylori antigen was detected among children who suffered from heartburn (34.4%; P =0.557), regurgitation (38.7%; P =0.143), and heartburn and regurgitation (56.7%; P =0.000). This result is in consonance with the recent finding that revealed that the anti-H. pylori was significantly higher among children who suffered from heartburn, regurgitation, and heartburn and regurgitation with statistical differences (P ˂0.05) 32**.** In contrast, it was reported that the high rate of H. pylori seropositivity was among children who didn't suffer from clinical signs and symptoms with non-significant differences 13,29,64**.** H. pylori infection in many children may be clinically silent throughout life 11**.**

However, the current result found that the high risk of hepatitis A infection was among children whose family had a history of HAV cases (OR = 19.800; 95% CI=10.824–36.220), followed by receiving blood transfusion (OR =16.500; 95% CI=9.535–28.552), and had a history of surgical operation (OR = 6.387; 95% CI=4.623–8.825). In addition, the high risk of H. pylori infection was noticed among subjects who had a history of hospitalizations (OR = 3.262; 95% CI=1.403–7.581) and H. pylori cases in the family (OR = 3.107; 95% CI=1.681–5.742).

This result showed that the seroprevalence of H. pylori infection demonstrated an increasing trend with age similar but not related significantly to HAV infection. Moreover, no significant correlation was detected between the seropositivity of anti-HAV and H. pylori antigen. This result is in agreement with previous studies36,37,65**.**

.**Limitations**

The limitations of this study are including; the small sample size, serologic tests done by rapid tests, and the absence of advanced diagnostic techniques such as Enzyme-linked Immunosorbent assay (ELISA) that is highly accurate and reliable due to limited resources.

**CONCLUSION**

In conclusion, the high seroprevalence of H. pylori among study subjects remaining life-threatening to infected individuals when will become adults if not completely eradicated. Also, poor hygiene practices, inadequate awareness, livinginovercrowded conditions, absence of institutional stability, and lack of access to safe water may contribute to spread of the HAV and H. pylori infections. So, effective preventative measures are important to reduce infections among orphaned children through increasing knowledge about disease transmission, hygiene practices, improving living conditions, and supply of safe water and foods.

**CONFLICT OF INTEREST**

The authors declare that they have no competing interests.

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