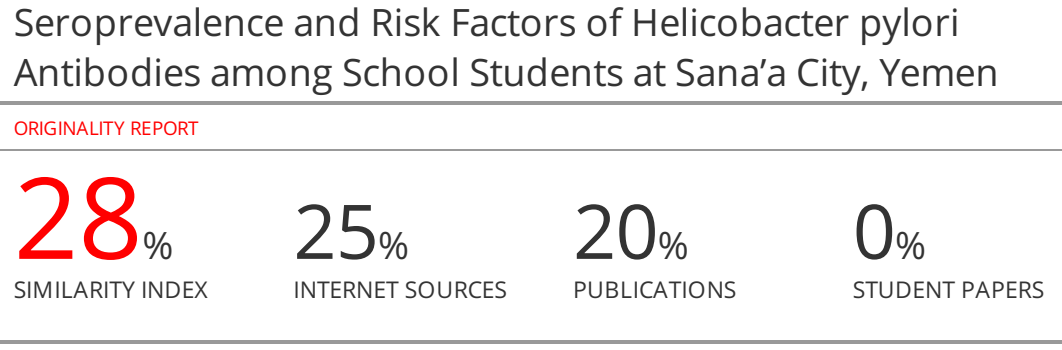
**Reviewer’s Comments**

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**Seroprevalence and Risk Factors of *Helicobacter pylori* Antibodies among School Students at Sana’a City, Yemen**

**Abstract**

**Background and Objectives:** *Helicobacter pylori* is the most common communicable bacterial infection spreading and affecting more than 50% of the population globally, particularly in developing countries. So, the present study aimed to estimate the seroprevalence and risk factors of *H. pylori* among School Students in Sana’a City, Yemen.

**Methods:** A cross-sectional study was conducted at primary and secondary schools in Sana'a during the period from October to December 2021.Two hundred and ninety-three (293) school students aged between 11-21 years were enrolled in this study and tested for *H. pylori* in the blood specimens by using the rapid antibody test cassette. The associated risk factors were gathered by a designed questionnaire.

**Result:**Overall, *H.pylori* antibody was positive in 82/293(27.99%) students. The higher rate of seroprevalenceof *H.pylori* antibodies was reported among male students (29.25%; *P*˃0.05), age group of 16-21 years (33.69%; *P* ˂0.05), and secondary students in schools (31.66%; *P* ˂0.05).Also, the highest rate of *H.pylori* infection was positive among students whodrank untreated water (32.61%), consuming of unwashed vegetables (28.71%) and fruits (30.51%), not been infected previously (28.45%), one of their family infected (28.98%), sometimes eating outof home (32.47%), and didn't non use antibiotics (29.12%) and there was non-statistical significant difference (*P* ˃0.05). In addition, there were no significant relationships between seropositivity of *H. pylori* and clinical signs and symptoms as well as antibiotic use. Finally, most of the students with blood group (O) had *H. pylori* antibodies (*P* ˃0.05).**Conclusion:** It can be concluded that the increasing rate of *H. pylori* among school students is will become a real serious health problem if it is not monitored. Therefore, an effective educational health program is important for preventing and controlling *H. pylori* infection among school students.

**Conclusion:** It can be concluded that the increasing rate of *H. pylori* among school students is will become a real serious health problem if it is not monitored. Therefore, an effective educational health program is important for preventing and controlling *H. pylori* infection among school students.

**Keywords:** *Helicobacter pylori*, Seroprevalence, Students, School, Sana’a, Yemen.

**INTRODUCTION**

*Helicobacter pylori* (*H. pylori*) is the commonest bacterium widespread in the world that infects more than 50% of individuals and over 80% of individuals infected with this bacterium are asymptomatic1.

*H. pylori*c a uses long-term inflammation of the mucous membrane of the stomach representing gastric and duodenal ulcers which progress to develop into gastric cancer if untreated2,3,4. Also, it is responsible for iron deficiency anemia, decreasing blood platelet count, fetal malformation, and fetal growth retardation in pregnant women5.

The acquisition of *H. pylori* infection rises often during childhood that could be referred to as outdoor activities and exposure to potential external sources6.Seroepidemiologic reports have revealed that over 50% and 90% of adults in developed and developing countries, respectively, are positive for serum antibodies against *H. pylori*7.

The route of *H. pylori* transmission is via person-to-person and fecal-oral routes. Also, the overcrowding conditions, inadequate personal hygienic practices, low socioeconomic conditions, lack of waste treatment system, and use of contaminated water are the most factors that contribute to the increasing prevalence of bacterial infection in developing countries 8,9,10,11,12,13.

In developing countries, school students are at higher risk of *H. pylori* infection due to the mentioned factors. Numerous studies documented the prevalence of *H. pylori* infection among school students in several countries. In Nigeria, Mynepalli *et al*.14 found 59% of participating school students had *H. pylori* infection. Also, it was reported that 23.6% of examined school students were positive for *H. pylori* infection in Poland15. In Yemen, the prevalence studies of *H. pylori* infection were documented among school children, and no report up to now performed among school students. Therefore, the present study aimed to find out the *pylori* infection among school students in Sana’a city, Yemen.

**MATERIALS AND METHODS**

**Study area and period**

This study is a cross-sectional study carried out at primary and secondary schools in Al-Meaen and Al-Thourah districts during the period from October to December 2021.

**Sample size**

Two hundred and ninety-three(293) blood specimens were randomly collected from school students aged between 11-21 years old attending the primary and secondary schools in Sana’a city.

**Data collection**

A designed questionnaire was subjected to collect information from participating school students. In the questionnaire, questions such as gender, age, study level, parents’ educational status, family size, source of drinking water, consumption of raw vegetables and fruits, hand washing after defecation, infected previously, one of your family infected, and eating food out home were interviewed. Also, the clinical signs and symptoms such as heartburn, nausea, regurgitation, heartburn and regurgitation, abdominal pain, and weight loss as well as antibiotics used were obtained. The questionnaire was constructed in Arabic and translated into English. The students have voluntarily participated into this study. The age group was divided into a group that included; children (11-15 years) and adolescents (16-21 years).

**Inclusion and exclusion criteria**

The students who signed informed consent and delivered blood specimens were included. In contrast, didn't sign an informed consent and did not properly collect their blood sample were excluded.

**Specimens collection and examination**

About five mL of blood specimens were sampled from each student by venipuncture and transferred into a clean tube containing no anticoagulant. The detection of *H. pylori* antibody was performed by using the rapid test of ACON *H. pylori* Ab Test Cassette (ACON Laboratories, Inc, USA).One drop of whole blood was placed cassette test. Also, the blood group was assessed for each student.

**Ethical statement**

The protocol of the present study was approved by the Yemen and Research Ethics Review Committee of Gulf University For Science and Technology, Yemen and permission to start data collection by the Education office belonging to Sana’a city. Further, participation was voluntary and participants completed a consent form by themselves or investigators.

**Statistical analysis**

The obtained findings were analyzed by using the version 18.0 SPSS (Statistical Package for Social Science). A significant difference between the proportions and the groups or variables was determined by and *P*-value (< 0.05 considered significant).

**RESULTS**

**Participated characteristics**

Most A total of 53.24% of the blood specimens were collected were from female students (53.24%) aged between 16-21 years (62.80%) old, who studied at secondary school (67.9%) and their parents have a secondary certificate (35.49%).Also, it was found that the higher specimens were collected from students living with family sizes between 3-7 individuals (50.51%) drinking treated water (84.3%) consuming unwashed vegetables (65.53%) and fruits (59.73%), washed their hands after defecation by water and soap (81.23%), didn't infect previously (81.57%), no one of their family infected (52.9%), always eating food out home, and didn't use antibiotics (703.1%)(70.31%) as summarized in Table (1).

**Table 1: Socio-demographic of schoolchildren participating in a study**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variables** | | **Examined No. (%)** | **Variables** | | **Examined No. (%)** |
| **Gander** | Male | 137(46.76) | **Consumption of raw vegetables** | Yes | 101(34.47) |
| Female | 156(53.24) | No | 192(65.53) |
| **Age**  **(in years)** | 11-15 | 109(37.20) | **Consumption of raw fruits** | Yes | 118(40.27) |
| 16-21 | 184(62.80) | No | 175(59.73) |
| **Study level** | Primary | 94(32.1) | **Hand washing after defecation** | Water and soap | 238(81.23) |
| Secondary | 199(67.9) | Water only | 55(18.77) |
| **Parents’ educational status** | Illiterate | 51(17.41) | **Infected previously** | Yes | 54(18.43) |
| Primary | 49(16.72) | No | 239(81.57) |
| Secondary | 104(35.49) | **One of your family infected** | Yes | 138(47.1) |
| Graduate | 89(30.38) | No | 155(52.9) |
| **Family size** | 3-7 | 148(50.51) | **Eating food out home** | Always | 111(37.88) |
| 8-12 | 106(36.18) | Sometimes | 77(26.28) |
| 13-16 | 39(13.31) | Rare | 105(35.84) |
| **Source of drinking water** | Treated water | 247(84.3) | **Antibiotics used** | Yes | 87(29.69) |
| Not treated | 46(15.7) | No | 206(70.31) |

Table 2 shows that most of the specimens were collected didn’t, the students did not suffer from clinical signs and symptoms such as heartburn, nausea, regurgitation, heartburn and regurgitation, abdominal pain, and weight loss.

**Table 2: Clinical signs and symptoms characterization**

|  |  |  |
| --- | --- | --- |
| **Variables** | | **No. examined (%)** |
| **Heartburn** | Yes | 142 (48.46) |
| No | 151(51.54) |
| **Nausea** | Yes | 133(45.39) |
| No | 160(54.61) |
| **Regurgitation** | Yes | 90(30.72) |
| No | 203(69.28) |
| **Heartburn and regurgitation** | Yes | 134(45.73) |
| No | 159(54.27) |
| **Abdominal pain** | Yes | 141(48.12) |
| No | 152(51.88) |
| **Weight loss** | Yes | 98(33.45) |
| No | 195(66.55) |

**Seroprevalence of H. *H. pylori*antibodies**

The present result revealed that the sero-prevalence of H. *H. pylori* antibody was 82(27.99%) reported among participating students. While211(72.01%) specimens were negative for *H. pylori* antibody (Figure 1).

**Figure 1: Seroprevalence of H. *H. pylori* antibody**

**Seroprevalence of *H. pylori* and its associated risk factors**

The present finding revealed thatmale students had a higher rate (29.25%) of *H. pylori* infection than a female females with a statistically non-significant difference (*P* =0.221). The result according to the age, the age group of 16-21 years had the highest *H. pylori* antibodies with 33.69% when compared to age group of 11-15 years with 18.34%with a statistically significant difference (*P*= 0.031).

Also, it was observed that ~~the student~~ students attending secondary schools (31.66%) and whose parents graduated from university (31.46%) were more infected by *H. pylori* bacterium. Regarding family size, this ~~result~~ findings showed that a higher rate of *H. pylori* infection was recorded among a small number of family sizes (3-7) at 50.51% (Table 3).

However, a higher rate of seroprevalence of *H. pylori* antibodies was recorded among students who drank untreated water (32.61%), consuming of unwashed vegetables (28.71%) and fruits (30.51%), washed their hands after defecation with water and soap (29.41%), not infected previously (28.45%), one of their family infected (28.98%), sometimes eating out of home (32.47%), and didn't ~~non~~ use of antibiotics (29.12%) (Table 3).

**Table 3: Seroprevalence of H. *H. pylori* and according to associated risk factors**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | | **Examined**  **No. (%)** | **Infected**  **No. (%)** | ***P* value** |
| **Gander** | Male | 137(46.76) | 43(29.25) | 0.221 |
| Female | 156(53.24) | 39(25) |
| **Age**  **(in years)** | 11-15 | 109(37.20) | 20(18.34) | 0.031 |
| 16-21 | 184(62.80) | 62(33.69) |
| **Study level** | Primary | 94(32.1) | 19(20.21) | 0.042 |
| Secondary | 199(67.9) | 63(31.66) |
| **Parents’ educational status** | Illiterate | 51(17.41) | 11(21.57) | 0.307 |
| Primary | 49(16.72) | 15(30.61) |
| Secondary | 104(35.49) | 28(26.92) |
| Graduate | 89(30.38) | 28(31.46) |
| **Family size** | 3-7 | 148(50.51) | 45(30.40) | 0.436 |
| 8-12 | 106(36.18) | 30(28.30) |
| 13-16 | 39(13.31) | 7(17.95) |
| **Source of drinking water** | Treated water | 247(84.3) | 67(27.12) | 0.449 |
| Not treated | 46(15.7) | 15(32.61) |
| **Consumption of raw vegetables** | Yes | 101(34.47) | 29(28.71) | 0.841 |
| No | 192(65.53) | 53(27.60) |
| **Consumption of raw fruits** | Yes | 118(40.27) | 36(30.51) | 0.431 |
| No | 175(59.73) | 46(26.28) |
| **Hand washing after defecation** | Water and soap | 238(81.23) | 70(29.41) | 0.260 |
| Water only | 55(18.77) | 12(21.82) |
| **Infected previously** | Yes | 54(18.43) | 14(25.92) | 0.710 |
| No | 239(81.57) | 68(28.45) |
| **One of your family infected** | Yes | 138(47.1) | 40(28.98) | 0.720 |
| No | 155(52.9) | 42(27.09) |
| **Eating food out home** | Always | 111(37.88) | 35(31.53) | 0.087 |
| Sometimes | 77(26.28) | 25(32.47) |
| Rare | 105(35.84) | 22(20.95) |
| **Antibiotics used** | Yes | 87(29.69) | 22(25.28) | 0.505 |
| No | 206(70.31) | 60(29.12) |

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

Table 4 shows that the seroprevalence of *H. pylori* antibodies was higher among students who didn't did not suffer from heartburn (31.13%), nausea (32.5%), regurgitation (30.05%), heartburn and regurgitation (31.45%), and abdominal pain (28.29%) with non-statistical differences (*P* ˃0.05). In contrast, the student with weight loss had more prevalence rate of *H. pylori* antibodies at 29.59%.

**Table 4: Clinical signs and symptoms associated with *H. pylori* infection**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | | **No. examined (%)** | **Infected No. (%)** | ***P* value** |
| **Heartburn** | Yes | 142 (48.46) | 35(24.65) | 0.218 |
| No | 151(51.54) | 47(31.13) |
| **Nausea** | Yes | 133(45.39) | 30(22.56) | 0.059 |
| No | 160(54.61) | 52(32.5) |
| **Regurgitation** | Yes | 90(30.72) | 21(23.33) | 0.239 |
| No | 203(69.28) | 61(30.05) |
| **Heartburn and regurgitation** | Yes | 134(45.73) | 32(23.88) | 0.152 |
| No | 159(54.27) | 50(31.45) |
| **Abdominal pain** | Yes | 141(48.12) | 39(27.66) | 0.905 |
| No | 152(51.88) | 43(28.29) |
| **Weight loss** | Yes | 98(33.45) | 29(29.59) | 0.666 |
| No | 195(66.55) | 52(26.67) |

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

In the present result regarding the blood group, it was found that the higher rate of *H. pylori* antibodies was 30.43% reported among students who had a blood blood group (O) as shown in Table (5)5.

**Table 5: Seroprevelance of *H. pylori* antibodies in relation to blood group**

|  |  |  |  |
| --- | --- | --- | --- |
| **Blood group** | **No. examined (%)** | **Infected No. (%)** | ***P* value** |
| **A** | 120 | 33(27.5) | 0.287 |
| **O** | 138 | 42(30.43) |
| **B** | 29 | 6(20.69) |
| **AB** | 6 | 1(16.67) |

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

**DISCUSSION**

The current study showed that the overall positive seroprevalence of *H. pylori* antibodies was 27.99% recorded among school students. This is in line with the studies that reported the prevalence of *H. pylori* antibody school students 27.4%in Makkah City, Saudi Arabia16, 24.3% in South Western Uganda17, 23.6% in Grudziadz, Poland15. However, the lower rate of *H. pylori* antibodies was recorded at; 9% in Sana'a 6, 15.1% in Taiwan18, and 21.8% in East of Sudan19. In contrast, the higher rate was reported in Yemen at 43.9% in Sana'a20,68% in Hodeidah21, 75.8% in Dhamar22, and at 55.8% in Iraq23.

This result found the male students had a higher rate of *H. pylori* infection than female and were not statistically significant (*P* =0.221). This result is in agreement with a report by Abbas *et al*.19. In contrast, this finding is not constant with several reports that showed that female students had a higher rate of*H. pylori* infection21,22.

These findings indicate that the more higher rate was found among male students might be referred to activities performed outdoor which make them more exposed topotential external sources of *H. pylori* through eating contaminated food from fast food retailers or street vendors with poor sanitation practices.

The present work indicated a high proportion of *H. pylori* antibodies in the age groups of 16-21 years with insignificant differences (*P*= 0.031). This result is in agreement with the study conducted in Hadhramout, Yemen by Bin-Hameed and Barajash[9] who that the older age group had a higher rate of *H. pylori* antibodies. Also, Mehata *et al*. 24 observed that the age group of 15-19 years had the highest rate of *H. pylori* infection.

In the present finding, it was found that the student students with educational secondary level secondary school education level had the highest secondary school education level of participants were more positive for *H. pylori* antibodies and significant association. A study by Bin-Hameed and Barajash9 revealed that the primary and high school education level of participants students accounts for the majority of the positive results for *H. pylori*with no statistically significant difference.

This work found that the students whose parents who graduated from the university were more infected by *H. pylori* bacterium and this is in agreement with the study by Mynepalli *et al*14. The high rate of *H. pylori* prevalence indicates that the education level did not influence on the decrease in the transmission of pathogenic microorganisms in Yemen. Also, some reports mentioned that most individuals educated at the university level may lack awareness of the way pathogens are spread and transmitted25,26.

With respect to family size, In current result findings revealed that the small sized families number of family sizes (3-7 persons) were found to have higher seroprevalence of *H. pylori* with a non-statistical difference. This result is different than most of the reports carried out in different countries that proved that the large family size is more acceptable for the acquisition of *H. pylori* infection but didn't play played no a significant role in the transmission of *H. pylori* 27,28.

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*. 28 28and Mynepalli *et al*14.

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 microorganisms29.Consumption of raw Raw vegetables play an important role in the transmission of pathogenic microorganisms in Yemen30,31,32.

Most student who were positive for *H. pylori* antibodies in exiting work was not infected previously and one of their family infected as well as sometimes eating out of home and didn't use antibiotics with non-statistical significant differences. These results are consents with several reports conducted in different countries21,22,27.

Some reports documented that the antibiotics used were noticed observed to be a significant risk factor for *H. pylori* infection33,34.*H. pylori* resistance to antibiotics is an increasing trend due to the overuse and misuse worldwide of antibiotics, especially in developing countries, for the treatment of other infections35,36,37,38,39 and this is resulting in falling success rates of *H.pylori* eradication and treatment40,41,43.

The seroprevalence of *H. pylori* antibodies was higher among students who didn't did not suffer from clinical signs and symptoms with non-significant differences and this result is similar to some studies9,15,42.*H. pylori* infection in many children may be asymptomatic clinically silent throughout life44,45.

According to the blood group, the present result was found revealed that a higher rate of *H. pylori* antibodies was reported among students who had a possessing blood group (O) with non-statistically significant differences. In similar, Al-Kadassy *et al*. 21 found that the higher prevalence of *H. pylori* antibodies was among students with blood group (O) and non-significant differences.

**Limitations**

The limitations of the present study are represented in the sample size collected from some schools due to limited resources and equipment as a result of the economic circumstances in Yemen. In addition, the lack of advancing diagnostic techniques capable of accurate diagnosis and expensive commercial kits.

**CONCLUSION**

The higher seroprevalence of *H. pylori* infection among school students is considered a threat to the health of the population in the future if it is not controlled. So, applying of health awareness program among school students to enhance their hygienic practices as well as improve water and sanitation might decrease the risk of disease and prevalence of *H. pylori* among school students in Yemen.

**CONFLICT OF INTEREST**

The author declares that this article's content has no conflict of interest.

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