Original Research Article

**Assessment of *Helicobacter pylori* Infection and Risk Factors among Patients with Gastroenteritis in Sebha City, Libya**

.

ABSTRACT

|  |
| --- |
| **Background:** *Helicobacter pylori* infection is the most frequent bacterial infection in humans, affecting 50% of the population worldwide and representing the major pathogen cause of gastritis, peptic ulcer disease, and gastric cancer. Infection with *H. pylori* is a major public health problem in many countries all over the world, particularly in Africa, South America, and Western Asia. This study aimed at assessing the prevalence and risk factors of *H.* *pylori* infection among patients with gastroenteritis in Sebha city, Libya.  **Methods:** This is a cross-sectional study that was conducted on patients with gastroenteritis who had attended the medical Algene laboratory from January to November 2022. Data was obtained through the review of medical records and interviews with patients. *H. pylori* infection was determined by antibody detection using the Alegria® immunodiagnostic system. Statistical analysis was done by SPSS.  **Results:** Out of 175 samples tested, there were 89 (50.9%) males and 86 (49.1%) females, and the mean age of the subjects was 38.9 years. Of the 93 subjects who were reactive to the *H. pylori* screening test, the reactivity of *H. pylori* was found to be 53.5%. The prevalence rates of *H. pylori* among male and female patients were 52.8% and 53.5%, respectively. The maximum positivity rate of *H. pylori* was found among patients aged between 41 and 60 years (60%) and the minimum among those aged less than 20 years (45.8%). There was no significant association between the presence of *H. pylori* infection and gender or age (P > 0.05). Also, there was no significant difference in *H. pylori* infection with dietary habits, sources of drinking water, or smoking (P > 0.05).  **Conclusion**: This study found a high prevalence of *H. pylori* infection in patients with gastroenteritis. It is imperative to effectively manage stressful circumstances in the 41-60 age group. Health education is crucial for understanding risk factors, modes of transmission and prevention methods. |

*Kay words:**Helicobacter pylori, Prevalence, Risk, Factors, Sebha, Libya.*

1. INTRODUCTION

*Helicobacter pylori (H. pylori)* is a spiral-shaped gram-negative bacterium that has a 3-5 pole flagellum for motility and restrictively colonizes gastric epithelial cells. Bacteria are positive for urease, catalase, and oxidase(Wroblewski, Peek Jr, & Wilson, 2010). It was isolated in 1982 by Barry Marshall and Robin Warren from the stomachs of patients with gastritis (Marshall & Warren, 1984). *H. pylori* infection is the most frequent bacterial infection in humans, affecting 50% of the population worldwide, and is responsible for many gastroduodenal pathologies, including duodenal and gastric ulcers, gastric adenocarcinoma, B-cell lymphoma of mucosa-associated lymphoid tissue (MALT), and autoimmune gastritis(D’Elios & Andersen, 2009). According to the International Agency for Research on Cancer, H. pylori has been recognized as a Class I carcinogen(Iarc, 1994), and *H. pylori* infection is associated with an increased risk of gastric malignancies(Parsonnet et al., 1991). The mode of transmission is unclear, but there are most likely numerous ways that infections can be transmitted from one person to another, including contact between people directly through either oral-oral or fecal-oral contact with water sources or food that have been contaminated with the bacteria, from a health care provider during an operation or dental care, and transmission from animals to people(Corojan, Dumitrașcu, Ciobanca, & Leucuta, 2020; Parsonnet et al., 1991). The risk of infection with *H. Pylori* is strongly correlated with hygienic conditions and socioeconomic status. Infection with *H. pylori* is a major public health problem in many countries all over the world, but the prevalence varies widely among countries and among inhabitants groups inside the same country(Suerbaum & Michetti, 2002). The global prevalence of *H. pylori* infection accounted for a wide range, from 18.9% up to 87.7%. It is believed that infection rates are higher in places where there is less access to medical care, such as in developing countries. Worldwide, Africa is the region with the highest prevalence of *H. pylori* 79.1%, which is due to different factors like socio-economic status and hygiene. In developed countries, the range of infection is between 24% and 34.7%(Hooi et al., 2017).The new infection most often occurs in children during their early years through oral-fecal contact and may persist for a long time, especially in developing countries, consequence in a high incidence of *H. pylori* infection. In contrast to that in developed countries, it is more common for people to get infections later in their childhood or adolescence, and the risk of getting an *H. pylori* infection increases with age(Mbulaiteye, Hisada, & El-Omar, 2009). It is important to recognize *H. pylori* infection in different groups of people in different parts of the world. Libya, a developing country in North Africa with over 7 million inhabitants. Most previous studies on the prevalence of *H. pylori* have been conducted with a focus on blood donors. Knowledge of the true prevalence of *H. pylori* infection among patients with gastrointestinal disorders is essential for grasping the significance and scope of this public health issue, and its potential effects on healthcare in the future. Nevertheless, there remains a significant lack of data regarding the burden of *H. pylori* in regions of South Libya, including Sebha city. Therefore, the aim of this study was to assessing the prevalence of *H. pylori* among patients with gastrointestinal disorders and investigate possible associated factors such as gender, drinking water sources, dietary habits, and smoking in Sebha, Libya.

2. methods

**2.1 Study area, design and period:** Sebha is the largest city of southern Libya and is located about 750 kilometers south of the capital, Tripoli. The hospitals did not have the capacity to test for *H. pylori*; there are only a few laboratories that perform the test. This cross-sectional study was conducted on patients with gastroenteritis who had attended the medical Algene laboratory from January 1 to November 30, 2022 in Sebha city, Libya.

**2.2 Data collection:** Thedata about the patient`s gender, age, and diagnosis have been extracted from the laboratory database using the laboratory information system. The patients were asked through a several-option questionnaire about some other important factors, such as ingestion of uncooked or raw food materials, smoking, source of home drinking water, source of school drinking water, the sanitary facility at home, family history of peptic ulcer disease, family history of stomach cancer, overcrowding in the family, abdominal pain regardless of intensity, and a history of decreased appetite.

**2.3 Collection and preparation of specimen:** Venous blood (5 ml) was collected in a white tube; the samples were allowed to clot for 20 minutes at room temperature and then centrifuged at 3000 rpm for 5 minutes. Following this, the serum was transported to a sample cup.

**2.4 Determination of *H. pylori* status**: 175 serum samples collected from patients were tested for the presence of IgG antibodies against the bacterium *H. pylori* by Enzyme-Linked Immunosorbent Assay (ELISA) using commercial kits (Orgentec Diagnostika GmbH Mainz, Germany) through an automated serologic analyzer Alegria® immunodiagnostic system (Germany) according to manufacture instruction and procedure. The interpretation of results: Negative test for *H. Pylori*: < 20 U/ml. Positive test for *H. Pylori*: > 25 U/ml. Borderline for *H. Pylori*: 20 - 25 U/ml.

**2.5 Statistical Analysis:** Information from the laboratory investigation and questionnaire was entered into Microsoft Office and exported to Statistical Package for Social Sciences (SPSS) 26. Descriptive statistics were used, and Chi-square was used to compare between groups and a P < 0.05 was considered significant.

**3. RESULTS**

Out of the 175 patients that were enrolled in the study, 89 (50.9%) were males and 86 (49.1%) were females. The age of the subjects ranged from 2 to 88 years, and the mean age was 38.9 ± SD 18.3 years. The age of the patients was divided into four age groups: <20, 20–40, 41–60, and >60 years. 45.1% were aged between 20 and 40 years, followed by 25.7% for the age group between 41 and 60 years old. The frequency and percentage of the demographic characteristics such as sex and age are shown in (Table 1).

**Table 1.** **Socio-demographic characteristics of patients with gastroenteritis in Sebha, Libya**

|  |  |  |
| --- | --- | --- |
| **Variables** | **Frequency** | **Percent (%)** |
| **Sex** | | |
| Male | 89 | 50.9 |
| Female | 86 | 49.1 |
| **Age** | | |
| <20 years | 24 | 13.7 |
| 20-40 yrs | 79 | 45.1 |
| 41-60 yrs | 45 | 25.7 |
| >60 yrs | 27 | 15.4 |
| Total | 175 | 100 |

Comparative analysis of the data regarding anti-*H. pylori* positive and negative subjects is summarized in (Table 2). Of the 175 serum samples analyzed, anti-*H. pylori* IgG was detected in 93 (53.1%). The prevalence of *H. pylori* infection in males was 52.8% (47/175), nearly the same as that in females, 53.5% (76/175). In the distribution of *H. pylori* IgG positivity among patients by age groups, the higher positive sample rate (60.0%) was reported in the age group 41–60 years, the lower positive samples (45.8%) showed in the age group <20 years, *H. pylori* prevalence has no statistically significant association with sex or age (p> 0.05).

**Table 2.** **Prevalence of *H. pylori* infection by demographic characteristics and associated risk factors of study participants.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | ***Helicobacter Pylori* Infection** | | **p-value** |
| Positive | Negative |
| **Sex** | | | |
| Male | 47 (52.8%) | 42 (47.2%) | 0.928 |
| Female | 46 (53.5%) | 40 (46.5%) |
| **Age** | | | |
| <20 years | 11 (45.8%) | 13 (54.2%) | 0.653 |
| 20-40 yrs | 40 (50.6%) | 39 (49.4%) |
| 41-60 yrs | 27 (60.0%) | 18 (40.0%) |
| >60 yrs | 15 (55.6%) | 12 (44.4%) |
| Total | 93 (53.1%) | 82 (46.9%) |
| **Ingestion of uncooked/ raw food materials** | | | |
| Yes | 4 (100%) | 0 (0.0%) | 0.164 |
| No | 81 (51.9%) | 75 (48.1% |
| No answer | 8 (53.3%) | 7 (46.7%) |
| **Smoking** | | | |
| Yes | 24 (58.5%) | 17 (41.5%) | 0.723 |
| No | 61 (51.3%) | 58(48.7%) |
| No answer | 8 (53.3%) | 7 (46.7%) |
| **Source of drinking water** | | | |
| Mineral water | 76 (53.5%) | 66 (46.5%) | 0.961 |
| Borehole | 9 (50.0%) | 9 (50.0%) |
| No answer | 8 (53.3%) | 7 (46.7%) |
| **Sanitary facility at home** | | | |
| Yes | 84 (53.8%) | 72 (46.2%) | 0.174 |
| No | 0 (0.0%) | 3 (100%) |
| No answer | 9 (56.3%) | 7 (43.8%) |
| **Family history of peptic ulcer disease** | | | |
| Yes | 21 (55.3%) | 17 (44.7%) | 0.955 |
| No | 64 (52.5%) | 58 (47.5%) |
| No answer | 8 (53.3%) | 7 (46.7%) |
| **Family history of cancer of stomach** | | | |
| Yes | 3 (60.0%) | 2 (40.0%) | 0.489 |
| No | 81 (53.3%) | 71 (46.7%) |
| No answer | 9 (56.3%) | 7 (43.8%) |
| **Overcrowding in the family** | | | |
| Yes | 7 (63.6%) | 4 (36.4%) | 0.769 |
| No | 78 (52.3%) | 71 (47.7%) |
| No answer | 8 (53.3%) | 7 (46.7%) |
| **Abdominal pain regardless of intensity** | | | |
| Yes | 72 (53.3%) | 63 (46.7%) | 0.992 |
| No | 13 (52.0%) | 12 (48.0%) |
| No answer | 8 (53.3%) | 7 (46.7%) |
| **Decreased appetite** | | | |
| Yes | 64 (52.5%) | 58 (47.5%) | 0.955 |
| No | 21 (55.3%) | 17 (44.7%) |
| No answer | 8 (53.3%) | 7 (46.7%) |

As revealed in Table 2, antibodies against *H. pylori* were detected in 100% of individuals who inhaled uncooked or raw food materials (P = 0.164), whereas in those who smoked, they reached 58.5%  (P=0.723). while The prevalence among participants using mineral water sources was 53.5% (P = 0.961)  and 53.8% among those who have sanitary facilities at home (P = 0.174), whereas 55.3% of *H. pylori* infection was higher among those who had a family history of peptic ulcer disease  (P=0.955), 60% of patients with a family history of stomach cancer were positive for *H. pylori* IgG (P = 0.489); the sero-positivity of *H. pylori* in individuals who had overcrowding in the family was 63.6% (P=0.769). Antibody against *H.* *pylori* infection was found in 53.3% of patients who had abdominal pain regardless of intensity (P = 0.992)  and in 52.5% of patients who had decreased appetite (P=0.955). In this finding, there was no statistically significant association between all these expected risk factors and the prevalence of *H. pylori* (p > 0.05).

**4. DISCUSSION**

*Helicobacter pylori* is a major cause of gastritis and as a consequence increases the morbidity and mortality of the patients and is extra common in developing nations than in developed nations. It has been reported that the highest burden of *H. pylori* is in Africa (D’Elios & Andersen, 2009; Hooi et al., 2017), There is a little information on the extent of infection with *H. pylori* in southern Libya. Therefore, we selected Sebha city, in south Libya, for this study, in addition to its nearness to sub-Saharan countries and the fact that it has many African immigrants. The present study shows that *H.* *pylori* causing gastroenteritis has an overall prevalence of 53.1% which is lower compared to the studies done in Libya, which were in Benghazi 56.5%(Almehdawi & Ali, 2016), Sirte 83%(A. Abdallah et al., 2021), and Mesllata 76.8%(Ajedi, Mohamed, & Mohamed). However, the prevalence of *H. pylori* in the present study was consistent with that reported by (Diab et al., 2018). ) among Egyptian patients (53.1%). Our study is in agreement with that reported in the recent study done in Erbil city, Iraq which was 53.3% (Majeed & Khoshnaw, 2020). Whereas the finding is lower compared to the studies conducted in Uganda 87%(Newton et al., 2006), Nigeria, 81.7% (Bello, Umar, & Borodo, 2018), Afghanistan 75.6%(Hamrah et al., 2017), South Africa, 66.1%(Tanih et al., 2010), Eastern Sudan, 65.8%(T. M. Abdallah, Mohammed, Mohammed, & Ali, 2014), and 64.39% Cameroon(Kouitcheu Mabeku, Noundjeu Ngamga, & Leundji, 2018). Moreover, the study prevalence was high with those reported in North Jakarta 22.5%(Darnindro, Syam, Fauzi, & Rumende, 2015), Southwest Ethiopia 42.8%(Belay, Abateneh, & Yehualashet, 2020), Tanzania 39.1%(Jaka et al., 2016), USA 36.3%(SMITH, Li, & Rosson, 2009) and UK 27.6% (Moayyedi et al., 2002).

Sex is suggested to be a possible risk factor for H*.*pylori infection(Torres et al., 1998) reported a higher prevalence rate of 62.7 % in females than 59.8% in males. In the current study, sex distribution, the *H. pylori* infection prevalence among females (53.5%) compared to males (52.8%). This is similar to what was reported by (Alebie & Kaba, 2016) with H*.*pylori prevalence higher among females (75.5%) than males (68.5%), (Almashhadany, Mayas, Mohammed, Hassan, & Khan, 2023) found higher H*.*pylori  prevalence among females (21.9%) than males (17.2%). Nonetheless, and disagree with a systematic review and meta-analysis study done by (Zamani et al., 2018) about the worldwide prevalence of *H. pylori* infection concluded that the rate was 42.7% in females compared to 46.3% in males.

This study has shown that age distribution, the highest rate of *H. pylori* prevalence (60%) was founded among the age group 41-60 years, while the lowest rate (45.8%) was shown in patients <20 years, showing a high incidence of *H. pylori* infection for more than 40 years. The prevalence rates increased with age, this finding agreed with other studies conducted in Mexico(Torres et al., 1998), Iran(Alizadeh et al., 2009), Lebanon(Ismail, Osman, Raad, Achkar, & Hamze, 2022), Korea(Lim et al., 2018), and it is differed from other previous research that demonstrated a high prevalence rate of *H. pylori* infection recorded in less than 40 years, which reported in Iraq(Al-Mossawei, Rzooqi, & Abdulrazzaq, 2016), Sudan(T. M. Abdallah et al., 2014), Benghazi(Almehdawi & Ali, 2016).Therefore, the dissimilarities between the current findings and some prior studies are perhaps due to the dietary habits of the patient, poor socioeconomic status, poor hygienic conditions, water supply and environmental circumstances(Al-Mossawei et al., 2016).

The current study showed that there was no statistically significant association between the prevalence of *H. pylori* infection and raw food materials, which was in agreement with findings reported by (Santos et al., 2005), however, a contrasting result was documented by (Goodman et al., 1996), who found that *H. pylori* prevalence occurred more in individuals who frequently consumed raw vegetables.

In this study, a record of smoking was not associated with *H. pylori* positivity, which is in accordance with that notes in previous reports in Sudan and Lebanon(T. M. Abdallah et al., 2014; Assaad, Chaaban, Tannous, & Costanian, 2018).

Concerning overcrowding in the family, when there are too many people in a place, it's harder to keep everyone safe. This study has not found an association between the number of persons who lived in the home and *H. pylori* infection (p>0.05) which is similar to other epidemiologic studies in Ethiopia and Bahrain(Habbash et al., 2022; Shiferaw & Abera, 2019). Contrary to this, a study done by (Goodman et al., 1996), found an association between *H.* *Pylori* and the number of persons who lived in the home in Colombian population. The absence of association in this study might be due to the difference in the sample size.

Regarding to the source of drinking water was not significantly associated with *H. pylori* infection (p > 0.05), this result is consistent with other previous research in Ethiopia and China(Shi et al., 2008; Shiferaw & Abera, 2019). In this study, the majority of inhabitants use mineral water, so it's hard to distinguish between different sources of drinking water.

In term of the family history of cancer of stomach and peptic ulcer disease, appears no relation to *H. pylori* infection in the current study. Consistent with the findings of (Shi et al., 2008) in Chinese populations as no association detected between *H. pylori* infection and any of the history of these factors.

Furthermore, in the present study, there was no significant association of *H. pylori* positivity with other gastrointestinal symptoms, such as abdominal pain and early satiety, this finding is similar to the report of (Hamrah et al., 2017). Knowing the *H. pylori* status of a community or country can help protect people's health. This report describes a patients with gastrointestinal disorders status of *H. pylori* infection rates in Sebha city. Although, the public health importance of this study, there are limitations, first, all the participants in this study were hospital patients exhibiting symptoms and signs of chronic gastrointestinal disorders, which might not be a good epidemiological representation of *H. pylori* infection in the city, Secondly, molecular detection methods were not utilized, even though they provide a confirm diagnosis for this pathogen.

5. Conclusion

This study has found a high occurrence of *H. pylori* infection among patients with gastroenteritis in Sebha city. Furthermore, females have a higher rate of *H. pylori* infection than males; the majority of the patients found positive for *H. pylori* were between 41 and 60 years old, but it was not significantly related to gender, age, or lifestyle factors. There should be routine screening of *H. pylori* infections in diagnosed patients with gastroenteritis in Sebha city to guide therapeutic decisions. Molecular characterization and fecal detection of the *H. pylori* antigen should be performed to accurately assess the prevalence of *H. pylori* in future studies. Additionally, larger-scale studies involving household contacts of patients who test positive are necessary to obtain more conclusive results. It is also recommended to implement health education programs aimed at improving food and water security.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Consent

This study was conducted in accordance with the guidelines of the Declaration of Helsinki and its subsequent amendments, and informed consent was obtained from all patients enrolled in the study. Additionally, permission to conduct the study at the Algene Medical Laboratory in Sebha was granted by the laboratory authorities.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

References

Abdallah, A., Abdallah, A., Adabo, H., Alfughi, F., Ali, N., Said, A., & Majduob, M. (2021). Study to determine the prevalence of *Helicobacter pylori* infection among the Sirte population (Libya) using an Antibody Rapid Test Cassette method. *Libyan Journal of Science &Technology. 2021;13: 1:1-4*

Abdallah, T. M., Mohammed, H. B., Mohammed, M. H., & Ali, A. A. A. (2014). Sero-prevalence and factors associated with *Helicobacter pylori* infection in Eastern Sudan. *Asian Pacific journal of tropical disease, 4*(2), 115-119.

Ajedi, A. S., Mohamed, A. A., & Mohamed, S. A. Sero-prevalence of *Helicobacter pylori* in Libyan patient with gastroenteritis.

Al-Mossawei, M. T., Rzooqi, W. H., & Abdulrazzaq, S. (2016). Detection of *Helicobacter* *pylori* IgG and IgM antibodies in Iraqi dyspeptic patients. *Journal of Biotechnology Research Center, 10*(1), 5-9.

Alebie, G., & Kaba, D. (2016). Prevalence of *Helicobacter pylori* infection and associated factors among gastritis students in Jigjiga University, Jigjiga, Somali regional state of Ethiopia. *J Bacteriol Mycol, 3*(3), 00060.

Alizadeh, A., Ansari, S., Ranjbar, M., Shalmani, H., Habibi, I., Firouzi, M., & Zali, M. (2009). Seroprevalence of *Helicobacter pylori* in Nahavand: a population-based study. *EMHJ-Eastern Mediterranean Health Journal, 15 (1), 129-135, 2009*.

Almashhadany, D. A., Mayas, S. M., Mohammed, H. I., Hassan, A. A., & Khan, I. U. (2023). Population-and Gender-Based Investigation for Prevalence of *Helicobacter pylori* in Dhamar, Yemen. *Canadian Journal of Gastroenterology and Hepatology, 2023*.

Almehdawi, K. A., & Ali, R. H. (2016). The prevalence of *Helicobacter pylori* infection in Benghazi, Libya. *IOSR Journal of Dental and Medical Sciences, 16*(04).

Assaad, S., Chaaban, R., Tannous, F., & Costanian, C. (2018). Dietary habits and Helicobacter pylori infection: a cross sectional study at a Lebanese hospital. *BMC gastroenterology, 18*, 1-13.

Belay, A. S., Abateneh, D. D., & Yehualashet, S. S. (2020). Seroprevalence of *Helicobacter* *pylori* infection and associated factors among adult dyspeptic patients in public health facilities, Mizan Aman town, Southwest, Ethiopia: Institutional-based cross-sectional study. *International Journal of General Medicine*, 577-585.

Bello, A., Umar, A., & Borodo, M. (2018). Prevalence and risk factors for *Helicobacter pylori* infection in gastroduodenal diseases in Kano, Nigeria. *African Journal of Medical and Health Sciences, 17*(1), 41-41.

Corojan, A. L., Dumitrașcu, D. L., Ciobanca, P., & Leucuta, D. C. (2020). Prevalence of *Helicobacter pylori* infection among dyspeptic patients in Northwestern Romania: A decreasing epidemiological trend in the last 30 years. *Experimental and Therapeutic Medicine, 20*(4), 3488-3492.

D’Elios, M. M., & Andersen, L. P. (2009). Inflammation, immunity, and vaccines for *Helicobacter pylori*. *Helicobacter, 14*, 21-28.

Darnindro, N., Syam, A. F., Fauzi, A., & Rumende, C. M. (2015). Seroprevalence and socio-demographic factors of *Helicobacter pylori* infection in patients with dyspepsia in Kalibaru primary health care north Jakarta. *Acta Med Indones, 47*(4), 297-303.

Diab, M., El-Shenawy, A., Shemis, M., Ghannam, M., Said, M., Abdelnasser, M., . . . Saber, M. (2018). *Helicobacter pylori* infection in egyptian patients with dyspepsia: diagnostic, demographic, endoscopic and clinical characteristics. *International Journal of Advanced Research, 6*(6), 226-234.

Goodman, K. J., Correa, P., Aux, H. J. T., Ramirez, H., DeLany, J. P., Pepinosa, O. G., . . . Parra, T. C. (1996). *Helicobacter pylori* infection in the Colombian Andes: a population-based study of transmission pathways. *American journal of epidemiology, 144*(3), 290-299.

Habbash, F., Alalwan, T. A., Perna, S., Ahmed, N., Sharif, O., Al Sayyad, A., . . . Rondanelli, M. (2022). Association between Dietary Habits and *Helicobacter pylori* Infection among Bahraini Adults. *Nutrients, 14*(19), 4215.

Hamrah, M. H., Hamrah, M. S., Hamrah, M. H., Kanda, M., Hamrah, A. E., Dahi, A. E., . . . Sakamoto, J. (2017). Prevalence of *Helicobacter pylori* infection in dyspeptic patients in Andkhoy Afghanistan. *Asian Pacific journal of cancer prevention: APJCP, 18*(11), 3123.

Hooi, J. K., Lai, W. Y., Ng, W. K., Suen, M. M., Underwood, F. E., Tanyingoh, D., . . . Wu, J. C. (2017). Global prevalence of *Helicobacter pylori* infection: systematic review and meta-analysis. *Gastroenterology, 153*(2), 420-429.

Iarc, L. (1994). Schistosomes, liver flukes and *Helicobacter pylori*. *IARC Monographs on the Evalutaion of Carcinogenic Risks to Humans, 61*, 1-241.

Ismail, M. B., Osman, M., Raad, E. B., Achkar, M., & Hamze, M. (2022). Seroprevalence of *Helicobacter pylori* among dyspeptic patients in northern Lebanon: a 6-year retrospective study in two tertiary hospitals. *Access Microbiology, 4*(4).

Jaka, H., Mushi, M. F., Mirambo, M. M., Wilson, L., Seni, J., Mtebe, M., & Mshana, S. E. (2016). Sero-prevalence and associated factors of *Helicobacter pylori* infection among adult patients with dyspepsia attending the gastroenterology unit in a tertiary hospital in Mwanza, Tanzania. *African Health Sciences, 16*(3), 684-689.

Kouitcheu Mabeku, L. B., Noundjeu Ngamga, M. L., & Leundji, H. (2018). Potential risk factors and prevalence of *Helicobacter pylori* infection among adult patients with dyspepsia symptoms in Cameroon. *BMC infectious diseases, 18*, 1-11.

Lim, S. H., Kim, N., Kwon, J. W., Kim, S. E., Baik, G. H., Lee, J. Y., . . . Myung, D.-S. (2018). Trends in the seroprevalence of *Helicobacter pylori* infection and its putative eradication rate over 18 years in Korea: a cross-sectional nationwide multicenter study. *PLoS One, 13*(10), e0204762.

Majeed, P. D., & Khoshnaw, K. J. S. (2020). Seroprevalence of *Helicobacter pylori* infection among patients with gastroduodenal disorders in Erbil city. *Diyala Journal of Medicine, 18*(1), 91-101.

Marshall, B., & Warren, J. R. (1984). Unidentified curved bacilli in the stomach of patients with gastritis and peptic ulceration. *The lancet, 323*(8390), 1311-1315.

Mbulaiteye, S. M., Hisada, M., & El-Omar, E. M. (2009). *Helicobacter pylori* associated global gastric cancer burden. *Frontiers in Bioscience-Landmark, 14*(4), 1490-1504.

Moayyedi, P., Axon, A. T., Feltbower, R., Duffett, S., Crocombe, W., Braunholtz, D., . . . Forman, D. (2002). Relation of adult lifestyle and socioeconomic factors to the prevalence of *Helicobacter pylori* infection. *International journal of epidemiology, 31*(3), 624-631.

Newton, R., Ziegler, J. L., Casabonne, D., Carpenter, L., Gold, B. D., Owens, M., . . . Wabinga, H. (2006). *Helicobacter pylori* and cancer among adults in Uganda. *Infectious agents and cancer, 1*(1), 1-5.

Parsonnet, J., Friedman, G. D., Vandersteen, D. P., Chang, Y., Vogelman, J. H., Orentreich, N., & Sibley, R. K. (1991). *Helicobacter pylori* infection and the risk of gastric carcinoma. *New England Journal of Medicine, 325*(16), 1127-1131.

Santos, I. S., Boccio, J., Santos, A. S., Valle, N. C., Halal, C. S., Bachilli, M. C., & Lopes, R. D. (2005). Prevalence of *Helicobacter pylori* infection and associated factors among adults in Southern Brazil: a population-based cross-sectional study. *BMC public health, 5*(1), 1-10.

Shi, R., Xu, S., Zhang, H., Ding, Y., Sun, G., Huang, X., . . . Zhang, G. (2008). Prevalence and risk factors for *Helicobacter pylori* infection in Chinese populations. *Helicobacter, 13*(2), 157-165.

Shiferaw, G., & Abera, D. (2019). Magnitude of *Helicobacter pylori* and associated risk factors among symptomatic patients attending at Jasmin internal medicine and pediatrics specialized private clinic in Addis Ababa city, Ethiopia. *BMC infectious diseases, 19*, 1-6.

SMITH, J. G., Li, W., & Rosson, R. S. (2009). Prevalence, clinical and endoscopic predictors of *Helicobacter pylori* infection in an urban population. *Connecticut medicine, 73*(3).

Suerbaum, S., & Michetti, P. (2002). Helicobacter pylori infection. *New England Journal of Medicine, 347*(15), 1175-1186.

Tanih, N., Okeleye, B., Ndip, I., Clarke, A., Naidoo, N., Mkwetshana, N., . . . Ndip, R. (2010). *Helicobacter pylori* prevalence in dyspeptic patients in the Eastern Cape Province–race and disease status. *South African Medical Journal, 100*(11), 734-737.

Torres, J., Leal-Herrera, Y., Perez-Perez, G., Gomez, A., Camorlinga-Ponce, M., Cedillo-Rivera, R., . . . Munoz, O. (1998). A community-based seroepidemiologic study of *Helicobacter pylori* infection in Mexico. *The Journal of infectious diseases, 178*(4), 1089-1094.

Wroblewski, L. E., Peek Jr, R. M., & Wilson, K. T. (2010). *Helicobacter pylori* and gastric cancer: factors that modulate disease risk. *Clinical microbiology reviews, 23*(4), 713-739.

Zamani, M., Ebrahimtabar, F., Zamani, V., Miller, W., Alizadeh‐Navaei, R., Shokri‐Shirvani, J., & Derakhshan, M. (2018). Systematic review with meta‐analysis: the worldwide prevalence of *Helicobacter pylori* infection. *Alimentary pharmacology & therapeutics, 47*(7), 868-876.