زانکۆی سەلاحەدین-هەولێر

Salahaddin University-Erbil

H.pylori and Food Product a Public Health Problem

Research project

Submitted to the department of Biology /College of Education in partial fulfillment of the requirements for the degree of BSc. in Biology

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(قُلْ هَلْ يَسْتَوِي الّذِينَ يَعْلَمُونَ وَالّذِينَ لاَ يَعْلَمُونَ إِنَّمَا يَتَذَكَّرُ أُولُو الأَلْبَابِ)

سورة الزمر / الآية 9

SUPERVISOR CERTIFICATE

This research project has been written under my supervision and has been submitted for the award of the degree of BSc. in Biology with my approval as a supervisor.

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Date**:**

I confirm that all requirements have been fulfilled

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Head of the department of biology

Date**:**

DEDICATION

This work is dedicated to

My family

My special friends

My supervisor

My cousin

ACKNOWLEDGEMENTS

Thanks for Allah, the only one ,and for his bounty , which will not be completed .

My deepest gratitude to my supervisor Prof. Dr. Khadija Kh. M. Barzani for her supervision and choosing of this project, scientific guidance, and support during the period of the study.

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Thanks for all my friends who help me to complete my study and thanks for my family which help me for complete my research.

ABSTRACT

Helicobacter pylori (*H. pylori*) is a major human pathogen causing gastritis and chronic superficial infection . This bacterium is associated with the gastric antral epithelium in patients with active chronic gastritis, peptic (gastric) or duodenal ulcers, and gastric adenocarcinoma . Therefore, consumption of sewage-contaminated drinking water and vegetables may pose a risk; properly cooking foods and chlorinating water reduces the risk of transmitting *H. pylori* to humans. In present study , the total number of patients admitted to several private hospitals in Erbil city during (2023) were 865patients including 581 males and 284 females with age ranged between 14- 60 years old and the collected data in present study depended on urea breath test.The results showed that 313 patients infected with *H. pylori* with percentage (36.18%) . However, the *H. pylori* infection in females was higher than males in current study which were 582 and 284 with percentage (67.2%) and (32.8%) respectively. On the other hand, urea breath test is the gold test for detection of *H. pylori* infection and more accurate.

Keyword: Bacteria, Food product, Health problem, Ulcer, Dietary habits, Clinical specimens,Cancer.

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1. INTRODUCTION

Gastrointestinal (GI) diseases are so common that, unfortunately, most people have had first-hand experience with the unpleasant symptoms, such as diarrhea, vomiting, and abdominal discomfort. The causes of gastrointestinal illness can vary widely, but such diseases can be grouped into two categories: those caused by infection (the growth of a pathogen in the GI tract) or intoxication (the presence of a microbial toxin in the GI tract). Once of the most common bacterial gastric infections worldwide is *H. pylori. Helicobacter pylori (H. pylori*) was first identified in the stomach of dogs as a spiral microorganism by Giulio Bizzozero in 1892 (Bizzozero,1893). Named it "*Helicobacter pylori"* as it has a helical structure and is mostly found in the pyloric region of the stomach (Goodwin,1993). *H. pylori* is a 0.5–1 μm wide, 2–4 μm long, short helical, S-shaped Gram-negative microorganism and infects more than half of the world's population (Öztekin et al.,2021). *H. pylori* has many flagella at the same location which gives it a high motility.

Most people infected with *H. pylori* never experience symptoms or complications (de Brito et al,. 2019). However, individuals infected with *H. pylori* have a 10% to 20% risk of developing peptic ulcers, and 0.5% to 2% risk of developing stomach cancer (Debowski et al., 2017). Acute infection may appear as an acute gastritis with upper abdominal pain (stomach ache) or nausea (Butcher,.2003).Where this develops into chronic gastritis, the symptoms, if present, are often those of indigestion, stomach pains, nausea, bloating, belching, and sometimes vomiting. Pain typically occurs when the stomach is empty, between meals, and in the early morning hours, but it can also occur at other times. Symptoms of an ulcer may include nausea, vomiting, and loss of appetite(Ryan, 2010).

H. pylori plays a role in the development of diseases such as gastritis and mucosa-associated lymphoid tissue (MALT) lymphoma, as well as peptic ulcer and gastric cancer (Suerbaum et al., 2002). The mode of transmission of *H. pylori* is not known exactly, but the faecal–oral or oral–oral routes via water or food consumption are thought to be a very common cause (Brown, 2000).Many antibiotic treatments are used for the treatment of H. pylori, and studies show that the number of strains resistant to antibiotics used for treatment is increasing rapidly (Rymond et al., 2010), which has led to the search for alternative agents to create safer and more effective results in addition to antibiotic treatments (Guttner et al., 2003).

It is thought that dietary factors may play a considerably important role in *H. pylori* infection, and it has been reported that an adequate and balanced diet, especially high and abundant fruit and vegetable consumption, has a protective effect against the outcomes of *H. pylori* infection (Mard et al., 2014). However, some studies have suggested a relationship between *H. pylori* infection and malabsorption of essential micronutrients, and it may cause malnutrition in some groups in the long term (Franceschin et al., 2014). This study aimed to discuss the general clinical features of *H. pylori* and its relationship with nutrition, in addition to the treatment practices related to the disease.

2. LITERATURE REVIEW

2.1 *Helicobacter pylori* History

Helicobacter pylori migrated out of Africa along with its human host circa 60,000 years ago (Correa et al., 2007). Recent research states that genetic diversity in *H. pylori*, like that of its host, decreases with geographic distance from East Africa. Using the genetic diversity data, researchers have created simulations that indicate the bacteria seem to have spread from East Africa around 58,000 years ago. Their results indicate modern humans were already infected by *H. pylori* before their migrations out of Africa, and it has remained associated with human hosts since that time (Linz et al., 2007). *H. pylori* was first discovered in the stomachs of patients with gastritis and ulcers in 1982 by Barry Marshall and Robin Warren of Perth, Western Australia. At the time, the conventional thinking was that no bacterium could live in the acid environment of the human stomach. In recognition of their discovery, Marshall and Warren were awarded the 2005 Nobel Prize in Physiology or Medicine (Öztekin et al., 2021). As they are Campylobacter-like spiral microorganisms, they were named *Campylobacter pyloridis* by Barry Marshall and Robin Warren in 1983. Named it "*Helicobacter pylori"* in1989, as it has a helical structure and mostly found in the pyloric region of the stomach (Öztekin et al., 2021). Some skepticism was expressed initially, but within a few years multiple research groups had verified the association of *H. pylori* with gastritis and, to a lesser extent, ulcers (Atood, 2004). To demonstrate *H. pylori* caused gastritis and was not merely a bystander, Marshall drank a beaker of *H. pylori* culture. He became ill with nausea and vomiting several days later. An endoscopy 10 days after inoculation revealed signs of gastritis and the presence of *H. pylori*. These results suggested *H. pylori* was the causative agent. Marshall and Warren went on to demonstrate antibiotics are effective in the treatment of many cases of gastritis. In 1994, the National Institutes of Health stated most recurrent duodenal and gastric ulcers

were caused by *H. pylori*, and recommended antibiotics be included in the treatment regimen. In 2023, it was estimated that about two-third's of the world's population had *H. pylori* infection, with its being more common in developing countries. The prevalence has declined in many countries due to eradication treatments with antibiotics, and proton-pump inhibitors (Li Yunhao et al., 2023) and with increased standards of living (Hooi et al., 2017). The classification of *H. pylori* as follow:-

Phylum: Campylobacterota

Class:" Campylobacteria"

Order: Campylobacterales

Family: Helicobacteraceae

Genus: Helicobacter

Species: *H. pylori* (Li Yunhao et al., 2023)

2.2 *Helicobacter pylori* Morphology

H.pylori a dominant human pathogen, is now recognized as the first member of an ultrastructurally diverse genus. The predominant morphological form of this genus is curved to spiral These basic characteristics of morphology and motility are thought to be advantageous to these organisms due to their localization in the mucous layer of the gastrointestinal tracts of humans and a variety of animals (Allen et al.,1997) . Helicobacters are motile by means of flagella. The bacterium is urease , catalase and oxidase-positive is spiral- shaped and possesses 3-5 polar flagella that are used for motility (Sowaid et al , 2022) as shown in figure (1).

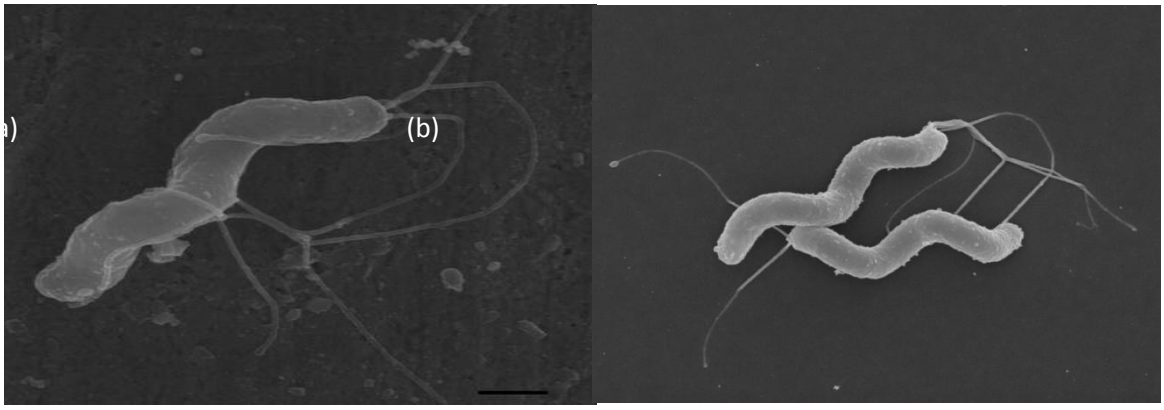

Figure 1. (a) *Helicobacter pylori* has several flagella at the one polar to give motility. (b) it "*Helicobacter pylori*" as it has a helical structure 0.5–1 µm wide, 2–4 µm long, short helical

Morphological plasticity as a mechanism enabling the adaptation of microbes to changing environmental conditions Classical classification of *H. pylori* morphological forms includes the division into: live, culturable spiral forms – related to the process of host colonisation, and live, non-culturable coccoid forms – associated with the viable but non-culturable (VBNC) process and the

survival of this bacterium under unfavourable conditions (Kryzek et al., 2018). In addition, the existence of rod-shaped and filamentous forms of *H. pylori* (Sycuro et al., 2010). They also may appear in different shapes such as:-

a- Coccoid forms

The transformation of *H. pylori* from culturable spiral forms into non-culturable coccoids occurs during exposition to adverse conditions, including: nutrient starvation (Enorth et al., 1996), prolonged in vitro incubation (Nilson et al.,2002), presence of low or high temperature incubation at alkaline pH drastic change of culture environment from a nutrient-rich medium to pure water (Catrenich et al.,1991).

b- **Rod forms**

An alternative phenotype for spiral and spherical is rod-shaped morphology Little is known about the environmental conditions that stimulate the transition to rod forms, whereas it is observed that in freshly isolated strains of *H. pylori* about 10–15% of all cells become rod-like forms (Waidner et al., 2009).

c- Filamentous forms

Another morphological form presented by *H. pylori* is the filamentous, elongated phenotype (Singh et al.,2015). Normally, filamentation contributes to the increase of adhesion to the mucosal surfaces, promoting slow, ligand-dependent uptake of filamentous microbes into the interior of eukaryotic cells (invasion), and by multiplying the cell length this process is also responsible for phagocytosis avoidance [Yang et al.,2016].

2.3 *Helicobacter pylori* Infection

Helicobacter pylori harms the stomach and duodenal linings by several mechanisms. The ammonia produced to regulate pH is toxic to epithelial cells, as are biochemicals produced by H. pylori such as proteases, vacuolating cytotoxin A (VacA) (this damages epithelialcells),andcertain phospholipases (Smoot, 1997). Cytotoxin associated gene CagA can also cause inflammation and is potentially a carcinogen (Hatakeyama et al., 2005). Colonization of the stomach by *H. pylori* can result in chronic gastritis, an inflammation of the stomach lining, at the site of infection. Helicobacter cysteine-rich proteins (Hcp), particularly HcpA (hp0211), are known to trigger an immune response, causing inflammation (Dumrese et al., 2009). Chronic gastritis is likely to underlie *H. pylori*-related diseases. Peptic ulcers in the stomach and duodenum are a consequence of inflammation that allows stomach acid and the digestive enzyme pepsin to overwhelm the protective mechanisms of the stomach and duodenal mucous membranes. The location of colonization of *H. pylori*, which affects the location of the ulcer, depends on the acidity of the stomach (Dixon, 2000). In people producing large amounts of acid, *H. pylori* colonizes near the pyloric antrum (exit to the duodenum) to avoid the acid-secreting parietal cells at the fundus (near the entrance to the stomach) (Kuster et al., 2006). In people producing normal or reduced amounts of acid, *H. pylori* can also colonize the rest of the stomach. The inflammatory response caused by bacteria colonizing near the pyloric antrum induces G cells in the antrum to secrete the hormone gastrin, which travels through the bloodstream to parietal cells in the fundus (Blaser at el., 2004). Gastrin stimulates the parietal cells to secrete more acid into the stomach lumen, and over time increases the number of parietal cells, as well. The increased acid load damages the duodenum, which may eventually result in ulcers forming in the duodenum. When *H. pylori* colonizes other areas of the stomach, the inflammatory response can result in atrophy of the stomach lining and eventually ulcers in the stomach. This also may increase

the risk of stomach cancer (Suerbaum et al., 2002). Individuals with chronic *H. pylori* infection have an increased risk of acquiring a cancer that is directly related to this infection (Abbas et al., 2017).

2.4 *Helicobacter pylori* Phathogenesis

H. pylori is easily killed in hydrochloric acid solutions with a pH below 4.0. It is quite paradoxical for a microorganism whose primary site is the stomach. H. pylori continues to live in the lower part of the stomach by penetrating the mucus layer of the stomach through the contribution of its spiral shape and flagella . To neutralise the acidic pH-related bactericidal activity against *H. pylori*, which can colonise the gastric epithelial surface, *H. pylori* hydrolyses urea to ammonia and carbon dioxide with the urease enzyme it produces (Öztekin et al., 2021). Immune activation elicited by *H. pylori* begins with the recognition of the bacterial pathogen-associated molecular patterns (PAMPs) by PRRs that are expressed by the innate immune cells or gastric epithelial cells. The major classifications of PRRs, including toll-like receptors (TLRs), NOD-like receptors (NLRs), C-type lectin receptors (CLRs), and retinoic acid-inducible gene (RIG)-I-like receptors (RLRs), are all involved in *H. pylori* recognition and innate immune activation (Cheok et al., 2022). The epithelial cell of the human gastric region prevents the adhesion, proliferation, and movement of invading pathogens through its ability to form a tight structure. Pathogens like *H. pylori* disrupt the gastric barrier by the production of harmful soluble components. It also adheres to many epithelial cell receptors and stimulates various signalling pathways within the host. The colonization and the establishment of diseases and infection by *H. pylori* depend on four major stages: adaptation to the acidic environment of the gastric mucosa, the movement towards and penetration of the epithelial cell barrier, attachment to specifc receptors, and fnally, tissue damage and other detrimental health effects (Sharndama et al., 2022). After entering the host stomach, *H. pylori* utilizes its urease activity to neutralize the hostile acidic condition at the beginning of infection. Flagella-mediated motility is then required for *H. pylori* to move toward host gastric epithelium cells, followed by specific interactions between

bacterial adhesins with host cell receptors, which thus leads to successful colonization and persistent infection (Kao et al., 2016).

2.5 *Helicobacter pylori* Diagnosis

Diagnosis of *H. pylori* infection is one of the most important step in infection management. Several diagnostic methods are currently available for detecting *H. pylori* infection, with both high sensitivity and specificity. Diagnostic tests are classified into non-invasive and invasive (when an endoscopy is needed) methods. The non-invasive diagnostic tests are the urea breath test, stool antigen test, serological tests and tests using molecular methods. On the other hand, the invasive diagnostic available methods are endoscopic imaging, histology determination, rapid urease testing, and tests using culture and molecular methods. Each method has advantages, disadvantages and limitations

2.5.1 Non-Invasive Tests

Non-invasive tests are those that do not require an endoscopy to diagnose *H. pylori* infection. They have some advantages because they are cheaper, safer and easier for the patient. Performing a gastroscopy is an invasive procedure, this procedure can only be performed in hospitals, so its availability and accessibility are more limited (Wang et al., 2015).

2.5.1.1 Urea Breath Test

The urea breath test (UBT) is based on a particular mechanism of *H. pylori* (urease enzyme activity). First, the patient swallows a 13C- or 14C-labeled urea tablet. Subsequently, due to the urease present in *H .pylori*, the urea is broken down, labeled CO2 is released, and then it is absorbed in the blood. Finally, labeled CO2 is exhaled, thus allowing the measurement of its concentration. The UBT has a high sensitivity and specificity close to 95% (Wang et al., 2015). Nowadays, UBT is still one of the most commonly used tests due to its characteristics (low cost, high availability and the ease of performing it). UBT remains an important diagnostic method in *H.*

pylori infection before and after eradication treatment (Malfertheiner et al., 2022).

2.5.1.2 Stool Antigen Test

The stool antigen test (SAT) is other non-invasive test with high sensitivity and specificity. This diagnosis method analyzes and detects the presence of the *H. pylori* antigen in fecal samples. *H. pylori* strains in the stomach can produce bacterial antigens, which are execrated in the patients' stool. Different tests can be used to detect those *H. pylori*-specific antigens in stool samples. (Malfertheiner et al., 2022).

2.5.1.3 Serology

H. pylori infection provokes both local and systemic antibody responses. The response typically includes a transient rise in IgM, followed by a rise in IgA and IgG throughout the infection. The most commonly employed method is enzyme-linked immunosorbent assay (ELISA). Others include latex agglutination and Western blotting. A number of antigens have been used to date in a variety of ELISAs including highly purified antigens such as urease, glycine extracts, whole cell sonicates and filtrates of culture supernatants. Because of the high level heterogeneity of the immune response in *H. pylori* infected persons, the antigen preparation variety must be as high as possible. Antigen can be prepared from up to six strains of *H. pylori*. Serology tests can be applied to whole blood, saliva, urine or serum samples. Detection of salivary IgA is less sensitive.(Wong et al.,1997).

2.5.2 Invasive Tests

All invasive tests are based in the performance of upper GI endoscopy. Endoscopy images allow detecting mucosal features that could suggest the presence of *H. pylori* infection. Other methods based on conventional

endoscopy have been developed, such as chromoendoscopy or, more recently, magnifying endoscopy that provides direct observation of gastric mucosa microstructure, in which histopathological changes produced by *H. pylori* infection can be detected with high sensitivity and specificity in the corpus (Wang et al., 2015).

2.5.2.1 Histology

Histology is considered the gold standard in the direct diagnosis of *H. pylori* infection, but some factors could be important for diagnosis**,** Gastric biopsies from the antrum and body are immersed in formalin and sent to pathology department for embedding and section onto glass slides under routine preparations for microscopic examination (Wong et al., 1997).

5.2.2 Rapid Urease Test

Rapid urease tests are very common because they are easy to perform and cheap. These tests are based on *H. pylori* urease enzyme activity. The presence of the bacteria in biopsy samples produces ammonia from the urea of the kit, which increases the pH and subsequently changes the color on the pH monitor. (Wang et al., 2015).

5.2.3 Culture

Culture of *H. pylori* from a gastric biopsy is the method with the highest specificity, which is close to 100% specificity, but the sensitivity is lower (85–95%) (Wang et al., 2015).Although culture is not very accessible since it is not performed in all hospitals, and it is expensive and laborious, the main advantage of this technique is that it provides the antibiotic sensitivity of (Tshibangu et al., 2021).

5.2.4 Molecular Methods

The use of molecular diagnostic methods such as polymerase chain reaction (PCR) has been employed for the diagnosis of *H. pylori* infection. These methods have been applied in several human samples (saliva, fecal samples or gastric biopsies). Molecular methods that are PCR-based have high sensitivity and specificity (more than 95%), and multiple genes have been used for the diagnosis of *H. pylori* infection (16S rRNA, 23S rRNA, UreA, glmM, UreC, HSP60 or VacA). The use of two genes in the same test may increase diagnostic accuracy mainly when non-gastric samples are used. This technique has many advantages such as faster results, no need for specific and complex transportation methods, and a lower bacterial load in the sample for a positive result (Sun et al., 2018).

2.6 *Helicobacter pylori* Transmission

According to a large number of studies, the main routes of *H. pylori* transmission are person to person by oral-oral or fecal-oral routes. The level of contamination is strongly dependent of familial and environmental parameters, with a more drastic impact of living environment including poor hygiene and sanitation which are promoting factors for *H. pylori*, especially in developing countries. However, either for developing or developed countries, familial socioeconomic status is the main risk factor for *H. pylori* infection among children. level and living conditions including crowding occupancy. Abundant evidences from many studies demonstrated that low socioeconomic status is a major risk factor in the acquisition of *H. pylori* infection or Gut microbiota composition can be affected by many factors among which diet, environmental compounds, lifestyle habits, infection and disease (Rodriguez et al. 2015). Water and access to sanitary and hygiene According to many epidemiologic studies, water could be an important source of *H. pylori* contamination Particularly in developing countries waterborne infection is the main infection route of *H. pylori* due to poor sanitary distribution of water among the population(Ozaydin et al., 2013).

2.7 Risk factor:

Risk factors can be categorized on a societal or individual level. The former encompasses geographic location; economic development; and sanitation, including access to clean food and water . Low familial socioeconomic status and overcrowding (i.e., crowded living conditions and large family sizes) are also associated with increased Hp prevalence . Consumption of unpasteurized dairy products , sheepherding , high-risk occupations (healthcare) , obesity , male gender , and the gut microbiome pose an increased risk of infection. Smoking and alcohol are two variables that are controversial with respect to their role in Hp infections (Shatila and Thomas, 2022) .

Other virulence factors such as vacuolating cytotoxin (VacA) or cytotoxin-associated antigen (CagA) make major contributions to the development of *H. pylori* chronic gastritis, which is a complex process involving also the contribution of the host's immune responses . Vac A is expressed by approximately 50% of *H. pylori* strains in its mature form and enables the synthesis of pro-inflammatory cytokines, also facilitating chronic colonization of the gastric mucosa . In addition, VacA is able to change the structure of anions within endosomes, causing osmotic edema and subsequent apoptosis in the gastric epithelium . CagA, probably the most important virulence factor of *H. pylori*, if present, contributes to the activation of certain pro-inflammatory pathways such as NF-kB, resulting in severe inflammatory responses, but at the same time, it favors the production of catalase, which enhances the survival of H. pylori within the host's gastric microenvironment by hindering the formation of reactive oxygen compounds from hydrogen peroxide.(Mărginean et al., 2022)

2.8 *Helicobacter pylori* Treatment and food

In study found that into stomach ulcer diets is based on evidence that suggests that *H. pylori* infection plays a role in the formation of stomach ulcers. Stomach ulcers usually require a combination of medications, including antibiotics. However, there is growing evidence to suggest that eating certain foods can also help get rid of stomach ulcers or, at least, reduce the symptoms they cause. It was focused on readily available food products with proven bacteriostatic or bactericidal properties against *H. pylori*, highlighting those in which its anti-*H. pylori* effectiveness *in vivo* was confirmed in humans. Relatively low cost, overall availability, and lack of side effects are the main advantages of such methods (Chatterjee et al., 2004). The foods are:-

a- **Lactoferrin**

Lactoferrin is a glycoprotein exhibiting antibacterial properties. It chelates iron ions, and thus limits the availability of this element to bacteria. Lactoferrin is present in mothers' and cow's milk, neutrophils' granules, saliva, and tears. It is an element of non-specific immunity. In a study, Wang et al. demonstrated in a mouse model that lactoferrin decreased bacterial colonisation and *H. pylori*-induced gastritis. Beside a reduction in the availability of iron ions, lactoferrin may exhibit synergistic effects with antibiotics due to facilitation of their penetration through the cell membrane (Wang et al., 2001).

b- **Isothiocyanates**

In traditional medicine, sauerkraut juice has been considered as an efficacious remedy for peptic ulcer disease for centuries. Brassica vegetables (among others cauliflower, swede, headed cabbage, rape, radish) contain substances called isothiocyanates. The above-mentioned substances exhibit anti-cancer activity, Sulforaphane, the highest concentrations of which (in the form of a precursor

called glucoraphanin) are observed in broccolis and their sprouts, is one of the isothiocyanates inhibing growth of *H. pylori* (Moy et al., 2009).

c- **Phenolic derivative**

Many fruits exhibit *in vitro* bacteriostatic activity against *H. pylori*. It is believed that the antibacterial activity of fruit extracts results from their content of phenolic derivatives (Nohynek et al., 2006). Highbush blueberry extract exhibits *in vitro* activity reducing *H. pylori* adhesion to mucous, erythrocytes, and gastric epithelial cell culture. In their study, Chatterjee *et al*. proved that raspberry, strawberry, blackberry, and bilberry extracts demonstrate potent bacteriostatic activity against clarithromycin-resistant *H. pylori* strains (Chatterjee et al., 2004).

d- Honeys

Antibacterial activity of honeys is attributable, *inter alia*, to their high osmolarity, and low pH and hydrogen peroxide content. Some types of honeys, such as oak tree and manuka honeys , honey intake at least once a week was associated with significantly lower prevalence of *H. pylori* infection (Chatterjee et al., 2004).

e- Oils and fatty acids

In 1994, Thompson *et al*. demonstrated that polyunsaturated fatty acids, omega-3 and -6, inhibit *in vitro* growth of *H. pylori* (Thompson et al., 1994). Moreover, oils of plant origin contain many polyphenols exhibiting bacteriostatic activity against *H. pylori*. In laboratory conditions, the following food products exhibit bacteriostatic activity against *H. pylori*: blackcurrant seed oil, fish oil, carrot seed, or grapefruit seed oils (Bergonzelli et al., 2003).

f- Probiotics

Certain probiotic strains exhibit antibacterial activity resulting from, *inter alia*, their capability to modify immunologic response of the host, secreting antibacterial substances such as lactic acid and disturbing bacterial adherence

mechanisms (Matjaz et al., 2015). A number of diet components have been shown to have potential anti-*H. pylori* activity in *in vitro* and animal models. Thus far, the outcomes in human trials have been mixed. Garlic, vitamin C and E, green tea, red wine, and liquorice have been most commonly investigated as potential therapeutic agents. Further well-designed clinical trials are required to determine their effectiveness in affected populations, as a treatment option and preventive measure (Fahey et al., 2015).

2.9 Association between *Helicobacter pylori* and Dietary habits

Helicobacter pylori is a group 1 carcinogen and the etiological agent of gastric diseases such as gastritis, ulcers, and gastric cancer. It infects approximately half of the world's population. Risk factors associated with *H. pylori* infection include socioeconomic status , lifestyle, and diet."Over the past years, epidemiological studies have found that diet plays a significant role in the development of *H. pylori* infection and investigated the association between the intake of certain foods and nutrients and the development of such infection (Monno et al.,2019). Some studies have reported that salty, pickled, fermented, or smoked foods increased the risk of H. pylori infection (Fox et al.,1999). On the other hand, other studies have shown that antioxidant-rich fruits and vegetables were protective against *H. pylori* infection (Jarosz et al.,2009). Moreover, it was reported that lower intakes of raw vegetables were significantly associated with a higher risk of *H. pylori* infection (Eslami et al.,2017)Similarly, meat consumption and consumption of restaurant food were associated in some studies with an increased risk of *H. pylori* infection, while chili pepper intake was shown to have a protective effect " In addition, diet is an important risk factor for infection (Sjomina et al.,2018)Frequent consumption of fresh fruits and vegetables has been associated with protection against *H. pylori* infection (Zhang et al.,2021) In addition, a diet consisting of a high intake of whole grains, roots and tubers, vegetables, mushrooms, various beans, vegetable oils, nuts, and seeds is associated with a decreased risk of infection (Shu et al.,2019) These associations may be attributed to the properties of some compounds present in these foods such as vitamin C, polyphenols, and flavonoids. These compounds may protect the gastric mucosa and inhibit the colonization of bacteria (Ullah et al., 2021) In contrast, a diet high in carbohydrates, sweets, sausages, hamburgers, mayonnaise, and soft drinks was positively associated with *H. pylori* infection(Xia et al., 2016) Furthermore, a

dietary pattern characterized by a high consumption of refined grains, pickled vegetables, bacon, salted fish, salted pickled eggs, processed and cooked meat, wine, and tea is associated with an increased risk of the infection.14"*H. pylori* prevalence found Africa to be the continent with the highest rate of this infection, presenting a prevalence of 70.1%, followed closely by South America 69.4% and Western Asia 66.6%. In fact, the authors of this meta-analysis concluded that Nigeria has the highest H. pylori prevalence worldwide, at 87.7%. In Southern Africat, Because this continent does not have healthy food and water and is poor (Hooi et al., 2017).

3. Methodology

In current study the data and information including age , sex, and test for detection of *H. pylori* and this data were collected in 2023 from the medical records in private hospitals in Erbil city in Iraq Kurdistan region including 865 patient including 581 males and 284 females with age ranged between 10- 65 years old. All studied cases were diagnosed by specialist doctor in different private hospitals .

4. RESULTS AND DISCUSSIONS

The total number of patients admitted to several private hospitals in Erbil city during (2023) were 865patients including 581 males and 284 females with age ranged between 14- 60 years old and the collected data in present study depended on urea breath test. Depending on hospital medical records the results showed that 313 patients infected with *H. pylori* with percentage (36.18%) as illustrated in table (1) and figure (1). However, the *H. pylori* infection in females was higher than males in current study which were 582 and 284 with percentage (67.2%) and (32.8%) respectively as shown in figure (2).

Table 1. Total cases, number and percentage of infected and non- infected patients with *H. pylori* in 2023.

Gender	Total cases	No. of infected patients	% of infected patients	No. of non-infected patients	% of non-infected patients
Female	**581**	**189**	**32.53**	**392**	**67.46**
Male	**284**	**124**	**43.67**	**160**	**56.33**
Total	**865**	**313**	**36.18**	**552**	**63.81**

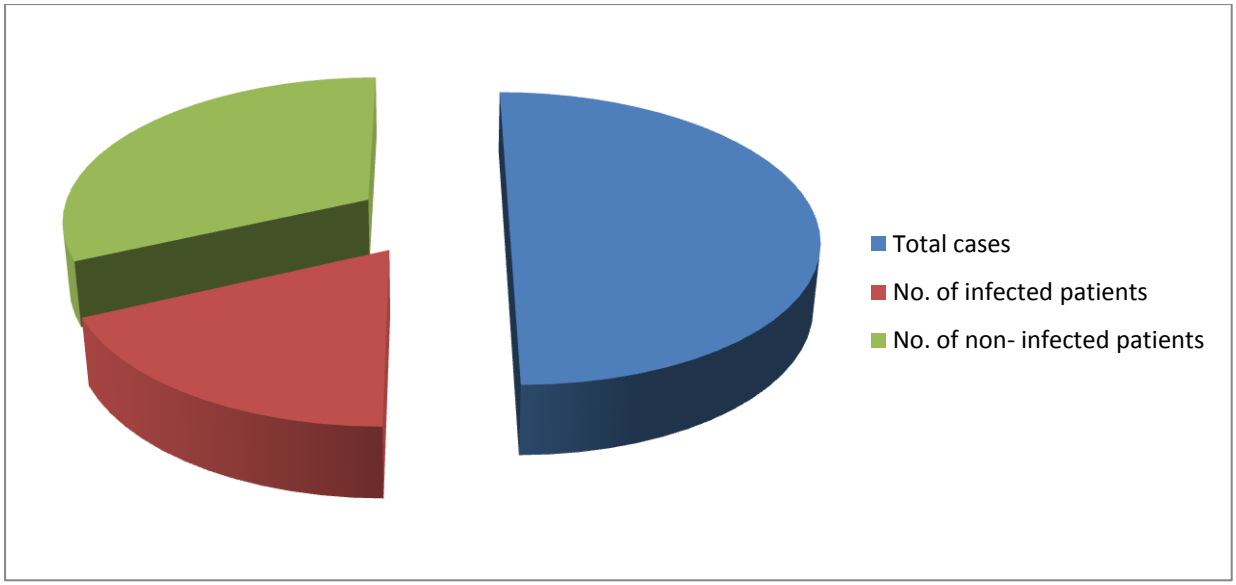

Figure 2. Total numbers of infected and non infected patients with *H. pylori.*

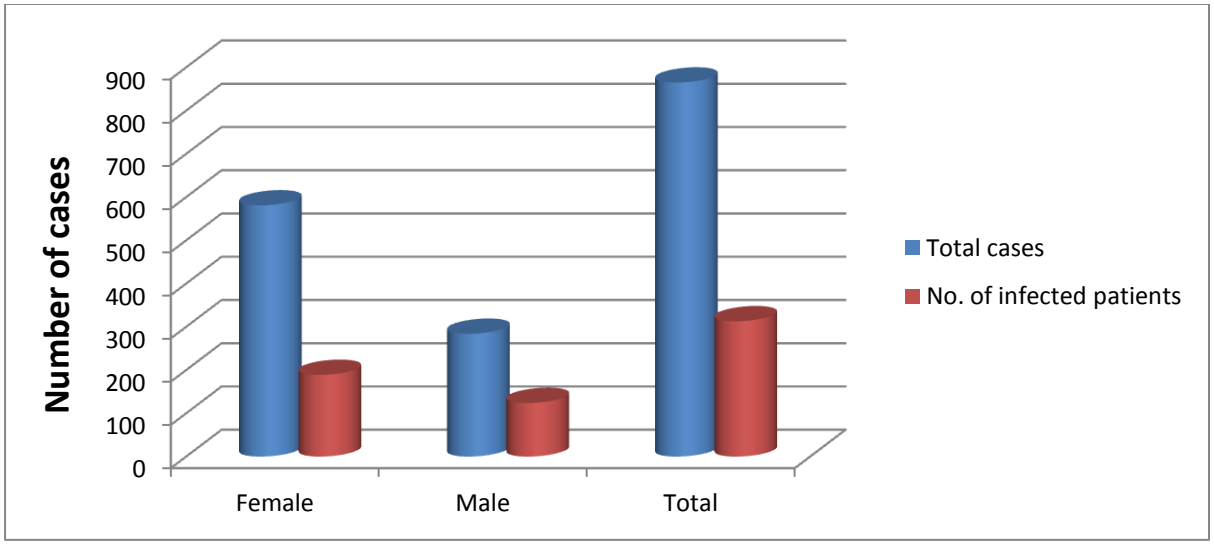

Figure 3. Number of males and females infected with *H. pylori* .

The bacterium *H. pylori* colonize in the stomach approximately half of the world's population. H.pylori is strongly associated with duodenal ulcers (present in as many as 90% of cases), gastric ulcers (up to 80%), and malignancy; it can lead to mucosa- associated lymphoid tissue (MALT) lymphoma, as well as gastric cancer in as many as 90% of cases. Among many unique characteristics of H. pylori, one of the most remarkable is its capacity to persist for decades in

the harsh gastric environment due to the inability of the host to eliminate the infection. Unlike other viruses and bacteria, *H. pylori* have evolved the ability to colonize the highly acidic environment found within the stomach by metabolizing urea to ammonia via urcase, which generates a neutral environment enveloping the bacterium (Sowaid et al., 2022).

Infection with this bacterium is associated with gastritis, peptic ulcer, adenocarcinoma, and gastric mucosa-associated lymphoid tissue lymphoma. Besides being a pathogen with worldwide prevalence, *H. pylori* show increasingly high antibiotic resistance rates. making the development of new therapeutic strategies against this bacterium challenging (Angela et al., 2020). Urease is an important adjuvant factor for bacterial colonization since it breaks urea into ammonia such that the increase in gastric pH required for bacterial survive in the gastric microenvironment can be determined. *H. pylori* has developed an acid acclimation mechanism that promotes adjustment of periplasmic pH in the harsh acidic environment of the stomach by regulating urease activity (Mărginean et al., 2022).

The variations in peptic ulcer in different geographical, historical, and social contexts are unequivocal evidence of the influence of ways of life in this disease. The specific elements that contribute to the variations probably include diet, alcohol, cigarette smoking. emotional strain, personality, and genotype and this does not 11 exclude the possibility that a major single causal effect awaits discovery (Alipour, 2021) assessed the relationship between subjects with a history of gastric or duodenal ulcer and the risk of infection in their offspring in population which is considered the population being considered at high risk of stomach cancer. It was observed that the transmission of *H. pylori* may be influenced by the presence of ulcer or that *H. pylori* strains causing peptic ulcer may be more infective than other strains as published in earlier studies. Chances of exposure are widespread and infection occurs early in life under the age of

five. About 79.83% of the population is exposed to *H. pylori* during the first two decades of life Also these results support the hypothesis that sex-specific metabolic factors are associated with pylori infections (Wu et al., 2022), The explanation behind in the females more than males it was that people under stressful conditions develop low immunity, so they are more liable for contracting the infection.

On the other hand, in 2023 all specimens were taken from patients' breath. In 865 breath specimens 313 of them (36.18%) were positive for *H. pylori* including 124 males and 189 females, while 552 specimens were negative for *H. pylori* including 160 males and 392 females (Table 2).

Table 2. Positive and Negative for *H.pylori* from Breath specimens .

Specimens	**Posative for *H.pylori***		**Negative for *H.pylori***	
Urea Breath (865)	Male	Female	Male	Female
	124	189	160	392
Total	313		552	

UBT is considered one of the most useful non-invasive diagnostic methods when it comes to a 'test-and-treat strategy' Use of Urea breath test (UBT) is often considered as the gold standard test in the diagnosis of *H. pylori* infection. UBT consistently produces better results in comparison to many of the other available tests because if *H. pylori* are present, the bacteria convert the urea into carbon dioxide, which is detected and recorded in your exhaled breath after 10 minutes (Siddiqi et al., 2022). This test can identify almost all people who have *H. pylori*. It can also be used to check that the infection has been fully treated. There are different methods for *H. pylori* infections which are breath tests, blood tests, stool test, endoscopy, simple poo tests, serologic method, and

molecular methods .In addition, the prevalence of *H. pylori* infections varies between studies based on geographical locations, environmental factors, sociodemographic characteristics, and socioeconomic status. Besides the genetic diversity of *H. pylori*, environmental factors (i.e. socioeconomic status, diet and smoking) and host genetic susceptibility have been reported to be related to the infection outcome . As little is known about the mode of transmission, a literature search was carried out to determine whether food acts a reservoir or vehicle in the transmission of *H. pylori*. Although growth of the pathogen should be possible in the gastrointestinal tract of all warm-blooded animals, the human stomach is its only known reservoir. Under conditions where growth is not possible(Correa et al., 2008).

H. pylori can enter a viable, but nonculturable state. *H. pylori* has been detected in such states in water, but not in food. Person-to-person contact is thought to be the most likely mode of transmission, and there is no direct evidence that food is involved in the transmission of *H. pylori*." Fecal–oral appears to be the most common *H. pylori* transmission routes (Sahay et al.,1994) Although the oral–oral pathway is also important, the evidence does not support that this route of transmission is universal. The gastric–oral route occurs primarily in children and patients who are prone to vomiting. Meanwhile, the anal–oral and genital–oral routes remain hypothetical. Person-to-person and foodborne infections represent the predominant transmission patterns of *H. pylori*, whereas strong environmental and occupational limitations are associated with animal-to-human and occupational exposure . The gastric colonization with *H. pylori* can lead to variety of upper gastrointestinal disorders, such as chronic gastritis, peptic ulcer disease, gastric mucosa-associated lymphoid tissue (MALT) lymphoma, and gastric cancer (Megraud, 1995). It was indicated that this bacterium could be present in raw food products, such as milk and ready-to-eat foods like vegetables, and suggest that consumption of such foods maybe

constitute a source of *H. pylori* infection for humans. The frequency of *H. pylori* infection increases with age. The rate of development is higher in societies with low socioeconomic status .The fact that *H. pylori* survives in the stomach and creates chronic inflammation shows that it can be resistant to both the immune response and acid (Siddiqi et al., 2022) .

5. **CONCLUSSION**

The present study concluded that infection with *H. pylori* in Erbil city is very high and the infection in female more than male. On the other hand, Urea breath test is the gold test for detection of *H. pylori* infection and more accurate .

6.**RECOMMENDATION**

Further study on the *H. pylori* by using molecular studies ..

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