RESEARCH PAPER

Dyspepsia: Prevalence, Helicobacter pylori Infection, and the Role of Pepsinogen and Gastrin in Gastric Mucosal Changes

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Received: 19th June, 2026; **Revised:** 19th June, 2026; **Accepted:** 19th June, 2026; **Available Online:** 19th June, 2026

ABSTRACT
The symptoms of the gastrointestinal disorder dyspepsia, which often affects people, come from the gastroduodenal area. The occurrence of dyspepsia differs on a worldwide scale and is impacted by elements like age, sex, economic standing, and the criteria employed for its diagnosis. The presence of H. pylori infection has been closely linked to dyspepsia, with its occurrence differing across various population groups. Test and treat strategies have been effective in reducing unnecessary invasive procedures like upper gastrointestinal endoscopies. Furthermore, dyspepsia has been linked to factors including neurological disorders like depression, gastric ulcers, and changes in gastric mucosa. Dyspepsia significantly impairs the quality of life for individuals affected by it, and it also places a notable economic strain on society. Moreover, research efforts should aim to develop more accurate and non-invasive diagnostic tests for dyspepsia, including the assessment of biomarkers such as pepsinogen and gastrin levels. Improvements in diagnostic methods will help optimize treatment strategies and personalize management approaches for individuals with dyspepsia.
Keywords: Dyspepsia, Pepsinogen, Helicobacter Pylori, Gastrin-17, Gastrointestinal Disorder.
How to cite this article: Kumar R, Yadav BB, Yaseen H, Bansal SK. Dyspepsia: Prevalence, Helicobacter pylori Infection, and the Role of Pepsinogen and Gastrin in Gastric Mucosal Changes. Int J Drug Deliv Technol. 2026;16(61s):1409-1415. DOI: 10.25258/ijddt.16.61s.158
Source of support: Nil.
Conflict of interest: None

Introduction

Dyspepsia, characterized by symptoms originating in the gastroduodenal region such as bothersome postprandial fullness, early satiation, epigastric pain, and burning, are now recognized as indicative of a gastroduodenal source. However, various other symptoms are often observed to coexist alongside them (1). Dyspepsia has been estimated global prevalence of about 20%. The prevalence of dyspepsia varied by country, and this variance was attributable to the definition of dyspepsia used. (2) The prevalence of un-investigated dyspepsia can be easily adjusted by the definition, and the researched population is frequently tested on the condition. The Asian prevalence of un-investigated dyspepsia ranges from 5.3 percent to 20.4 percent. (3) A college-based study among undergraduate medical student study from north India shown a dyspepsia prevalence was 18% based on identification and socio-demographic data, questions related to lifestyle and Rome III criteria and found that the subjects diagnosed with un-investigated dyspepsia and IBS were in the age group of 18-20 years. Prevalence was more seen in Female gender. (4) Singh et al from North India showed a prevalence of H. pylori infection in dyspepsia patients was 61.3%. (5) A study from south India showed, the current prevalence of H pylori infection in dyspeptic patients is less than 50%. The decrease in the risk of peptic ulcer disease could be due to the increased prevalence of H. pylori infection. (6)

Livelihood quality and dyspepsia

Dyspepsia diminishes quality of life and generates economic strain, impacting both societal and healthcare aspects. Approximately 25%of Dyspepsia patients suffer from gastric, peptic ulcer, GERD (gastroesophageal reflux disease), or malignancy; the most important organic etiologies of dyspepsia. Dyspepsia management in primary health care vary

considerably and often a treatment is determined without a diagnostically test and mainly relies on clinical accuracy. Research has taken into account the shortcoming and ill effects of diagnosis only on clinical symptoms due to its complex pathophysiology. Gastrointestinal endoscopy is used to overrule organic origin of condition wherever its accessible. (22) Majority of the patient with dyspepsia do not have an organic etiology but may have pathophysiological changes leading to functional disorders and changes in the upper GI motility. (9)A study found that people with a poor socioeconomic position are more likely to experience dyspeptic symptoms, which are linked to both upper and lower gastrointestinal disorders. (23)

A study from urban Mumbai found that prevalence of dyspeptic symptoms was more common in adults age above 40 years. (24)

In the study conducted by Kuntoji et al., it was observed that the prevalence of dyspepsia was highest among individuals in their fifth and sixth decades of life, whereas the lowest number of cases occurred in individuals under the age of 30 (25). The patients who present with dyspepsia, serious pathology is uncommon. Physicians should be aware of warning signs and refer patients for endoscopy or subspecialty care as soon as possible. In the case of certain dyspepsia patients, employing a test and treat approach for H. pylori infection proves to be cost-effective and offers relief from symptoms (26). A normal endoscopy is found in the majority of dyspepsia patients. As a result, not everyone complaining from upper gastrointestinal problems requires invasive testing. (22) Shah et al. Interviewed 2549 people and found that 774 of them experienced dyspeptic symptoms. Abdominal discomfort (374), heartburn (272), and belching are some of the symptoms (271). Additionally, 306 (12%) of the population has serious symptoms that occur at least once a week. Subjects who overused alcohol and tobacco were more likely to experience dyspeptic symptoms (24). Costa et al. examined the presence of small intestinal bacterial overgrowth (SIBO) in 56.5 percent of individuals experiencing dyspeptic symptoms. Abnormalities in the breath test were identified, which was in contrast to the control group where no such evidence was observed. Additionally, the study revealed that SIBO was more prevalent among dyspepsia patients using PPIs. The findings also suggested that, regardless of dosage or treatment duration, PPIs were more effective than a placebo for managing FD. Although PPIs might exhibit slightly greater efficacy than prokinetics in treating FD, the available evidence to support this notion remains limited. (28)

Patient with the functional dyspepsia reduces a quality of life in patient is noted in comparison with the general population or healthy group. Dyspepsia lower potency at work, missed resting and leads to higher proportion of absenteeism from their workplace, lowers activity around the habitation and considerable medical prescription medicine cost per year that leads to economic effect of dyspepsia for society.(9) Kurata et al was reported two major findings from his study.one of them was patients of dyspepsia were high utilizers of medical services and another one was more number of patients remained symptomatic or developed new gastrointestinal symptoms.(29)

There is no ‘bench mark’ by which dyspepsia can be categorized clinically. Some of the methods like Endoscopy and H. pylori testing has been proposed as bench mark, but these methods are not fit in primary care, as the treatment in primary care is usually based on their symptoms and observational, and secondly, feedback to treatment has been revealed that a strong connection is nil in between endoscopic or diagnosis of H. pylori. (30)

Neurological disorders have also been linked to dyspepsia. A recent study conducted by Soboka et al. (2022) unveiled a potential connection between depression, dyspepsia, and H. pylori infection in Ethiopia. The researchers utilized stool antigen and serology tests to evaluate H. pylori infection among participants. After accounting for possible confounding factors through multivariate logistic regression analysis, the association between depression, dyspepsia, and H. pylori infection was established. It was found that 13.3% of patients exhibiting at least one dyspepsia symptom were likely to have cases of depression. In comparison, the percentage was 11.9% for patients with H. pylori infection ($X2 = 1.23$, $p = 0.26$). (15)

Some of the most common causes of dyspepsia as shown in[fig.1] (7)

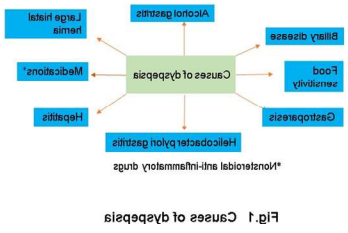


Fig.1 Causes of dyspepsia

Dyspepsia and H. Pylori infection

A study carried out in Nepal unveiled a robust correlation between H. pylori infection and prolonged

instances of active gastritis and reflux esophagitis. This infection frequently links to enduring cases of atrophic gastritis and reflux esophagitis. In cases where a patient has chronic atrophic gastritis and is undergoing an upper gastrointestinal endoscopy (EGD) for dyspepsia, it might be appropriate to consider administering anti H. pylori medication without definitive confirmation of the infection (3). The recommendations provided by the American College of Gastroenterology (ACG) and the Canadian Association of Gastroenterology (CAG) regarding dyspepsia mainly focused on initial evaluations such as testing for Helicobacter pylori (H. pylori) and performing endoscopy. Moreover, they delved into pharmaceutical strategies, encompassing H. pylori treatment, proton pump inhibitors (PPIs), and prokinetic therapy (8). Both in countries with high and low prevalence of H. pylori, significant reductions in upper gastrointestinal (GI) endoscopies were achieved through trials employing a test and treat strategy for managing dyspepsia. PPIs are now the most effective treatment for dyspepsia. Eradication of symptoms is a massive component of avoiding unnecessary upper GI endoscopies. (9)

In a study by Manimaran et al. (2016) in southern India, one-step antibody (SD bioloin) immunity card testing against Helicobacter pylori was performed on patients presenting to a hospital outpatient clinic with upper gastrointestinal symptoms lasting for more than 6 weeks. A screening test for Helicobacter pylori was conducted using This study found that the prevalence of Helicobacter pylori infection was 29.25%. Notably, the highest frequency was observed in individuals aged 41 to 50 years, and the prevalence gradually decreased in older age groups. (10)

A study conducted in Poland used the 13C urea breath test (UBT), which uses 13C-enriched urea, along with isotope ratio mass spectrometry to identify Helicobacter pylori infection. The study found that the infection rate was 35.8%. Additionally, this study found no significant association between Helicobacter pylori infection and variables such as patient age, gender, and BMI (11).

Toosi et al. (2021) conducted a study in patients with dyspepsia who had previously undergone upper gastrointestinal endoscopy. An approach to treat Helicobacter pylori infection was established based on rapid urease test (RUT) results and the application of Giemsa staining to pathological samples. As a result of the research, H. pylori infection in patients with dyspepsia. Each patient completed a questionnaire covering factors such as endoscopic findings, demographic details, and socio-economic status information. The study results showed that H. pylori infection is less common in people under 30 years of age and is associated with good socio-economic status. (12)

686 patients met ROME IV criteria for dyspepsia and subsequently underwent a urea breath test. The ratio of male to female patients was 1.25: 1. Of all patients diagnosed with positive dyspepsia according to ROME IV criteria, 39.5% were found to be infected with Helicobacter pylori. These results highlight the need to investigate the risk factors associated with the increasing prevalence of H. pylori in the urban population of KSA. Such evaluation aims to alleviate upper gastrointestinal discomfort and reduce the occurrence of gastric cancer. (13)

In 1995, the serological test indicated that 51.7% (95% CI: 42–61%) of students tested positive for H. pylori antibodies. However, by the year 2020, the seroprevalence of Helicobacter pylori among Lithuanian University of Health Sciences students had decreased to 14.2%. This represents a significant decline over the past 25 years. There were no consistent variations in dyspeptic symptoms observed between groups with positive and negative H. pylori serology. (14)

Ulcer and dyspepsia

Duodenal ulcers are a relatively infrequent discovery during endoscopic examinations of patients with dyspepsia. They tend to be present in younger individuals, especially those who smoke, consume alcohol, and exhibit symptoms like epigastric pain and postprandial fullness. In a study involving 156 individuals with dyspepsia conducted by [Author's Name] and colleagues, 87 (55.8%) were male and 69 (44.2%) were female, with an average age of 36.96 ± 11.71 years. Among the most commonly reported symptoms were epigastric burning (48.7%) and postprandial fullness (37%). The study noted duodenal ulcers in 18 patients (11.5%), which were significantly associated with alcohol consumption, smoking, epigastric pain ($p = 0.001$), and postprandial fullness ($p = 0.013$).

Scientific evidence suggests that eradicating Helicobacter pylori through therapy provides better outcomes for treating peptic ulcers in comparison to non-ulcer dyspepsia. This advantage becomes especially apparent when employing 7-day proton pump inhibitor (PPI)-based triple regimens or 5-day bismuth-based quadruple therapy. However, the 7-day bismuth-based triple regimen demonstrates similar effectiveness in addressing both conditions.(17)

There is no substantial evidence that patients with non-ulcer dyspepsia (NUD) and patients with peptic ulcer disease (PUD) respond differently to H. pylori eradication therapy. However, when looking at his PCA therapy for 7 days, a clear trend emerges (18). The duodenal ulcer-promoting gene (dupA) and its associated cluster within Helicobacter pylori have

been identified as potential risk factors for duodenal ulcer development in certain populations.

In a study, the occurrence of dupA1 was noted in 25.5% (25 out of 98) of individuals with duodenal ulcers (DU) and 11.1% (8 out of 72) of individuals with non-ulcer dyspepsia (NUD). Notably, dupA1 displayed a stronger association with DU compared to NUD (P = 0.029). However, the presence of the dupA1 cluster did not significantly influence disease manifestation within the Indian context (P = 0.79). Consequently, the presence of dupA1 could potentially function as a valuable biomarker for identifying duodenal ulcer patients in India. (19) A cross-sectional investigation was conducted on patients who underwent surgery for perforated peritonitis and were diagnosed with gastric ulcer perforation at a tertiary care facility. The study revealed a 48.8% prevalence of Helicobacter pylori in cases of gastric ulcer perforation. Given these findings, incorporating Helicobacter pylori eradication into treatment protocols for individuals with perforated gastric ulcers is recommended. (20) Two important virulence elements encoded by the cytotoxin-associated gene (cagA) and the vacuolating cytotoxin gene (vacA) of Helicobacter pylori have been shown to be associated with gastroduodenal pathological conditions .The presence of the cagA gene showed a strong association with the vac s1 genotype and was detected in 85% of patients with the s1m1 and s1m2 genotypes. As an indicator of duodenal ulcer, the cagA gene was identified in 87% of patients with duodenal ulcer and 55% of patients with non-ulcer disease.(21)

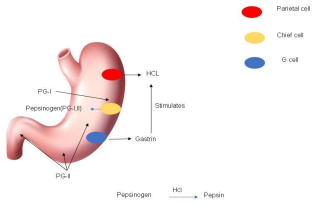
Role of pepsinogen and Gastrin in Dyspepsia

The secretion of pepsinogen takes place within the corpus region of the stomach, and it is produced by the chief cells located there. There are two types of pepsinogens known as PG-I and PG-II. PG-I is exclusively secreted in the corpus section of the stomach, while PG-II is secreted in the corpus, antrum, and the proximal part of the duodenum. Within the fundus/corpus region of the stomach, chief cells also secrete hydrochloric acid (HCl), which aids in the conversion of pepsinogen to pepsin. Additionally, G-cells situated in the antrum part of the stomach are responsible for secreting gastrin. (Fig. 2).

Fig. 2 Secretion of Pepsinogen, Gastrin, HCL into different parts of Stomach

Haj- sheykholeslami A et. al found that for any gastritis screening from normal mucosa PGII is an appropriate marker, but alone PG I, ratio of PG I&II, gastrin 17, and their combination were not fit to select those with corpus-predominant gastritis and precancerous conditions in the gastric cancer patients of first-degree relatives.(31)

Earlier Serum pepsinogen I(PGI) & pepsinogen



II(PGII) considered as a prospective serological gastric biopsy. secretion of low acid and gastric atrophy lowers, level of PGI, PGI/PGII ratio. It was also found a strict link between high levels of PGI and duodenal ulcer which also put forward as an inherited threatening factor for duodenal ulcer. Many times, after H pylori eradication, anti H pylori antibodies can present which suggest an infection of H pylori there in patients of corpus gastric atrophy even they have negative histology as well as C13 urea breath test. (32)Germaná B et al reported that, a combination of Gastro panel PG I&II, G-17 and IgG-Hp is used for diagnosis and treatment of primary care management of patient with dyspepsia.(33)

If H. pylori will be negative and PG I&II and G-17b normal, it will indicate healthy stomach. If H. pylori will be positive and PG I&II, G- 17b normal, it will indicate H. pylori gastritis. If H. pylori will be negative/positive, PGI&II low & G-17b raised, it will show atrophic gastritis in corpus. If H. pylori will be positive, PG I&II normal, G-17b reduced, it will indicate H. pylori atrophic gastritis in antrum. If H. pylori will be positive, PG I&II low, G-17b reduced, it will show H. pylori atrophic pan gastritis. (34) Gastro panel is non-invasive test bit developed for Gastric cancer screening and subject at threat for Gastric cancer that is those with H. pylori infection and atrophy gastritis. Sensitivity and specificity of Gastro panel in detection of atrophic gastritis is inconsistent. (30)

The results show that certain foods, especially spicy foods, pickled foods, and high-fat foods, can cause indigestion and worsen symptoms in indigestion patients. Foods that most often reduced symptoms were apples, rice, bread, and cumin.(35)

Gasbarrini et al. demonstrated that among dyspeptic patients, the prevalence of gastrointestinal symptoms was reduced following water supplementation therapy. Symptoms such as stomach fullness, epigastric pyrosis, and bloating notably decreased. The supplementation of mineral water seems to offer a beneficial effect, enhancing stomach acid output, oro-cecal transit time, and symptom relief in individuals

with functional dyspepsia. This treatment approach is straightforward, well-tolerated, and cost-effective for individuals with dyspepsia. (36) For individuals with undiagnosed dyspepsia who do not respond to empirical medication, referral for an examination, including endoscopy, is recommended. The use of prokinetics, tricyclic antidepressants, fundal relaxants, antidepressants, or psychotherapy should be determined based on symptom severity and the presence of psychological factors. (37)

The serum levels of PGI and PGII remain consistent over time and remain unaltered by preanalytical factors like centrifugation duration, storage conditions, or the addition of stabilizers. However, the stability of G-17 is notably influenced by processing and the duration of storage. The addition of the G-17 stabilizer did not yield additional advantages if the samples were frozen post centrifugation. (38)

According to Crafa et al, persons with a higher PGI level and a higher PG I/II ratio are more likely to experience dyspeptic symptoms. In people with upper G.I. complaints but no alarm symptoms like anemia or weight loss, serology could be recommended, allowing for a thorough non-invasive assessment of both stomach function and morphology. (39) Tsuda et al. used a questionnaire-based study to evaluate differences in dyspeptic symptoms after H. pylori eradication. Eradication therapy was given to participants with H. pylori infection and abdominal discomfort. And They evaluated their symptoms before and after eradication, as well as at one-month and one-year intervals. At one month after H. pylori eradication, they found almost 60% of H. pylori associated Dyspepsia participants improved. (40) A score of four points or more for at least one of four criteria was considered dyspepsia (postprandial fullness, early satiety, epigastric pain, and hunger pain). Changes in Global Overall Systems scores were used to determine symptom improvement. After eradication, the scores for abdominal symptoms improved for an average of 54.8 months. H. pylori eradication improved dyspepsia symptoms for the long term, irrespective of age. (41)

Hosseini M et al. concluded a valuable link in gastric atrophy and serum levels of PGII, ratio of PGI&II, G-17. However, P-I serum level was not linked with atrophy. (42)

In a 2022 study, Wang et al. showed that persistent H. pylori infection causes permanent changes in the proliferative areas of the gastric mucosa. These changes include impaired cell proliferation, insufficient downward migration of stem cells, excessive upward migration of stem cells leading to lesion progression, and development of segmental atrophy within the lamina propria.Consequently, this study suggested the presence of gastric mucosal atrophy caused by H. pylori infection can cause irreversible damage.(43)

In their study conducted in 2022, Zhou et al. utilized an enzyme-linked immunosorbent assay to measure serum levels of pepsinogens and gastrin-17. Additionally, H. pylori infection was identified using a 14C-urea breath test (UBT). The study revealed a H. pylori prevalence of 33.18%. Notably, the average levels of pepsinogens and gastrin-17 were elevated, while the mean Pepsinogen-I/II ratio was lower in H. pylori-positive individuals compared to those who tested negative. Among H. pylori-positive subjects, those with higher UBT values were less likely to experience gastric atrophy, although they could potentially be at a heightened risk of severe gastritis or peptic ulcers. Study results suggest that people who are H. pylori positive and have elevated UBT levels may benefit greatly from H. pylori eradication. (44)

Recent studies aimed to evaluate the diagnostic value of serum pepsinogen I levels in patients with dyspepsia. The results showed that patients with dyspepsia had lower serum pepsinogen I levels compared to the control group. Furthermore, this assay showed a high level of specificity in detecting dysplasia, suggesting its potential as a biomarker for early detection of gastric cancer.

Conclusion

In summary, dyspepsia is a common disease characterized by the following symptoms originating from the gastroduodenal region, Early satiety, postprandial bloating, pain in the epigastrium, and burning sensation in the epigastrium. The global prevalence of dyspepsia is estimated to be around 20%, but this number varies by country and definition. Several studies have shown that there is a close association between Helicobacter pylori infection and dyspepsia, with prevalence ranging from 35.8% to 61.3% in different populations.Addressing the diagnosis and management of dyspepsia necessitates a comprehensive approach. Guidelines from prominent institutions like the American College of Gastroenterology and the Canadian Association of Gastroenterology propose initial evaluations involving H. pylori testing and endoscopy. These guidelines also underscore the significance of pharmacological interventions encompassing H. pylori treatment, proton pump inhibitors (PPIs), and prokinetic therapy. Implementing test and treat strategies has proven effective in curbing unnecessary upper gastrointestinal endoscopies. Among these approaches, PPIs are considered the most efficacious for treating dyspepsia. Within the realm of diagnosing and managing dyspepsia, scrutiny has been given to pepsinogen and gastrin levels as possible markers. The serum concentrations of PGI, PGII, and G-17 have displayed associations with gastric atrophy, H. pylori infection,

and the susceptibility to duodenal ulcers. The development of non-invasive tests like the Gastro panel has aimed to assess stomach function and morphology, particularly in individuals at risk for gastric cancer.

In summary, dyspepsia emerges as a prevalent condition with diverse causal factors, including the presence of H. pylori infection. Approaching the diagnosis and management of dyspepsia necessitates a multi-faceted strategy that takes into account symptoms, demographic variables, and the utilization of diagnostic examinations. Ongoing research endeavors are directed at enhancing comprehension and refining treatment outcomes concerning dyspepsia.

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