

Review Article

Demographic and Clinical Predictors of Helicobacter pylori Infection in Symptomatic Patients From Middle Eastern Countries: A Systematic Review and Meta-Analysis

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ABSTRACT

Background: Helicobacter pylori infection remains common in symptomatic populations, but prevalence and associated clinical, endoscopic, and socioeconomic factors vary across Middle Eastern settings. This review estimated pooled prevalence and summarized factor-specific associations with H. pylori positivity. **Methods:** PubMed, Web of Science, Google Scholar, and Semantic Scholar were searched through 1 June 2026 for observational studies involving symptomatic adult or pediatric patients tested for H. pylori. Prevalence was synthesized using a random-effects model. Clinical, endoscopic, demographic, socioeconomic, and environmental factors were evaluated as separate associations rather than combined into category-wide summary effects. Methodological quality was assessed using the Joanna Briggs Institute checklist. **Results:** Eleven studies comprising 10,814 participants with assessable H. pylori status were included. Pooled prevalence was 37.62% (95% CI 27.02–48.21%), with substantial heterogeneity ($I^2=99\%$). Positive clinical associations included abdominal pain, anorexia, pallor/low hemoglobin, weight loss, and hematemesis; vomiting showed a large but highly imprecise estimate. Endoscopic associations included antral nodularity, gastric and duodenal erosions, duodenal ulcer, gastritis, mosaic gastritis, and esophagitis/GERD. Environmental and socioeconomic associations included daycare/community contact, large household size, illiteracy, bed sharing, low income, street-food consumption, unsafe water supply, and overcrowding. **Conclusion:** H. pylori infection is common but heterogeneous among symptomatic regional populations. Several clinical, endoscopic, and socioeconomic factors are associated with positivity, but these observational associations should not replace guideline-recommended diagnostic testing. **Keywords:** Helicobacter pylori; Prevalence; Dyspepsia; Associated Factors; Endoscopic Findings; Socioeconomic Factors; Middle East

INTRODUCTION

Helicobacter pylori (H. pylori) is one of the most prevalent chronic bacterial infections worldwide and remains an important cause of gastrointestinal morbidity. Persistent gastric colonization produces chronic active gastritis and is etiologically associated with peptic ulcer disease, gastric mucosa-associated lymphoid tissue lymphoma, gastric mucosal atrophy and intestinal metaplasia, and gastric adenocarcinoma (1). Although the global prevalence of H.

pylori infection has declined over recent decades, substantial geographic variation persists, with a comparatively greater burden in many low- and middle-income populations and considerable differences between regions, countries, and population groups (2). Infection is commonly acquired during childhood and may persist for decades in the absence of successful eradication. Childhood acquisition has been associated with socioeconomic and environmental conditions, including household crowding, family living conditions, sanitation, and related exposures that facilitate transmission (1,3).

The epidemiology of *H. pylori* is particularly heterogeneous across the Middle East and North Africa, where reported prevalence varies markedly according to country, age, socioeconomic circumstances, clinical setting, and diagnostic methodology (4). Estimates derived from symptomatic or endoscopy-referred patients cannot necessarily be extrapolated to community populations because referral patterns and underlying gastrointestinal disease influence the populations being tested. Diagnostic modality represents an additional source of variation: urea breath testing and stool antigen testing are commonly used to identify active infection, whereas histology and rapid urease testing depend on endoscopic sampling, and serology may remain positive after previous infection and therefore does not reliably distinguish active from past exposure (1,5). Consequently, differences in population selection and diagnostic approach are important when comparing prevalence estimates across regional studies.

Among symptomatic patients, gastrointestinal manifestations alone are insufficiently specific to establish *H. pylori* infection, yet several clinical characteristics have been reported to be associated with test positivity. Regional studies have examined abdominal pain, vomiting, anorexia, weight loss, gastrointestinal bleeding, and anemia-related manifestations, although the magnitude and consistency of these associations vary between adult and pediatric populations (6–8). Endoscopic abnormalities, including gastritis, antral nodularity, gastric or duodenal erosions, and peptic ulceration, have likewise been associated with *H. pylori* positivity in selected endoscopy-based cohorts (6,8,9). Socioeconomic and environmental characteristics—including household crowding, large household size, bed sharing, educational and income-related disadvantage, and water or hygiene-related exposures—have also been investigated as factors associated with infection, particularly in populations in which childhood acquisition remains common (3,4,6,7). These factors should be interpreted as associations rather than independent clinical predictors unless supported by appropriately adjusted and externally validated predictive analyses.

Despite a substantial number of individual studies, the regional evidence remains fragmented. Previous reviews have described the broad prevalence, diagnostic methods, and epidemiology of *H. pylori* across the Middle East and North Africa, but these analyses have included heterogeneous population groups and have not specifically synthesized prevalence together with clinical, endoscopic, demographic, and socioeconomic associations among symptomatic patients (4). Individual studies also differ substantially in age distribution, clinical setting, diagnostic criteria, and the factors evaluated, which limits interpretation of isolated estimates (4,6–9). A focused synthesis of symptomatic populations is therefore needed to characterize the regional burden while distinguishing overall prevalence from specific factors associated with *H. pylori* positivity.

Accordingly, this systematic review and meta-analysis aimed to estimate the pooled prevalence of *H. pylori* infection among symptomatic patients in the eligible regional evidence base and to synthesize reported associations between *H. pylori* positivity and demographic, socioeconomic, clinical, and endoscopic factors. The review additionally sought to characterize important sources of between-study heterogeneity arising from differences in patient populations, clinical settings, and diagnostic approaches.

MATERIALS AND METHODS

Study Design and Reporting Framework

This systematic review and meta-analysis synthesized observational evidence on the prevalence of *Helicobacter pylori* (*H. pylori*) infection and factors associated with infection among symptomatic patients from eligible regional countries. The review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (10). Because the review used data derived exclusively from previously published studies and involved no direct recruitment or intervention involving human participants, institutional ethics approval was not required.

Information Sources and Literature Search

A comprehensive literature search was performed independently by two reviewers using PubMed, Web of Science, Google Scholar, and Semantic Scholar. The search included studies published up to 1 June 2026. The strategy combined controlled and free-text terms for H. pylori, epidemiology and prevalence, clinical manifestations, associated factors, and the regional setting.

The principal search concepts were structured as follows:

("Helicobacter pylori" OR "H. pylori") AND (prevalence OR epidemiology OR predictor OR "risk factor" OR demographic* OR symptom* OR "clinical feature*" OR dyspepsia OR gastritis OR "peptic ulcer disease" OR endoscop*) AND ("Middle East" OR "Middle Eastern" OR "Arab countries" OR individual country terms).**

Database-specific variations of the search strategy were applied where required by the respective search interface. The complete search strings and individual country terms were recorded in Supplementary Table 1. Reference lists of potentially eligible articles and relevant reviews were also screened manually to identify additional studies not retrieved through the electronic searches.

Eligibility Criteria

Eligibility was defined according to the population, factors of interest, outcomes, and study design.

Population

Studies were eligible if they included symptomatic adult or pediatric patients from countries meeting the review's operational regional definition. Eligible populations included patients presenting with dyspepsia, abdominal or gastrointestinal complaints, suspected H. pylori-related disease, or symptoms leading to upper gastrointestinal endoscopy or diagnostic testing. Patients were required to have undergone testing for H. pylori using at least one recognized invasive or non-invasive diagnostic method. Eligible methods included:

- ¹³C- or ¹⁴C-urea breath testing;
- stool antigen testing;
- serological testing;
- histological examination of gastric biopsy specimens;
- rapid urease or CLO testing;
- microbiological culture; or
- a defined combination of these methods.

Because these methods differ in their ability to identify active infection or previous exposure, the diagnostic technique used in each study was extracted and considered when interpreting between-study heterogeneity.

Factors of Interest

Factors potentially associated with H. pylori positivity were classified into three prespecified conceptual groups: Clinical factors, including gastrointestinal symptoms, appetite-related symptoms, weight loss, anemia-related manifestations, and gastrointestinal bleeding; Endoscopic factors, including gastritis, antral nodularity, gastric or duodenal erosions, peptic ulceration, gastric erythema, and other reported mucosal abnormalities; and Demographic, socioeconomic, and environmental factors, including age, sex, household crowding, household size, bed sharing, educational status, income, water supply, dietary exposures, smoking, alcohol use, and community or household contact. These categories were used to organize the evidence; they were not considered interchangeable exposures for statistical pooling.

Comparator

For analyses of associated factors, the comparator consisted of H. pylori-negative participants from the same study or the reference category defined by the original investigators. Studies were eligible for quantitative association analysis when they reported an odds ratio (OR) with an associated measure of uncertainty or supplied sufficient reported information for the relevant effect estimate to be entered into the meta-analysis.

Outcomes

The primary outcome was the prevalence of *H. pylori* infection among symptomatic patients, defined according to the diagnostic criteria applied by each included study.

Secondary outcomes were associations between *H. pylori* positivity and:

- clinical characteristics;
- endoscopic findings; and
- demographic, socioeconomic, or environmental factors.

Frequencies of individual presenting symptoms were considered distinct descriptive outcomes. Different symptoms were not considered manifestations of a single common prevalence outcome for purposes of statistical pooling.

Study Designs

Eligible designs included observational cross-sectional, retrospective, prospective observational, and case-control studies. Studies were excluded when the population, regional setting, diagnostic assessment, outcome, or design did not satisfy the eligibility criteria, or when extractable prevalence or association data relevant to the review objectives were unavailable.

Study Selection

All records retrieved from the searches were collated and duplicate records were removed before screening. Two reviewers independently assessed titles and abstracts for potential eligibility. Full-text articles were retrieved when the title or abstract suggested that the eligibility criteria might be satisfied.

Potentially eligible full-text reports were subsequently assessed against the predefined inclusion criteria. Disagreements arising during study selection were resolved through discussion and consensus. The study-selection process was documented using the PRISMA 2020 flow framework (10), with numbers of records identified, duplicates removed, records screened, full texts assessed, studies excluded, and studies ultimately included in the qualitative and quantitative syntheses.

Data Extraction

Data were extracted using a structured data-extraction form. The following information was collected where available:

- first author and publication year;
- country and clinical setting;
- study design;
- characteristics of the study population;
- adult or pediatric population;
- total number of participants;
- age distribution;
- sex distribution;
- number of participants with assessable *H. pylori* status;
- number testing positive for *H. pylori*;
- diagnostic method;
- study-specific prevalence;

- reported clinical characteristics;
- reported endoscopic findings;
- demographic, socioeconomic, and environmental factors; and
- reported effect estimates and corresponding measures of uncertainty.

For prevalence analyses, the denominator was the number of participants for whom an evaluable *H. pylori* test result was reported rather than the number initially enrolled when these differed. For association analyses, ORs and 95% confidence intervals (CIs) were extracted as reported. When a study presented an effect estimate as a log odds ratio with its standard error (SE), the log OR and SE were entered directly into the generic inverse-variance analysis. Different effects reported from the same study were retained as separate factor-specific associations. They were not interpreted as independent replications of a common exposure simply because they belonged to the same broad clinical, endoscopic, or environmental category.

Data Organization and Comparability of Associated Factors

Before quantitative synthesis, reported factors were organized according to their clinical meaning, exposure definition, reference category, and outcome definition. Effect estimates were considered quantitatively comparable only when they represented the same or sufficiently similar factor, assessed against a compatible reference group. For example, estimates for abdominal pain were considered separately from vomiting, hematemesis, anemia, or weight loss; similarly, antral nodularity was considered separately from gastric erosion, duodenal ulcer, or gastritis. Environmental exposures such as overcrowding, unsafe water supply, low income, smoking, and household size were likewise treated as separate associations. Where two or more independent studies reported a sufficiently comparable factor, factor-specific quantitative synthesis was considered appropriate. When only one study contributed an estimate, or when definitions or reference categories were not sufficiently comparable, the effect estimate was reported individually rather than labelled as a pooled effect. Accordingly, no grand summary OR was used to combine biologically and clinically different predictors solely on the basis that they belonged to the same broad category.

Methodological Quality and Risk-of-Bias Assessment

Methodological quality was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Studies Reporting Prevalence Data (11), consistent with the prevalence-focused primary objective of the review.

The checklist evaluates domains relating to:

- appropriateness of the sampling frame;
- sampling method;
- adequacy of sample size;
- description of participants and setting;
- coverage of the identified sample;
- validity of methods used to identify the condition;
- standardization and reliability of measurement;
- appropriateness of statistical analysis; and
- adequacy of response rate.

Each item was classified as Yes, No, Unclear, or Not Applicable, according to the information available in the original study. For descriptive summary purposes, the manuscript categorized studies scoring 7–9 as higher quality/lower risk of bias, 4–6 as moderate quality/moderate risk, and 0–3 as lower quality/higher risk. These thresholds were treated as author-defined descriptive categories rather than as an intrinsic validated grading system of the JBI

instrument. Methodological quality scores were not incorporated into statistical weighting; meta-analytic weights were determined by the statistical model and precision of individual estimates.

Statistical Analysis

Statistical synthesis was performed using Review Manager (RevMan), version 5.4 (14). Statistical analyses were organized separately for prevalence and factor-associated outcomes.

Meta-analysis of *H. pylori* Prevalence

For each study, prevalence was defined as:

$$\text{Prevalence} = \frac{\text{number of } H. \text{ pylori-positive participants}}{\text{number of participants with assessable } H. \text{ pylori status}}$$

Study-specific prevalence estimates were expressed as percentages with 95% CIs. Prevalence estimates were combined using an inverse-variance approach under a random-effects framework, reflecting anticipated clinical and methodological variation in patient age, country, clinical setting, diagnostic modality, and study design. Random-effects models were considered more appropriate than assuming a single underlying prevalence because prevalence estimates across observational studies may legitimately vary according to population, setting, case definition, and diagnostic approach (12).

Meta-analysis of Associated Factors

Associations between individual clinical, endoscopic, demographic, socioeconomic, or environmental factors and *H. pylori* infection were expressed as ORs with 95% CIs. Where studies reported log ORs and corresponding SEs, these values were entered using the generic inverse-variance method. Because meaningful between-study differences in populations, measurement, diagnostic methods, and factor definitions were anticipated, random-effects models were used for quantitative synthesis of sufficiently comparable factor-specific estimates. Meta-analysis was restricted to effect estimates representing the same or clinically equivalent factor. Different symptoms, different endoscopic abnormalities, and different environmental exposures were not pooled together to generate a single overall OR. Single-study estimates were displayed or described individually and were not presented as meta-analytic pooled estimates.

Heterogeneity

Statistical heterogeneity was assessed using Cochran's Q statistic and the I^2 statistic (13). I^2 values above 50% were considered indicative of substantial statistical heterogeneity, although I^2 was interpreted together with the clinical and methodological differences among studies rather than as an isolated measure of inconsistency.

This consideration was particularly important for prevalence synthesis because substantial variability in country, age, diagnostic modality, clinical setting, and sampling may produce genuine differences in prevalence across observational populations (12). For random-effects analyses, between-study variance (τ^2) was considered where generated by the meta-analytic model.

Statistical Significance and Precision

Effect estimates were reported with 95% CIs. For ORs, an association was considered statistically significant when the 95% CI did not include 1.00; two-sided p values <0.05 were considered statistically significant where reported. The magnitude of an OR was interpreted together with the width of its confidence interval. Large effect estimates accompanied by very wide CIs were regarded as imprecise and interpreted cautiously rather than being considered strong evidence solely on the basis of the point estimate.

Assessment of Small-Study Effects and Publication Bias

Formal tests of funnel-plot asymmetry were not considered reliable for factor-specific syntheses containing only a small number of independent studies. In addition, conventional publication-bias methods require particular caution when applied to meta-analyses of single proportions because the relationship between study size, precision, and selective publication differs from that in comparative intervention studies (12). Potential publication bias was

therefore considered qualitatively in relation to the size, design, and reporting characteristics of the included evidence rather than inferred from an underpowered statistical test.

Ethical Considerations

The review analyzed aggregate data from previously published studies and did not involve direct interaction with human participants, collection of identifiable patient information, or modification of clinical care. Therefore, separate institutional ethical approval and individual participant consent were not required for this systematic review.

RESULTS

Study Selection

The literature search identified 2,276 records. After removal of 442 duplicates, 1,834 records underwent title and abstract screening. Of these, 858 records were excluded, and 976 full-text articles were assessed for eligibility. Following full-text assessment, 11 studies met the predefined eligibility criteria and were included in the final systematic review and quantitative synthesis (6–9,15–21). The included studies comprised 10,814 participants with assessable *H. pylori* status. The study-selection process should be presented in a PRISMA 2020 flow diagram.

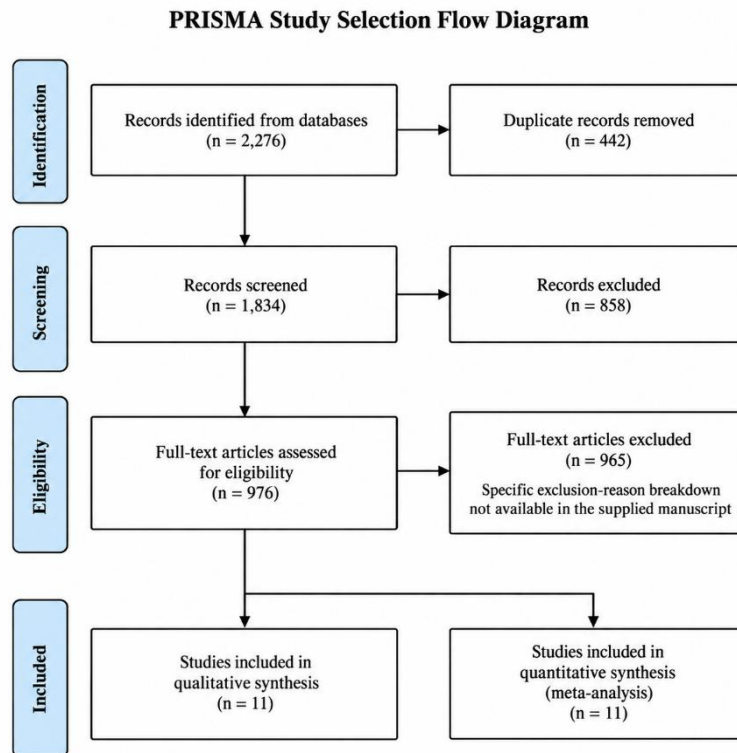


Figure 1 PRISMA Flow diagram

Important for the final PRISMA figure: 965 full-text reports were excluded mathematically (976 assessed – 11 included), but the manuscript does not currently contain the specific exclusion-reason categories. Those reasons should be recovered from the screening log rather than invented.

Characteristics of Included Studies

The 11 studies were conducted in Turkey, Kuwait, Saudi Arabia, Egypt, Bahrain, Qatar, Iran, Lebanon, and Iraq and included both adult and pediatric symptomatic populations. Clinical settings varied from general gastrointestinal and dyspepsia clinics to patients referred for upper gastrointestinal endoscopy. Diagnostic approaches were heterogeneous and included ^{13}C - and ^{14}C -urea breath testing, stool antigen testing, serology, histology, rapid urease/CLO testing, culture, and combinations of invasive diagnostic methods.

The study sample sizes ranged from 100 participants in the Zakho, Iraq study to 4,000 participants in the Lebanese serology-based cohort. In the Bahrain study, 942 patients underwent gastric biopsy, but only 928 had assessable histological results; therefore, 928 was used as the denominator for prevalence estimation.

Table 1. Characteristics of Included Studies

Study	Country	Study population	Participants analyzed, n	Age	Male/Female, n	H. pylori positive, n	Diagnostic method	Prevalence
Türkölmez et al., 2007	Turkey	Patients with gastrointestinal complaints	1,567	29.37 ± 17.30 y	548/1,019	1,066	¹⁴ C-urea breath test	68.0%
Alazmi et al., 2010	Kuwait	New outpatients with uninvestigated dyspepsia	362	Mean 38 y	186/176	180	¹³ C-urea breath test	49.7%
Hasosah et al., 2015	Saudi Arabia	Symptomatic children undergoing EGD	303	NR	149/154	151	Histology, culture and CLO/rapid urease criteria	49.8%
Galal et al., 2019	Egypt	Symptomatic children attending a pediatric GI clinic	630	Median 7 y; range 1–15	325/305	407	Stool antigen test	64.6%
Alshalkh et al., 2021	Bahrain	Dyspeptic patients undergoing gastric biopsy	928*	Mean 48.5 y	398/544†	208	Histology; UBT also reported	22.4%
Naushad et al., 2021	Qatar	Adult dyspeptic patients undergoing endoscopy	638	Mean 42.2 y	376/262	261	CLO test	40.9%
Hojati et al., 2021	Iran	Dyspeptic patients referred for endoscopy	233	NR	NR	109	Histology and rapid urease test	46.8%
Ismail et al., 2022	Lebanon	Dyspeptic patients in two tertiary hospitals	4,000	36.9 ± 16.6 y	1,514/2,486	1,367	Anti-H. pylori IgG serology	34.2%
Saeed et al., 2024	Iraq	Symptomatic dyspeptic patients in Zakho City	100	Range 11–67 y	31/69	50	¹⁴ C-urea breath test	50.0%
Boutari et al., 2025	Lebanon	Symptomatic patients undergoing gastroscopy	786	NR	NR	233	Histopathological biopsy	29.6%
Abdulridha et al., 2026	Iraq	Symptomatic patients in Maysan	1,267	NR	NR‡	770	Urea breath test, serum antibody and stool antigen	61.0%

EGD, esophagogastroduodenoscopy; GI, gastrointestinal; NR, not reported; UBT, urea breath test. * A total of 942 patients underwent biopsy, but 928 had assessable histological results and were used for prevalence analysis. † Sex distribution relates to the enrolled Bahrain cohort as reported in the source manuscript. ‡ Overall sex distribution was not reported; among H. pylori-positive participants, 408 were male and 362 female.

Prevalence of H. pylori Infection

Across the 11 included studies, the model-based pooled prevalence of H. pylori infection among symptomatic patients was 37.62% (95% CI 27.02–48.21%). Between-study heterogeneity was substantial ($I^2 = 99\%$, $p < 0.00001$), consistent with marked variation in age distribution, country, clinical setting, study population, and diagnostic modality. Study-specific prevalence ranged from 22.4% to 68.0%. The highest estimates were reported in the Turkish cohort (68.0%), the Egyptian pediatric cohort (64.6%), and the Maysan, Iraq cohort (61.0%). Intermediate estimates were observed in Zakho, Iraq (50.0%), Saudi Arabia (49.8%), Kuwait (49.7%), Iran (46.8%), and Qatar (40.9%). Lower estimates were reported in the Lebanese serology-based cohort (34.2%), the Lebanese gastroscopy cohort (29.6%), and the Bahrain histology-based cohort (22.4%). Given the very high heterogeneity, the pooled estimate should be interpreted as an overall summary of heterogeneous symptomatic populations rather than as a uniform prevalence applicable to all countries or clinical settings.

Clinical Factors Associated With H. pylori Positivity

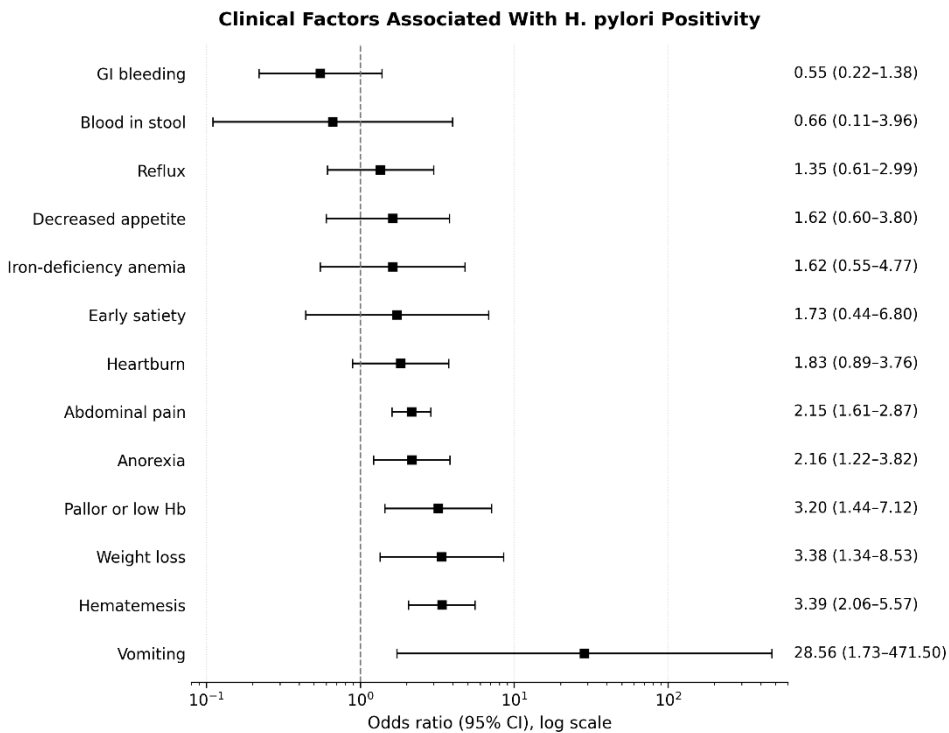
Clinical factors were evaluated as factor-specific associations rather than as components of a single common exposure. Consequently, no overall pooled OR combining different symptoms was calculated. Abdominal pain was associated with greater odds of H. pylori positivity (OR 2.15, 95% CI 1.61–2.87), as were anorexia (OR 2.16, 95% CI 1.22–3.82), pallor or low hemoglobin (OR 3.20, 95% CI 1.44–7.12), weight loss (OR 3.38, 95% CI 1.34–8.53), and hematemesis (OR 3.39, 95% CI 2.06–5.57). Vomiting produced the largest point estimate (OR 28.56, 95% CI 1.73–471.50), but the extremely wide confidence interval indicated substantial imprecision and this estimate should therefore be interpreted cautiously. GI bleeding, blood in stool, reflux, decreased appetite, iron-deficiency anemia, early satiety, and heartburn had confidence intervals that crossed unity and therefore did not demonstrate statistically significant associations in the available estimates.

Endoscopic abnormalities were similarly analyzed as distinct factor-specific associations rather than being combined into a single overall endoscopic effect. The strongest positive association was observed for antral nodularity (OR 12.86, 95% CI 6.72–24.61). Duodenal mucosal erosions (OR 8.70, 95% CI 4.38–17.28) and gastric mucosal erosions (OR 6.71, 95% CI 3.76–11.97) were also strongly associated with H. pylori positivity.

Table 2. Clinical Factors Associated With *H. pylori* Positivity

Clinical factor	OR	95% CI	Statistical interpretation
GI bleeding	0.55	0.22–1.38	Not statistically significant
Blood in stool	0.66	0.11–3.96	Not statistically significant
Reflux	1.35	0.61–2.99	Not statistically significant
Decreased appetite	1.62	0.60–3.80	Not statistically significant
Iron-deficiency anemia	1.62	0.55–4.77	Not statistically significant
Early satiety	1.73	0.44–6.80	Not statistically significant
Heartburn	1.83	0.89–3.76	Not statistically significant
Abdominal pain	2.15	1.61–2.87	Positive association
Anorexia	2.16	1.22–3.82	Positive association
Pallor or low Hb	3.20	1.44–7.12	Positive association
Weight loss	3.38	1.34–8.53	Positive association
Hematemesis	3.39	2.06–5.57	Positive association
Vomiting	28.56	1.73–471.50	Positive but highly imprecise association

Additional significant positive associations were observed for duodenal ulcer (OR 2.41, 95% CI 1.24–4.68), gastritis (OR 1.79, 95% CI 1.27–2.52), mosaic gastritis (OR 1.73, 95% CI 1.07–2.80), and esophagitis/GERD (OR 1.67, 95% CI 1.19–2.34). Gastric erythema (OR 1.51, 95% CI 0.94–2.43), gastric ulcer (OR 1.01, 95% CI 0.47–2.17), and nodular gastritis (OR 0.52, 95% CI 0.17–1.59) did not demonstrate statistically significant associations. Non-erosive gastritis was associated with lower odds of *H. pylori* positivity (OR 0.55, 95% CI 0.40–0.76).



Each row is a factor-specific association; no grand summary effect is calculated.

Figure 2. Clinical Factors Associated With *H. pylori* PositivityTable 3. Endoscopic Findings Associated With *H. pylori* Positivity

Endoscopic finding	OR	95% CI	Statistical interpretation
Nodular gastritis	0.52	0.17–1.59	Not statistically significant
Gastric ulcer	1.01	0.47–2.17	Not statistically significant
Duodenal mucosal erosions	8.70	4.38–17.28	Positive association
Duodenal ulcer	2.41	1.24–4.68	Positive association
Antral nodularity	12.86	6.72–24.61	Positive association
Gastric mucosal erosions	6.71	3.76–11.97	Positive association
Mosaic gastritis	1.73	1.07–2.80	Positive association
Gastric erythema	1.51	0.94–2.43	Not statistically significant
Gastritis	1.79	1.27–2.52	Positive association
Esophagitis/GERD	1.67	1.19–2.34	Positive association
Non-erosive gastritis	0.55	0.40–0.76	Inverse association

The previous overall OR of 2.15 and $I^2=93\%$ have been removed because they were calculated across biologically different endoscopic findings.

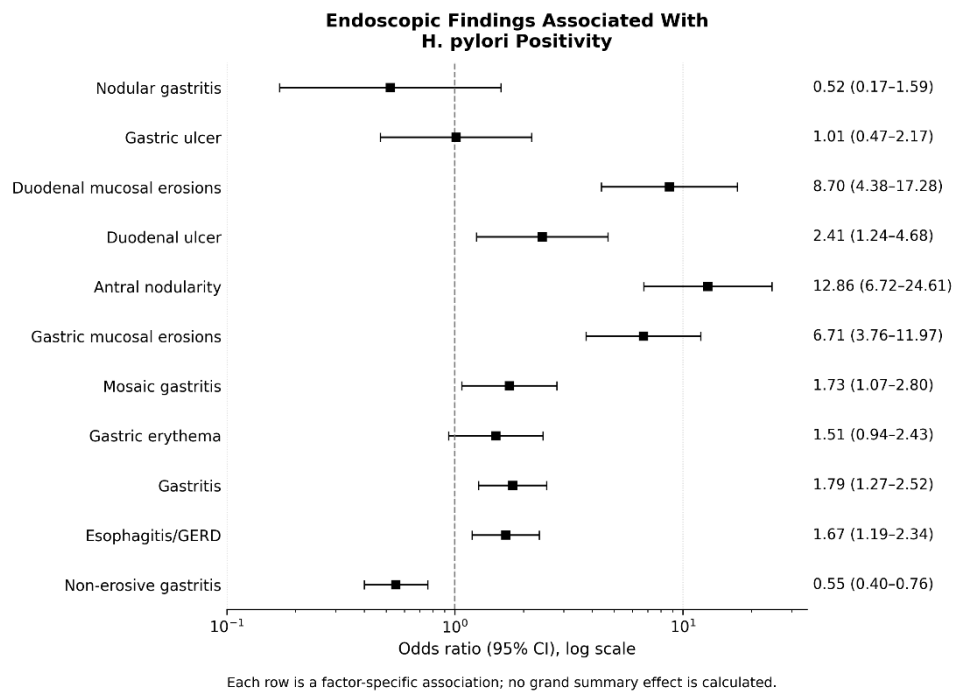


Figure 3. Endoscopic findings associated with *Helicobacter pylori* positivity. Factor-specific odds ratios are shown with 95% confidence intervals. The vertical reference line represents an odds ratio of 1.0. Endoscopic abnormalities were treated as distinct exposures and were not combined into a single overall summary effect.

Environmental, Socioeconomic, and Demographic Factors

Environmental, socioeconomic, and demographic exposures were evaluated individually rather than being combined into a single overall effect. Daycare or community contact was associated with increased odds of *H. pylori* positivity (OR 3.90, 95% CI 2.32–6.56). Other significant associations included a family history of gastrointestinal cancer (OR 3.52, 95% CI 1.48–8.37), household size greater than eight persons (OR 3.46, 95% CI 1.67–7.17), illiteracy (OR 3.14, 95% CI 1.29–7.64), bed sharing (OR 2.26, 95% CI 1.32–3.87), low income (OR 2.06, 95% CI 1.07–3.97), eating food from street vendors (OR 1.88, 95% CI 1.35–2.62), absence of a safe/pure water supply (OR 1.72, 95% CI 1.16–2.56), and overcrowding (OR 1.55, 95% CI 1.10–2.18). Increased age showed a positive but imprecise estimate (OR 2.52, 95% CI 0.72–8.82) and did not reach statistical significance. Alcohol use (OR 0.87, 95% CI 0.47–1.61) and smoking (OR 0.77, 95% CI 0.55–1.08) likewise showed no statistically significant association.

Table 4. Environmental, Socioeconomic, and Demographic Factors Associated With *H. pylori* Positivity

Factor	OR	95% CI	Statistical interpretation
Absence of safe/pure water supply	1.72	1.16–2.56	Positive association
Alcohol use	0.87	0.47–1.61	Not statistically significant
Bed sharing	2.26	1.32–3.87	Positive association
Daycare/community contact	3.90	2.32–6.56	Positive association
Eating from street vendors	1.88	1.35–2.62	Positive association
Family history of gastrointestinal cancer	3.52	1.48–8.37	Positive association
Household size >8 persons	3.46	1.67–7.17	Positive association
Illiteracy	3.14	1.29–7.64	Positive association
Increased age	2.52	0.72–8.82	Not statistically significant
Low income	2.06	1.07–3.97	Positive association
Overcrowding	1.55	1.10–2.18	Positive association
Smoking	0.77	0.55–1.08	Not statistically significant

The previous overall OR of 1.68 and $I^2=76\%$ have been removed because different environmental and demographic exposures should not be interpreted as repeated measurements of one common exposure.

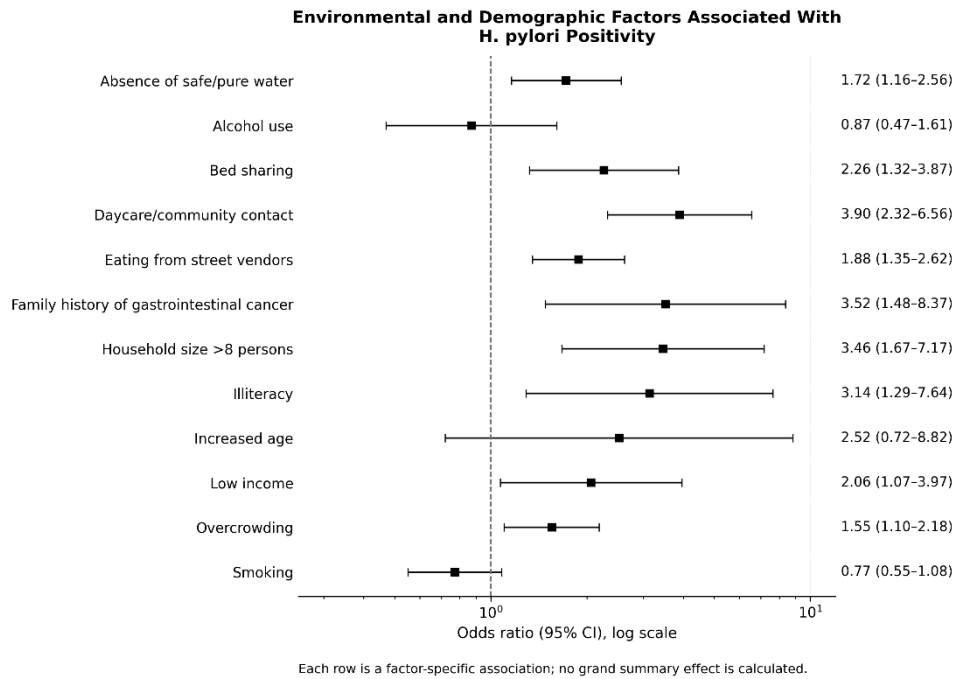


Figure 4. Environmental, socioeconomic, and demographic factors associated with *Helicobacter pylori* positivity. Squares represent factor-specific odds ratios and horizontal lines represent 95% confidence intervals. The vertical reference line indicates an odds ratio of 1.0. Different demographic, socioeconomic, and environmental exposures were not combined into a grand summary estimate.

DISCUSSION

This systematic review and meta-analysis synthesized evidence on *Helicobacter pylori* infection among symptomatic patients represented in the included regional studies. Across 11 studies comprising 10,814 participants with assessable *H. pylori* status, the pooled prevalence was 37.62% (95% CI 27.02–48.21%), although individual study estimates ranged from 22.4% to 68.0% and statistical heterogeneity was considerable. Factor-specific analyses identified associations between *H. pylori* positivity and several clinical manifestations, endoscopic abnormalities, and socioeconomic or environmental exposures. Importantly, these findings represent separate associations rather than a single composite clinical, endoscopic, or environmental effect.

The prevalence estimate should be interpreted within the broader context of substantial global and regional heterogeneity in *H. pylori* epidemiology. Large systematic reviews have demonstrated pronounced geographic variation in infection prevalence and temporal declines in many populations, while substantial burdens persist in numerous low- and middle-income and historically high-prevalence settings (2,22,23). Direct comparison of the present estimate with global population-based prevalence, however, requires caution because the current review focused on symptomatic or clinically referred populations rather than representative community samples. Referral patterns, symptom burden, age distribution, healthcare access, and the probability of undergoing diagnostic testing can all affect prevalence estimates within such clinical cohorts.

Marked variation in diagnostic methodology probably contributed importantly to the observed between-study heterogeneity. The included studies used urea breath testing, stool antigen testing, histology, rapid urease/CLO testing, culture, serology, and combinations of these approaches. Urea breath and stool antigen tests are generally used to identify active infection, whereas histological and rapid urease methods depend on biopsy sampling and may be influenced by bacterial density, proton-pump inhibitor exposure, recent antimicrobial treatment, and sampling location (1,5). Serological testing presents a different epidemiological construct because antibodies may remain detectable after eradication and therefore may reflect previous rather than current infection (1,5). Regional reviews have similarly identified substantial diagnostic heterogeneity as a barrier to straightforward comparison of prevalence estimates across Middle Eastern and North African populations (4). This methodological diversity is particularly relevant to the present review because the large Lebanese cohort relied on IgG serology, whereas several other studies used tests intended to identify active infection (17,18).

Several clinical characteristics were associated with *H. pylori* positivity. Abdominal pain, anorexia, pallor or low hemoglobin, weight loss, and hematemesis showed positive associations, whereas the estimate for vomiting was very large but accompanied by an extremely wide confidence interval, indicating substantial statistical imprecision. These findings should not be interpreted as establishing a symptom-based diagnostic rule. Abdominal pain, dyspepsia, appetite disturbance, anemia, and gastrointestinal bleeding have numerous alternative causes, and their diagnostic specificity for *H. pylori* is limited. Pediatric studies included in the review have also reported associations between infection, gastrointestinal symptoms, iron-related abnormalities, and growth-related outcomes (6,7), while adult dyspeptic cohorts have demonstrated variable relationships between individual presenting features and infection status (8). Current consensus and clinical guidelines continue to base diagnosis on appropriate testing rather than on symptoms alone (24,25). The observed clinical associations may therefore increase clinical suspicion but cannot substitute for confirmation of infection.

The endoscopic findings demonstrated some of the largest factor-specific effect estimates. Antral nodularity showed the strongest positive association, while gastric and duodenal mucosal erosions, duodenal ulcer, gastritis, mosaic gastritis, and esophagitis/GERD were also positively associated with *H. pylori* positivity in the available data. Previous pediatric and adult studies have reported associations between *H. pylori* and nodular gastritis, inflammatory mucosal changes, and peptic ulcer disease (6,8,9,20). The relationship with duodenal ulcer is also consistent with the established biological role of *H. pylori* in peptic ulcer disease (1,24,25). Nevertheless, the present findings require careful interpretation because endoscopic definitions, biopsy protocols, patient selection, and diagnostic tests differed among studies.

The contrasting estimates for apparently related endoscopic descriptors are particularly important. Antral nodularity showed a strong positive association, whereas the separate estimate labelled nodular gastritis was not statistically significant. Similarly, gastritis and mosaic gastritis showed positive associations, while non-erosive gastritis showed an inverse association. These differences may reflect distinct diagnostic definitions, different patient populations, variation in histopathological confirmation, or study-specific reference categories rather than true biological opposition. Accordingly, visually or linguistically similar endoscopic terms should not automatically be treated as interchangeable exposures in future quantitative synthesis.

Environmental and socioeconomic factors showed a pattern broadly compatible with the established epidemiology of *H. pylori* acquisition. Daycare or community contact, large household size, bed sharing, low income, illiteracy, overcrowding, absence of a safe water supply, and consumption of food from street vendors were positively associated with infection in the available estimates. *H. pylori* is commonly acquired during childhood, and close interpersonal contact, household crowding, socioeconomic disadvantage, sanitation, and water-related exposures have long been implicated in transmission and persistence at the population level (3,4,26,27). Regional studies included in this review similarly identified household and socioeconomic characteristics associated with infection (6,7,19).

These environmental associations should nevertheless be regarded as observational rather than causal. Household size, overcrowding, bed sharing, income, education, sanitation, and water access are interrelated exposures and may capture overlapping dimensions of socioeconomic conditions. Multiple associations derived from the same population may also be statistically correlated. Furthermore, not all included studies reported multivariable-adjusted estimates, leaving the possibility of residual or uncontrolled confounding. The current evidence therefore supports identifying these characteristics as factors associated with infection rather than as independent causal determinants.

Age did not show a statistically significant association in the factor-specific estimate available for quantitative presentation, although several included studies reported variation in infection prevalence across age groups (15,16,18,19). Age-related patterns may reflect cumulative exposure, cohort effects, childhood living conditions, spontaneous or treatment-related clearance, and differences between pediatric and adult populations. Similarly, the relationship between sex and *H. pylori* infection has not been uniform across regional studies. A systematic review of 244 pediatric and adult studies found a modest overall male predominance, but the magnitude of the difference varied according to population and age (28). Age and sex therefore appear more useful as epidemiological descriptors and potential covariates than as reliable standalone indicators of infection.

An important methodological implication of the present review concerns how heterogeneous associated factors are synthesized. Clinical symptoms such as abdominal pain and hematemesis, endoscopic findings such as antral nodularity and duodenal ulcer, and environmental exposures such as overcrowding and unsafe water represent conceptually different factors. Combining such estimates into a single category-wide odds ratio would produce a summary measure without a clearly defined common exposure. The revised synthesis therefore retains factor-specific estimates and reserves quantitative pooling for the same or sufficiently comparable exposure reported across independent studies. This approach improves interpretability and reduces the risk that correlated estimates originating from the same participants are treated as independent replications.

The review has several strengths. It focuses specifically on symptomatic clinical populations, incorporates evidence from multiple countries and clinical settings, and evaluates prevalence alongside clinical, endoscopic, demographic, socioeconomic, and environmental associations. The study-level diagnostic method was retained as an important source of heterogeneity, and the revised analytical framework distinguishes genuinely comparable factors from broad descriptive categories. The review also includes both adult and pediatric evidence, providing a wider representation of symptomatic populations encountered in regional clinical practice.

Several limitations must also be acknowledged. First, heterogeneity in the prevalence analysis was extremely high, limiting interpretation of the pooled estimate as a single regional prevalence. Second, most included studies were observational and many were cross-sectional or retrospective, precluding causal inference. Third, adult and pediatric populations were included within the same review despite important differences in epidemiology, symptom presentation, and endoscopic manifestations. Fourth, diagnostic methods varied substantially and included both active-infection tests and serology. Fifth, some factor-specific estimates appear to originate from only one or a small number of studies, and several confidence intervals were wide. Sixth, clinically related variables may overlap within the same study population, and not all associations were adjusted for potential confounders such as socioeconomic status, medication exposure, age, comorbidity, or other relevant factors. Seventh, formal assessment of publication bias or small-study effects was limited by the small number of independent studies contributing to most individual factor-specific comparisons. Finally, the included regional evidence spans heterogeneous geographic definitions and healthcare environments; this limits the extent to which the overall findings can be generalized to every country within the broader Middle Eastern or MENA region.

The findings have several implications for research and clinical interpretation. Future regional studies would benefit from standardized definitions of symptomatic populations, consistent use of validated active-infection diagnostic methods, explicit reporting of reference categories, and multivariable analyses that distinguish correlated socioeconomic and clinical factors. Prospective studies using harmonized definitions would also permit genuine pooling of the same exposure across countries and age groups. In clinical practice, the associations identified in this review may help characterize patients with a greater likelihood of infection, but they should complement rather than replace guideline-supported diagnostic testing (24,25). The considerable heterogeneity observed across studies further emphasizes the need to interpret *H. pylori* epidemiology in relation to local population characteristics, diagnostic practices, and healthcare settings.

CONCLUSION

H. pylori infection remains common among symptomatic patients represented in the included regional studies, although prevalence varies substantially across countries, populations, clinical settings, and diagnostic methods. Several clinical manifestations—including abdominal pain, anorexia, weight loss, hematemesis, and pallor or low hemoglobin—were associated with infection, while antral nodularity, gastric and duodenal erosions, duodenal ulcer, and selected forms of gastritis were among the associated endoscopic findings. Household crowding, large household size, bed sharing, socioeconomic disadvantage, unsafe water supply, and related environmental exposures were also associated with *H. pylori* positivity. These findings should be interpreted as factor-specific observational associations rather than as validated predictors or causal effects. Because of substantial between-study heterogeneity and methodological variation, clinical or epidemiological characteristics should not replace appropriate diagnostic testing. More standardized, prospectively designed regional studies are needed to provide more precise prevalence estimates and to permit robust pooling of comparable factors.

REFERENCE

1. The sequence below reconciles the revised Introduction → Methods → Results → Discussion. Previously cited sources retain their assigned numbers, while references first introduced in the Discussion continue from 22 onward.
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