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Relationship between dietary factors and *helicobacter pylori* infection: a cross-sectional study

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Abstract

Introduction: *Helicobacter pylori* (*H. pylori*) is a common bacterial infection linked to gastritis, peptic ulcers, and gastric cancer. Dietary habits may influence the acquisition, progression, and symptoms of this infection. In Palestine, the prevalence of *H.pylori* and dietary patterns raise public health concerns. This study explores the association between dietary factors and *H. pylori* infection severity in Palestine. **Objectives:** To assess the relationship between specific dietary practices and the prevalence and severity of *H. pylori* infection in Palestinian patients, aiming to inform preventive strategies and dietary management protocols. M**ethods:** A cross-sectional study was conducted between 2023 and 2024, involving 269 *H. pylori* patients. Participants completed an online semi-quantitative food frequency questionnaire (FFQ) shared via social media. The questionnaire collected data on demographics, infection status, dietary intake, lifestyle factors, and medical history. Statistical analyses included t-tests, Mann-Whitney U-tests, χ^2-tests, and Fisher's exact tests, with significance set at $p \leq 0.05$. Ethical approval was obtained from the IRB of An-Najah National University, Palestine. R**esults:** Significant associations were found between diet and *H. pylori* symptoms. Fast food consumption correlated with bloating and heartburn ($p < 0.01$). Low vegetable intake was linked to upper abdominal pain ($p < 0.01$). Energy drink consumption was associated with bloating and nausea ($p < 0.01$), and citrus intake with upper abdominal pain ($p < 0.01$). C**onclusion:** Certain

dietary behaviors, including high fast food and low vegetable intake, may exacerbate *H. pylori* symptoms. Integrating dietary modifications into *H. pylori* treatment plans is recommended, especially in resource-limited settings.

Keywords: Helicobacter pylori. Gastric cancer. Dietary factors. Nutrology.

Introduction

Helicobacter pylori (*H. pylori)* is a spiral microaerophilic, gram-negative bacterium that invades the human stomach and duodenum, ranking among some of the most prevalent infections in humans worldwide **[1]**. Although *H. pylori* can endure the bitterly acid environment of the stomach, this infection is usually asymptomatic **[2]**, nevertheless, the disease should be diagnosed and treated owing to its serious effects. For example, peptic ulcers, gastric adenocarcinoma, and gastric lymphoma can often follow **[3]**. Pathogenicity is characterized by seven major factors, including urease activity, flagella motility, adhesion to gastric epithelial cells, and the secretion of effector proteins such as VacA and CagA, inducing inflammation and causing reasonable damage to the host tissues **[4]**.

Research evidence indicates that dietary factors may play an important role in affecting *H. pylori* infection in many aspects, such as its onset, progression, or severity. An increased intake of fruits, vegetables, and foods rich in vitamins C and E, and polyphenols is associated with a reduced risk for the infection and its related sequelae **[5]**. Conversely, diets rich in processed meats, refined carbohydrates, and fatty foods are associated with *H. pylori* colonization and an increased risk of developing gastrointestinal diseases. Additionally, a diet rich in antioxidants can help stave off the inflammatory response induced by *H. pylori*, thereby reducing gastric cancer incidents **[5]**.

However, this area is still marked by significant gaps of understanding, and the precise relationship between diet and the *H. pylori* infection remains unclear. The manner in which various dietary factors promote or inhibit the colonization of bacteria, the interactions, and their effect on treatment outcome remain to be fully elucidated. Moreover, socioeconomic factors, lifestyle habits, and dietary patterns vary extensively worldwide, thus influencing the prevalence of the infection and its severity in different populations **[5]**.

Despite the high global prevalence of *H. pylori* and its established link to serious gastrointestinal diseases, there remains a significant gap in understanding the role of dietary factors in the onset, progression, and symptom severity of this infection. Most existing studies have focused on pharmacological treatments, while the impact of specific dietary habits on *H. pylori* infection has been understudied, particularly in low-resource settings. This gap limits the development of comprehensive, non-pharmacological strategies for managing and preventing the infection **[6]**.

Therefore, this study aimed to investigate the relationship between dietary factors and *H. pylori* infection. Specifically, it seeks to identify individual dietary components that may either increase or reduce the risk and severity of *H. pylori* symptoms. The findings could enhance our understanding of how diet influences infection outcomes and support the creation of evidence-based dietary guidelines. This may be particularly valuable in regions with limited access to medical treatment, where nutrition-based interventions could serve as practical, low-cost strategies to help reduce the global burden of H. pylori-related diseases.

Methods

Study Design and Settings

This cross-sectional study, according STROBE checklist (Available on: https://www.strobe-statement.org/, accessed on 10/10/2025, aimed to investigate the relationship between dietary factors and *Helicobacter pylori* (*H. pylori*) infection. The research involved 269 patients diagnosed with *H. pylori* in Palestine during the years 2023 to 2024. Diagnosis of *H. pylori* infection was confirmed using one or more of the following clinical tests: stool antigen test, breath test, or blood antibody test, with the stool test being the most commonly used (67.1%). Eligible participants were invited to complete an online questionnaire distributed through social media platforms.

Ethical Approval

Institutional Review Board (IRB) approval was granted on December 5, 2023 (Bse.L Dec 2023/5), by An-Najah National University, Palestine, and written informed consent was obtained from all participants prior to their involvement. A convenience sampling method was used to recruit participants. This approach was chosen due to its practicality and efficiency in accessing the target population.

Sample Size

The sample size was calculated using the Raosoft sample size calculator, with a 50% response distribution, a 5% margin of error, and a 95%

confidence interval. Based on this calculation, a sample size of 150 was initially determined; however, to account for potential non-response and missing data, the sample size was increased to 269 participants.

Questionnaire Development

A structured questionnaire was developed and divided into six sections. The first section gathered general demographic information. The second section focused on *H. pylori* infection status. The third section addressed dietary habits and symptoms associated with the infection. The fourth section explored lifestyle factors. The fifth section collected information on medical history. The sixth section included outcome variables relevant to health and dietary information. The purpose of the questionnaire was to investigate potential relationships between dietary patterns and the severity of symptoms in patients with H. pylori, using a food frequency questionnaire (FFQ) as the primary tool for dietary assessment.

Statistical Analysis

Data were presented as mean ± standard deviation and compared using either the student's t-test or Mann–Whitney U-test, as appropriate for continuous variables. For categorical variables, counts and percentages were reported, with comparisons made using the χ^2 test or Fisher's exact test. A p-value of less than 0.05 was deemed statistically significant. Data analysis was conducted using Stata 17.0.

Results

The study sample consisted predominantly of females, representing 83.6% (n=225), while males accounted for 16.4% (n = 44). Most participants were between the ages of 18 and 40, comprising 82.5% (n=222), followed by 14.1% (n=38) over the age of 40, and 3.3% (n=9) under the age of 18. In terms of marital status, 63.6% (n=171) were single and 34.9% (n=94) were married, with a small percentage categorized as other. Regarding lifestyle habits, a significant majority (88.5%) reported not engaging in regular physical activity, whereas only 22.7% exercised regularly. Similarly, 88.5% of participants were non-smokers, and 11.5% reported smoking. With respect to hygiene and water consumption habits, 68.8% of respondents consumed regular tap water, while 31.2% preferred mineral water. Most participants practiced good hygiene, with 92.2% reporting that they washed fruits and vegetables before consumption, 86.2% washed their hands before eating, and 96.7% washed their hands after using the toilet. Furthermore, 73.6% of participants did not share utensils such as spoons or cups with family members, while 26.4% reported sharing these items. These sociodemographic and lifestyle characteristics provide essential context for analyzing the association between dietary habits and *H. pylori* infection within the study population (Table 1).

Table 1. Demographic data and life style.

Parameter	Variable	No. of Participants	Percentage
Gender	Female	225	83.6
	Male	44	16.4
Age Group	<18 years	9	3.3
	18-40 years	222	82.5
	More than 40 years	38	14.1
Marital Status	Single	171	63.6
	Married	94	34.9
Life Style	other	4	1.5
Do Exercise	No	208	77.3
	Yes	61	22.7
Smoking	No	238	88.5
	Yes	31	11.5
Kind of Water for drink	Mineral	84	31.2
	Normal	185	68.8
Wash fruits and vegetables	No	21	7.8
	Yes	248	92.2
Wash hand before eating	No	37	13.8
	Yes	232	86.2
Wash hand after used W.C	No	9	3.3
	Yes	260	96.7
Used spoon or cup (other family member)	No	198	73.6
	Yes	71	26.4

Source: Own authorship.

All the participants of the study had this diagnosis of *H. pylori*. In Figure 1, the highest diagnostic test used was for the stool examination at 67.1%. Followed by this was the breath test used at 15.1%. A majority of the participants, specifically 91.1%, obtained treatment for *H. pylori.*

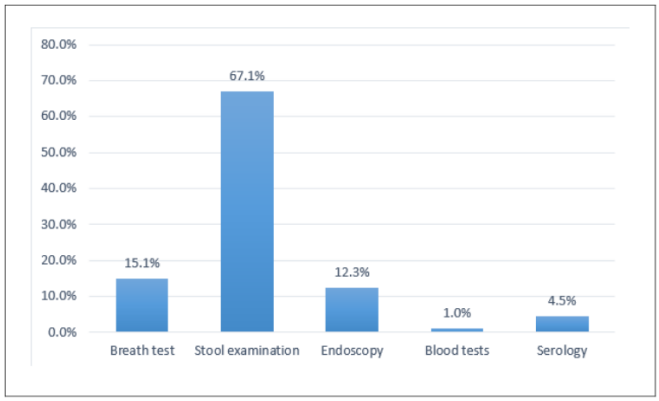

Figure 1. Pylori examination test (n=269). Source: Own authorship.

Regarding the diet, most participants 84.4% had a balanced diet with both vegetables and animal-based foods. Then 8.9% took mostly animal-based diets, and 6.7% were vegetarians (Figure 2).

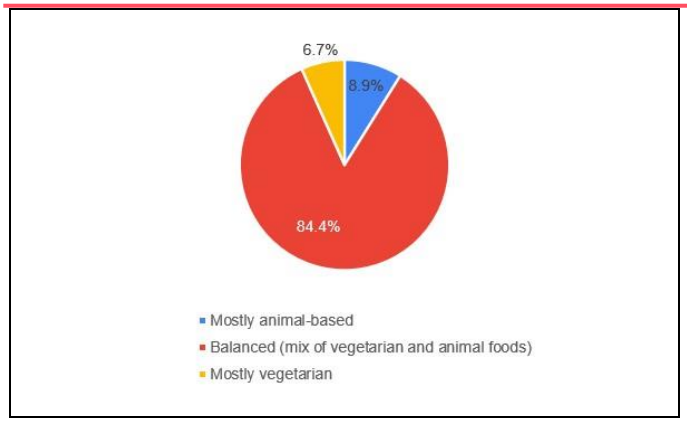

Figure 2. dietary patterns (n=269). Source: Own authorship.

Table 2 displays the various diet patterns, along with their associated symptoms, which in some cases differ considerably. In the case of milk intake, all diet patterns shared similar symptoms, including bloating and pain in the upper abdomen, with no significant difference and p = 0.99. For chicken, meat, and fish intake, there were. Comparatively speaking, the vegetarian diets had more frequent incidences of burping with a feeling of uncomfortably being too full after small food intake. In contrast, the animal-based diet was more commonly associated with heartburn.

In contrast, potato and bread consumption did not show any significant difference in symptoms among the dietary groups, p=0.69, though bloating was most common among subjects on an animal-based diet. Symptomatically, the consumption of spices also did not differ significantly, p=0.95, where constipation without blood was most prevalent among subjects on an animal-based diet.

There were no significant differences in symptoms with regard to coffee consumption, p=0.976, with heartburn being a common complaint, more so in those on an animal-based diet. Significant association was found between energy drink consumption and reported difference in symptoms, p<0.01, where vegetarians indicated the highest rate for bloating and nausea/vomiting. There were no significant differences in symptoms from garlic consumption (p=0.242), although there were many reports of bloating and heartburn. Physical symptoms from the consumption of citrus did show a significant difference, p<0.01, with upper abdominal pain more common in the mixed diet group. Onion consumption did not vary significantly in symptoms by dietary pattern, p=0.90, though the greatest number reporting bloating were on an animal-based diet. Green pepper consumption was significantly associated with different symptoms, p<0.01, with upper abdominal pain being reported by the highest percentage of vegetarians.

There were no significant differences in symptoms with processed meat consumption, and bloating was a common symptom independent of processed meat consumption (p=0.76). Tea consumption did not significantly alter symptoms, although heartburn was quite common, particularly among those on an animal-based diet. Finally, tomato consumption did not significantly differ by symptoms, with heartburn and bloating commonly shown across all dietary groups.

Table 2: Association between dietary patterns and experience symptoms.

Parameter	Symptoms	Animal based %	Mixed %	Vegetarian %	p-value
Milk	Normal diarrhea without blood	8.6	5.7	7.7	0.99
	Diarrhea with blood	0.0	0.3	0.0	
	Bloating	19.0	17.7	17.3	
	Burping	8.6	7.9	5.8	
	Feeling full after eating a small amount of food	10.3	9.2	9.6	
	Upper abdominal pain	13.8	13.1	13.5	
	Normal constipation without blood	5.2	4.6	1.9	
	Constipation with blood	0.0	0.9	0.0	
	Dark stool	1.7	6.3	5.8	
	Heartburn	13.8	10.2	13.5	
	Nothing	10.3	7.4	3.8	
	I don't drink milk	0.0	0.6	1.9	
	Lack of appetite	3.4	6.5	9.6	
	Nausea or vomiting	5.2	9.6	9.6	
Chicken, Meat & Fish	Normal diarrhea without blood	0.0	4.7	0.0	**< 0.01**
	Diarrhea with blood	0.0	1.3	0.0	
	Bloating	8.7	7.3	0.0	
	Burping	13.0	7.7	28.6	
	Feeling full after eating a small amount of food	17.4	14.1	28.6	
	Upper abdominal pain	17.4	17.5	0.0	
	Normal constipation without blood	13.0	6.4	0.0	
	Constipation with blood	0.0	1.3	0.0	
	Dark stool	4.3	7.7	0.0	
	Heartburn	26.1	18.8	28.6	
	I don't eat meat	0.0	0.0	14.3	
	I don't take large amounts; half a piece is enough	0.0	0.4	0.0	
	Nothing	0.0	2.1	0.0	
	Lack of appetite	0.0	10.3	0.0	
	Earache with itching. Dry throat	0.0	0.4	0.0	
Potato and bread	Normal diarrhea without blood	0.0	1.7	0.0	0.69
	Diarrhea with blood	0.0	0.4	0.0	
	Bloating	26.7	17.1	24.3	
	Burping	8.9	6.9	5.4	
	Feeling full after eating a small amount of food	8.9	11.3	8.1	
	Upper abdominal pain	6.7	12.1	13.5	
	Normal constipation without blood	11.1	7.2	0.0	
	Constipation with blood	2.2	1.1	5.4	
	Dark stool	0.0	2.4	5.4	
	Heartburn	13.3	11.1	13.5	
	Nothing	17.8	17.8	10.8	
	Lack of appetite	0.0	5.0	8.1	
	Earache with itching. Dry throat	0.0	0.2	0.0	
	Nausea or vomiting	4.4	5.6	5.4	
Species	Normal diarrhea without blood				0.95
	Diarrhea with blood	3.6	2.8	4.9	
	Bloating	1.8	0.2	0.0	
	Burping	14.3	13.2	12.2	
	Feeling full after eating a small amount of food	8.9	5.9	4.9	
	Upper abdominal pain	3.6	5.1	12.2	
	Normal constipation without blood	21.4	16.8	14.6	
	Constipation with blood	5.4	3.4	2.4	
	Dark stool	0.0	0.2	0.0	
	Heartburn	0.0	3.0	2.4	
	Lack of appetite	28.6	27.2	22.0	
	Earache with itching.. Dry throat	3.6	4.3	7.3	
	Nausea or vomiting	0.0	0.2	0.0	
	Nothing	3.6	7.7	7.3	
Coffee	Normal diarrhea without blood	5.7	2.6	8.3	0.98
	Bloating	8.6	7.2	5.6	
	Burping	8.6	5.5	5.6	
	Feeling full after eating a small amount of food	0.0	3.4	2.8	
	Upper abdominal pain	5.7	12.4	5.6	
	Normal constipation without blood	0.0	0.6	0.0	

	Constipation with blood	0.0	0.3	0.0	
	Dark stool	0.0	1.4	2.8	
	Heartburn	28.6	21.6	25.0	
	Don't drink coffee	34.3	26.7	25.0	
	Lack of appetite	2.9	6.3	11.1	
	increase in heart rate	0.0	0.3	0.0	
	Nausea or vomiting	5.7	10.6	8.3	
Energy Drink	Normal diarrhea without blood	1.1	0.4	0.0	< 0.01
	Bloating	11.7	20.1	33.3	
	Burping	23.5	10.5	0.0	
	Feeling full after eating a small amount of food	4.5	1.7	0.0	
	Upper abdominal pain	18.4	7.9	0.0	
	Normal constipation without blood	1.7	0.4	0.0	
	Dark stool	1.1	0.4	0.0	
	Heartburn	19.0	5.4	5.6	
	Don't drink energy drink	6.1	43.5	50.0	
	Nothing	1.7	0.0	0.0	
	Lack of appetite	9.5	0.8	0.0	
	Nausea or vomiting	1.1	7.5	11.1	
Garlic	Normal diarrhea without blood	0.0	1.0	0.0	0.24
	Bloating	11.1	13.4	7.5	
	Burping	11.1	13.4	12.5	
	Feeling full after eating a small amount of food	4.4	3.4	5.0	
	Upper abdominal pain	17.8	11.1	12.5	
	Normal constipation without blood	0.0	0.5	0.0	
	Constipation with blood	2.2	0.3	0.0	
	Dark stool	0.0	1.3	0.0	
	Heartburn	17.8	18.6	17.5	
	Lack of appetite	11.1	3.4	12.5	
	Nausea or vomiting	6.7	7.8	15.0	
	Don't eat Garlic	2.2	0.3	0.0	
	Nothing	15.6	25.6	17.5	
Citrus	Normal diarrhea without blood	1.1	1.6	1.1	< 0.01
	Headache	0.0	0.4	0.0	
	Bloating	3.3	9.3	4.3	
	Burping	4.4	10.1	4.3	
	Feeling full after eating a small amount of food	3.3	6.5	3.2	
	Upper abdominal pain	6.6	25.0	5.3	
	Normal constipation without blood	0.0	2.4	0.0	
	Constipation with blood	0.0	0.4	0.0	
	Dark stool	0.0	2.0	1.1	
	Heartburn	11.0	4.0	10.6	
	Nothing	65.9	24.2	63.8	
	Lack of appetite	1.1	0.4	1.1	
	Pain stomach	0.0	0.4	0.0	
	Nausea or vomiting	2.2	13.3	5.3	
	diarrhea with blood	1.1	0.0	0.0	
Onions	Normal diarrhea without blood	0.0	0.3	0.0	0.90
	diarrhea with blood	0.0	0.3	0.0	
	Bloating	19.6	19.3	6.7	
	Burping	13.0	11.2	13.3	
	Feeling full after eating a small amount of food	6.5	2.6	3.3	
	Upper abdominal pain	13.0	11.2	13.3	
	Normal constipation without blood	2.2	0.5	0.0	
	Dark stool	0.0	0.5	3.3	
	Heartburn	17.4	15.7	20.0	
	Nothing	15.2	25.3	23.3	
	Lack of appetite	4.3	4.2	6.7	
	Nausea or vomiting	6.5	8.4	10.0	
	Don't eat onions	2.2	0.5	0.0	
Green pepper	Normal diarrhea without blood	7.1	2.7	4.3	**< 0.01**
	diarrhea with blood	2.4	0.0	0.0	
	Bloating	16.7	10.1	13.0	
	Burping	7.1	8.0	13.0	
	Feeling full after eating a small amount of food	2.4	1.5	4.3	
	Upper abdominal pain	14.3	13.6	21.7	
	Normal constipation without blood	0.0	0.3	4.3	
	Constipation with blood	0.0	0.6	0.0	
	Dark stool	0.0	0.9	0.0	
	Heartburn	19.0	20.8	13.0	
	Nothing	21.4	34.7	4.3	
	Lack of appetite	2.4	0.9	8.7	
	Nausea or vomiting	7.1	5.3	8.7	
	Don't eat green pepper	0.0	0.6	4.3	
Processed Meat	Normal diarrhea without blood	1.7	3.2	5.6	0.76
	diarrhea with blood	0.0	0.2	1.9	
	Bloating	24.1	18.3	22.2	
	Burping	12.1	10.1	13.0	
	Feeling full after eating a small amount of food	8.6	9.2	13.0	
	Upper abdominal pain	17.2	15.6	16.7	
	Normal constipation without blood	3.4	3.2	0.0	
	Constipation with blood	0.0	0.5	0.0	
	Dark stool	5.2	3.8	0.0	
	Heartburn	13.8	15.6	11.1	
	pain stomach	0.0	0.2	0.0	
	Lack of appetite	0.0	3.9	3.7	
	Nausea or vomiting	10.3	8.6	11.1	
	Nothing	3.4	7.5	1.9	
Tea	Normal diarrhea without blood	0.0	0.7	0.0	0.88
	Bloating	12.0	7.8	13.0	
	Burping	0.0	4.9	8.7	
	Feeling full after eating a small amount of food	4.0	2.2	4.3	
	Upper abdominal pain	0.0	8.2	8.7	
	Constipation with blood	0.0	1.5	0.0	
	Dark stool	4.0	0.7	0.0	
	Heartburn	12.0	11.9	4.3	
	Nothing	64.0	56.3	52.2	
	Lack of appetite	0.0	3.7	4.3	
	Don't drink tea	4.0	1.9	4.3	
Tomato	Normal diarrhea without blood	0.0	2.3	6.5	0.29
	Bloating	12.2	7.4	9.7	
	Burping	9.8	5.9	9.7	
	Feeling full after eating a small amount of food	9.8	4.5	12.9	
	Upper abdominal pain	12.2	11.9	16.1	
	Normal constipation without blood	2.4	0.8	0.0	
	Heartburn	24.4	28.0	25.8	
	Nothing	22.0	28.9	6.5	
	Lack of appetite	4.9	2.5	6.5	
	Earache with itching. Dry throat	0.0	0.3	0.0	
	Nausea or vomiting	2.4	6.8	3.2	
	Dark stool	0.0	0.6	3.2	

Source: Own authorship.

The most prevalent symptoms that participants responded to the survey with were heartburn, which affected 16.52% of the subjects, and no symptoms at all, which was indicated by 13.95%. Other dominant symptoms included bloating, indicated by 13.66%, and upper abdominal pain by 13.42%. Other important symptoms were burping, indicated by 8.74%, nausea or vomiting by 7.00%, and feeling full after eating a small amount of food by 6.16%. Besides, 4.38% of the subjects showed a lack of appetite, 4.85% showed normal constipation without blood, and 2.36% dark stool (Figure 3).

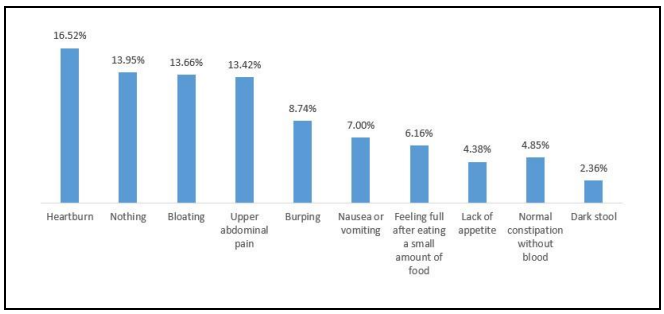

Figure 3. Most common symptoms. Source: Own authorship.

Discussion

This study provides a comprehensive understanding of the demographic distribution, lifestyle behaviors, and dietary habits in relation to symptoms of H. pylori. The outcome indicates associations between diet, exercise habits, hygiene practices, and the presence of symptoms related to H. pylori. These factors suggest that certain lifestyle modifications may help in symptom management. The following

discussion compares these findings with relevant literature to understand their broader implications and identify directions for future research. The demographic distribution of the study population showed a dominance of females (83.6%) and. This gender imbalance may reflect greater health-seeking behavior among females, as supported by similar studies **[6-9]**. The concentration of younger participants, with most (82.5%) being between the ages of 18–40 years, aligns with global patterns showing earlier acquisition of *H. pylori* infection, particularly in developing countries **[10]**.

Lifestyle analysis revealed that 88.5% of participants did not engage in regular physical activity, while an equal proportion reported not smoking. The lack of exercise has been linked in literature to increased risk of gastrointestinal symptoms **[11-14]**. The role of smoking in *H. pylori* symptomatology remains unclear, with some studies suggesting it aggravates symptoms **[15]**, while others report the opposite **[16]**. In this study, no strong pattern between smoking and symptom presentation was observed.

In terms of hygiene, 68.8% consumed ordinary tap water, and most participants reported positive hygiene practices, including handwashing and washing of fruits and vegetables. Although poor hygiene and unsafe water are known risk factors for *H. pylori* infection **[17,18]**, the lack of significant association in this study may be due to high adherence to hygiene practices among respondents.

Dietary habits significantly impact symptom presentation, with 84.4% of participants consuming a mixed diet of animal- and plant-based foods. Bloating, burping, and heartburn were common, particularly linked to energy drinks, fast food, spices, and citrus. Vegetarians experienced more bloating and burping, while those on animal-based diets more often had heartburn. These findings align with previous studies connecting fatty and spicy foods to worsened symptoms in H. pylori-positive individuals **[5,19-21]**.

Certain foods such as milk, citrus, and meats produced distinguishable symptom patterns among dietary groups. For example, milk consumption was associated with fullness and bloating across all groups, a symptom profile that mirrors lactose intolerance and may be exacerbated by H. pylori-induced gastric changes **[20,21]**. High consumption of meat and fish correlated with more frequent reports of heartburn, possibly due to delayed gastric emptying linked to high-fat diets **[5]**. Vegetarian participants more commonly reported symptoms like burping and early satiety, suggesting variations in digestive response. Garlic, tea, and processed meats did not show statistically significant differences across dietary groups, though symptoms such as bloating and heartburn were still commonly reported by consumers of these items.

Future research should further explore the complex interaction between diet, lifestyle factors, and symptom expression in H. pylori-positive individuals. Studies with more diverse demographic samples, especially older adults and males, are needed. Longitudinal research could also help clarify the long-term effects of dietary adjustments on symptom patterns.

Study Limitations

This study has several limitations. Its cross-sectional design does not allow for causal conclusions. Data were self-reported, introducing potential recall bias. The sample was skewed toward young females, limiting generalizability. Additionally, the food frequency questionnaire may not have captured all relevant dietary nuances.

Conclusion

This study provides valuable insights into the relationships between demographic factors, lifestyle, and dietary habits among individuals infected with H. pylori. However, further research is needed to fully understand these associations. Gaining a deeper understanding of how these factors influence symptom manifestation could play a significant role in improving the management and treatment of *H. pylori* infections.

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Author contributions: All authors contributed significantly to this work. MA, HAK, AD, and LK were responsible for designing the study and drafting the manuscript. DN, MA, and NAH analyzed the data. AD, HAA, ABS, AAK, AS, BM, FH, MJ, and AAA were responsible for data collection and interpretation. All authors reviewed, edited, and approved the final version of the manuscript.

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Ethical Approval

The study was approved by An-Najah University Institutional Review Board (IRB), Palestine, dated December 5, 2023 with approval number: Bse.L Dec 2023/5. The study was conducted according to the ethical principles of the Helsinki Declaration.

Informed Consent

Written informed consent was obtained from each participant before enrollment into the study.

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Data Sharing Statement

Authors are available and ready to supply the data upon request through the corresponding author.

Conflict of Interest

The authors have no conflicts of interest to declare.

Similarity Check

It was applied by Ithenticate[@].

Application of Artificial Intelligence (AI)

Not applicable.

Peer Review Process

It was performed.

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