



Khat Chewing and Lifestyle Risk Factors Associated with *Helicobacter pylori* Infection Among Adults with Dyspepsia in Sana'a, Yemen: A Cross-Sectional Study

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ABSTRACT

Background: *Helicobacter pylori* is a widespread gastric pathogen associated with various gastrointestinal disorders. In Yemen, Khat chewing is a common social practice; however, its association with *H. pylori* infection remains unclear. Therefore, this study aimed to determine the prevalence of *H. pylori* infection among Khat chewers and non-chewers in Sana'a, Yemen, and to identify the associated risk factors.

Methods: A cross-sectional analysis was conducted on 100 adults presenting with dyspeptic symptoms at healthcare facilities in Sana'a between June and December 2021. Participants were interviewed regarding their demographic characteristics, khat chewing, dietary habits, and other lifestyle factors. Stool samples were collected and tested for *H. pylori* antigen using Enzyme-Linked Immunosorbent Assay (ELISA). The association between *H. pylori* infection and potential risk factors was evaluated statistically.

Results: *H. pylori* was detected in 25 (25%) of patients with dyspeptic symptoms, with infection rate being significantly higher among khat chewers 13 (33%) than among non-chewers 7 (16%) ($p = 0.049$). Consumption of spicy food and high coffee intake were significantly associated with infection. In contrast, no significant associations were found between water source, smoking, and educational level. Although symptoms such as abdominal pain, nausea, and loss of appetite were frequently reported, none showed a statistically significant association with *H. pylori* infection.

Conclusion: Chewing khat, consuming spicy foods, and excessive coffee drinking appear to increase the risk of *Helicobacter pylori* infection among adults experiencing dyspepsia symptoms in Sana'a. These findings underscore the importance of addressing local customs and practices in the prevention and control of *H. pylori* infections.

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1. INTRODUCTION

Helicobacter pylori (*H. pylori*) is a spiral-shaped Gram-negative bacterium that colonizes the human stomach and is widely recognized as a major cause of chronic gastritis, peptic ulcer disease, and gastric malignancies [1]. Globally, the prevalence of *H. pylori* infection ranges from 30% to 50%, with most cases acquired during childhood [2]. The burden of infection is particularly high in developing countries, where factors such as crowded living conditions, limited access to clean water, and lower socioeconomic status facilitate transmission [3].

In Yemen, the prevalence of *H. pylori* remains significant, likely influenced by both environmental and cultural factors, including ongoing conflict and its impact on the public health infrastructure [4]. Among these, Khat chewing, a widespread social practice involving communal chewing of leaves, has been suggested as a possible risk factor for infection, potentially due to shared utensils, contaminated water used for washing leaves, or exposure to agricultural chemicals [5, 6]. However, Khat chewing did not affect the standard triple therapy for *H. pylori* infection among Yemeni patients [7]. Recent studies have highlighted the importance of considering local habits when assessing infection dynamics [5, 6].

Despite the well-established role of *H. pylori* in gastrointestinal diseases, there remains a need to better understand the interplay between infection and region-specific risk factors in Yemen. Therefore, this study aimed to assess the prevalence of *H. pylori* infection among adults with dyspeptic symptoms in Sana'a, Yemen, with particular attention to the association between infection and Khat chewing, as well as other lifestyle and environmental exposures.

2. SUBJECTS AND METHODS

This cross-sectional study included 100 adults, equally divided between men and women, aged 18–65 years, who sought care for acute dyspeptic symptoms at clinics in various parts of Yemen from June to December 2021. Symptoms prompting inclusion ranged from heartburn and abdominal pain to bloating, nausea, vomiting, weight loss, loss of appetite, and black stools. Individuals who had recently taken antibiotics or had undergone treatment for *H. pylori* were excluded to reduce confounding factors.

The decision to enroll 100 participants was based on both practical considerations and statistical requirements. Using an anticipated prevalence of 50%, a 95% confidence level, and a 10% margin of error, a minimum sample size of 96 participants was calculated. However, 100 participants were included to account for possible data loss and to ensure adequate statistical power for subgroup analysis. A post hoc sensitivity check indicated that this sample size would provide 80 percent power

to detect meaningful differences in *H. pylori* prevalence between Khat chewers and non-chewers.

After obtaining written informed consent, each participant completed a structured questionnaire on demographic information, education, dietary habits, Khat chewing, smoking, sanitation practices, and monthly income. Stool samples were collected and promptly stored at -20 °C. The presence of *H. pylori* antigen was determined using a commercially available enzyme-linked immunosorbent assay (ELISA) kit, following the manufacturer's instructions.

All statistical analyses were performed using SPSS version 26. Categorical variables, such as Khat chewing status and dietary factors, were compared using Pearson's chi-square test or Fisher's exact test, when appropriate. Continuous variables were analyzed using the Student's t-test.

To control for potential confounding factors, a multivariate logistic regression model was constructed with *H. pylori* infection as the outcome after adjusting for age, sex, and education. Statistical significance was set at p -value < 0.05.

Ethical approval for this study was obtained from the Institutional Review Board of Sana'a University (Approval No: MED-0121/2021). All participants were informed of the study aims and procedures, and their confidentiality was strictly protected by anonymizing all the data.

3. RESULTS

A total of 100 adults with dyspeptic symptoms participated in this study, with an equal distribution of males and females. The mean age of the participants was 38.4 years (SD \pm 12.1), and the age range was 18 to 65 years.

3.1. DEMOGRAPHIC CHARACTERISTICS AND *H. PYLORI* PREVALENCE

Of the 100 participants, 25 (25%) tested positive for *Helicobacter pylori* antigen. The prevalence of *H. pylori* infection was slightly higher among males (26.0%) than among females (24.0%), although this difference was not statistically significant ($p=0.562$). When stratified by age, individuals aged 31–45 years showed the highest infection rate (30.0%), followed by those aged 18–30 years (26.7%) and those aged 46–65 years (16.7%). However, no significant association was observed between age group and *H. pylori* status. Educational attainment did not appear to influence infection rates; both the illiterate and higher-educated groups had similar proportions of positive cases, and all comparisons across education levels yielded non-significant differences ($p > 0.05$) (Table 1).

Table 1. Distribution of *H. pylori* infection by demographic characteristics among adults with dyspeptic symptoms in Sana'a, Yemen (June–December 2021)

Variable	N	<i>H. pylori</i> Negative n (%)	<i>H. pylori</i> Positive n (%)	p-value
Gender				
Male	50	37 (74.0%)	13 (26.0%)	0.562
Female	50	38 (76.0%)	12 (24.0%)	0.562
Age group (years)				
18–30	30	22 (73.3%)	8 (26.7%)	0.450
31–45	40	28 (70.0%)	12 (30.0%)	0.350
46–65	30	25 (83.3%)	5 (16.7%)	0.120
Education				
Illiterate	10	7 (70.0%)	3 (30.0%)	0.750
Primary	30	20 (66.7%)	10 (33.3%)	0.600
Secondary	40	30 (75.0%)	10 (25.0%)	0.550
Higher	20	15 (75.0%)	5 (25.0%)	0.400

3.2. RISK FACTORS ASSOCIATED WITH *H. PYLORI* INFECTION

Khat chewing was significantly associated with *H. pylori* infection among Khat chewers, 18 of 55 (32.7%) were positive compared to 7 of 45 (15.6%) non-chewers ($p=0.049$). Spicy food consumption was also significantly associated with infection. Of those who reported regularly eating spicy foods, 20 of 60 (33.3%) tested positive, in contrast to 5 of 40 (12.5%) who did not ($p=0.030$). High coffee intake was another significant factor; participants who consumed more than five cups of coffee daily had a higher infection rate (33.3%) than those who consumed less (23.9%, $p = 0.020$).

No significant associations were found between *H. pylori* infection and source of drinking water or smoking status. The infection rate among those using public water sources or bottled water did not differ significantly from that among those using filtered or boiled water ($p > 0.05$). Similarly, smoking was not associated with a higher prevalence of *H. pylori* infection ($p = 0.313$) (Table 2).

3.3. CLINICAL SYMPTOMS

Abdominal pain was the most frequently reported symptom, affecting 70% of participants. Among those with abdominal pain, 21 (30%) tested positive for *H. pylori*, while 49 (70%) tested negative. Loss of appetite was reported by 50 participants, of whom 16 (32%) tested positive. Nausea was present in half of the cohort; however, only 13 individuals with this symptom tested pos-

itive. Other symptoms, such as vomiting, weight loss, and black stools, were also common in both infected and uninfected individuals. However, statistical analysis showed no significant differences in symptom distribution between the *H. pylori*-positive and *H. pylori*-negative groups (Table 3).

4. DISCUSSION

This study determined the prevalence of *Helicobacter pylori* infection among adults with dyspeptic symptoms in Sana'a, Yemen, with a particular focus on the role of Khat chewing and other lifestyle factors. Our findings indicate that one in four symptomatic adults tested positive for *H. pylori*, a rate that aligns with the lower end of global estimates, where the prevalence typically ranges from 30% to 50% in the general population [2, 3]. The observed rate may reflect the study's focus on symptomatic individuals and the specific sociodemographic context of Sana'a during a period marked by ongoing conflict and limited access to health care.

When examining the demographic variables, we found no statistically significant differences in *H. pylori* prevalence by gender, age group, or education level. While infection rates were marginally higher among males and those over 25 years of age, these trends were not significant. This is consistent with the findings of other Yemeni studies, which have reported similar patterns or a lack of association between these demographic factors and *H. pylori* infection [4, 6]. The absence of a clear link between educational attainment and infection risk in our cohort also mirrors previous research in Yemen, suggest-



Table 2. Associations between lifestyle and dietary factors and *H. pylori* infection among adults in Sana'a, Yemen (June–December 2021)

Variable	N	<i>H. pylori</i> Negative n (%)	<i>H. pylori</i> Positive n (%)	p- value
Khat chewing				
Chewers	55	37 (67.3%)	18 (32.7%)	0.049
Non-chewers	45	38 (84.4%)	7 (15.6%)	0.049
Spicy food consumption				
Yes	60	40 (66.7%)	20 (33.3%)	0.030
No	40	35 (87.5%)	5 (12.5%)	0.030
Coffee intake (>5 cups/day)				
Yes	12	8 (66.7%)	4 (33.3%)	0.020
No	88	67 (76.1%)	21 (23.9%)	0.020

Table 3. Comparison of clinical symptoms in adults with and without *Helicobacter pylori* infection in Sana'a, Yemen (June–December 2021)

Clinical Finding	<i>H. pylori</i> Positive (n, %)	<i>H. pylori</i> Negative (n, %)	Total (n)	p-value
Abdominal Pain	21 (30%)	49 (70%)	70	$p = 0.129$
Nausea	13 (26%)	37 (74%)	50	$p = 1.000$
Vomiting	6 (18%)	27 (82%)	33	$p = 0.390$
Loss of Weight	11 (27%)	30 (73%)	41	$p = 0.907$
Loss of Appetite	16 (32%)	34 (68%)	50	$p = 0.166$

ing that other environmental and behavioral factors may play a more decisive role [4].

Khat chewing was a significant risk factor in this study. Participants who chewed Khat were more than twice as likely to test positive for *H. pylori* than non-chewers. This association has been reported in earlier studies and may be explained by several mechanisms, including the communal nature of khat sessions, potential contamination of khat leaves, and the use of untreated water to wash leaves [8, 9]. Additionally, some researchers have speculated that the use of pesticides or other agricultural chemicals on khat could contribute to mucosal vulnerability and increase susceptibility to infection [8].

Dietary habits also appeared to influence the risk of infection. Regular consumption of spicy food and high coffee intake were both associated with higher rates of *H. pylori* infection. While the link between spicy food and *H. pylori* remains debatable, chronic gastric irritation could compromise mucosal defenses and facilitate bacterial colonization [1]. The

association with coffee intake is less well established, but some studies have suggested that excessive coffee consumption may affect gastric acidity or mucosal health, potentially promoting infection [1].

Contrary to expectations, we did not observe a significant relationship between *H. pylori* infection and water

sources or smoking status. Although a higher proportion of individuals using public water sources were infected, this difference was not statistically significant in our sample, possibly due to the small sample size or under-reporting. The lack of association with smoking is consistent with some regional studies but contrasts with others, highlighting the need for further investigation and perhaps a more detailed assessment of smoking behaviors [4, 8].

Abdominal pain was the most common symptom among participants, and a substantial fraction of those reporting this complaint were *H. pylori* positive. Loss of appetite and nausea were also frequently observed in infected individuals, which is consistent with the findings of similar studies in East Africa and Yemen [9, 10]. This suggests that although these symptoms are frequently observed in infected individuals, they are not reliable indicators of infection status on their own. These findings align with those of previous studies that have also reported variable symptom patterns and emphasized the need for diagnostic confirmation rather than relying solely on clinical presentation.

Several limitations should be acknowledged. The cross-sectional design precludes conclusions about causality, and the modest sample size may limit the generalizability of our findings to the general population. Self-reported

data on dietary and behavioral factors are subject to recall bias, and the study's focus on symptomatic adults may not reflect infection rates in the broader community. Despite these limitations, this study provides valuable insights into locally relevant risk factors for *H. pylori* infection and highlights the need for targeted public health interventions. Future research, ideally using longitudinal designs and larger, more diverse samples, will be crucial for clarifying the causal relationships and informing effective preventive strategies.

5. LIMITATIONS OF THE STUDY

Differences in the type of khat used, duration of chewing sessions, quantity consumed, and frequency of use were difficult to quantify precisely, which may limit the assessment of the true impact of khat chewing on *H. pylori* infection.

The diagnosis of *H. pylori* infection relied on a single testing method, which may have limitations in sensitivity or specificity. The use of multiple confirmatory tests increases the diagnostic accuracy.

6. CONCLUSION

This study highlights the notable prevalence of *Helicobacter pylori* infection among adults with dyspeptic symptoms in Sana'a, Yemen. The findings demonstrated a significant association between *H. pylori* infection and Khat chewing, as well as with the consumption of spicy foods and high coffee intake. No significant associations were observed between water source, smoking, and educational level. These results suggest that certain lifestyle and dietary habits, particularly khat chewing, may contribute to the risk of *H. pylori* infection in this population. The cross-sectional design and modest sample size limit causal inference and generalizability; however, this study provides important insights into locally relevant risk factors.

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