

## RESEARCH ARTICLE

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# Incidence and Risk Factors of *Helicobacter pylori* Infections Among Asymptomatic Pakistani Tobacco Consumers

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## Abstract

**Objective:** This study aimed to assess the incidence of *H. pylori* infection and its associated risk factors among asymptomatic Pakistani tobacco users, with the goal of informing targeted screening and prevention strategies. **Methods:** A cross-sectional study was conducted from September 2024 to February 2025 in Punjab and Khyber Pakhtunkhwa, Pakistan. A total of 129 asymptomatic adults (aged  $\geq 25$ ), reporting regular tobacco use, were enrolled through non-probability purposive sampling from outpatient and community health settings. Non-probability purposive sampling was used to recruit participants who met the study's eligibility criteria. Data were collected using a structured questionnaire and *H. pylori* stool antigen testing. Descriptive statistics, chi-square tests, and binary logistic regression were used for analysis. **Results:** The mean age of participants was  $38.6 \pm 9.2$  years, with 68.2% being male. Overall, 34.1% had used tobacco for over five years, and 81.4% reported daily use. *H. pylori* infection was significantly associated with prolonged tobacco use ( $>5$  years;  $p = 0.01$ ), use of smokeless tobacco ( $p = 0.02$ ), consumption of untreated water ( $p = 0.02$ ), shared sanitation ( $p < 0.001$ ), and family history of gastric disorders ( $p < 0.001$ ). Logistic regression revealed that tobacco use  $>5$  years (AOR = 2.34), untreated water (AOR = 1.96), shared sanitation (AOR = 1.89), and family history of gastrointestinal disorders (AOR = 2.67) were independent predictors of infection. **Conclusion:** This study demonstrates a high prevalence of *H. pylori* infection among asymptomatic tobacco users in Pakistan. Key modifiable risk factors, including prolonged tobacco use and environmental exposures, highlight the need for integrated public health interventions focusing on tobacco cessation, sanitation improvement, and targeted screening.

**Keywords:** *Helicobacter pylori* infections- tobacco use- asymptomatic infection- public health- risk factors

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## Introduction

*Helicobacter pylori* (*H. pylori*) are a gram-negative, spiral-shaped bacterium that colonizes the gastric mucosa and is implicated in a wide spectrum of gastrointestinal diseases, ranging from chronic gastritis to peptic ulcer disease and gastric cancer [1]. Globally, more than 50% of the population is estimated to be infected with *H. pylori*, with markedly higher prevalence in developing countries such as Pakistan, where poor sanitation, overcrowding, and limited access to healthcare are contributing factors [2, 3]. Despite its high prevalence, a significant portion of *H. pylori* infections remain asymptomatic, which complicates timely diagnosis and public health interventions [4]. In Pakistan, recent studies estimate that between 60–80% of the population may be carriers of the bacterium,

with varying prevalence across socio-economic and demographic groups [5]. The asymptomatic nature of infection makes it particularly insidious, allowing chronic gastritis and mucosal damage to progress undetected [6]. Among the known risk factors for *H. pylori* infection, tobacco consumption has garnered increasing attention. Tobacco use was defined as consuming any smoked or smokeless tobacco product at least once daily for  $\geq 6$  months, representing a level of exposure associated with sustained nicotine dependence and clinically measurable health effects as per Benowitz, 2010 and Hukkanen et al., 2005 [7, 8]. Tobacco use may not only compromise the mucosal barrier and immune response but also alter gastric micro-environmental conditions, facilitating bacterial colonization and persistence [9]. Both smoked and smokeless forms of tobacco are prevalent in Pakistani

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society, with a significant burden of consumption among lower socio-economic classes where *H. pylori* prevalence is already disproportionately high [10]. Moreover, tobacco use has been linked to delay gastric healing, increased inflammation, and greater bacterial virulence expression, compounding the risk of gastric pathology in infected individuals [11]. However, there remains a lack of localized epidemiological data assessing the incidence and risk factors for *H. pylori* infection specifically among asymptomatic tobacco consumers in Pakistan. Exploring this relationship is essential for designing targeted public health interventions, given the co-existence of high tobacco use and *H. pylori* burden in the population. This study aims to evaluate the incidence of *H. pylori* infection and its associated risk factors among asymptomatic Pakistani tobacco users, thereby contributing to the development of context-specific screening and prevention strategies.

## Materials and Methods

The current study employed a cross-sectional design to assess the incidence and associated risk factors of *Helicobacter pylori* infection among asymptomatic tobacco users in Pakistan. The study was conducted over a period of six months (September 2024–February 2025) across selected regions in major provinces including Punjab and Khyber Pakhtunkhwa. Two institutions were included such as Ayub Medical College, Abbottabad, Pakistan project in collaboration with King Edward Medical University/Mayo Hospital, Lahore. Ethical approval was obtained from the Ayub Medical College, Abbottabad, Pakistan and King Edward Medical University/Mayo Hospital, Lahore, and informed consent was secured from all participants. Data confidentiality, anonymity, and the right to withdraw at any point were ensured throughout the study process. Non-probability purposive sampling was used to recruit participants who met the study’s eligibility criteria. Although practical for targeting relevant individuals, this method introduces selection bias because participants are not randomly selected and may differ from those not included. As a result, the sample may not fully represent the wider population, limiting the generalizability of the findings, which are most applicable to groups with similar characteristics to the study sample.

The target population included asymptomatic Pakistani adults aged 25 years and above, who reported regular tobacco use (including smoking and smokeless forms) and had no current gastrointestinal symptoms such as abdominal pain, nausea, or dyspepsia. Participants were recruited from outpatient departments of general medicine, as well as community health. A non-probability purposive sampling method was used to enroll eligible participants. Inclusion criteria required that individuals should be Pakistani nationals, asymptomatic for any gastrointestinal illness, report active tobacco consumption (minimum use of once daily for ≥6 months), and signed informed consent. A total sample size of 129 participants was calculated using Cochran’s formula at a 95% confidence level and an assumed proportion of 0.5 to ensure maximum statistical power. Final participation was subject to actual response

rates and exclusion of incomplete or invalid responses.

The required sample size was calculated using the Cochran formula for estimating proportions in cross-sectional studies:

$$n = \frac{Z^2 p(1 - p)}{d^2}$$

Z = 1.96 for 95% confidence

p=0.5(assumed proportion for maximum sample size when true proportion is unknown)

d=0.086 (margin of error chosen to yield a target sample of approximately 129)

$$n = \frac{(1.96)^2 0.5(1 - 0.5)}{(0.086)^2}$$

$$n = \frac{3.8416 \times 0.25}{0.007396}$$

$$n = \frac{0.9604}{0.007396} \approx 129$$

The exclusion criteria for participants were: a personal history of gastric or colorectal cancer, gastric resection due to benign disease, self-reported or documented *H. pylori* eradication therapy in the past, antibiotic use within one month prior to the enrolment, proton pump inhibitors or bismuth-containing drug use within two weeks prior enrolment, presence of alarm symptoms for digestive or any other diseases.

Data was collected using a structured questionnaire comprising three sections e.g., demographics (age, gender, socioeconomic status, education level), tobacco use profile (type of tobacco (cigarettes, hookah, betel nut, gutka, naswar)), frequency, duration of use, and risk factors (duration of tobacco use (>5 years), use of smokeless tobacco, use of untreated water, shared household toilets, family history of gastric issues). Additionally, participants underwent *H. pylori* (stool), a WHO-approved, validated method for detecting active infection.

Prior to fieldwork pilot testing was performed. The questionnaire was piloted on 13 participants (~10% of the target sample) drawn from the same source population but excluded from the main study. The pilot assessed clarity, question flow, average completion time, and feasibility of *H. pylori* stool collection. Minor wording and ordering changes were made to improve comprehension and reduce respondent burden; logistics for sample handling and supervisor checks were refined. Where applicable, internal consistency of multi-item scales was evaluated (Cronbach’s α), and items showing poor performance were revised or removed. Pilot data were not included in the final analysis. For quality assurance, supervisors reviewed 10% of completed forms daily for consistency and double-entry of data was performed to minimize errors in digital transcription. All data were anonymized and assigned unique codes. Physical copies were stored securely at the primary research site, and electronic data were saved in a password-protected database accessible only to the research team. Data were analyzed

using SPSS (Version 25). Descriptive statistics (mean, standard deviation, frequencies, and percentages) were used to summarize demographic characteristics and prevalence rates. Chi-square tests were applied to examine associations between *H. pylori* positivity and independent variables such as tobacco type, duration, and demographic indicators. A binary logistic regression model was used to identify significant predictors of *H. pylori* infection among the sample population. A p-value < 0.05 was considered statistically significant.

## Results

The demographic and tobacco use profile of the 129 asymptomatic tobacco users surveyed reveals key characteristics relevant to the study of *Helicobacter pylori* (*H. pylori*) infection (Table 1). Among the 129 participants, 88 (68.2%) were male and 41 (31.8%) were female. A majority resided in urban areas (72, 55.8%), and most reported low-to-middle socioeconomic status (93, 72.1%). Cigarette use was the most common form of tobacco (61, 47.3%), followed by smokeless tobacco such as gutka/naswar (42, 32.6%). Additionally, 105 participants (81.4%) reported daily tobacco use. Daily tobacco use was markedly more common than occasional use (81.4% vs. 18.6%), suggesting a predominantly habitual user population. Longer duration of tobacco use

was also notable, with one-third (34.1%) reporting use for more than 5 years, indicating substantial chronic exposure within the sample. The duration and type of tobacco use are particularly important given their potential role as risk factors for gastrointestinal colonization and infection, reinforcing the need to further explore these associations.

Table 2 highlights significant associations between specific risk factors and *H. pylori* infection among asymptomatic tobacco users. Participants with over five years of tobacco use had a notably higher infection rate (62.2%,  $p = 0.01$ ), indicating a correlation between prolonged exposure and infection risk. Smokeless tobacco users also showed a significantly elevated prevalence (58.1%,  $p = 0.02$ ). Bivariate analysis showed that several factors were significantly associated with *H. pylori* infection. Participants with >5 years of tobacco use had over twice the odds of infection compared with shorter-duration users (OR  $\approx 2.1$ ). Similar elevated risks were seen for smokeless tobacco use and consumption of untreated water. Shared household toilets and family history of gastric issues showed the strongest associations, each indicating substantially increased odds of *H. pylori* positivity.

Table 3 presents the logistic regression analysis identifying significant predictors of *H. pylori* infection. Prolonged tobacco use (>5 years) was associated with more than twice the odds of infection (AOR = 2.34,  $p =$

Table 1. Demographic and Tobacco Use Characteristics of Participants (n = 129)

Variable	Category	Frequency (n)	Percentage (%)
Age (Mean $\pm$ SD)	38.6 $\pm$ 9.2	-	-
Gender	Male	88	68.2
	Female	41	31.8
Residence	Urban	72	55.8
	Rural	57	44.2
Education Level	Below Higher Education	79	61.2
	Higher Education	50	38.8
Socioeconomic Status	Low to Middle	93	72.1
	High	36	27.9
Type of Tobacco	Cigarette	61	47.3
	Smokeless (gutka/naswar)	42	32.6
	Hookah	19	14.7
	Mixed forms	7	5.4
Frequency of Use of Tobacco	Daily	105	81.4
	Occasionally	24	18.6
Duration of Tobacco Use	6 months – 1 year	32	24.8
	1–5 years	53	41.1
	Over 5 years	44	34.1

Table 2. Bivariate Analysis of *H. pylori* Prevalence by Risk Factors (n = 129)

Risk Factor	<i>H. pylori</i> Positive (%)	OR (95% CI)	p-value
Duration >5 years	62.2	2.10 (1.18–3.74)	0.01
Smokeless tobacco use	58.1	1.98 (1.10–3.55)	0.02
Use of untreated water	60.9	2.15 (1.16–3.97)	0.02
Shared household toilets	57.4	2.40 (1.32–4.36)	<0.001
Family history of gastric issues	64.3	2.90 (1.56–5.39)	<0.001

Table 3. Logistic Regression Analysis for Predictors of *H. pylori* Infection

Predictor	Adjusted Odds Ratio (AOR)	95% CI	p-value
Duration of tobacco use (>5 years)	2.34	1.19–4.61	0.013
Use of untreated water	1.96	1.02–3.75	0.041
Shared sanitation facilities	1.89	1.01–3.52	0.045
Family history of GI disorders	2.67	1.34–5.30	0.006

0.013). Use of untreated water (AOR = 1.96, p = 0.041) and shared sanitation facilities (AOR = 1.89, p = 0.045) were also significant predictors, highlighting the role of poor hygiene and environmental exposure. The strongest predictor was a family history of gastrointestinal disorders (AOR = 2.67, p = 0.006), underscoring possible genetic or household transmission factors.

### Discussion

This study assessed the prevalence and associated risk factors of *Helicobacter pylori* (*H. pylori*) infection among asymptomatic tobacco users in Pakistan. The findings revealed a high incidence of *H. pylori* infection, with significant associations observed between infection and factors such as prolonged tobacco use, the use of smokeless tobacco, consumption of untreated water, shared sanitation facilities, and a family history of gastrointestinal disorders. These findings align with and extend previous literature, particularly in low- and middle-income countries (LMICs), where environmental and behavioral factors play a significant role in the transmission and persistence of *H. pylori* infection [12-14]. Tobacco use, particularly prolonged usage (>5 years), was identified as a strong predictor of infection, echoing the findings of studies conducted in Iran, India, and Nigeria [15, 16]. Tobacco may contribute to gastric mucosal damage, reduce immune response, and facilitate colonization by *H. pylori* [17, 18]. Smokeless tobacco, specifically gutka and naswar, was also significantly associated with infection, potentially due to direct mucosal exposure and the unhygienic handling of these products [19, 20]. Environmental factors such as the use of untreated water and shared sanitation were also identified as significant predictors, reinforcing the role of fecal-oral transmission routes in the persistence of *H. pylori* in developing countries [21-24]. Similar trends have been reported in rural India, Bangladesh, and Ethiopia [25, 26]. Our data suggest that water quality and hygiene remain critical intervention points for reducing infection rates. A notable finding was the significant association between *H. pylori* infection and a family history of gastrointestinal issues. This supports the hypothesis of intrafamilial transmission, as reported in both Western and South Asian studies [24]. In homes with shared facilities and limited hygiene practices, the risk of transmission through shared utensils and bathrooms increases [18]. Educational and socioeconomic disparities also played a role, although not as strongly as other variables. Lower education levels and lower socioeconomic status have been previously associated with higher *H. pylori* prevalence due to poorer living conditions and limited access to clean water and

healthcare [22, 25]. Despite the valuable findings, this study is limited by its cross-sectional nature, which precludes causal inference. Additionally, self-reported tobacco use and sanitation behaviors may be subject to bias. Nevertheless, the multicenter approach and inclusion of various forms of tobacco enhance the generalizability of results across different regions in Pakistan. Given the high prevalence and the association with modifiable risk factors, this study underscores the need for targeted public health interventions, including hygiene education, water sanitation improvements, tobacco cessation programs, and early screening strategies in high-risk populations.

In conclusion, this cross-sectional study highlights a notably high incidence of *Helicobacter pylori* infection among asymptomatic tobacco users in Pakistan, with significant associations identified between infection and key modifiable risk factors. Prolonged tobacco use, particularly beyond five years, along with the use of smokeless tobacco, consumption of untreated water, shared sanitation facilities, and a family history of gastrointestinal disorders emerged as strong predictors of infection. These findings underscore the critical role of environmental hygiene, public health education, and behavioral risk reduction in addressing *H. pylori* prevalence. Targeted screening of high-risk populations, especially those with prolonged tobacco exposure and poor sanitation, along with integrated tobacco cessation and hygiene awareness programs, are essential for early detection and effective prevention of infection. Further longitudinal studies are warranted to establish causal relationships and evaluate the impact of intervention strategies on reducing *H. pylori*-related disease burden in Pakistan.

### Author Contribution Statement

Rabia Zulfiqar & Imran Mahfooz Khan: Substantial contributions to the conception or design of the work; or the acquisition. Tariq Hassan: analysis, or interpretation of data for the work. Prof. Saima Bukhari: Drafting the work or reviewing it critically for important intellectual content; AND Final approval of the version to be published. Shovit Dutta & Jestoni Maniago: Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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