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RESEARCH ARTICLE

The Magnitude and associated factors of *Helicobacter Pylori* Infection among Dyspeptic Patients at the Arba Minch General Hospital in Southern Ethiopia

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Abstract:

Background:

Infection with *Helicobacter pylori* (*H. pylori*) is a major public health problem, with a higher prevalence reported in developing countries, including Ethiopia. Persistent *H. pylori* infection could result in chronic gastritis, duodenal ulcers, and subsequently gastric carcinoma. However, the burden of the infection varies within and between countries.

Methods:

An institution-based cross-sectional study was carried out on 422 adult dyspeptic patients attended at Arba Minch General Hospital from March 1st to June 30th, 2022. Pretested structured questionnaires were used to collect socio-demographic characteristics, clinical information, and other related factors for *H. pylori* infection. Stool samples were analyzed using the *H. pylori* fecal antigen rapid test kit. The data was analyzed using SPSS version 25. The *p*-value < 0.05 was considered statistically significant.

Results:

The overall magnitude of *H. pylori* was found to be 32.2% (136/422), with a 95% CI = (27.7-36.5). The highest proportion of *H. pylori* occurred in male study participants (55.1%) and in participants aged 31-40 years (42.6%). *H. pylori* stool antigen positivity was significantly associated with alcohol consumption [AOR = 1.87, 95% CI: (1.06-3.29)], smoking cigarettes [AOR = 2.75, 95% CI: (1.43-5.27)], and hand washing practice after the toilet [AOR = 3.02, 95% CI: (1.41-6.48)].

Conclusion:

Overall, a considerable magnitude of *H. pylori* was identified in the setting. Alcohol consumption, smoking cigarettes, and hand washing practice after using the toilet were found to be statistically significantly associated with *H. pylori* infection. Health education is therefore essential, particularly regarding societal lifestyle changes and knowledge of the potential sources of infection and *H. pylori* transmission.

Keywords: Helicobacter pylori, Stool antigen, Dyspeptic, Arba Minch, Ethiopia, Alcohol consumption, Cigarettes, Stool samples.

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1. INTRODUCTION

Infection with *Helicobacter pylori* (*H. pylori*) is a major public health problem both in developed and developing countries, with varying levels of prevalence. The global systematic review shows that approximately 4.4 billion people worldwide are estimated to be positive for *H. pylori*, with a high burden in developing countries [1, 2]. According to epidemiologic studies, approximately 20-50% of developed-country populations and 70-90% of developing-country populations (nearly 80% among the elderly) are H. pylori positive, while only 10-20% of infected individuals experience symptoms [3 - 5].

H. pylori is the principal species of the genus *Helicobacter*, which is a Gram-negative bacillus that is tiny, curved, highly mobile, and biochemically positive for urease, catalase, and oxidase and is known to repeatedly colonize the human stomach [1, 5 - 7]. The pathogen is acquired *via* the fecal-oral, or oral-oral, route, though the exact route of transmission is unknown, and if left untreated, it can persist throughout life [2 - 6]. *H. pylori* infection is clinically characterized by stomach aches or burning pain, stomach pain that may be worse when your stomach is empty, nausea, loss of appetite, frequent

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burping, bloating, and unintentional weight loss [2 - 10].

H. pylori plays a significant role in the pathogenesis of chronic gastritis, peptic ulcer disease (PUD), mucosa-associated lymphoid tissue (MALT) lymphoma, and gastric adenocarcinoma, which is the third most deadly cancer in the world [5 - 10]. In Africa, *H. pylori* infection is thought to be the root cause of about 70% of stomach ulcers and 90% of duodenal ulcers, respectively [5, 11 - 14]. Additionally, numerous extra-gastric disorders have been studied for the potential involvement of *H. pylori*, including neuro-degeneration, nonalcoholic fatty liver disease, iron deficiency anemia, idiopathic thrombocytopenic purpura, and vitamin B12 insufficiency [5, 7, 13, 14]. However, differences in virulence and the ensuing interactions with host and environmental variables result in variations in disease expression [3, 4, 11, 12].

The prevalence of *H. pylori* varies from one geographical location to another; within a country, it is possible to have a different prevalence considering age, ethnicity, level of literacy, socioeconomic status, environmental factors, and diagnostic techniques [4 - 7]. Statistical studies have also revealed the burden of *H. pylori* infection in continental terms as 69.4% in South America, 37.1% in North America, 34.3%-47.0% in Western Europe, 24.4% in Oceania, 54.6% in Asia, and 79.1% in Africa [2 - 5, 15, 16]. Infection rates are higher in developing countries due to low socioeconomic status, overcrowding, poor housing, poor sanitation (both personal and environmental hygiene), contaminated water supplies, animal feces accumulation, and food contamination [6, 7, 17 - 20].

The prevalence of *H. pylori* in Ethiopia shows remarkable variations from place to place as well as from study to study, even in the same setting [2, 4]. In dyspeptic Ethiopian patients, the prevalence of *H. pylori* infection varies from 17.7% to 91% across the country [4, 11, 12, 17 - 25]. However, the majority of the previous prevalence research was conducted using antibody rapid tests, which have questionable performance in detecting acute infection and distinguishing active infection from previous exposure. Besides, there is a paucity of data, particularly in the study setting, about the prevalence of *H. pylori* infection and its associated factors. Hence, the current study aimed to determine the prevalence and associated factors of *H. pylori* infection using a stool antigen test among dyspeptic patients at Arba Minch General Hospital in southern Ethiopia.

2. MATERIALS AND METHODS

2.1. Study Design and Area

An institution-based cross-sectional study was conducted at the outpatient department of Arba Minch General Hospital, Southern Ethiopia, from March 1st to June 30th, 2022. The hospital is located in Arba Minch town in Gamo Zone, Southern Nations, Nationalities, and Peoples (SNNP), Southern Ethiopia. Arba Minch is the seat of administration for the Gamo zone, which is located 454 km from the capital city of Ethiopia (Addis Ababa). Arba Minch General Hospital was established in 1961 E.C. during Empierer Hailesilasie and provides preventive, curative, and rehabilitative care for more than 1.5 million people from the Gamo zone and other nearby zones.

2.2. Population and Eligibility Criteria

The study population consisted of all adult dyspeptic patients who provided stool samples in the outpatient department during the study period; patients who had taken antibiotics within the previous two weeks and those who were unable to reply were excluded.

2.3. Sample Size Determination and Sampling Technique

The sample size was computed by using the single population proportion formula, taking the 51.4% prevalence of *H. pylori* infection in adult dyspeptic patients from a previous study done in Hadiya Zone, Southern Ethiopia [2], and by considering a 95% confidence interval ($Z\alpha/2= 1.96$), and a 5% margin of error. The total of 422 sample sizes were determined using a consecutive sampling technique after accounting for the 10% non-response rate.

2.4. Data Collection

Data on the socio-demographic (gender, age, marital status, residence, occupational status, and educational status) and personal habit (smoking, alcohol intake, and coffee consumption) characteristics of the study participants were gathered at the outpatient department (OPD) using a pretested structured questionnaire through face-to-face interviews.

2.5. Sample Collection and Processing

Following instructions on collecting quality fecal samples, every study participant provided approximately two grams of stool in a clean, leak-proof, screw-capped plastic container. The stool samples were subsequently transferred to a vial with diluents, rapidly agitated, and after two minutes of resting the tube, two to three drops (80µL) were dropped into the round window of the test kit. The presence of *H. pylori* stool antigen was detected using a HENSO Medical (Hangez HOUS, O.Ltd.) rapid test kit with a monoclonal anti-*H. pylori* antibody conjugated with a colloid gold nitrocellulose membrane based on a lateral flow chromatographic immunoassay technique with 96.9% sensitivity and 99.2% specificity [2, 21, 22].

2.6. Data Quality Assurance

To ensure data quality, pre-testing on 5% of the sample size was performed at Arba Minch Dilfana Primary Hospital, and appropriate precautions were taken throughout the data collecting and laboratory work processes. Standard Operating Procedures (SOPs) were meticulously followed at every step in accordance with the manufacturer's guidelines.

2.7. Ethical Clearances

The study was conducted after it was ethically reviewed and approved by the Ethical Committee of the Department of Medical Laboratory Sciences at Arba Minch University (Ref. No. MeLT/06/14). Permission was obtained from Arba Minch General Hospital. Informed written consent was obtained from each participant before data collection. All conventional safety measures were taken to prevent COVID-19, including wearing a mask and using personal protective equipment when collecting and processing the sample. All the information obtained from the study subjects was coded to be maintained confidentially. Positive laboratory results were reported to the respective patients' physicians to receive proper treatment and counseling.

2.8. Data Processing and Analysis

Data processing and analysis were done using the Statistical Package for the Social Sciences, version 25. Descriptive statistics like frequency, mean, and percentage were calculated. Logistic regression analysis was applied to identify predictor variables associated with H. pylori infection. A bivariate logistic regression analysis was used to assess associated factors. Variables with a *p*-value less than 0.25 in the bivariable analysis were jointly entered into a multivariable analysis. The presence of associations and statistical significance was determined at a *p*-value less than or equal to 0.05.

3. RESULTS

3.1. Socio-demographic Characteristics of the Study Participants

A total of 422 suspected adult patients participated in the study. About 235 (55.7%) patients were male. The mean (±SD) age of the study population was 31 ± 11.4 years, with a range of 18 to 63 years. Among the age distribution, 173 (41% of the study participants) were in the 31-40 age group. The majority of the study participants (57.1%) lived in rural areas, and more than half (58.9%) had more than four family members (Table **1**).

The overall magnitude of *H. pylori* infection was 32.2% (136/422). The prevalence was higher among males (55.1%) than females (44.9%). Participants aged 31-40 years had the highest frequency of *H. pylori* infection (42.6%). In terms of marital status, it was discovered that married people had the highest prevalence of the infection (50.7%), followed by unmarried (33.8%), whereas 52.2% of *H. pylori* infections were identified in rural residents. However, none of the socio-demographic characteristics were statistically significant (P > 0.05) (Table **1**).

3.2. Environmental and Behavioral Characteristics

Among the total number of study participants, 20.1% of them had an unprotected drinking water source. A total of 34.6% of study participants had the habit of drinking alcohol three or more times per week, while 20.9% of participants were habitual of smoking cigarettes, and 81% of the participants had the habit of drinking coffee more than two cups per day. Moreover, 17.1% of the study participants did not wash their hands after toilet visits (Table **2**).

Among the study participants with a habit of alcohol drinking, coffee drinking, and cigarette smoking, the *H. pylori* infection rate was 55.9%, 77.1%, and 40.4%, respectively. Participants in the study who drank from unprotected water sources and those who never washed their hands after visiting the toilet were found to have infection rates of 25.7% and 26.5% of *H. pylori,* respectively. Moreover, patients who had alcohol three or more times per week, regardless of type or dose, were 1.87 times more likely to develop *H. pylori* infection [AOR = 1.87, 95% CI: (1.06-3.29), *p* = 0.030], whereas cigarette smokers were 2.75 times more likely [AOR = 2.75, 95% CI: (1.43-5.27), *p* = 0.002]. Likewise, being unable to wash hands after a toilet visit increased the chance of *H. pylori* infection by 3.02 times [AOR = 3.02, 95% CI: 1.41-6.48), *p* = 0.005] (Table **2**).

Table 1. Magnitude of *H. pylori* infection in relation to socio-demographic characteristics among dyspeptic patients at Arba Minch general hospital, 2022.

Variables	Categories	*H. pylori* Infection (%)		COR (95% CI)	AOR (95% CI)	*P*-value
		Positive (%)	Negative (%)			
Gender	Male	75 (55.1)	160 (55.9)	0.97 (0.64-1.46)	1.305 (0.51-3.37)	0.582
	Female	61 (44.9)	126 (44.1)	1	1	-
Age (year)	18-30	43 (31.6)	63 (22.0)	0.74 (0.45-1.22)	-	-
	31-40	58 (42.6)	115 (40.2)	0.48 (0.26-0.86)	-	-
	41-50	24 (17.6)	74 (25.9)	0.47 (0.22-1.03)	-	-
	≥51	11 (8.1)	34 (11.9)	1	-	-
Residence	Urban	65 (47.8)	116 (40.6)	1	-	-
	Rural	71 (52.2)	170 (59.4)	0.75 (0.49-1.12)	-	-
Marital Status	Single	46 (33.8)	101 (35.3)	0.85 (0.34-2.16)	-	-
	Married	69 (50.7)	144 (50.3)	0.89 (0.36-2.22)	-	-
	Divorced	13 (9.6)	26 (9.1)	0.94 (0.32-2.78)	-	-
	Widowed	8 (5.9)	15 (5.2)	1	-	-
Occupation	Farmer	14 (10.3)	34 (11.9)	0.94 (0.45-2.00)	0.96 (0.37-2.45)	0.925
	Daily labour	23 (16.9)	35 (12.2)	1.51 (0.77-2.95)	1.85 (0.74-4.56)	0.184
	Merchant	41 (30.1)	76 (26.6)	1.24 (0.70-2.18)	0.92 (0.25-3.33)	0.897
	Student	27 (19.9)	70 (24.5)	0.88 (0.48-1.63)	0.37 (0.10-1.32)	0.126
	Employee	31 (22.8)	71 (24.8)	1	1	-

(Table 1) contd.....

Variables	Categories	*H. pylori* Infection (%)		COR (95% CI)	AOR (95% CI)	*P*-value
		Positive (%)	Negative (%)			
Educational Status	Illiterate	10 (7.4)	12 (4.2)	1.17 (0.47-2.91)	0.48 (0.13-1.78)	0.271
	Primary school	23 (16.9)	75 (26.2)	0.43 (0.24-0.78)	0.24 (0.08-0.71)	0.011
	Secondary school	53 (39.0)	129 (45.1)	0.58 (0.36-0.93)	0.39 (0.19-0.85)	0.018
	College & above	50 (36.8)	70 (24.5)	1	1	-
Family Size	< 4	52 (38.2)	121 (42.3)	1	-	-
	≥ 4	84 (61.8)	165 (57.7)	1.19 (0.78-1.79)	-	-

Note: *Statistically Significant Variables
Abbreviations: AOR: Adjusted Odds Ratio; CI: Confidence Interval; COR: Crude Odds Ratio.

Table 2. The magnitude of *H. pylori* infection in relation to environmental factors and behavioral habits among dyspeptic patients at arba minch general hospital, 2022.

Variables	Categories	*H. pylori* Infection		COR (95% CI)	AOR (95% CI)	*P*-value
		Positive (%)	Negative (%)			
Drinking water source	Pipe water	101 (74.3)	236 (82.5)	1	1	-
	Unprotected water	35 (25.7)	50 (17.5)	1.64 (1.00-2.67)	1.03 (0.49-2.16)	0.934
Alcohol drinking	Yes	76 (55.9)	70 (24.5)	3.91 (2.54-6.03)	1.87 (1.06-3.29)	0.030*
	No	60 (44.1)	216 (75.5)	1	1	-
Coffee drinking	Yes	106 (77.9)	236 (82.5)	1.34 (0.80-2.21)	-	-
	No	30 (22.1)	50 (17.5)	1	-	-
Cigarette smoking	Yes	55 (40.4)	33 (11.5)	5.21 (3.16-8.57)	2.75 (1.43-5.27)	0.002*
	No	81 (59.6)	253 (88.5)	1	1	-
Defecation practice	Toilet	118 (86.8)	254 (88.8)	1	1	-
	Open FD	18 (13.2)	32 (11.2)	0.83 (0.45-1.53)	1.45 (0.68-3.06)	0.33
Hand washing practice after toilet	Yes	100 (73.5)	250 (87.4)	1	1	-
	No	36 (26.5)	36 (12.6)	2.50 (1.49-4.19)	3.02 (1.41-6.48)	0.005*

Note: Open FD = Open field defecation; Unprotected water = underground, river, and ponds.
Abbreviations: *Statistically Significant; AOR: Adjusted Odds Ratio; CI: Confidence Interval; COR: Crude Odds Ratio.

4. DISCUSSION

There has been a lot of variation in the prevalence of *H. pylori* infection reported across Ethiopia, even within the same geographic area, because of things like processing sample and method deference, geographic location, and socioeconomic, behavioral, environmental, and clinical factors, all of which have a big impact [2, 4, 26 - 28]. The current study determined an overall magnitude of *H. pylori* stool antigen positivity in adults (≥18 years old) with dyspepsia of 32.2% with a 95% CI of (27.7-36.5). This magnitude was comparable with studies in Dessie 30.4% [19], Addis Ababa 36.8% [26], Gonder, Ethiopia 37.6% [23], Canada 29.4% [27], and Uganda 35.7% [7]. On the contrary, a lower rate of *H. pylori* infection was reported in Yirga Cheffe, Southern Ethiopia, at 7.7% [17]. However, our finding was lower than those of studies conducted in various parts of Ethiopia, with prevalence rates ranging from 49.2% to 91% [2, 4, 24, 25, 28], and studies conducted in different parts of the world, with prevalence rates ranging from 40.9% to 87.7% [6, 29 - 33]. The disparity could be explained by a difference in the study area, sample size, study population, personal hygienic conditions, socioeconomic status, and lifestyle, as well as behavioral factors of study participants. Despite these factors, the difference in testing methodology as well as the sensitivity and specificity of the employed serological tests may affect the detection rate of *H. pylori*. In fact, antibody tests do not differentiate between current and past infections.

In this study, the prevalence of *H. pylori* infection in male participants (55.1%) was higher than that in females. In line with previous studies done in Ethiopia [12, 19], the difference was not statistically significant. In contrast, previous studies done in Ethiopia [2, 11, 21, 22, 34] and in Nakuru, Kenya [35] reported that the rate of *H. pylori* infection should be statistically associated with sex, although the exact preferences for sex are not well documented. The variation in prevalence between males and females could probably be due to the difference in lifestyles, exposure to potential environmental sources, and habits such as smoking and alcohol consumption.

In this study, age had no significant association with *H. pylori* infection (p > 0.05), which is in line with previous reports from Ethiopia [2, 4, 19]. In contrast, there are studies in Ethiopia that show a significant association between age and *H. pylori* infection [12, 21, 34]. These differences might be influenced by the participants' age range. In our study, it ranged from 18 to 63 years old. Likewise, in this study, there was no statistically significant difference in the prevalence of *H. pylori* with respect to family size in the household, which is contrary to previous studies done in Ethiopia [19, 21]. All these findings are consistent with the concept that the most important factors influencing the transmission of infection may differ with socio-demographic features, geographical location, and study population.

In this study, drinking alcohol was shown to be significantly associated with the rate of *H. pylori* stool antigen positivity (*P* = 0.030). This result agrees with studies done in different areas of Ethiopia [2, 19, 4, 12, 34]. The reason might be that frequent alcohol consumption affects the contribution of the intestinal microbial populations by disturbing the balance of intestinal homeostasis as well as by damaging gastric mucosa with a significant alteration of the immune system, which facilitates the colonization of *H. pylori* [4, 12, 36]. Besides, heavy drinking can possibly predispose consumers to social contacts that favor transmission of the *H. pylori* infection [4, 12]. However, there are studies that support a preventive effect of alcohol consumption against active *H. pylori* infection on the assumption that (a) alcohol may have a protective anti-bactericidal effect against new *H. pylori* infection; (b) alcohol may be bactericidal against existing *H. pylori*; and (c) alcohol causes repeated local damage to the gastric mucosa, which accelerates atrophic changes and causes *H. pylori* auto-eradication [2, 36, 37].

Cigarette smoking was another behavioral factor associated with *H. pylori* stool antigen positivity (P = 0.002), which is consistent with a previous study conducted in Butajira, Ethiopia [12]. This could possibly be due to using nicotine, which promotes chronic stomach inflammation, reduces mucosal blood flow, reduces mucus and epidermal growth factor secretion, and impairs the immune system. This, in turn, facilitates *H. pylori* colonization and makes infection difficult to eradicate [12, 38]. However, this contradicts the assumption hypothesized by studies done in Tokyo [36] and Porto, Portugal [39], which is that the elevated acid and pepsin secretion caused by smoking protect the gastric mucosa from *H. pylori* infections.

On the other hand, study participants who did not wash their hands after visiting the toilet had a higher chance of having an *H. pylori* infection (P = 0.005). This is in agreement with previous studies done in Ethiopia [4, 21, 34]. The assumption is that poor personal and environmental hygiene plays a great role in the transmission of *H. pylori* bacteria, and this finding supports the notion of an oral-oral or fecal-oral route with or without intermediate vectors of transmission, which is thought to be the primary route of transmission [1, 2, 4, 5]. Lack of proper sanitation and basic hygiene after using the toilet, therefore, can be a source of infection and increase the chance of acquiring *H. pylori*.

5. LIMITATIONS OF THE STUDY

The limitations of the present study include the cross-sectional study design with consecutive sampling technique and the fact that it was limited to only adult patients with dyspepsia in a single institution, which may not infer the prevalence of *H. pylori* infection in the general population. In addition, alcohol consumption data with regard to type, amount, and duration was not gathered. Moreover, body mass index (BMI), ABO blood grouping, and anemia status of dyspeptic patients as well as the prognosis of the patient were not considered in this study due to budget and resource constraints.

CONCLUSION

This study demonstrated that the magnitude of *H. pylori* among our study population was less as compared to the findings quoted in previous studies. Lifestyle factors such as alcohol consumption, cigarette smoking, and hand washing practice after toilet visits were found to be risk factors for *H. pylori* infection. However, no significant association was observed between other socio-demographic variables and *H. pylori* stool antigen detection. However, the given magnitude of *H. pylori* that we identified, it is essential to develop and implement intervention strategies, particularly those that focus on modifying social lifestyles to prevent transmission and, in turn, lessen the clinical effects of infection. Moreover, large-scale cohort-type community-based studies are needed to better characterize and formulate a cause-and-effect relationship between the risk factors and *H. pylori* infection.

AUTHORS' CONTRIBUTIONS

Dagninet Alelign conceived, designed, and drafted the manuscript; all other authors made substantial contributions to conception and design; acquisition of data, or analysis and interpretation of data; agreed to submit to the current journal; gave final approval of the version to be published; and agreed to be accountable for all aspects of the work.

LIST OF ABBREVIATIONS

AOR	=	Adjusted Odds Ratio
CI	=	Confidence Interval
COR	=	Crude Odds Ratio

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was conducted after it was ethically reviewed and approved by the Ethical Committee of the Department of Medical Laboratory Sciences at Arba Minch University (Ref. No. MeLT/06/14).

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committees and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Informed written consent was obtained from each participant before data collection.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The datasets analyzed during the current study are only available from the corresponding author [D.A] upon reasonable request.

CONFLICT OF INTEREST

The authors declare no conflict of interest financial or otherwise.

FUNDING

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