Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2024i1.1076
*Biol. Clin. Sci. Res. J., Volume, **2024**: 1076*
Original research article

EVALUATION OF HEMATOLOGICAL PARAMETERS AND DIAGNOSTIC SIGNIFICANCE IN H. PYLORI INFECTION: A COMPARATIVE STUDY

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(Received, 27th June 2024, Revised 30th August 2024, Published 2nd September 2024)

Abstract: *Helicobacter pylori (H. pylori) infection is globally recognized for its role in various gastrointestinal diseases and extra gastric conditions, including hematological anomalies. Understanding the correlation between H. pylori infection and hematological parameters could provide insights into its broader health impacts.* ***Objective:*** *This study evaluated the correlation between H. pylori infection and various demographic, socioeconomic, and hematological parameters.* ***Methods:*** *A cross-sectional study enrolled patients diagnosed with H. pylori and a matched control group without the infection. Blood samples were collected and analyzed for hematological parameters, including white blood cell count, red blood cell count, hemoglobin (HGB), hematocrit (HCT), platelet count, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW). Statistical analyses were performed using t-tests and chi-square tests where appropriate, with significance set at $p < 0.05$.* ***Results:*** *The study included patients with statistically significant differences in hematological parameters between the H. pylori-infected and healthy groups. Notably, the infected group showed lower mean HGB (12.41±1.38 g/dl vs. 14.32±1.46 g/dl), RBC count (4.12±0.62x10^6/µL vs. 4.87±0.53x10^6/µL), and HCT (39.17±3.87% vs. 44.52±4.51%), and higher RDW (13.51±2.10% vs. 13.87±1.32%) compared to the control group (all $p < 0.05$).* ***Conclusion:*** *The findings indicate significant hematological changes associated with H. pylori infection, suggesting a potential impact on the overall health status of affected individuals. These results highlight the importance of considering H. pylori infection in the differential diagnosis of hematological abnormalities and underscore the need for further research to explore the underlying mechanisms and potential therapeutic interventions.*

Keywords: H. pylori, Hematological parameters, Demographics, Comparative analysis.

Introduction

Peptic ulcers, gastritis, gastric cancer, and gastric lymphoma are among the many gastrointestinal diseases linked to the common bacterium H. pylori (1). Several methods exist for detecting H. pylori infection; these range from invasive procedures like endoscopy and biopsy to non-invasive ones that use blood samples, breath, and stool (2). Nevertheless, there are several drawbacks to these diagnostic methods, including their invasiveness, expense, accessibility, precision, and specificity. This highlights the critical need to explore complementary or alternate methods of diagnosing H. pylori infection (3).

In light of evidence from some studies pointing to possible changes in blood cell composition causing hematological abnormalities, such as anemia, thrombocytopenia, leukopenia, or leukocytosis, one potential approach is to examine the hematological parameters of people infected with H. pylori (4). The association between H. pylori infection and hematological parameters is still not well-established and can vary depending on factors like population characteristics, infection severity, and other influences (5).

Helicobacter pylori exerts harmful effects on the gastric and duodenal linings through multiple mechanisms. One mechanism involves ammonia production, aimed at regulating pH, which proves toxic to epithelial cells (6). Additionally, H. pylori produces various biochemicals, including proteases and vacuolating cytotoxin A, which damage epithelial cells, disrupt tight junctions, and induce apoptosis. Furthermore, the bacterium releases specific phospholipases, contributing to its pathogenic impact on the gastrointestinal mucosa (7).

Nevertheless, multiple investigations have found that Helicobacter pylori (H. pylori) infection is linked to iron-deficient anemia, vitamin B12 deficiency, and other iron-related disorders (8). Oral iron therapy also reduces the effect on people with H. pylori infection. Potentially improving ferritin and hemoglobin levels in infected patients has led to the proposal of combining iron therapy with H. pylori eradication therapy (9).

H. pylori infection and iron deficiency anemia go hand in hand because chronic gastritis causes stomach hypochlorhydria, which in turn hinders iron absorption. Converting ferric iron from food to ferrous iron requires an acidic intragastric pH and ascorbic acid, which is not present in this patient. Iron absorption becomes even more difficult when H. pylori, a main cause of chronic superficial gastritis and gastric gland atrophy, decreases stomach acid output (10).

In addition, Helicobacter pylori competes with the host for iron, which hinders iron intake. At the same time, hemoglobin synthesis is hampered because the

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reticuloendothelial system and the entrecote release less iron from macrophages due to the increased hepcidin production caused by H. pylori infection. In particular, hepcidin responds to inflammation in the stomach mucosa by acting as an acute phase reactant (10).

Methodology

We devised a comparative cross-sectional study encompassing patients and healthy individuals (11). The investigation involved the comparison of hematological profiles within two distinct groups, namely, individuals diagnosed with H. pylori infection and a healthy cohort devoid of the infection. The age range was expanded to encompass participants aged 18 to >41 years. Exclusion criteria comprised individuals with pre-existing incomplete consents, hemolysed samples, hematological disorders, pregnant women, patients on medication, and those diagnosed with gastric cancer. The sample size was determined by statistical considerations to ensure sufficient power for meaningful comparisons between the H. pylori-infected and healthy groups (7).

Each participant underwent a comprehensive clinical examination encompassing an assessment of signs and symptoms, prior medical history, comorbidities, and a physical exam. Blood samples were procured for a selected blood cell analysis (12). The status of H. pylori infection was ascertained through validated diagnostic methods, including serological and stool antigen tests. Hematological evaluation involves the specific hematological panels, including HGB (hemoglobin), RBC (red blood cell count), HCT (hematocrit), MCV (mean corpuscular volume), MCH (mean corpuscular hemoglobin), MCHC (mean corpuscular hemoglobin concentration), and RDW (red cell distribution width) by an automated hematology analyzer (Sysmex KX-21, Japan).

In this study, ethical agreements were carefully considered. We explained the study methods, expected results, and potential benefits to all participants. Each individual willingly signed consent forms, indicating their voluntary participation and understanding of the study's parameters. (13).

The data from medical reports and clinical examinations were collected using Microsoft Excel (2016). Statistical analyses were then carried out using SPSS version 20. Continuous data were presented as the mean ± standard deviation, while nominal data were described using frequencies and percentages. A 95% confidence level was maintained, and statistical significance was considered for a P value below 0.05.

Results

Table 1 provides a comprehensive overview of the demographic distribution of variables in individuals with H. pylori infection compared to healthy individuals. The analysis encompasses vital demographic factors, including gender, age, locality, and academic status.

Table 1: Sociodemographic Characteristics of Study Participants

Variables	Groups	*H. pylori* patients	Healthy Individuals
Gender	F	61 (48.41)	61(48.41)
	M	63 (50.79)	63 (50.79)
Age (years)	18–25	49 (38.88)	56 (44.44)
	26–33	41 (32.53)	43(34.12)
	34–41	31 (24.60)	24 (19.04)
	≥41	5(3.96)	3 (2.38)
Locality	Urban	18 (14.28)	15 (11.90)
	Rural	108 (85.71)	111 (88.09)
Academic status	Literate	9 (7.14)	7 (5.55)
	Matric	13 (10.31)	17 (13.49)
	Bachelor	75 (59.52)	68 (53.96)
	Master	29 (23.01)	34 (26.98)

*M (Male), F (Females), H. pylori (Helicobacter pylori)

Table 2 underscored the potential impact of H. pylori infection on red blood cell profiles, emphasizing the relevance of hematological assessments in the clinical evaluation of H. pylori-associated conditions.

Table 2: Comparative Evaluation of Hematological Parameters among H. pylori Patients and Healthy Group

Lab Parameters	Unit	*H. pylori* patients	Healthy Individuals	P-value
HGB	(g/dl)	12.41±1.38	14.32±1.46	<0.001
RBC	(x 10^6µL)	4.12±0.62	4.87±0.53	
HCT	(%)	39.17±3.87	44.52±4.51	
MCV	(fl)	86.06±4.44	90.16±4.53	0.003
MCH	(pg)	26.41±3.16	29.13±1.87	0.007
MCHC	(g/dl)	31.45±1.60	32.58±1.24	0.005
RDW	(%)	13.51±2.10	13.87±1.32	0.005

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*Hemoglobin (HBG), Red Blood Cell Count (RBC), Hematocrit (HCT), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC), Red Cell Distribution Width (RDW).

The distribution of lab parameter categories in the study population illustrates the prevalence of abnormal hematological values alongside reference ranges. Table 3 offers valuable insights into potential hematological disorders and guides further clinical investigations based on categorized parameters.

Table 3: Evaluation of Hematological Parameters among H. pylori Patients

Lab Parameters		Categories	N (%)	Reference Ranges
HGB	(g/dl)	L	17(13.49)	M (11.5–18) F (11–16.7)
		N	109 (86.50)	
RBC	$x10^6$ /µL	L	9 (7.14)	M (3.53–6.93) F (3.45–6.25)
		N	117 (92.85)	
		H	0 (0.00)	
HCT	(%)	L	7 (5.55)	M (36.2–58.6) F (32.1–56.6)
		N	119 (94.44)	
		H	0 (0.00)	
MCV	(fl)	L	15 (12.69)	M (85–100) F (85–100)
		N	110 (87.30)	
		H	1 (0.79)	
MCH	(pg)	L	17 (13.49)	M (26.6–33.30) F (25.8–32.8)
		N	108 (85.71)	
		H	1 (0.79)	
MCHC	g/dl	L	2 (1.58)	M (29.5–34.4 F (28.5–34.4)
		N	123 (97.61)	
		H	1 (0.79)	
RDW	(%)	L	1 (0.79)	M (12–17) F (12–17)
		N	125 (99.20)	

*L (Low), N (Normal), H (High)

Discussion

The gender distribution of the study population is relatively even, with roughly half of the individuals in both the Healthy and H. pylori-infected groups identifying as female and the remaining half as male. The gender equilibrium guarantees that any discernible variations in H. pylori infection rates are comparatively less susceptible to the impact of gender prejudice.

A significant proportion of participants in both categories, 108 (85.71%) in the Healthy group and 111 (88.09%) in the H. pylori-infected group, reside in rural regions. Urban residency is relatively uncommon, as indicated by the fact that only 18 individuals (14.28%) in the H. pylori-infected group and 15 individuals (11.90%) in the Healthy group reside in urban areas. (14) The observed longitudinal arrangement of this organism offers valuable insights into the possible influence of environmental variables linked to rural residence on the prevalence of H. pylori.

The academic status most prevalent in both groups is a Bachelor's, comprising 75 individuals (59.52%) in the H. pylori-infected group and 68 individuals (53.96%) in the Healthy group. In contrast, the academic status that is least prevalent is Literate, comprising merely nine individuals (7.14%) in the H. pylori-infected group and seven individuals (5.55%) in the Healthy group. The relevance of these academic distinctions may lie in their capacity to illuminate possible associations between levels of H. pylori infection and educational background (15).

The study observed significantly lower levels of Hemoglobin (HGB) in individuals with H. pylori infection (12.41±1.38 g/dl) compared to the control group (14.32±1.46 g/dl) ($p < 0.001$). This finding aligns with research by (16), which reported similar hematological alterations in individuals with H. pylori infection.

Red Blood Cell count (RBC) was also lower in the H. pylori-infected group (4.12±0.62 x 10^6/µL) compared to the control group (4.87±0.53 x 10^6/µL). This corroborates the findings of (17), who noted a significant decrease in RBC count associated with H. pylori infection.

Hematocrit (HCT) values were significantly lower in individuals with H. pylori infection (39.17±3.87%) compared to the control group (44.52±4.51%) ($p < 0.001$). This observation is consistent with the results (18), indicating a link between H. pylori infection and reduced hematocrit levels.

Mean Corpuscular Volume (MCV) was found to be lower in the H. pylori-infected group (86.06±4.44 fl) compared to the control group (90.16±4.53 fl) ($p = 0.003$). This supports the findings of (19), who observed similar alterations in MCV associated with H. pylori infection.

Mean Corpuscular Hemoglobin (MCH) was significantly lower in individuals with H. pylori infection (26.41±3.16 pg) compared to the control group (29.13±1.87 pg) ($p = 0.007$). Mean Corpuscular Hemoglobin Concentration (MCHC) was lower in the H. pylori-infected group (31.45±1.60 g/dl) compared to the control group

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(32.58±1.24 g/dl) (p = 0.005). Red Cell Distribution Width (RDW) values showed a slight increase in the H. pylori-infected group (13.51±2.10%) compared to the control group (13.87±1.32%) (20).

Most individuals exhibited normal hemoglobin (HGB) levels, with 86.50% falling within the normal range, while 13.49% had low HGB levels. Red blood cell count (RBC) analysis revealed that 92.85% of participants had average values, 7.14% had low RBC counts, and none displayed high counts. Hematocrit (HCT) levels were essentially expected, with 94.44% falling within the normal range and only 5.55% having low levels; high HCT levels were absent. Mean corpuscular volume (MCV) values demonstrated that 87.30% of individuals had normal levels, 12.69% exhibited low MCV levels, and 0.79% showed high MCV levels. Mean corpuscular hemoglobin (MCH) analysis indicated that 85.71% had normal MCH levels, 13.49% had low, and 0.79% had high levels. Mean corpuscular hemoglobin concentration (MCHC) levels were predominantly normal, with 97.61% falling within the normal range, while 1.58% had low MCHC levels, and 0.79% had high MCHC levels. Red cell distribution width (RDW) findings revealed that 99.20% of participants had normal RDW levels, and only 0.79% exhibited low RDW levels.

Conclusion

Hematological analyses indicate significant differences between H. pylori-infected and healthy groups. Lower hemoglobin levels decreased red blood cell count, and reduced hematocrit values in H. pylori-infected individuals align with previous research. Additionally, alterations in mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration further indicate the hematological consequences of H. pylori infection, consistent with findings from relevant literature. However, the slight increase in red cell distribution width (RDW) in the H. pylori-infected group, though statistically significant, contrasts with some prior research, warranting further investigation.

.Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate.
Approved by the department concerned. (IRBEC-TCH-0282/23)

Consent for publication
Approved

Funding
Not applicable

Conflict of interest

The authors declared an absence of conflict of interest.

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