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Evaluation of Hematological Parameters and Diagnostic Significance in *H. pylori* Infection: A Comparative Study

Khuzin Dinislam[1*], Shah Zeb[2,3], Pershina Valeria[4], Sidorov Ilya[5], Musaev Rasul[6], Adiganova Irina[7], Guseynov Ruslan[8], Falakhova Anna[8], Kolobova Alexandra Evgenievna[9], Bogatyreva Shuanet Akramatovna[10]
[1*]Department of Chemistry, Bashkir State Medical University.
[2]Faculty of Biomedical and Health Sciences, Department of Microbiology, University of Haripur, Haripur.
[3]Department of Microbiology, Pakistan Kidney and Liver Institute & Research Center, 54000, Lahore, Pakistan.
[4]Privolzhsky Research Medical University, Russia.
[5]Kursk State Medical University, Russia.
[6]Ivanovo State Medical Academy, Russia.
[7]Kirov State Medical University, Russia.
[8]Ural State Medical University, Russia.
[9]The Russian National Research Medical University, Russia.
[10]Kemerovo State Medical University, Russia.

***Correspondence Shah Zeb**, **Khuzin Dinislam**
Department of Microbiology, Pakistan Kidney and Liver Institute & Research Center, 54000, Lahore, Pakistan.
Department of Chemistry, Bashkir State Medical University, Russia.

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H. pylori, Hematological parameters, Demographics, Comparative analysis

ABSTRACT:
Peptic ulcers, gastritis, gastric cancer, and gastric lymphoma are among the many gastrointestinal diseases linked to the common bacterium H. pylori. This study evaluated the correlation between H. pylori infection and diverse demographic, socioeconomic, and hematological parameters in a study population. Blood samples were collected from patients diagnosed with H. pylori and a control group. Subsequently, various hematological parameters, such as white blood cell counts, red blood cell count, hemoglobin, hematocrit, platelet count, mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration were evaluated. Hematological analysis reveals statistically significant differences between the H. pylori-infected and Healthy groups. Patients with H. pylori infection demonstrated a mean HGB of 12.41±1.38 g/dl, compared to the healthy group 14.32±1.46g/dl ($p < 0.001$). Similarly, the mean RBC count in the infected group was 4.12±0.62x106/µL lower than the healthy group 4.87±0.53 x 10^6/µL. HCT values were significantly lower in patients with H. pylori infection (39.17±3.87%) compared to the healthy group (44.52±4.51%) ($p < 0.001$). Patients with H. pylori infection demonstrated a lower MCV of 86.06±4.44fl compared to the healthy group 90.16±4.53fl ($p = 0.003$). MCH was significantly lower in the infected group (26.41±3.16pg) compared to the control group (29.13±1.87pg) ($p = 0.007$). MCHC was also lower in the H. pylori-infected group (31.45±1.60 g/dl) compared to the healthy group (32.58±1.24g/dl) ($p = 0.005$). While red cell distribution width (RDW) exhibited a statistically significant increase in the infected group (13.51±2.10%) compared to the healthy group (13.87±1.32%). this study contributes valuable insights into the complex interplay between H. pylori infection and demographic, socioeconomic, and hematological factors. These findings enhance our understanding of the potential public health implications of H. pylori and provide a footmark for future research and interventions in populations at risk of infection.

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Introduction

Peptic ulcers, gastritis, gastric cancer, and gastric lymphoma are among the many gastrointestinal diseases linked to the common bacterium *H. pylori* (Crowe, 2019). Several methods exist for detecting *H. pylori* infection; these range from invasive procedures like endoscopy and biopsy to non-invasive ones that use samples of blood, breath, and stool (Tshibangu-Kabamba & Yamaoka, 2021). 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 (FitzGerald & Smith, 2021).

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 (Öztekin, Yılmaz, Ağagündüz, & Capasso, 2021)*. 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 (Ren et al., 2022).

Helicobacter pylori exerts deleterious effects on the gastric and duodenal linings through multiple mechanisms. One mechanism involves the production of ammonia, aimed at regulating pH, which in turn proves toxic to epithelial cells (Godbole, Mégraud, & Bessède, 2020). Additionally, *H. pylori* produces various biochemical, including proteases, vacuolating cytotoxin A causing damage to epithelial cells, disruption of tight junctions, and inducing apoptosis. Furthermore, the bacterium releases specific phospholipases that contribute to its pathogenic impact on the gastrointestinal mucosa (Shimamoto et al., 2020).

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 (Talari, Moniri, Mollaghanbari, Kashani, & Jalalian, 2021). Oral iron therapy also has a reduced effect on people who have *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 (Ansari & Yamaoka, 2022).

The reason why *H. pylori* infection and iron deficiency anemia go hand in hand because chronic gastritis causes stomach hypochlorhydria, which in turn hinders iron absorption. The process of 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 (George, Lucero, Torres, Lagomarcino, & O'Ryan, 2020).

In addition, Helicobacter pylori competes with the host for iron, which hinders iron intake. At the same time, hemoglobin synthesis is hindered because the 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 (George et al., 2020).

Methodology

Study Design

We devised a comparative cross-sectional study encompassing both patients and healthy individuals [Zafar, 2023 #649]. The investigation involved the comparison of hematological profiles within two distinct groups such as 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 determination of the sample size was guided by statistical considerations to ensure sufficient power for meaningful comparisons between the *H. pylori*-infected and healthy groups (Shimamoto et al., 2020).

The Clinical Assessment & Laboratory Analysis

Each participant underwent a comprehensive clinical examination encompassing an assessment of signs and symptoms, prior medical history, comorbidities, and a

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physical examination. Blood samples were procured to conduct a selected blood cells analysis [Bordin, 2021 #603;Zeb, 2023 #650]. The status of *H. pylori* infection was ascertained through validated diagnostic methods, including serological tests 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).

Ethical Considerations

Ethical agreements were obtained from Faculty of Biomedical and Health Sciences, University of Haripur and Privolzhsky Research Medical University under registration no. MIC/UOH/F13-2013. Detailed explanations regarding the study methods, anticipated outcomes, and potential benefits were provided to each participant. Informed consent was obtained through signed consent forms from all participating individuals, signifying their voluntary involvement and comprehension of the study parameters (Park et al., 2020).

Statistical Measurements

The compilation of data from medical reports and clinical examinations was executed utilizing Microsoft Excel (2016). Subsequent statistical analyses were performed using SPSS version 20. Continuous data were succinctly presented as the mean ± standard deviation, and nominal data were delineated through frequencies and percentages [Rehman, 2022 #651]. A 95% confidence level was maintained, and statistical significance was attributed to 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 key 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.

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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	
RBC	(x 10^6µL)	4.12±0.62	4.87±0.53	<0.001
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

*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).

Table 3 offers valuable insights into potential hematological disorders and aids in guiding further clinical investigations based on categorized parameters.

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

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

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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. (Lucero et al., 2021) 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 that is 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 9 individuals (7.14%) in the *H. pylori*-infected group and 7 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 (Fang, Xie, & Fan, 2022).

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 (Xiong, Chen, He, Wu, & Yang, 2020), 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 (Chen et al., 2020), 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 reported by (Hussein, Al-Ouqaili, & Majeed, 2021), 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 (Ito et al., 2022), 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 (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%) (Kadhim & Al-Karawi, 2023).

A majority of 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 normal values, whereas 7.14% had low RBC counts, and none displayed high counts. Hematocrit (HCT) levels were largely normal, 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 levels, 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

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participants had normal RDW levels, and only 0.79% exhibited low RDW levels.

Conclusion

Hematological analyses reveal significant differences between the *H. pylori*-infected and Healthy groups. Lower hemoglobin levels decreased red blood cell count, and reduced hematocrit values in individuals with *H. pylori* infection align with previous research, indicating the impact of *H. pylori* on these parameters. Moreover, alterations in mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration further emphasize the hematological consequences associated with *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. This discrepancy warrants further investigation into the potential nuances of RDW alterations in *H. pylori*-infected individuals.

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