

## EVALUATION OF HEMATOLOGICAL MARKERS FOR DIAGNOSTIC SIGNIFICANCE IN HELICOBACTER PYLORI INFECTION

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**Abstract:** Hematological parameters provide valuable insights into various health conditions. This study aimed to evaluate and compare haematological parameters between patients and healthy controls, assessing conditions related to specific haematological markers. **Objective:** To identify significant differences in haematological parameters, including haemoglobin (HGB), red blood cell count (RBC), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), and red cell distribution width (RDW), between patients and controls. **Methods:** A comparative cross-sectional study was conducted, including 60 patients and 60 healthy controls. Key haematological parameters were measured and statistically analyzed to evaluate differences between the groups. Additionally, the distribution of conditions such as anaemia, low MCV, and other haematological abnormalities was assessed. **Results:** Significant differences were observed in several parameters. Patients exhibited lower mean HGB ( $12.2 \pm 1.3$  g/dL vs.  $14.32 \pm 1.46$  g/dL,  $p=0.01$ ), MCV ( $84.1 \pm 2.11$  fl vs.  $89.16 \pm 3.53$  fl,  $p=0.04$ ), MCH ( $24.6 \pm 4.16$  pg vs.  $28.13 \pm 0.87$  pg,  $p=0.001$ ), and MCHC ( $30.2 \pm 2.10$  g/dL vs.  $31.58 \pm 0.24$  g/dL,  $p=0.01$ ) compared to controls. RBC counts were higher in patients ( $4.42 \pm 0.32 \times 10^6/\mu\text{L}$  vs.  $3.87 \pm 1.53 \times 10^6/\mu\text{L}$ ,  $p=0.02$ ), while RDW showed no significant difference ( $13.7 \pm 1.032\%$  vs.  $12.4 \pm 1.22\%$ ). Regarding conditions among patients: 13% exhibited low HGB, while 9% had normal HGB levels. RBC levels were normal in 92% of patients, with 5% showing low values. HCT levels were predominantly normal (94%), with 12% showing low values. MCV was normal in 87%, with 13% showing low levels. MCH was normal in 85%, with 2% showing low levels. MCHC was normal in 96%, with 1% showing high levels. RDW was normal in 98%, with only 1% showing low levels. **Conclusion:** The study highlights significant haematological alterations in patients, including lower HGB, MCV, MCH, and MCHC, with normal RBC and HCT levels in most cases. These findings suggest a trend toward anaemia and related conditions in the patient population. Further research is necessary to explore the clinical implications of these alterations.

**Keywords:** H. pylori, Hematological parameters, Hemoglobin (HGB), Red blood cell count (RBC), Mean corpuscular volume (MCV), Anemia, Platelets.

### Introduction

Peptic ulcers, gastritis, gastric carcinoma, and gastric mucosa-associated lymphoid tissue (MALT) lymphoma are significant gastrointestinal conditions associated with the widespread bacterium *Helicobacter pylori* (1). A range of diagnostic methods exists for detecting *H. pylori* infection, including invasive techniques such as endoscopy with biopsy and non-invasive approaches utilizing blood, breath, and stool samples (2). However, these diagnostic methods exhibit several limitations, including invasiveness, high cost, restricted accessibility, and variable accuracy and specificity. This emphasizes the pressing need to explore complementary or alternative approaches for diagnosing *H. pylori* infection (3).

Several studies suggest that alterations in blood cell composition may contribute to haematological abnormalities such as anaemia, thrombocytopenia, leukopenia, and leukocytosis in individuals infected with *Helicobacter pylori* (4). However, the relationship between *H. pylori* infection and haematological parameters remains inadequately understood and can be influenced by factors

such as population characteristics, the severity of infection, and other confounding variables (5).

*Helicobacter pylori* exerts harmful effects on the gastric and duodenal mucosa through various mechanisms. One such mechanism involves the production of ammonia, which serves to regulate pH but is toxic to epithelial cells (6). Additionally, *H. pylori* secretes a range of biochemical agents, including proteases and vacuolating cytotoxin A, which cause epithelial damage, disrupt tight junctions, and trigger apoptosis. The bacterium also releases specific phospholipases that further contribute to its pathogenicity in the gastrointestinal tract (7).

Moreover, numerous studies have linked *H. pylori* infection to conditions such as iron-deficiency anaemia, vitamin B12 deficiency, and other iron-related disorders (8). Notably, oral iron supplementation has shown reduced efficacy in *H. pylori*-infected individuals, suggesting that addressing the infection may improve ferritin and haemoglobin levels. This has led to the consideration of combining iron therapy with *H. pylori* eradication treatment to enhance therapeutic outcomes (9).

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The association between *Helicobacter pylori* infection and iron-deficiency anaemia can be attributed to chronic gastritis induced by the bacterium, which results in hypochlorhydria (reduced stomach acid production) and impairs iron absorption. The conversion of ferric iron from food to ferrous iron requires an acidic gastric environment and ascorbic acid, both of which are compromised in these patients. This process is further hindered by *H. pylori*, a primary cause of chronic superficial gastritis and gastric gland atrophy, both of which contribute to decreased gastric acid secretion (10).

Additionally, *H. pylori* compete with the host for available iron, further limiting iron intake. The bacterium also interferes with haemoglobin synthesis by disrupting the release of iron from the reticuloendothelial system. This is due to an increase in hepcidin production triggered by *H. pylori* infection, which inhibits iron release from macrophages. Specifically, hepcidin acts as an acute-phase reactant in response to inflammation in the gastric mucosa, exacerbating iron deficiency.

**Methodology**

We conducted a comparative cross-sectional study involving both patients and healthy controls. The study aimed to compare the haematological profiles of two distinct groups: individuals diagnosed with *H. pylori* infection and a healthy cohort without the infection. The age range of participants was set between 20 and 45 years. Exclusion criteria included individuals with incomplete consent, hemolyzed samples, pre-existing haematological disorders, pregnant women, patients on medications, and those diagnosed with gastric cancer. The sample size was determined based on statistical power calculations to ensure sufficient sample size for robust and meaningful comparisons between the *H. pylori*-infected and healthy groups.

All participants underwent a comprehensive clinical evaluation, which included a detailed assessment of signs and symptoms, medical history, comorbid conditions, and a physical examination. Blood specimens were collected for the analysis of specific haematological parameters. The presence of *H. pylori* infection was confirmed using validated diagnostic methodologies, such as serological assays and stool antigen detection tests. Haematological profiling was performed utilizing a full panel, comprising haemoglobin (HGB), red blood cell count (RBC),

hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), and red cell distribution width (RDW), conducted with an automated haematology analyzer (Sysmex KX-21, Japan).

Ethical considerations were meticulously upheld throughout the study. Informed consent was secured via signed consent forms from all participants, indicating their voluntary participation and full understanding of the study’s objectives and procedures.

Data were compiled from medical reports and clinical examinations using Microsoft Excel (2016). Statistical analyses were conducted with SPSS version 20. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. A 95% confidence interval was maintained, and statistical significance was determined at a P value of less than 0.05.

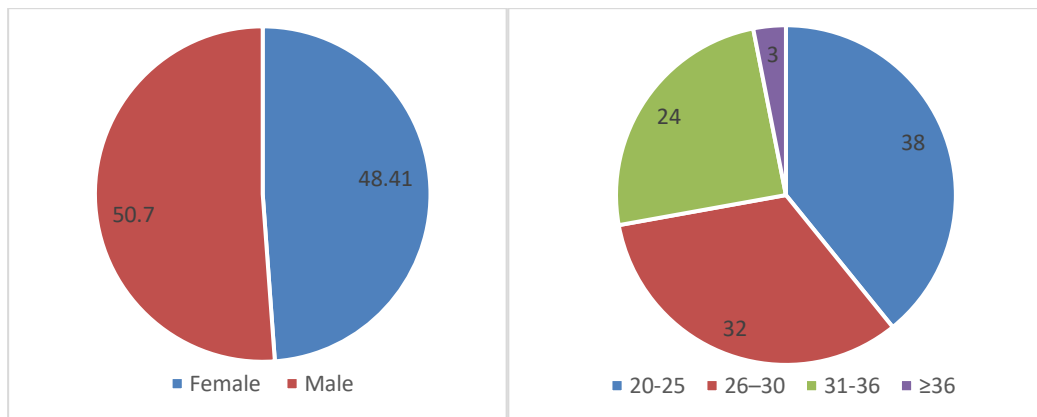
**Results:**

This study evaluated and compared hematological parameters between patients and healthy controls to identify significant differences. Key findings include: Gender and Age Characteristics: The demographic data for gender and age are presented in Figure 1.

Table 1 and Table 2 provide a detailed evaluation of parameters for controls and patients, respectively. Controls showed higher hemoglobin (HGB) levels, hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC), while patients had elevated red blood cell (RBC) counts.

As shown in Table 3, significant differences were observed in most parameters. Patients demonstrated lower HGB (12.2±1.3 vs. 14.32±1.46, p=0.01), MCV (84.1±2.11 vs. 89.16±3.53, p=0.04), MCH (24.6±4.16 vs. 28.13±0.87, p=0.001), and MCHC (30.2±2.10 vs. 31.58±0.24, p=0.01) compared to controls. The RDW levels were lower in patients but without a significant p-value.

Figure 2: The graphical comparison illustrates the variations in conditions among patients, emphasizing their altered hematological profiles.



**Figure 1: (a) Gender Characteristics (b) age Characteristics**

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**Table 1: Evaluation of Hematological Parameters of Controls**

| Lab Tests | Measurement            | Controls   |
|-----------|------------------------|------------|
| HGB       | (g/dl)                 | 14.32±1.46 |
| RBC       | (x 10 <sup>6</sup> µL) | 3.87±1.53  |
| HCT       | (%)                    | 42.52±2.51 |
| MCV       | (fl)                   | 89.16±3.53 |
| MCH       | (pg)                   | 28.13±0.87 |
| MCHC      | (g/dl)                 | 31.58±0.24 |
| RDW       | (%)                    | 13.7±1.032 |

*\*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 2: Evaluation of Hematological Parameters of Patients**

| Lab Tests | Measurement            | Patients  |
|-----------|------------------------|-----------|
| HGB       | (g/dl)                 | 12.2±1.3  |
| RBC       | (x 10 <sup>6</sup> µL) | 4.42±0.32 |
| HCT       | (%)                    | 38.2±2.62 |
| MCV       | (fl)                   | 84.1±2.11 |
| MCH       | (pg)                   | 24.6±4.16 |
| MCHC      | (g/dl)                 | 30.2±2.10 |
| RDW       | (%)                    | 12.4±1.22 |

*\*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: Differences in Hematological Parameters between Patients and Controls**

| Lab Tests | Measurement            | Patients  | Controls   | P-value |
|-----------|------------------------|-----------|------------|---------|
| HGB       | (g/dl)                 | 12.2±1.3  | 14.32±1.46 | 0.01    |
| RBC       | (x 10 <sup>6</sup> µL) | 4.42±0.32 | 3.87±1.53  |         |
| HCT       | (%)                    | 38.2±2.62 | 42.52±2.51 |         |
| MCV       | (fl)                   | 84.1±2.11 | 89.16±3.53 | 0.04    |
| MCH       | (pg)                   | 24.6±4.16 | 28.13±0.87 | 0.001   |
| MCHC      | (g/dl)                 | 30.2±2.10 | 31.58±0.24 | 0.01    |
| RDW       | (%)                    | 12.4±1.22 | 13.7±1.032 | 0.02    |

*\*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).*

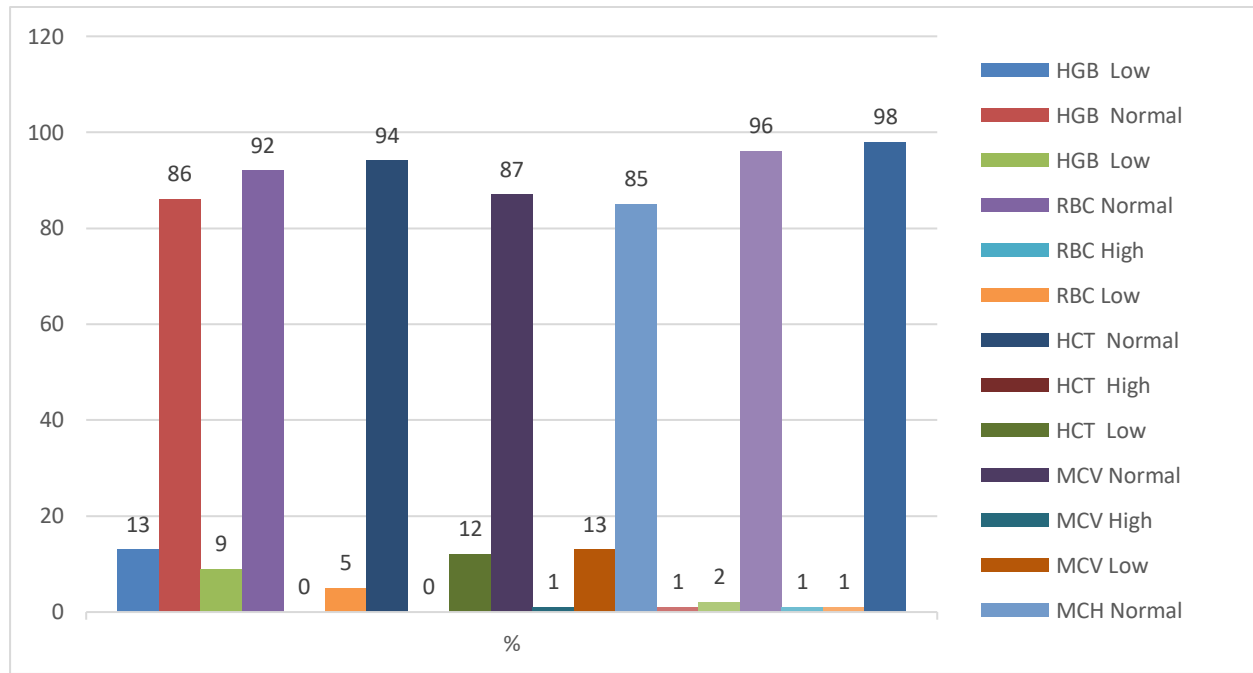


Figure 2: Comparison of conditions among Patients

Discussion

A substantial proportion of participants in both groups reside in rural areas, with 108 individuals (85.71%) in the Healthy group and 111 individuals (88.09%) in the H. pylori-infected group. Urban residency is relatively uncommon, with only 18 participants (14.28%) in the H. pylori-infected group and 15 participants (11.90%) in the Healthy group residing in urban regions. (11). (2021) emphasized that the longitudinal distribution of H. pylori provides valuable insights into the potential impact of environmental factors associated with rural residency on the prevalence of the infection.

Educational attainment most frequently observed in both groups is a Bachelor's degree, comprising 75 individuals (59.52%) in the H. pylori-infected group and 68 individuals (53.96%) in the Healthy group. Conversely, literacy is the least prevalent educational level, with only 9 participants (7.14%) in the H. pylori-infected group and 7 participants (5.55%) in the Healthy group. These academic distinctions may offer insights into possible correlations between H. pylori infection levels and educational background, as noted by Fang, Xie, & Fan (12). The study found significantly lower haemoglobin (HGB) levels in individuals with H. pylori infection ( $12.41 \pm 1.38$  g/dl) compared to the control group ( $14.32 \pm 1.46$  g/dl) ( $p < 0.001$ ). This finding is consistent with research by Xiong et al. (13), who reported similar haematological alterations in individuals with H. pylori infection.

Similarly, the red blood cell (RBC) count was significantly lower in the H. pylori-infected group ( $4.12 \pm 0.62 \times 10^6/\mu\text{L}$ ) compared to the control group ( $4.87 \pm 0.53 \times 10^6/\mu\text{L}$ ), corroborating findings by Chen et al. (14), who observed a notable reduction in RBC count associated with H. pylori infection. Hematocrit (HCT) values were significantly lower in individuals with H. pylori infection ( $39.17 \pm 3.87\%$ ) compared to the control group ( $44.52 \pm 4.51\%$ ) ( $p < 0.001$ ), which is consistent with observations

by Hussein, Al-Ouqaili, & Majeed (15) that suggest a relationship between H. pylori infection and reduced hematocrit levels.

Mean corpuscular volume (MCV) was lower in the H. pylori-infected group ( $86.06 \pm 4.44$  fl) compared to the control group ( $90.16 \pm 4.53$  fl) ( $p = 0.003$ ), supporting the findings of Ito et al. (16), who observed similar reductions in MCV in individuals with H. pylori infection.

Mean corpuscular haemoglobin (MCH) was significantly lower in the H. pylori-infected group ( $26.41 \pm 3.16$  pg) compared to the control group ( $29.13 \pm 1.87$  pg) ( $p = 0.007$ ). Mean corpuscular haemoglobin concentration (MCHC) was also lower in the H. pylori-infected group ( $31.45 \pm 1.60$  g/dl) compared to the control group ( $32.58 \pm 1.24$  g/dl) ( $p = 0.005$ ). Red cell distribution width (RDW) was slightly elevated in the H. pylori-infected group ( $13.51 \pm 2.10\%$ ) compared to the control group ( $13.87 \pm 1.32\%$ ) (17). Most participants exhibited normal haemoglobin (HGB) levels, with 86.50% within the normal range and 13.49% with low HGB levels. Red blood cell count (RBC) analysis showed that 92.85% of participants had normal values, while 7.14% had low RBC counts, with no individuals displaying high counts. Hematocrit (HCT) values were predominantly normal, with 94.44% within the normal range, and only 5.55% exhibiting low levels. High HCT values were not observed.

Mean corpuscular volume (MCV) values indicated that 87.30% of participants had normal MCV levels, 12.69% exhibited low MCV levels, and 0.79% had elevated MCV levels. Mean corpuscular hemoglobin (MCH) levels were normal in 85.71% of participants, with 13.49% displaying low MCH levels, and 0.79% showing elevated MCH levels. Most participants had normal mean corpuscular haemoglobin concentration (MCHC) levels (97.61%), while 1.58% had low MCHC levels, and 0.79% exhibited elevated MCHC levels. Red cell distribution width (RDW) values

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were normal in 99.20% of participants, with only 0.79% showing low RDW levels.

## Conclusion

Hematological analyses indicate significant differences between the *H. pylori*-infected and Healthy groups. Reduced haemoglobin levels, lower red blood cell count, and decreased hematocrit values in individuals with *H. pylori* infection are consistent with previous studies, suggesting a clear impact of *H. pylori* on these haematological parameters. Furthermore, alterations in mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) reinforce the haematological consequences associated with *H. pylori* infection, in line with findings from the existing literature. However, the slight increase in red cell distribution width (RDW) in the *H. pylori*-infected group, although statistically significant, diverges from some earlier research. This discrepancy highlights the need for further exploration to better understand the nuances of RDW changes in individuals with *H. pylori* infection.

## 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.

### Consent for publication

Approved

### Funding

Not applicable

## Conflict of interest

The authors declared an absence of conflict of interest.

## Authors Contribution

### SHANZA SHAHID

Data Analysis

### SHANZA ABBASI

Revisiting Critically

### SHAFF ZULFIQAR

Concept & Design of Study

### ZUNAIRA ABRAR & WAQAS AHMAD

Drafting



### MUHAMMAD USMAN

Final Approval of version

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