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Biochemical Changes Associated with Helicobacter Pylori Infection: Case Control Study

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KEYWORDS

H.pylori infection, Biochemical parameters, Changes, Significant different, Benghazi.

ABSTRACT:

Background: Bacteria, classified as gram-positive or gram-negative, infect various organs, causing disease and inflammation. Helicobacter pylori, a gram-negative bacteria, is linked to gastrointestinal diseases. It is a spiral-shaped, highly motile rod with 4-6 unipolar sheathed flagella and produces high amounts of urease enzyme for colonization and protection. It can penetrate the stomach's mucosal layer, forming colonies and causing gastric and peptic ulcers. H. pylori infects 4.4 billion people globally, infecting over half of the population. Direct transmission occurs through vomitus, saliva, or feces, facilitating non-digestive tract diseases like chronic urticaria, Alzheimer's, Parkinson's, and liver diseases. Diagnosis involves eradication therapy, with triple therapy being most effective. Eradication can reduce cancer in 62%–92% of cases. Due to the high prevalence and severity of H. pylori, the aim of this study was to investigate the relationship between the H. pylori infection of the patients and alterations in their biochemical markers in Benghazi, Libya.

Methods: The study excluded subjects with drugs that could affect the parameters targeted. Venous blood samples were collected from patients after an overnight fast, centrifuged, and stored at -80°C. Biochemical parameters were determined, including diagnostic tests for H. pylori infection, lipid profiles, C-reactive protein, liver enzymes, serum vitamin D level, and anemic patients' hematological parameters. Results were expressed as mean ± SD and statistically analyzed using the Statistical Package for Social Sciences (SPSS) version 20 program for Windows software.

Results: The study revealed significant differences between individuals with H. pylori infection and changes in blood levels of LDL and TC compared to the negative group. Other parameters did not show any significant variations, indicating that their levels were not affected by infection. Significant variations in blood ferritin, MCV, hemoglobin, hematocrit, and MCH levels were also seen between infected and non-infected females, according to the study.

Conclusion: According to our study in Benghazi, Helicobacter pylori infection can lead to dyslipidemia, increased atherosclerosis risk, and ischemic heart disease, with high CRP blood levels crucial for diagnosing inflammatory diseases. The relationship between H. pylori infection and iron deficiency anemia (IDA) differed significantly between men and women.

1. Introduction

Helicobacter pylori (H. pylori) is a gram-negative bacteria that lives in the mucosal layer of the stomach and is linked to many different kinds of gastrointestinal diseases. It was discovered for the first time in 1983 by two Australian scientists, Robin Warren and Barry Marshall (Abdelmaksoud et al., 2016). It is a tiny, spiral-shaped, highly

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motile rod with 4-6 unipolar sheathed flagella that is between 0.5 to 1.0 µm width and 2.5 to 5.0 µm in length. (Abu-Mugesieb, 2007). Biochemically, H. pylori possesses oxidase and catalase activities and is capable of producing high amounts of urease enzyme, which is shown to be necessary for colonization of the gastric surface (Flores, 2014).

The severity of H. pylori-related diseases is associated with numerous virulence factors (Baj et al., 2020). Urease, motility vacuolating cytotoxin Vac A, and the pathogenicity island (cag PAI) gene products are the main factors of virulence for H.pylori and play an essential role in the inflammatory response of the host and in the progression of the disease (Follmer, 2010). The virulence factors of H. pylori are not only involved in the induction of inflammatory responses, but they also control and regulate those responses, maintaining chronic inflammation. H. pylori virulence factors enable the colonization and survival of the bacterium within the gastric mucosa (Baj et al., 2020). Considering the high prevalence of H. pylori infection in the world and the problems it causes of varying severity, the current study was designed to evaluate the association between H. pylori infection and changes in blood levels of lipid profile, c-reactive protein (CRP), liver enzymes, serum vitamin D level, hematological parameters, serum iron and serum ferritin in Benghazi, Libya.

2. Material and Methods

2.1. Patients:

The study was taken out on 1–100 healthy people as a control group, and 2–100 patients infected with H. pylori were selected from the Alsaleem Lab in Benghazi, Libya. The participation of the respondents was voluntary, and informed consent was obtained from each of them.

2.2. Collection of sample

The study excluded patients with H. pylori infection who were pregnant, very sick, had other chronic diseases, had recently started treatment for anemia, had taken lipid-lowering medications (statins, ezetimibe, and niacin), or had received vitamin D supplementation. Sample collection and preparation: Without the use of a tourniquet, venous blood samples were collected into Vacationer plain tubes after an overnight fast (12–16 h) from the patients. The blood was allowed to clot, centrifuged at 5000 g for 15 min within 30 min of sample collection, and serum collected and stored at -80 °C until assay.

2.3. Biochemical parameters:

Biochemical parameters testing was done in all patients for the serum H. pylori IgG, IgM, IgA ELISA test, and the stool H. pylori antigen ELISA (Diagnostic Automation/Cortez Diagnostics, Inc., located in California, USA) for detection of H. pylori infection. Total Cholesterol (TC), triglycerides (TG), High Density Lipoprotein (HDL-Cholesterol), and Low Density Lipoprotein (LDL-Cholesterol) (Cobas Integra 400 plus Analyzer, Roche Diagnostics, Rotkreuz, Switzerland). C-reactive protein (CRP) (Cobas Integra 400 plus Analyzer, Roche Diagnostics, Rotkreuz, Switzerland), alkaline phosphatase (Cobas Integra 400 plus Analyzer, Roche Diagnostics, Rotkreuz, Switzerland) systems. Alanine transaminase (ALT) (Cobas Integra 400 Plus Analyzer, Roche Diagnostics, Rotkreuz, Switzerland) Aspartate transaminase (AST) (Cobas Integra 400 Plus Analyzer, Roche Diagnostics, Rotkreuz, Switzerland) Serum vitamin D level (Vitamin D direct AccuBind Elisa kit, Monobind Inc., Lake Forest, California, USA), hematological parameters (WBC, RBC, Hgb, HCT, MCV, MCH, MCHC, PLT, and RDW) (Sysmex automated hematology analyzer XN 330, Sysmex Corporation, Kobe, Japan). Serum Iron (Cobas Integra 400 Plus Analyzer, Roche Diagnostics, Rotkreuz, Switzerland) and Serum Ferritin (Elecsys and Cobas e 411 immunoassay analyzers, Roche Diagnostics, Mannheim, Germany).

2.4. Statistical analysis:

In this study, results were expressed as mean ± SD calculated for all groups and subgroups, and the following statistical analysis was conducted according to **Myers (1998)**. This test was estimated by using the **S**tatistical **P**ackage for **S**ocial **Sciences (SPSS)** version 20 program for Windows software to obtain the strength and significance of the association between all studied parameters. The

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results of all the above-mentioned procedures were accepted as statistically significant when the two-tailed p-value was less than 5% ($p < 0.05$) ***(Abbas et al.*, 2018*).***

3. Results

The current chapter presents the analysis of data for 200 patients (100 with H. pylori infection and 100 without infection) and then tests the assumption. The descriptive statistics of the sampling survey, which include the demographic characteristics of respondents, are presented. In the current chapter, the descriptive statistics of 20 biochemical parameters are presented.

3.1. Descriptive Statistics of Demographic Characteristics

Introducing the background of respondents is very important to make the readers understand the respondents based on their personal information, such as gender, age group, education level, and experience. This information has been shown in the following table to create a better understanding of their background.

Table 3.1. Demographic Characteristics of Respondents

Demographic Characteristic	Positive infection		Negative Infection	
	Frequency	**%**	**Frequency**	**%**
Gender				
Male	62	62.0	51	51.0
Female	38	38.0	49	49.0
Total	**100**	**100.0**	**100**	**100.0**
Age Group				
18-25 yrs	11	11.0	26	26.0
26-45 yrs	62	62.0	39	39.0
46-60 yrs	27	27.0	35	35.0
Total	**100**	**100.0**	**100**	**100.0**

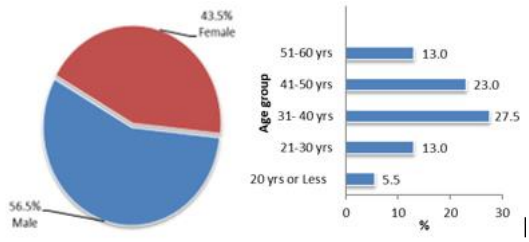

Figure 3.1: The distribution of each study sample (negative and positive H. Pylori infection) according to the demographic characteristics of respondents.

Table 3.1 and Figure 3.1 demonstrate that 113 out of 200 participants (or 56.5%) in the survey were males and 87 out of 200 (or 43.5%) were females. This table and figure show the majority of participants in the survey (27.5%) and (23.0%) from age groups (31–40) and (41–50) years, respectively, followed by 13.0% of each age group (21–30) and (51–60) years. The minority of participants in the age group (20 and younger) was about 5.5%. This result indicates that most of the respondents were aged 40–49, which may indicate a good knowledge of the effectiveness of the internal control process and financial performance in this survey.

3.2. Testing the Hypotheses for Differences

This study aimed to make inferences from sample statistics about population parameters. Therefore, hypothesis testing for differences was done to compare the H. pylori infection and changes in blood levels of biochemical parameters (first in general and then according to gender) for a given age group. To test the hypotheses stated above, the researcher conducted a parametric T-test to assess the validity of the proposed hypotheses.

H_0: There is no significant difference between H. pylori infection and changes in blood levels of biochemical parameters in general, nor according to demographic information (gender at age 18 to 60 years**).**

Emerging from this hypothesis, the following sub-hypotheses were found:

H_{01}: There is no significant difference between H. pylori infection and changes in blood levels of biochemical parameters in general.

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Table 3.2: *Independent sample t-test related to the changes in blood levels of liver enzyme parameters for positive and negative H. Pylori infection in general.*

Parameters	Infection	N	Mean	Std.Deviation	t-value	p-value
AST	Positive	100	18.930	9.863	0.888	0.376
	Negative	100	17.800	8.039		
ALT	Positive	100	24.400	20.820	2.015	0.047*
	Negative	100	19.510	12.523		
ALP	Positive	100	80.390	36.166	0.587	0.558
	Negative	100	77.720	27.611		

* Significant level at 0.05, ** highly significant level at the 0.01

Table 3.3*: Independent sample t-test related to the changes in blood levels of lipid profile, CRP and Vit D parameters for positive and negative H. Pylori infection in general.*

Parameters	Infection	Mean	Std.Deviation	t-value	p-value
HDL mg/dl	Positive	45.28	11.1138	-1.452	0.148
	Negative	47.67	12.134		
LDL mg/dl	Positive	112.891	31.952	3.819	0.000**
	Negative	97.043	26.475		
TC mg/dl	Positive	174.42	38.566	3.297	0.001**
	Negative	158.21	30.501		
TG mg/dl	Positive	126.02	59.352	1.32	0.188
	Negative	114.41	64.873		
VLDL mg/dl	Positive	24.879	12.774	1.989	0.049*
	Negative	21.956	13.342		
CRP mg/l	Positive	4.197	4.874	1.889	0.06
	Negative	3.047	3.649		
VitD ng/ml	Positive	19.762	11.136	-1.763	0.079
	Negative	22.472	10.594		

* Significant level at 0.05, ** highly significant level at the 0.01

Table 3.4: Independent sample t-test related to the changes in blood levels of Iron, Ferritin and hematological parameters for positive and negative H. Pylori infection in *general.*

Parameters	Infection	N	Mean	Std.Deviation	t-value	p-value
Iron ug/dl	Positive	100	72.990	35.119	-0.375	0.708
	Negative	100	74.799	33.128		
Ferritin ng/ml	Positive	100	63.663	43.026	-1.093	0.276
	Negative	100	70.089	40.055		
WBC (*10^3\ul)	Positive	100	7.707	2.006	0.597	0.551
	Negative	100	7.530	2.169		
RBC (*10^3\ul)	Positive	100	4.846	0.591	1.451	0.148
	Negative	100	4.732	0.518		
Hemoglobin	Positive	100	13.248	2.285	-0.135	0.893
	Negative	100	13.288	1.894		
Hematocrit	Positive	100	41.062	6.265	-0.260	0.795
	Negative	100	41.301	6.728		
MCV Fl	Positive	100	84.705	8.593	-2.188	0.030*
	Negative	100	87.073	6.577		
MCH pg	Positive	100	27.655	3.628	-0.870	0.385
	Negative	100	28.052	2.767		
MCHC g/dl	Positive	100	32.537	2.184	0.866	0.387
	Negative	100	32.295	1.742		
Platelets(*10^3\ul)	Positive	100	268.270	64.164	0.916	0.361
	Negative	100	260.170	60.808		

* Significant level at 0.05, ** highly significant level at the 0.01

In tables (3.2), (3.3) and (3.4), there were statistically significant differences between H. pylori infection and changes in blood levels of ALT (P = 0.047), VLDL (P = 0.049), and MCV (P = 0.030), P-values < 0.05, and highly significant differences of TC (P = 0.001) and LDL (P = 0.000) Compared to the negative H. Pylori infection group.

Regarding CRP and VitD parameters, the p-value was extremely near 0.05, at 0.06 and 0.079, respectively. This means that it is possible to give statistically significant results if the sample size is increased. As for the remaining parameters (AST ,ALP ,HDL ,TG ,Iron ,Ferritin ,WBC ,RBC ,Hemoglobin ,Hematocrit ,MCH ,MCHC ,Platelets), the p value was higher than 0.05, and this indicates that there are no significant differences between the infection and the change in its levels in the blood. The following graphs shows these results.

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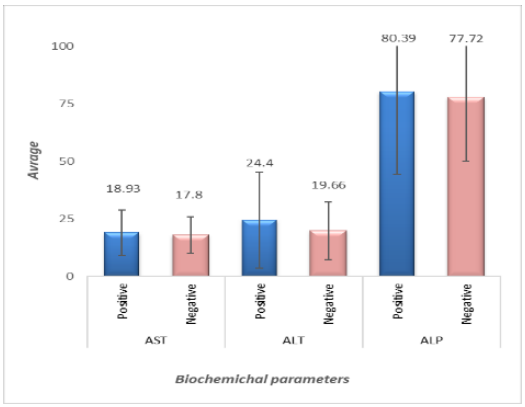


Figure 3.2: Bar chart of the average of the changes in blood levels of liver enzymes parameters for positive and negative H. Pylori infection in general (±SD).

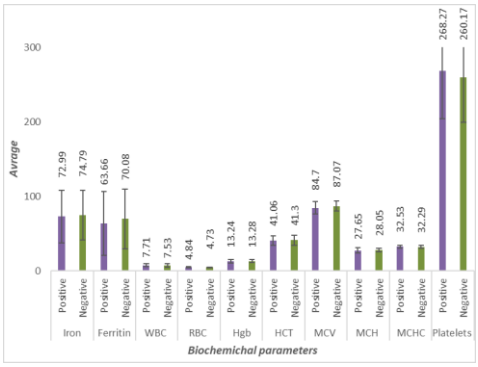
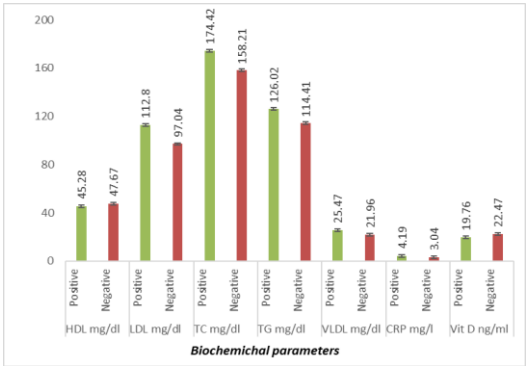


Figure 3.4: Bar chart of the average of the changes in blood levels of Iron, Ferritin and hematological parameters for positive and negative H. Pylori infection in general (±SD).



H_{02}: There is no significant difference between H. pylori infection and changes in blood levels of biochemical parameters according to gender.

Table 3.5: Independent sample t-test related to the changes in blood levels of lipid profile, CRP and Vit D parameters for positive and negative H. Pylori infection according to males aged 18 to 60 years.

Parameters	Infection	Mean	Std.Deviation	t-value	p-value
HDL mg/dl	Positive	42.355	9.422	-0.432	0.667
	Negative	43.059	11.008		
LDL mg/dl	Positive	115.345	29.836	2.88	0.005**
	Negative	101.084	27.294		
TC mg/dl	Positive	176.452	35.338	2.871	0.005**
	Negative	159.039	32.320		
TG mg/dl	Positive	135.694	63.950	0.849	0.398
	Negative	125.216	65.251		
VLDL mg/dl	Positive	27.721	13.673	1.227	0.222
	Negative	24.503	13.898		
CRP mg/l	Positive	3.737	4.441	2.154	0.033*
	Negative	2.352	1.838		
VitD ng/ml	Positive	20.604	10.4320	-1.251	0.214
	Negative	23.317	11.3450		

* Significant level at 0.05, ** highly significant level at the 0.01

Table 3.6: Independent sample t-test related to the changes in blood levels of Iron, Ferritin and hematological parameters for positive and negative H. Pylori infection according to males aged 18 to 60 years.

Parameters	*Infection*	*Mean*	*Std.Deviation*	*t-value*	*p-value*
Iron ug/dl	Positive	83.371	30.638	-0.626	0.533
	Negative	83.949	30.794		
Ferritin ng/ml	Positive	81.6574	38.8435	-0.186	0.853
	Negative	83.830	37.578		
WBC (*10^3\ul)	Positive	7.753	1.907	-0.33	0.742
	Negative	7.877	2.098		
RBC (*10^3\ul)	Positive	5.062	0.564	0.436	0.663
	Negative	5.010	0.502		
Hemoglobin	Positive	14.485	1.5425	0.287	0.775
	Negative	14.335	1.664		
Hematocrit	Positive	44.347	4.764	0.772	0.441
	Negative	43.351	4.636		
MCV fL	Positive	87.850	5.948	0.05	0.96
	Negative	87.273	4.948		
MCH pg	Positive	29.111	2.287	0.923	0.358
	Negative	28.565	2.282		
MCHC g/dl	Positive	33.177	2.095	0.9	0.37
	Negative	32.884	1.727		
Platelets(*10^3\ul)	Positive	253.194	52.715	0.007	0.994
	Negative	258.039	64.758		

* Significant level at 0.05, ** highly significant level at the 0.01

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Table 3.7 : Independent sample t-test related to the changes in blood levels of liver enzymes parameters for positive and negative H. Pylori infection and according to males aged 18 to 60 years.

Parameters	*Infection*	*Mean*	*Std.Deviation*	*t-value*	*p-value*
AST	Positive	20.226	11.262	0.061	0.952
	Negative	19.863	7.062		
ALT	Positive	29.161	24.636	1.356	0.178
	Negative	24.059	13.327		
ALP	Positive	77.403	37.828	-0.696	0.488
	Negative	82.235	21.891		

* Significant level at 0.05, ** highly significant level at the 0.01

According to tables **(3.5), (3.6)** and **(3.7)**, there were extremely significant differences in TC (P = 0.005) and LDL (P = 0.005), as well as statistically significant differences between H. pylori infection and changes in blood levels of CRP (P = 0.033), P-values < 0.05. P-values were less than 0.01 in contrast to the group that did not have H. pylori infection.

The p value was greater than 0.05 for the remaining parameters (AST, ALT, ALP, HDL, TG, VLDL, VitD, Iron, Ferritin, WBC, RBC, Hemoglobin, Hematocrit, MCV, MCH, MCC, Platelets), indicating that there are no significant differences between the infection and the change in its levels in the blood. These outcomes are displayed in the graphs below.

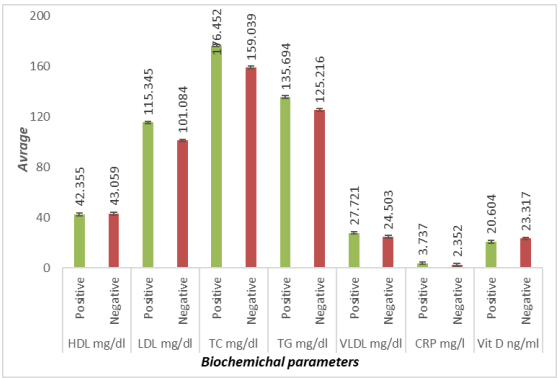

Figure 3.5: Bar chart of the average of the changes in blood levels of lipid profile, CRP and Vit D parameters for positive and negative H.pylori infection according to males aged 18 to 60 years. (±SD).

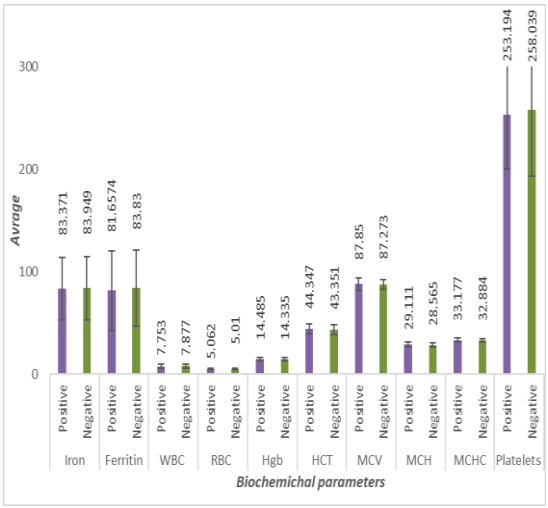

Figure 3.6 : Bar chart of the average of the changes in blood levels of Iron, Ferritin and hematological parameters for positive and negative H. Pylori infection according to males aged 18 to 60 years. (±SD).

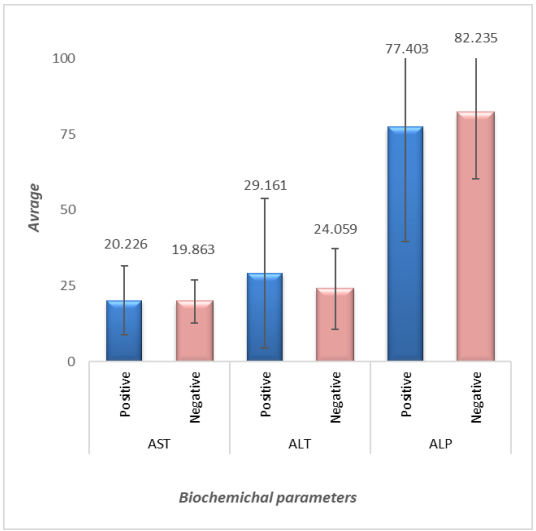

Figure 3.7: Bar Chart of the average of the changes in blood levels of liver enzymes parameters for positive and negative H. Pylori infection according to males aged 18 to 60 years. (±SD).

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Table 3.8: Independent sample t-test related to the changes in blood levels of lipid profile, CRP and Vit D parameters for positive and negative H. Pylori infection according to females aged 18 to 60 years.

Parameters	Infection	Mean	Std.Deviation	t-value	p-value
HDL mg/dl	Positive	49.921	12.092	-0.968	0.336
	Negative	52.429	11.480		
LDL mg/dl	Positive	108.029	35.840	2.229	0.028*
	Negative	93.433	24.864		
TC mg/dl	Positive	170.447	43.992	1.606	0.112
	Negative	157.776	28.596		
TG mg/dl	Positive	110.658	47.510	0.618	0.538
	Negative	102.531	63.337		
VLDL mg/dl	Positive	21.903	9.596	1.08	0.283
	Negative	19.198	12.345		
CRP mg/l	Positive	4.931	5.496	0.978	0.331
	Negative	3.786	4.778		
VitD ng/ml	Positive	18.643	12.076	-1.422	0.159
	Negative	21.656	9.768		

* Significant level at 0.05, ** highly significant level at the 0.01

Table 3.9: Independent sample t-test related to the changes in blood levels of Iron, Ferritin and hematological parameters for positive and negative H. Pylori infection according to females aged 18 to 60 years.

Parameters	Infection	Mean	Std.Deviation	t-value	p-value
Iron ug/dl	Positive	59.947	41.053	-0.602	0.549
	Negative	63.787	29.067		
Ferritin ng/ml	Positive	36.292	32.878	-2.706	0.008**
	Negative	56.682	38.971		
WBC (*10^3\ul)	Positive	7.687	2.149	0.992	0.324
	Negative	7.164	2.202		
RBC (*10^3\ul)	Positive	4.502	0.459	0.863	0.39
	Negative	4.434	0.340		
Hemoglobin	Positive	11.366	1.9571	-2.287	0.025*
	Negative	12.155	1.3801		
Hematocrit	Positive	36.082	4.914	-2.026	0.046*
	Negative	38.914	7.7605		
MCV fL	Positive	80.205	10.048	-3.366	0.001**
	Negative	86.457	8.0111		
MCH pg	Positive	25.489	4.234	-2.529	0.013*
	Negative	27.396	3.1085		
MCHC g/dl	Positive	31.518	1.927	-0.533	0.595
	Negative	31.702	1.5601		

* Significant level at 0.05, ** highly significant level at the 0.01

Table 3.10 : Independent sample t-test related to the changes in blood levels of liver enzymes parameters for positive and negative H. Pylori infection according to females aged 18 to 60 years**.**

Parameters	*Infection*	*mean*	*Std.Deviation*	*t-value*	*p-value*
AST	Positive	16.842	6.6517	0.949	0.345
	Negative	15.49	8.3644		
ALT	Positive	16.289	7.414	0.845	0.401
	Negative	15	9.8298		
ALP	Positive	83.395	32.2947	1.618	0.109
	Negative	73.449	32.0956		

* Significant level at 0.05, ** highly significant level at the 0.01

Tables **(3.8)**, **(3.9)** and **(3.10)**, report statistically significant differences (P-values < 0.05) between H. pylori infection and changes in blood levels of ferritin (P = 0.008) and MCV (P = 0.001), as well as highly significant differences (P = 0.028), hemoglobin (P = 0.025), hematocrit (P = 0.046), and MCH (P = 0.013) in contrast to the group of people who did not have H. Pylori.

The p value was greater than 0.05 for the remaining parameters (AST, ALT, ALP, HLDL, TC, TG, VLDL, CRP, VitD, Iron, WBC, RBC, MCHC, Platelets), indicating that there are no significant differences between the infection and the modification in its levels in the blood. These findings are displayed in the graphs below.

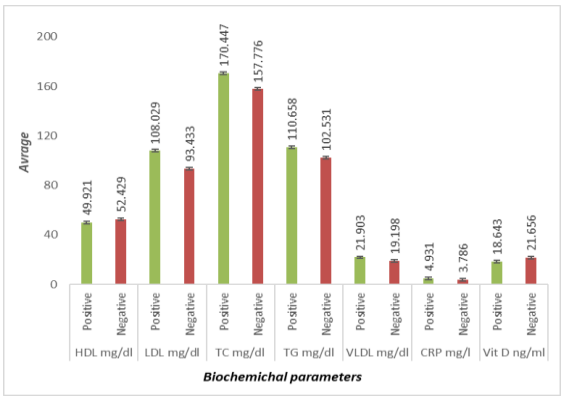

Figure 3.8: Bar Chart of the average of the changes in blood levels of blood levels of lipid profile, CRP and Vit D parameters for positive and negative H. Pylori infection according to females aged 18 to 60 years. (±SD).

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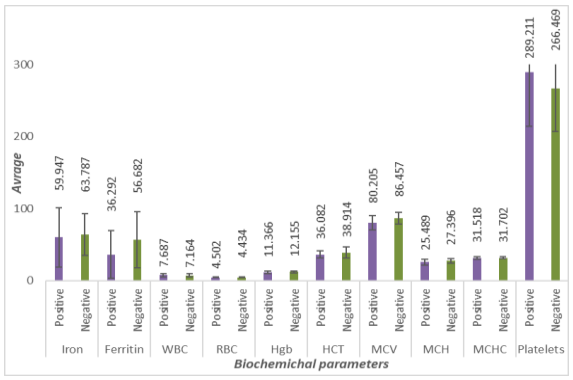

Figure 3.9: Bar Chart of the average of the changes in blood levels of Iron, Ferritin and hematological parameters for positive and negative H. Pylori infection according to females aged 18 to 60 years. (±SD)

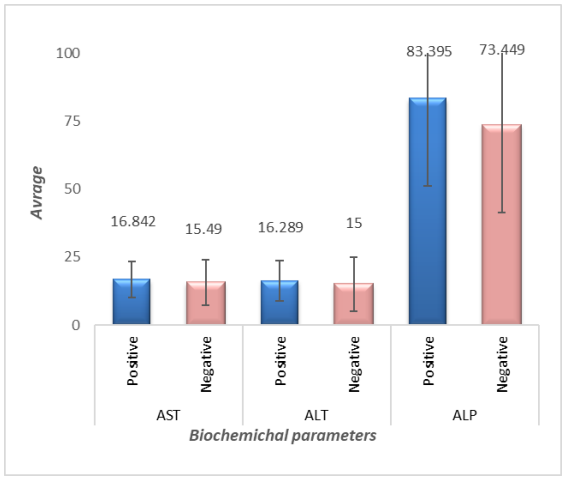

Figure 3.10: Bar Chart of the average of the changes in blood levels of liver enzymes parameters for positive and negative H. Pylori infection according to females aged 18 to 60 years. (±SD)

4.Discussion

Many studies have shown that Helicobacter pylori infection is linked to significant alterations in essential functions, leading to a variety of diseases. The diseases associated with H. pylori infection represent a serious public health issue due to their high frequency and the frequent healthcare needs they produce. Thus, the purpose of the current study is to evaluate the correlation between changes in biochemical parameters and H. pylori infection in adult patients in Benghazi, Libya.

Lipid profile tests detect atherosclerotic disease and dyslipidemia, which involve elevations in serum lipid profiles. Diagnosis involves measuring plasma levels of low-density lipoprotein, high-density lipoprotein, triglycerides, and total cholesterol **(Hashim *et al.*, 2022)**. Previous studies showed an association between H. pylori infection and cardiovascular diseases because of its effects on lipid metabolism **(Laurila *et al.*, 1999)**.

The effects of the H. pylori infection-induced inflammatory response system may be the cause of the alteration in lipid profiles. Gram-negative bacteria like H.pylori have lipopolysaccharides (LPS) in their cell walls, which cause the release of cytokines that inhibit the action of lipoprotein lipase. As a result, serum lipid levels increased due to the mobilization of fat from tissues into the blood, leading to dyslipidemia **(Nigatie *et al.*, 2022)**. Hashim et al. (2022) observed that, in comparison to healthy patients, H. pylori seropositive subjects had higher serum concentrations of LDL-cholesterol and total cholesterol, both of which are known to be risk factors for cardiovascular disease.

The findings of the current study indicate that serum LDL-Cholesterol (P = 0.000), TC (P = 0.001), and VLDL (P = 0.049) were all significantly elevated in the general case of H. pylori seropositivity. HDL-Cholesterol and TG levels were not significantly different between seropositive and seronegative H. pylori cases, despite the fact that lower levels were seen in the infection group. The levels of HDL- Cholesterol, TG, and VLDL did not significantly change between seropositive and seronegative individuals, while there were highly significant differences in the male case's TC (P = 0.005) and LDL-Cholesterol (P = 0.005). The blood levels of LDL-Cholesterol in the female case differed significantly (P = 0.028), while the levels of other lipid profile parameters did not differ significantly between seropositive and seronegative H. pylori patients. Our results support the hypothesis that H. pylori played a role in inducing atherosclerosis with lipid metabolism by elevating LDL-cholesterol levels.

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These results are in agreement with those of Kim et al. (2011), who showed that H. pylori is independently associated with elevated LDL-cholesterol levels. The results of a study conducted in Egypt by Abd El-Maksoud et al. (2016) indicated that H. pylori infection in patients indirectly caused changes in serum lipid profiles, which caused an increase in LDL-cholesterol and TC. Also, our finding in HDL-cholesterol concentration was not a statistical difference between cases and controls. In a study conducted in northwestern Ethiopia by Hashim et al. (2022), no relationship was found between H. pylori infection and HDL cholesterol.

In contrast, our result was not comparable with a study done in Finland by Pohjanen *et al.* (2016), which indicated that there was a significant difference between H. pylori-positive and control groups with serum TC, LDL-cholesterol, and TG and HDL-cholesterol concentrations. Another study conducted in China by Jia *et al.* (2009) also showed that the values of TG and LDL-cholesterol were not statistically different between H. pylori-positive and control groups. There are several possible explanations for the differences between the results of our study and others. The study design, the selection of sample size and participants, and the demographics studied, in addition to socioeconomic status, lifestyle, and diet, are all factors that contribute to the differences in results, as they may confound the association between changes in biochemical parameter levels and H. pylori infection.

H. pylori infection may affect the liver; however, the exact implications of this infection and the underlying mechanisms remain unknown. According to certain studies, an H. pylori infection may increase the chance of developing chronic liver and biliary system diseases. **(Salehi *et al.*, 2014)**. In the current study, patients with H. pylori infection had a considerably larger, non-significant increase in AST and ALT levels compared to those without infection. This is consistent with research by Karomi *et al.* (2019), who discovered that the effects of H. pylori infection on certain enzymes, like ALT and AST, were additionally not statistically significant.

While Sumida *et al.* (2015) reported that there was a significant difference between both groups regarding AST and ALT between those with or without H. pylori infection, the significant increase in serum ALT levels in the general group came in agreement with those recorded by Graham *et al*. (1998), whose study found a strong correlation between higher ALT levels and CagA-positive H. pylori infection.

One type of serum biomarker for hepatic disease is the liver isoform of the enzyme ALP. In this study, there was no significant difference in ALP levels between groups with and without an H. pylori infection. Serum ALP levels or H. pylori infection have not been reported to date. Thus, more research is needed to determine the function of ALP in both acute and chronic H. pylori infections.

C- reactive protein (CRP) is an important acute phase protein that is associated with infectious and can be used for the diagnosis and follow-up of various inflammatory and traumatic processes **(Gravina *et al.*, 2018)**. According to the results of the current study, in male cases, H. pylori seropositivity resulted in a significant increase in serum CRP (*P* value = 0.033); although higher levels of it were observed among H. pylori seropositive cases, there was no significant difference between seropositive and seronegative cases regarding the level of CRP in general and female cases.

In fact, Manolaki *et al.* (2007) did not find a correlation between CRP levels and H. pylori infection. While Ishida *et al.* (2008) in their study showed a significant association between H. pylori infection and serum CRP levels, supporting that H. pylori infection may increase the serum CRP. Also the study by Rahmani *et al.* (2016) found a significant correlation between the serum level of CRP and gender that was higher for men. In addition significant relationship between H. pylori infection and the severity of inflammation was highly significant, with an increase in inflammation markers as the infection severity increased.

Vitamin D (25-hydroxyvitamin D) is an immunoregulatory substance that is widely recognized for mediating bone metabolism and

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playing a key role in target tissues (**Yang *et al.*, 2019)**. Gastric vitamin D receptors and the systemic immunological response to chronic gastritis are the pathways via which H. pylori infection and serum vitamin D are connected. Thus, a previous study conducted in Italy by Antico *et al.* (2012) showed that individuals with H. pylori-related gastritis had lower serum vitamin D levels. However, our results revealed that there was no statistical difference in mean vitamin D level between individuals with and without H. pylori infection in all cases of study. These results were consistent with those of Chen *et al.* (2016).

Iron-deficiency anemia is considered a major public health problem. In addition, H. pylori is a common GI tract infection that affects the majority of people. Although H. pylori's role in IDA is confirmed, its relationship remains unclear. Iron deficiency is the most common cause of nutritional deficits leading to anemia in clinical practice. **(Nasif *et al.*, 2021)**.

Helicobacter pylori can cause iron-deficiency anemia through various mechanisms, including increased iron loss from hemorrhagic gastritis, peptic ulcers, and gastric adenocarcinoma. **(Tsay & Hsu, 2018)**. Second, Helicobacter pylori impairs iron absorption as a result of chronic gastritis. Most dietary iron is in the non-heme form and must be reduced to the ferrous form by the acidic pH of the stomach and ascorbic acid for absorption, so ascorbic acid is considered the most effective regulator of iron absorption. Helicobacter pylori is the main cause of chronic superficial gastritis, resulting in gastric gland atrophy, decreased gastric acid secretion, and hypochlorhydria, which in turn leads to impaired reduction of dietary iron from ferric to ferrous forms **(Chen, 2007)**. A third mechanism postulated to explain the relationship between iron deficiency and H. pylori infection is iron uptake by the bacteria themselves. Various microorganisms use iron as a growth factor, and H. pylori is one of them. H. pylori requires host-supplied iron for its growth and spread. It contains an iron-binding protein that is similar to ferritin and may therefore play a crucial role in storing excess iron **(Rahat & Kamani, 2021).**

In the present study, we showed no significant association between Helicobacter pylori infection and anemia in general or male cases. Although we observed lower levels of hemoglobin and other hematological parameters in the positive H. pylori infection group, there was no statistical significance. Also, we showed no significant association between H. pylori infection and iron-deficiency anemia (IDA), despite lower levels of serum iron and ferritin in the positive H. pylori-infected group. This is consistent with the study of Wang *et al.* (2024) in China, where they found a significant association between H. pylori and IDA in females but no correlation in males.

In the case of females, the study revealed a significant correlation between H. pylori infection and blood levels of ferritin ($P = 0.008$), MCV ($P = 0.001$), hemoglobin ($P = 0.025$), hematocrit ($P = 0.046$), and MCH ($P = 0.013$). These findings align with previous studies, indicating a potential link between H. pylori infection and anemia in the Chinese population. For instance, Xu et al. (2017) found a higher prevalence of anemia in individuals with H. pylori infection, particularly among females. The hemoglobin levels were lower in the H. pylori positive group compared to the negative group. Similarly, Queiroz *et al.* (2013) reported that H. pylori infection was associated with decreased MCV and MCH values, as well as lower ferritin and hemoglobin levels in Latin American patients.

Another study was conducted in Bangladesh, and there are significant differences in the lower values of mean red cell volume and mean hemoglobin in positive patients for Helicobacter pylori. Studies conducted by Nasif *et al.* (2021) in Saudi Arabia showed that the prevalence of Helicobacter pylori infection among iron deficiency anemia patients was 62%, with significant differences between females and males. There was also a significant difference between females and males with a positive Helicobacter pylori infection in terms of red blood cell count, hematocrit percentage, mean red cell volume, and mean hemoglobin.

While numerous studies have demonstrated a link between H. pylori infection and IDA, others have failed to provide conclusive evidence of a causal

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relationship between the two. For example, Santos *et al.* (2009) found no significant correlation between H. pylori infection and IDA in Latin America. Similarly, a study conducted on seniors in Australia by Kaffes *et al.* (2003) supported the notion that H. pylori has a detrimental impact on iron levels. In a study conducted by Shih *et al.* (2013) in Tunisia, no correlation was found between H. pylori infection and iron, ferritin, or TIBC, despite the fact that the positive H. pylori infection group had lower hemoglobin levels. Additionally, they found no evidence of an association between iron-deficiency anemia (IDA) and persistent H. pylori infection. The discrepancies in findings across studies may be attributed to variations in factors such as geographical and ethnic demographics of the study population, age groups, inclusion criteria, sample sizes, sampling methods, and the techniques used to detect anemia, iron markers, and H. pylori infection.

5. Conclusion

This study is the first in Benghazi to determine the possibility that H. pylori infection can alter the levels of biochemical parameters. According to the result of this work, we found that infection with Helicobacter pylori bacteria may cause dyslipidemia, as it changes the concentration of lipid in the blood, leading to an increased risk of atherosclerosis and ischemic heart disease.

These results also revealed that the H. pylori bacterial infection had no effect on liver enzymes, thus excluding liver damage as a possible consequence of the infection.

Measuring the CRP blood level is essential for the diagnosis of both acute and chronic inflammatory diseases, particularly in the case of H. pylori infection, which results in gastritis characterized by infiltration of polymorphonuclears, macrophages, and lymphocytes. High CRP levels may serve as an early indicator of alterations in the gastric mucosa and a promising therapeutic target for gastritis patients, but more research is needed in this area.

According to our study, there was no significant difference in the mean levels of vitamin D between individuals with an H. pylori infection compared to those without, suggesting that there was not an important connection between both of them.

The results of the present study indicate a significant difference between men and women in the connection between H. pylori infection and unexplained IDA. Therefore, eradicating the Helicobacter pylori bacteria may contribute significantly to improving IDA treatment and recurrence prevention, which are necessary and may provide a significant reduction in the overall disease burden.

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