Original Article

DOI: 10.4274/haseki.galenos.2025.65265
Med Bull Haseki 2025;63(3):150-158

The Correlation Between Systemic Immune-Inflammatory Index and *Helicobacter Pylori* Infection and Its Severity

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Abstract

Aim: The systemic immune-inflammatory index (SII), derived from routine hemogram parameters, has recently emerged as a novel marker reflecting the balance between host immune status and inflammatory burden and may offer information about the severity of *Helicobacter pylori (H. pylori)* associated gastric inflammation. We investigated whether there was a correlation between *H. pylori* inflammation, its severity, and this index.

Methods: This single-center, retrospective study was conducted between January and December 2021. A total of 1137 *H. pylori*-positive and 401 *H. pylori*-negative patients who underwent upper gastrointestinal endoscopy were included. Participants were grouped based on gastric tissue activity and chronicity scores, which reflect the histological severity of inflammation and mononuclear infiltration, respectively, as defined by the updated Sydney system. The SII and other inflammatory markers were statistically compared between groups. Correlation analysis was also performed to evaluate the relationship between histological severity and inflammatory parameters.

Results: Lymphocyte, neutrophil, platelet, SII, neutrophil-to-lymphocyte ratio, and platelet-to-lymphocyte ratio were compared between the groups. No significant differences were observed. There was no significant difference in terms of the SII and other parameters in the *H. pylori* (+) group when the "1(+)" and "2(+) and 3(+)" subgroups were compared. No significant relationship was found between tissue activity and chronicity score values and inflammatory markers.

Conclusion: No correlation was found between the presence and severity of *H. pylori* and the SII. This is the first study to compare inflammatory markers in the blood with activity and chronicity findings in the tissue.

Keywords: *Helicobacter pylori*, inflammation, systemic immune-inflammatory index, neutrophil-to-lymphocyte ratio platelet-to-lymphocyte ratio

Introduction

Helicobacter pylori (H. pylori) is a gram-negative microaerophilic bacterium (1). It tends to settle in the gastric antrum, which has a less acidic environment compared to other areas of the stomach. In the presence of *H. pylori* infection, mixed inflammation involving neutrophils, macrophages, and lymphocytes occurs in the gastric mucosa. The gold standard for *H. pylori* diagnosis is endoscopic detection of *H. pylori* in gastric biopsy materials (2). Endoscopic biopsy materials are classified and reported by a pathologist, according to the Sydney system (3). In the Sydney system, changes in the stomach lining are rated based on five key features: chronic inflammation, neutrophil activity, glandular atrophy, intestinal metaplasia, and *H. pylori* density (4). Through this classification, topographic, morphological, and etiological information is provided in a diagram. Thus, clinical diagnosis becomes more practical, and a common terminology is established between pathologists and clinicians within the reporting system.

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Received: 17.05.2025 **Accepted:** 31.05.2025 **Epub:** 12.08.2025 **Publication Date:** 29.08.2025

Cite this article as: Ordu M, Ozturk G, Ergin M. The correlation between systemic immune-inflammatory index and *Helicobacter pylori* infection and its severity. Med Bull Haseki. 2025;63(3):150-158

Studies show that as the number of neutrophils increases, so does the severity of *H. pylori* positivity. As a result of the physiological response of leukocytes to stress, there is an increase in the number of neutrophils and a decrease in the number of lymphocytes. The neutrophil-to-lymphocyte ratio (NLR) can be used as a sensitive marker of inflammation. The systemic immune-inflammatory index (SII) is a contemporary marker for inflammation that is calculated by multiplying the number of neutrophils by the number of platelets and then dividing that by the number of lymphocytes. During inflammation, there is an increase in the number of neutrophils and platelets in the blood, which is due to megakaryocyte growth in chronic inflammation. The number of lymphocytes tends to decrease owing to increased apoptosis (5). The SII was created by combining multiple values into a single parameter. The SII is an indicator of an individual's inflammatory and immune responses (6).

The immune system is unable to eliminate the bacteria because of *H. pylori* virulence factors. In the presence of a long-term infection, chronic inflammation, oxidative stress, and DNA damage may develop in the stomach. As a result, *H. pylori* is an important predisposing factor in the development of gastric cancer. The SII has been reported to be an important prognostic marker for many solid organ tumors. In cases in which the relationship between stomach cancer and SII was evaluated, an association with increased SII was found (6).

We hypothesized that a worse *H. pylori* infection in stomach tissue samples would be linked to a higher SII. Inthis context, we investigated whether there was a correlation between *H. pylori* inflammation, its severity, and this index.

Materials and Methods

Compliance with Ethical Standards

This retrospective study was conducted in accordance with the principles of the Declaration of Helsinki and approved by the Clinical Research Ethics Committee of Aksaray University Faculty of Medicine (approval no.: 2022/07-02, date: 07.04.2022).

Study Design

The study was designed as a single-center, controlled, retrospective study. Data from 3324 patients who underwent upper gastrointestinal system endoscopy between January 2021 and December 2021 were retrospectively examined. Patients with known chronic diseases were excluded from this study. Patients under 18 years of age and those diagnosed with primary gastric carcinoma/lymphoma were not included in the study. A total of 1137 patients with *H. pylori*-positive stomach biopsies were included in the study as the patient group, while 401 patients with *H. pylori*-negative results were included as the control group. The flowchart of the study is summarized in Figure 1. During endoscopy, gastric biopsies were obtained from patients in accordance with

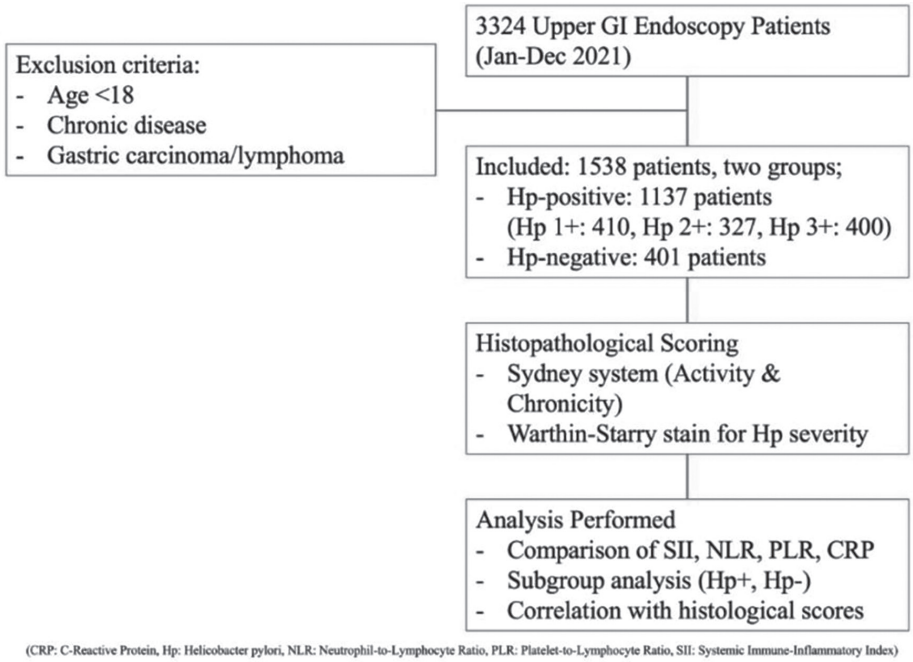

Figure 1. Flowchart of the study
GI: Gastrointestinal, Hp: *Helicobacter pylori*, SII: Systemic immune-inflammatory index, NLR: Neutrophil-to-lymphocyte ratio, PLR: Platelet-to-lymphocyte ratio, CRP: C-reactive protein

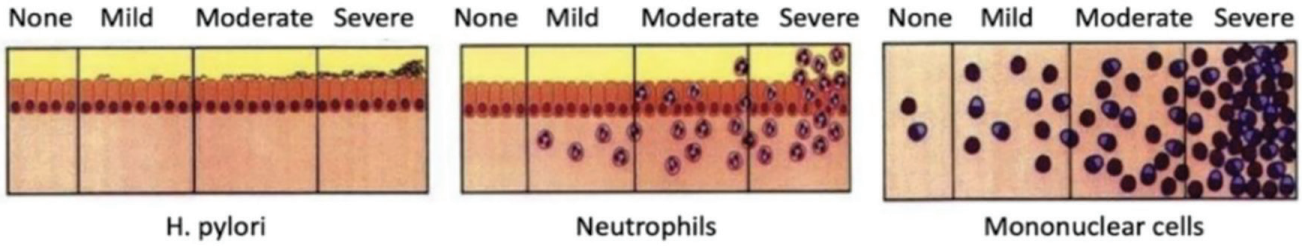

Figure 2. Sydney visual scoring, *Hp* severity, activity and chronicity severity

the Sydney protocol. The biopsy materials for the patients were classified by pathologists according to the Sydney system (Figure 2).

According to the classification, the activity and chronicity scores were categorized as "none, mild, moderate, and severe". According to activity score, it was evaluated as "mild: presence of a small number of neutrophils in the mucosa lamina propria; moderate: presence of neutrophils in the surface epithelium, foveola, and gland epithelium next to the lamina propria; severe: presence of pit abscess in addition to other findings." According to the chronicity score, it was evaluated as "normal: mononuclear cells should not exceed five at each high magnification; mild: mononuclear cells in the superficial part of the mucosa; moderate: inflammatory reaction exceeding two-thirds of the mucosa; severe: presence of inflammatory cells and lymphoid follicles in the entire mucosa layer" (7). Activity and chronicity scores are shown in the examples of our cases (Figures 3a-c).

Histochemically, the preparations stained with Warthin-Starry were categorized as "none, mild (1+), moderate (2+), or severe (3+)" using the Sydney classification. Accordingly, they were categorized as "None: *H. pylori* was not found; mild: *H. pylori* was found rarely or in less than one-third of the entire length of the sample; moderate: *H. pylori* was found in more than one-third but less than two-thirds of the entire sample length; severe: *H. pylori* was found in clusters throughout the sample." (7) The degree of *H. pylori* presence in the preparations stained histochemically with Warthin-Starry is shown in the samples from our cases (Figures 3d-g).

We obtained data from the patients included in this study from our hospital's electronic database. We recorded the patients' sex, age, and laboratory findings such as hemoglobin, leukocyte, platelet, neutrophil, lymphocyte, and C-reactive protein (CRP) (Advia 120 Siemens Healthcare Diagnostics, Eschborn, Germany). Based on the laboratory results, NLR, platelet-to-lymphocyte ratio (PLR), and SII were calculated (NLR=neutrophil count/lymphocyte count ratio, PLR=platelet count/lymphocyte count ratio, SII=platelet count x neutrophil count/lymphocyte count ratio).

Statistical Analysis

Statistical Package for the Social Sciences (SPSS) version 26.0 for Windows (SPSS, Windows 26.0, Chicago, Illinois, USA) was used. Differences between groups were compared using the chi-square test and Student's t-test. Pearson's correlation test was used to evaluate the correlation among the laboratory data points. The normality of continuous variables was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. The results of statistical analyses are presented as the mean ± standard deviation. Differences were considered statistically significant at $p<0.05$.

Results

Of the 1538 patients included in the study, 1137 were *H. pylori*-positive and 401 were *H. pylori*-negative. There were 410 *H. pylori* 1(+), 327 *H. pylori* 2(+), and 400 *H. pylori* 3(+) patients. There were 437 *H. pylori* (+) male and 700 female patients. There was no difference in the sex distribution between the *H. pylori* (+) and *H. pylori* (-) groups (p=0.327) (Table 1).

Age, lymphocyte count, neutrophil count, platelet count, SII, NLR, and PLR were compared between groups. We found no significant differences between the groups in terms of parameters, including SII, except for age. In terms of age, the *H. pylori* (-) and *H. pylori* 1(+) groups were statistically similar to each other and different from the *Hp*2 (+) and *Hp*3 (+) groups (Table 2 and Figures 4, 5).

The comparison of the "*H. pylori* 1(+) and *H. pylori* 2(+)" groups with the "*H. pylori* 3(+)" group showed a significant difference in age ($p<0.001$). There were no significant differences in terms of SII and other parameters (Table 3).

We found no significant relationship between tissue activity and chronicity score values, inflammatory markers, or the SII (Table 4).

Discussion

The SII, which is calculated using blood cell counts such as platelets, neutrophils, and lymphocytes, is suggested to be a better and more sensitive measure of immune-inflammatory status compared to older ratios like PLR

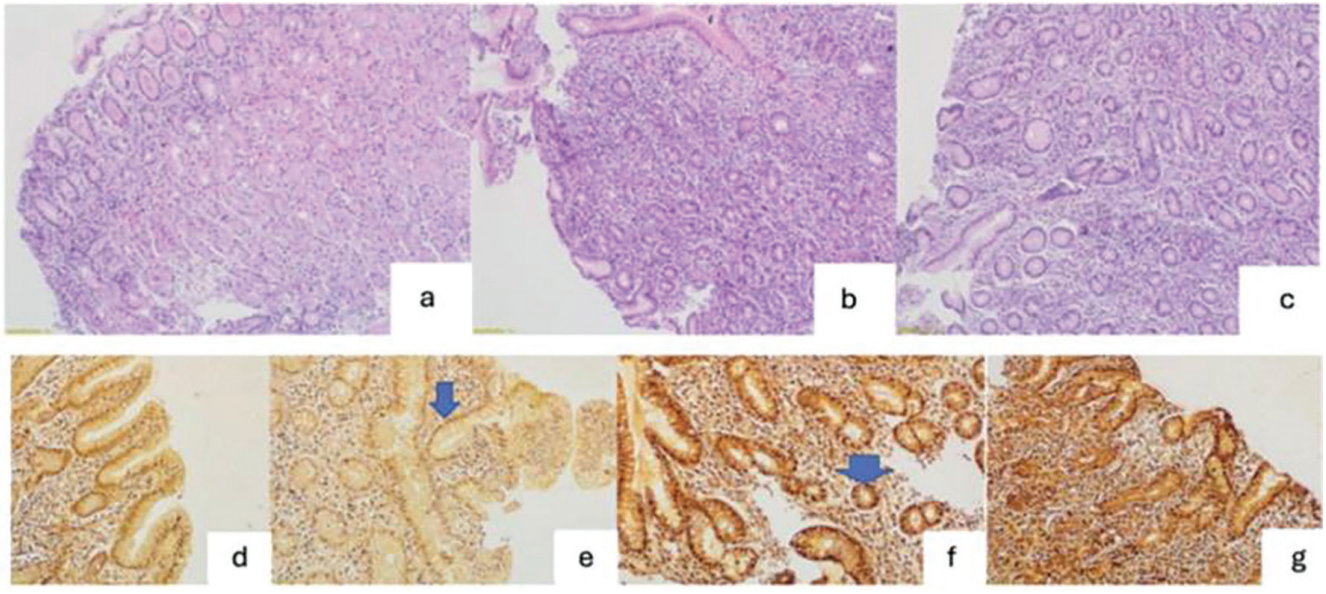

Figure 3. *H.pylori* associated chronic active gastritis; Inflammation severities in activity and chronicity in the antral mucosa. Mild (a), Moderate (b), Severe (c) findings are observed (H&E X10) d, e, f, g: Histochemically, *H.pylori* in mucus with Warthin Starry stain; None (d), Mild (e), Moderate (f), Severe (g)

H. pylori: Helicobacter pylori, H&E: Hematoxylin and eosin

Table 1. *Helicobacter pylori (Hp)* distribution by gender					
	***Hp* (-)**	***Hp*1 (+)**	***Hp*2 (+)**	***Hp*3 (+)**	**p**
Male	150 (25.6)	144 (24.5)	128 (21.8)	165 (28.1)	0.327
Female	251 (26.4)	266 (28.0)	199 (20.9)	235 (24.7)	

Table 2. Comparison of demographic, laboratory data and inflammatory markers of *Hp* (-) and *Hp* (+) groups and *Hp* (+) subgroups					
	***Hp* (-)**	***Hp*1 (+)**	***Hp*2 (+)**	***Hp*3 (+)**	**p**
Age	51.78±15.87[a] 53 (42-63)	50.67±15.36 51 (40-62)	46.67±14.99[b] 45 (35-56)	44.35±14.38 43 (33-53)	<0.00
Lymphocyte	2.26±0.75 2.2 (1.7-2.7)	2.34±0.77 2.3 (1.8-2.8)	2.45±1.8. 2.3 (1.8-2.8)	2.37±0.73 2.3 (1.9-2.8)	0.303
Neutrophil	4.44±1.64 4.1 (3.4-5.2)	4.77±2.59 4.3 (3.4-5.6)	4.57±1.83 4.2 (3.4-5.3)	4.51±1.7 4.3 (3.4-5.1)	0.406
Platelet	269.82±73.95 266 (218-309)	274.99±78 265.5 (225-315)	280.25±71.22 271(232-324)	275.99±70.68 271.5 (224.5-316.5)	0.808
SII	603.15±435.01 474.1 (359.4-684.9)	628.8±548.21 500.5 (374.2-734)	595.59±379.65 502 (374-700.5)	569.21±365.7 495.7 (362.8-670)	0.440
NLR	2.24±1.59 1.8 (1.5-2.6)	2.33±2.14 1.9 (1.4-2.6)	2.14±1.23 1.9 (1.5-2.5)	2.05±1.13 1.8 (1.5-2.3)	0.922
PLR	131.14±54.63 120.2 (96.2-153.3)	128.33±51.84 119.5 (93.7-152.9)	128.19±45.66 120.7 (97.6-151.6)	124.78±42.28 117.2 (95-147.2)	0.644

*p value from ANOVA and all others from Kruskal Wallis test. [a], and [a],[b] denotes statistically significant difference between means or medians
Mean ± standard deviation and Median 25-75%
NLR: Neutrophil-lymphocyte ratio, PLR: Platelet-lymphocyte ratio, SII: Systemic immune-inflammatory index, Hp: Helicobacter pylori,

and NLR. Elevated SII levels have been linked to increased disease activity and poor clinical outcomes in various inflammatory and malignant conditions (8-10). However, our findings revealed no significant differences in SII values between *H. pylori*-positive and *H. pylori*-negative patients, nor among patients with varying histopathological severity. The present study suggests that in the absence of systemic comorbidities, localized gastric inflammation induced by *H. pylori* may not lead to a measurable systemic inflammatory response. Although SII is often linked to

overall inflammation in the body and predicts mortality in patients with solid tumors, it may only be important in more serious cases where the immune system is not working properly. In our carefully chosen group of people who do not have cancer or long-term illnesses, it seems that the inflammation stays in the stomach lining and does not affect systemic health indicators. While an elevated SII may signal a higher risk of cancer in some individuals, its utility in identifying such risk among otherwise healthy subjects remains unclear. Prior research has identified SII as an independent prognostic marker in solid tumors (11). In the area around tumors, neutrophils help create substances that cause inflammation, and lymphocytes inhibit tumor growth, while platelets promote tumor

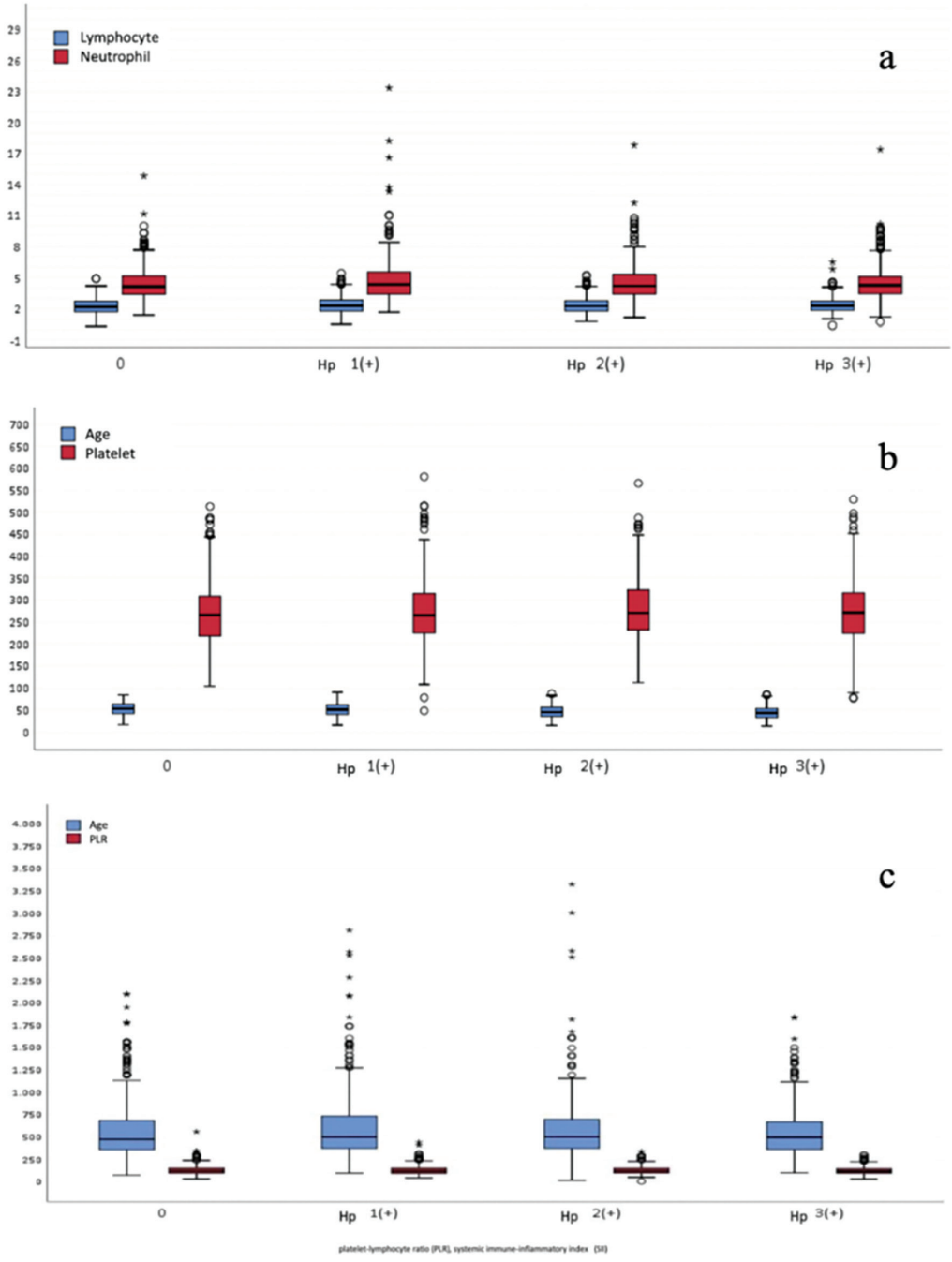

Figure 4. a. Relationship between neutrophil and lymphocyte count and H.pylori density b. Relationship between age, platelet count and H.pylori density c. Relationship between H.pylori density and SII and PLR

PLR: Platelet-lymphocyte ratio, SII: Systemic immune-inflammatory index, Hp: Helicobacter pylori

spread by releasing growth factors (6,12). In gastric cancer patients, increased SII has been associated with disease stage and outcome. Although threshold values ranging from 330 to 1600 have been proposed to predict prognosis, a universally accepted cut-off has yet to be determined (13).

Studies have indicated that SII can be used as a simple, easily accessible, and promising parameter to evaluate disease activity and the extent of disease involvement when colonoscopy cannot be performed for ulcerative colitis (14,15). However, the lack of a strong link between SII and *H. pylori*-related tissue changes, like activity and chronicity scores, raises doubts about the utility of SII in localized gastric inflammation. This finding may point to a threshold effect, below which localized inflammation does not manifest as systemic immune activation. This information indicates that SII cannot differentiate between patients who are positive for *H. pylori* and those who are negative, nor can it assess the link between *H. pylori* density and SII levels in patients who are positive for *H. pylori.*

It is known that CRP values increase in *H. pylori*-positive individuals (16-19). Research has found that substances in the body that respond to inflammation, like erythrocyte sedimentation rate, fibrinogen, and CRP, are elevated in *H. pylori*-positive patients, and there is a strong link between *H. pylori* and the body's overall inflammatory response (20,21). In our study, no significant difference was found between the *H. pylori*-positive and *H. pylori*-negative groups in terms of CRP levels. However, this may be because the preprocedural CRP value was not checked in every patient. Another important consideration is the potential disconnect between histological scoring systems and peripheral markers. While the Sydney system provides a valuable semi-quantitative assessment of gastric mucosal inflammation, it may not align proportionally with systemic indices like SII. The subjective nature of pathology scoring may contribute to this variability.

Table 3. Comparison of demographic and laboratory data and inflammatory markers between *Hp* "mild and moderate" and "severe" groups

	Mean	SD	Median	Mean	SD	Median	p
Age	48.89	15.32	49.00	44.35	14.38	43.00	<0.001
Lymphocyte	4.68	2.29	4.25	4.51	1.70	4.27	0.547
Neutrophil	2.39	1.33	2.28	2.37	0.73	2.29	0.740
Platelet	277.32	75.06	268.00	275.99	70.68	271.50	0.934
SII	614.06	480.75	501.95	569.21	365.70	495.71	0.293
NLR	2.25	1.80	1.86	2.05	1.13	1.83	0.405
PLR	128.27	49.16	120.25	124.78	42.28	117.21	0.561

NLR: Neutrophil-lymphocyte ratio, PLR: Platelet-lymphocyte ratio, SII: Systemic immune-inflammatory index, *Hp: Helicobacter pylor*i, SD: Standard deviation

Table 4. Comparison of tissue activity and chronicity and inflammatory markers

		SII		NLR		PLR	
Tissue activity	None	603.15±435.01	474.08 (72.69-4574.64)	2.24±1.59	1.85 (0.53-21.03)	131.14±54.63	120.19 (31.9-559.38)
	Mild	630.71±557.31	501.51 (97.01-7394.17)	2.33±2.17	1.86 (0.57-27.8)	128.41±50.57	118.39 (42.33-441.12)
	Moderate	609.78±448.7	516,95 (16.26-5186.21)	2.21±1.47	1.91 (0.14-16.89)	128.27±47.45	121.16 (3.61-408)
	Severe	555.29±281.05	490,92 (99.9-1831.16)	1.99±0.87	1.81 (0.32-6.73)	124.52±42.3	117.48 (30-302.63)
p		0.501		0.319		0.816	
Tissue chronicity	None	594.83±455.83	471.19 (72.69-4574.64)	2.2±1.68	1.84 (0.53-21.03)	130.05±56.43	117.35 (31.9-559.38)
	Mild	642.85±561.45	496.91 (136.42-7394.17)	2.42±2.22	1.88 (0.62-27.8)	130.21±50.08	121.16 (44.56-316.67)
	Moderate	580.3±352.14	498.51 (16.26-3324.53)	2.09±1.14	1.84 (0.14-10.22)	127.24±48.12	119,63 (3.61-441.12)
	Severe	586.16±403.39	499.46 (99.9-5186.21)	2.1±1.26	1.83 (0.32-16.89)	125.47±41.91	118.5 (30-298.06)
p		0.477		0.206		0.923	

NLR: Neutrophil-lymphocyte ratio, PLR: Platelet-lymphocyte ratio, SII: Systemic immune-inflammatory index

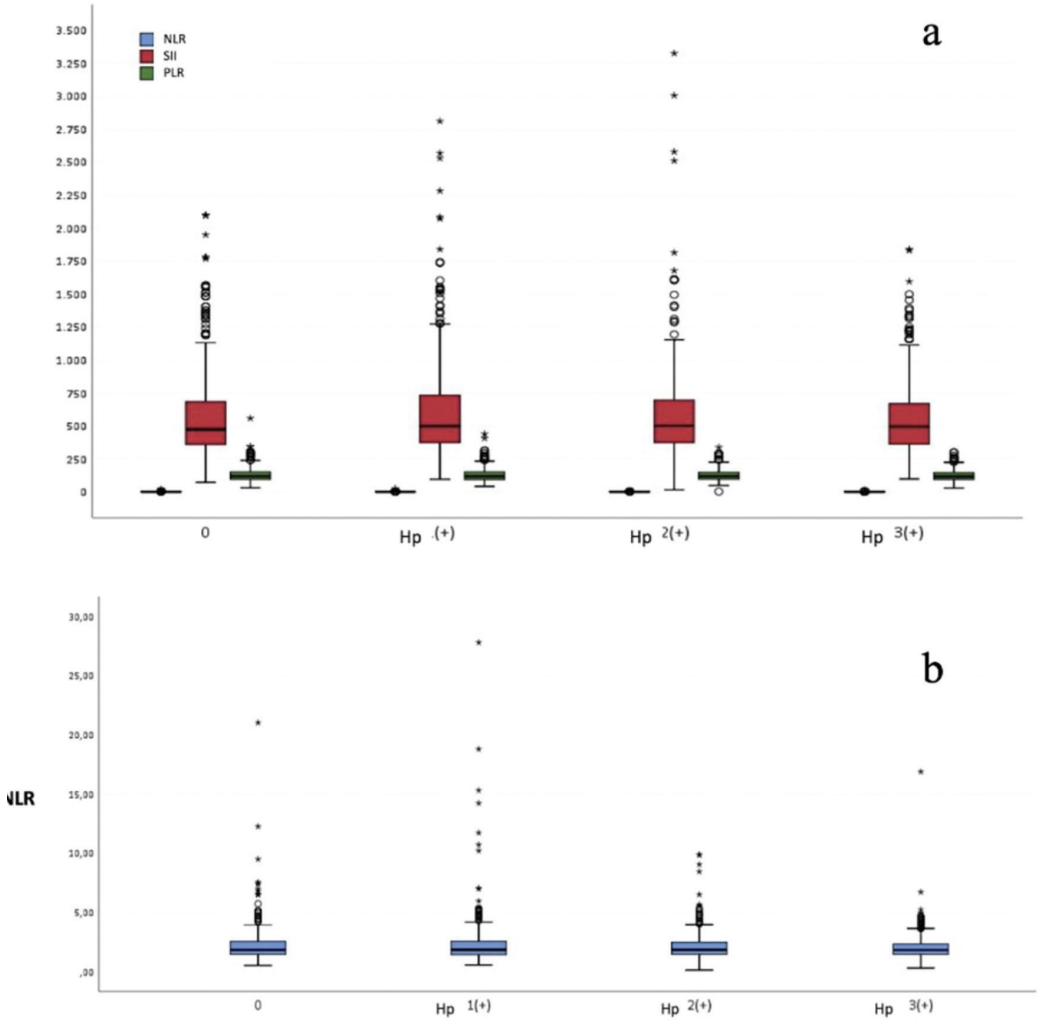

Figure 5. a. Relationship between *H.pylori* density and SII, NLR and PLR b. Relationship between *H.pylori* density and NLR

H. pylori: Helicobacter pylori,, NLR: Neutrophil-lymphocyte ratio, SII: Systemic Immune-inflammatory index, PLR: Platelet-lymphocyte ratio,

There are conflicting findings in the literature regarding CRP levels. This is because CRP levels may vary depending on age, sex, ethnicity, lifestyle, and comorbidities (22). In some studies, an insufficient number of patients may have caused this situation. Studies may differ in their CRP calculation methods, with many lacking a detailed explanation. The large number of patients in our study minimized the effect of at least one of these limitations, although it did not evaluate the CRP level of each patient before endoscopy, preventing the acquisition of clear data in the findings.

In recent years, the NLR has been frequently used as a parameter to indicate the presence of inflammation. In light of our results, tissue biopsy remains essential for the accurate assessment of *H. pylori* infection severity. Even though SII shows potential as a useful marker in various inflammatory and cancer situations, our results indicate that it cannot effectively distinguish mild to moderate mucosal inflammation from *H. pylori*, particularly in healthy people. In one study, a correlation was found between the severity of *H. pylori* gastritis and NLR (21). In another study, leukocyte, neutrophil, and NLR rates were higher in *H. pylori*-positive patients than in *H. pylori*-negative patients (4,22). It has been reported in the literature that platelets are activated by *H. pylori* infection and that *H. pylori* damage to tissues is associated with inflammatory mediators resulting from platelet activation (23,24). Researchers conducted these studies with a limited number of patient groups.

In our study, no significant differences were observed in NLR and PLR values between *H. pylori*-positive and *H. pylori*-negative groups. This finding may be attributed to the relatively large and heterogeneous study population, which likely minimized the influence of minor inflammatory

fluctuations. When we looked at the SII values for both *H. pylori*-positive and *H. pylori*-negative patients, and also within the *H. pylori*-positive groups based on bacterial density [1 (+), 2 (+), and 3 (+)], we did not find any significant differences. These results further suggest that localized gastric inflammation may not sufficiently impact systemic inflammatory markers in otherwise healthy individuals.

It is known that *H. pylori* can cause gastric cancer. Our study found no relationship between the SII and the severity of *H. pylori*. This may be related to the fact that the tumor microenvironment has not been formed, or it may be that SII is associated with cancer only above a certain threshold value. The inflammatory reaction caused by *H. pylori* may have remained below this threshold.

Study Limitations

Although only patients with dyspeptic complaints and no known comorbidities were included, the limitations of this study include the lack of information about the conditions that may affect SII, such as the patients' nutritional characteristics and the recent use of antibiotics and anti-inflammatory drugs. In addition, the retrospective design and reliance on single-timepoint laboratory values without serial follow-up may have reduced the sensitivity of inflammatory indices in reflecting disease severity. Despite these limitations, this study has several strengths. First, the large sample size and histologically verified diagnosis of *H. pylori* infection provide robust and reliable data. Second, the strict exclusion of patients with chronic diseases or malignancies allowed for a more focused assessment of the relationship between local gastric inflammation and systemic inflammatory markers in otherwise healthy individuals. Finally, the use of standardized histopathological grading according to the updated Sydney system enhances the reproducibility and clinical relevance of the findings.

Conclusion

We concluded that SII and other inflammation values are not sufficient to distinguish *H. pylori*-positive patients or to serve as a standalone prognostic marker in *H. pylori* follow-up. Tissue biopsy continues to be the most reliable method for diagnosing *H. pylori* and assessing its density. This study is the first to compare the tissue activity and chronic severity of an *H. pylori* infection with serum inflammatory markers. We have observed that the findings and severity of a gastric biopsy do not correlate with inflammatory values in the blood.

Ethics

Ethics Committee Approval: This study was approved by the Aksaray University Faculty of Medicine Clinical Research Ethics Committee (approval no.: 2022/07-02, date: 07.04.2022)

Informed Consent: The informed consent process was not required for the study because the research is a retrospective analysis.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.E., Concept: M.O., Design: M.O., G.O., Data Collection or Processing: M.O., G.O., Analysis or Interpretation: M.O., G.O., M.E., Literature Search: M.O., G.O., M.E., Writing: M.O., M.E.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: This study received no financial support.

References

1. Ali A, AlHussaini KI. *Helicobacter pylori*: a contemporary perspective on pathogenesis, diagnosis and treatment strategies. Microorganisms. 2024;12:222.
2. Haider SI, Akhtar N, Saleem M, et al. Diagnosis of "'*Helicobacter pylori* infection of the gastric biopsy'" by rapid urease test, histopathology and Raman spectroscopy. Diagn Microbiol Infect Dis. 2024;108:116129.
3. Stolte M, Meining A. The updated Sydney system: classification and grading of gastritis as the basis of diagnosis and treatment. Can J Gastroenterol. 2001;15:591-8.
4. Akarsu M, Dikker O. Relationship between Helicobacter pylori positivity, neutrophil-to-lymphocyte ratio, and mean platelet volume. Dicle Med J. 2019;46:201-7.
5. Gawaz M, Langer H, May AE. Platelets in inflammation and atherogenesis. J Clin Invest. 2005;115:3378-84.
6. Koyasu S, Moro K. Role of innate lymphocytes in infection and inflammation. Front Immunol. 2012;3:101.
7. Hirahara N, Tajima Y, Matsubara T, et al. Systemic immune-inflammation index predicts overall survival in patients with gastric cancer: a propensity score-matched analysis. J Gastrointest Surg. 2021;25:1124-33.
8. Yang R, Chang Q, Meng X, Gao N, Wang W. Prognostic value of systemic immune-inflammation index in cancer: a meta-analysis. J Cancer. 2018;9:3295-302.
9. Zhong JH, Huang DH, Chen ZY. Prognostic role of systemic immune-inflammation index in solid tumors: a systematic review and meta-analysis. Oncotarget. 2017;8:75381-8.
10. Menyhart O, Fekete JT, Győrffy B. Inflammation and colorectal cancer: a meta-analysis of the prognostic significance of the systemic immune-inflammation index (SII) and the systemic inflammation response index (SIRI). Int J Mol Sci. 2024;25:8441.
11. Fest J, Ruiter R, Mulder M, et al. The systemic immune-inflammation index is associated with an increased risk of incident cancer-a population-based cohort study. Int J Cancer. 2020;146:692-8.

12. Hou R, Wu X, Wang C, et al. Tumor-associated neutrophils: critical regulators in cancer progression and therapeutic resistance (Review). Int J Oncol. 2025;66:28.
13. Ercan Z, Ayli MD. Systemic immune inflammation index may predict mortality in dialysis patients. Turk J Clin Lab. 2023;14:392-8.
14. Adanır H, Akıncıoğlu P. The significance of the systemic immune-inflammation index in ulcerative colitis. Dicle Medical Journal. 2022;49:521–8.
15. Zeng QY, Qin Y, Shi Y, et al. Systemic immune-inflammation index and all-cause and cause-specific mortality in sarcopenia: a study from National Health and Nutrition Examination Survey 1999-2018. Front Immunol. 2024;15:1376544.
16. Alpsoy Ş, Oran M, Mete R, et al. The relationship between endothelial dysfunction and serum levels of CRP and vitamin B12 in *Helicobacter pylori*-positive subjects. Genel Tıp Derg. 2013;23:81-6.
17. Huang J, Yang X, Zhang J, Wang F. The correlation between *Helicobacter pylori* immunoglobulin G seropositivity and plasma homocysteine levels in adults. Mediators Inflamm. 2023;2023:7590549.
18. Jafarzadeh A, Hassanshahi GH, Nemati M. Serum levels of high-sensitivity C-reactive protein (hs-CRP)in *Helicobacter pylori*-infected peptic ulcer patients and its association with bacterial CagA virulence factor. Dig Dis Sci. 2009;54:2612-6.
19. Ishida Y, Suzuki K, Taki K, et al. Significant association between *Helicobacter pylori* infection and serum C-reactive protein. Int J Med Sci. 2008;5:224-9.
20. Jia Y, Qu B, Wang Z, Han X, Ren G. Effects of active and latent *H. pylori* infection coupled with chronic alcohol ingestion on cytokine profiles and markers of oxidative balance in men seropositive for *H. pylori* CagA Ab: an observational study. Medicine (Baltimore). 2018;97:e11991.
21. Guclu M, Faruq Agan A. Association of severity of *Helicobacter pylori* infection with peripheral blood neutrophil to lymphocyte ratio and mean platelet volume. Euroasian J Hepatogastroenterol. 2017;7:11-6.
22. Farah R, Khamisy-Farah R. Association of neutrophil to lymphocyte ratio with presence and severity of gastritis due to *Helicobacter pylori* infection. J Clin Lab Anal. 2014;28:219-23.
23. Watanabe J, Kotani K. The effect of *Helicobacter pylori* eradication on C-reactive protein: results from a meta-analysis. Arch Med Sci. 2021;18:958-64.
24. de Maat MP, Kluft C. Determinants of C-reactive protein concentration in blood. Ital Heart J. 2001;2:189-95.