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DIFFERENCES IN MENTZER INDEX VALUES IN CHILDREN WITH HELICOBACTER PYLORI AND NON-HELICOBACTER PYLORI INFECTIONS

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ABSTRACT

Helicobacter pylori infection is a common cause of chronic gastritis in children and has been associated with several haematological abnormalities, particularly iron deficiency anaemia. The Mentzer Index is a simple haematological parameter that may reflect disturbances in iron metabolism; however, its relationship with H. pylori infection in children remains unclear. To compare Mentzer Index values between children with and without Helicobacter pylori infection and to evaluate associated haematological characteristics. A cross-sectional analytical study was conducted involving 44 children aged 2–18 years who underwent diagnostic testing for H. pylori. Demographic data and haematological parameters, including haemoglobin, erythrocyte count, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, red cell distribution width, platelet count, white blood cell count, erythrocyte sedimentation rate, and Mentzer Index, were collected from medical records. Statistical analyses were performed using chi-square and comparative tests, with statistical significance defined as $p < 0.05$. No significant differences were observed between the two groups regarding age, sex, nutritional status, haemoglobin concentration, erythrocyte indices, platelet count, white blood cell count, or Mentzer Index (all $p > 0.05$). Most participants in both groups had a Mentzer Index $\geqslant$13, suggesting a haematological pattern compatible with iron deficiency anaemia. However, children with H. pylori infection demonstrated significantly higher ESR values compared with non-infected children (37.23 ± 6.20 vs. 27.32 ± 13.92 mm/hour; $p = 0.005$), indicating increased inflammatory activity. Helicobacter pylori infection in children was associated with elevated erythrocyte sedimentation rate but not with significant differences in Mentzer Index or other routine haematological parameters.

Keywords: anemia; helicobacter pylori; iron deficiency; mentzer index

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INTRODUCTION

Helicobacter pylori (H. pylori) infection is one of the most common bacterial infections recognized as a major cause of chronic gastritis in the pediatric population (Salahi-Niri et al., 2024). Epidemiological studies indicate that approximately half of the global population carries this microorganism, with infection often occurring in childhood (Săsăran et al., 2020). The prevalence of H. pylori in Indonesia varies widely across regions, ranging from 16.7% to 53.1% (Kristyanto et al., 2022). Although a gradual decline in infection rates has been reported in recent years, H. pylori continues to be a significant public health problem, particularly among individuals from low socioeconomic backgrounds and underserved communities (Mărginean et al., 2021).

The underlying pathophysiology of H. pylori-associated disease is complex and not fully understood. Colonization of the gastric mucosa, particularly in the antral region, can induce a persistent inflammatory response characterized by the production of pro-inflammatory cytokines (Aguilera Matos et al., 2020). One important mediator is interleukin-8 (IL-8), which promotes the recruitment of neutrophils and other inflammatory cells to the site of infection. IL-8 also stimulates

vascular endothelial growth factor (VEGF), which contributes to platelet activation and the maintenance of chronic inflammation. Gastric mucosal damage tends to be less severe in children than in adults, but prolonged inflammatory activity can lead to chronic gastritis and systemic consequences beyond the gastrointestinal tract (J. Nguyen et al., 2023).

Mounting evidence suggests a link between H. pylori infection and several hematological disorders, particularly iron deficiency anemia (IDA) (Wang et al., 2025). Study reported that nearly half of H. pylori-infected children were anemic, with more than half diagnosed with iron deficiency anemia (Walle et al., 2025). Similar observations have been reported in East Asian populations, where eradication therapy was associated with improvements in hematological parameters. Furthermore, a study from Vietnam demonstrated significant increases in hemoglobin and ferritin concentrations after successful eradication treatment combined with iron supplementation (Che et al., 2023). Meta-analyses also suggest that H. pylori-infected children are at increased risk of IDA, particularly during late childhood and adolescence (Pu et al., 2025). However, conflicting findings persist, as several studies failed to demonstrate a significant association between H. pylori infection and iron deficiency (Kato et al., 2022).

Erythropoiesis depends on adequate availability of iron, vitamin B12, folate, and other essential nutrients, so impaired iron metabolism can potentially cause anemia in infected children (Walle et al., 2025). One practical hematological parameter used to differentiate iron deficiency anemia from β-thalassemia trait is the Mentzer Index, which is calculated by dividing the mean corpuscular volume (MCV) by the red blood cell (RBC) count (Najmi et al., 2026). Although the prevalence of H. pylori infection is relatively high among Indonesian children, data on its association with iron deficiency anemia are still limited. Therefore, further research is needed to clarify the relationship between H. pylori infection and hematological changes in the Indonesian pediatric population, particularly in areas with a substantial infection burden. The aim of this study is to compare the Mentzer Index between children with Helicobacter pylori infection and those without Helicobacter pylori infection.

METHOD

This cross-sectional study was conducted to compare Mentzer Index values between children with and without Helicobacter pylori infection. The primary objective of this study was to determine whether H. pylori infection is associated with differences in the Mentzer Index and to explore the potential utility of this hematological parameter in identifying anemia-related changes in pediatric patients. Data collection was conducted from May to August 2025 at the pediatric gastroenterology and hepatology outpatient clinics and pediatric wards of Adam Malik General Hospital, Prof. Dr. Chairuddin P. Lubis Hospital, University of North Sumatra, and their affiliated hospitals.

The study population consisted of children aged 2–18 years undergoing diagnostic evaluation for H. pylori infection. Eligible participants were identified using a sequential sampling approach. Patients were included if they had a documented H. pylori diagnostic result obtained through stool antigen testing, urea breath testing, or histopathological examination of endoscopic biopsy specimens, as well as complete hematological data available in their medical records. Children with known hematologic disorders, chronic systemic diseases, recent H. pylori eradication therapy, recent use of antibiotics or acid-suppressing medications, gastrointestinal malignancies, or incomplete clinical records were excluded.

The minimum sample size was calculated for the comparison of two independent means using data from previous studies. Based on an expected mean difference in the Mentzer Index of 49 units, a pooled standard deviation of 63.66, a significance level of 5%, and a statistical power of 80%, the required sample size was estimated at 21 participants per group. Therefore, a minimum of 42 subjects were required, consisting of children with and without evidence of H. pylori infection.

Demographic and clinical information, including age, sex, nutritional status, and socioeconomic background, was obtained from medical records. Laboratory parameters collected from a complete blood count (CBC) included hemoglobin concentration, red blood cell (RBC) count, mean corpuscular volume (MCV), white blood cell count, and platelet count. The Mentzer Index was calculated by dividing the MCV (fL) by the RBC count ($\times 10^6/\mu L$). Participants were then categorized into H. pylori-positive and H. pylori-negative groups according to their diagnostic evaluation results.

All data were processed and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics were used to summarize participant characteristics and study variables. Bivariate analysis was performed to assess the association between H. pylori infection status and Mentzer Index categories. Categorical variables were compared using the chi-square test, and statistical significance was defined as a two-sided p-value less than 0.05. Ethical approval for this study was obtained from the Health Research Ethics Committee of the University of North Sumatra prior to data collection.

RESULT

This study involved 44 children divided into two groups based on their Helicobacter pylori infection status, with 22 participants in each group, respectively, positive and negative.

Table 1.
Demographic and Clinical Characteristics of the Study Participants (N = 44)

Characteristics	f	%
Sex		
Male	12	27.3
Female	32	72.7
Age Group (years)		
2–4	3	6.9
5–9	9	20.4
10–18	32	72.7
Nutritional Status		
Underweight	8	18.2
Normal	32	72.7
Overweight	2	4.5
Obese	2	4.5
Socioeconomic Status		
Low (≤2× Provincial Minimum Wage)	5	11.4
High (>2× Provincial Minimum Wage)	39	88.6
Father's Occupation		
Employee	19	43.2
Farmer	2	4.5
Civil Servant	9	20.5
Military/Police Officer	1	2.3
Self-employed	13	29.5
Mother's Occupation		
Employee	14	31.8
Farmer	3	6.8
Civil Servant	8	18.2
Homemaker	7	15.9
Self-employed	12	27.3
H. pylori Infection Status		
H. pylori Positive	22	50.0
H. pylori Negative	22	50.0

Table 1 shows patient characteristics. Female participants dominated the overall study population, comprising 72.7% of the subjects, while males represented 27.3%. Most participants were between 10 and 18 years old (72.7%), followed by those aged 5–9 years (20.4%) and 2–4 years (6.9%). The majority of children had normal nutritional status (72.7%) and came from families with a higher socioeconomic background (88.6%). Regarding parental occupation, employees and self-employed workers were the most commonly reported occupations among both fathers and mothers.

Table 2.
Differences in the characteristics of research subjects based on H. pylori and non-H. pylori infections

Characteristics	*H. pylori*		p-value
	Positive (n = 22)	Negative (n = 22)	
Sex, f (%)			0.176
Male	4 (18.2)	8 (36.4)	
Female	18 (81.8)	14 (63.6)	
Age Group (years), f (%)			0.459
2–4 years	2 (9.1)	1 (4.5)	
5–9 years	2 (9.1)	6 (27.3)	
10–18 years	18 (81.8)	15 (68.2)	
Nutritional Status, f (%)			0.096
Underweight	6 (27.3)	2 (9.1)	
Normal	14 (63.6)	18 (81.8)	
Overweight	0 (0.0)	2 (9.1)	
Obese	2 (9.1)	0 (0.0)	

When comparing baseline characteristics between the two groups (Table 2), no statistically significant differences were found. Female participants remained the dominant subgroup in both the H. pylori-positive and H. pylori-negative groups. The H. pylori-negative groups comprised 81.8% and 63.6% of participants, respectively (p = 0.176). Similarly, age distribution was comparable between groups, with adolescents aged 10–18 years representing the largest proportion of subjects in each group (81.8% vs. 68.2%; p = 0.459). Nutritional status also showed no significant variation between groups (p = 0.096), although malnutrition was more common in children with H. pylori infection than in children without.

Table 3.
Differences in hematological characteristics of research subjects based on H. pylori infection

Hematology Characteristics	*H. pylori*		p-value
	Positive (n = 22)	Negative (n = 22)	
Hemoglobin (g/dL)	9.65 (8.5–14.2)	10.05 (7.8–15.2)	0.330
Hematocrit (%)	30.0 (26–42)	33.17 ± 6.35	0.472
Red Blood Cell Count (×10⁶/µL)	4.67 ± 0.68	4.81 ± 0.61	0.476
Mean Corpuscular Volume (fL)	82.54 ± 4.81	80.05 (77–90.6)	0.222
Mean Corpuscular Hemoglobin (pg)	27.61 ± 1.77	27.25 ± 1.54	0.472
Mean Corpuscular Hemoglobin Concentration (g/dL)	33.49 ± 0.84	33.72 ± 1.08	0.433
Red Cell Distribution Width-CV (%)	12.7 (11.2–16.1)	13.08 ± 1.14	0.318
Platelet Count (×10³/µL)	317.46 ± 109.80	318.36 ± 95.37	0.977
White Blood Cell Count (×10³/µL)	8.57 ± 2.19	7.35 (5.2–16.8)	0.391
Erythrocyte Sedimentation Rate (mm/hour)	37.23 ± 6.20	27.32 ± 13.92	0.005 *

Table 3 shows an analysis of hematological parameters, which showed generally comparable findings between infected and uninfected children. The median hemoglobin concentration was 9.65 g/dL in the H. pylori-positive group* and 10.05 g/dL in the negative group, with no significant difference detected (p = 0.330). Similarly, hematocrit, red blood cell count, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red blood cell distribution width (RDW-CV) values did not differ significantly between groups (all p > 0.05).

Platelet and leukocyte counts were also similar regardless of infection status. The mean platelet count was 317.46 × 10³/µL in infected children and 318.36 × 10³/µL in uninfected children (p = 0.977). White blood cell count also showed no significant difference between groups (p = 0.391). These findings indicate that routine hematological indices are largely unaffected by the presence of infection in the study population.

The erythrocyte sedimentation rate (ESR) showed significant differences between groups. Children with H. pylori infection showed a higher mean ESR compared to those without infection (37.23 ±

6.20 mm/h versus 27.32 ± 13.92 mm/h, respectively). This difference reached statistical significance (p = 0.005), indicating a greater degree of systemic inflammatory activity among infected participants.

Table 4.
Comparison of Hematological Parameters Between Children With and Without Helicobacter pylori Infection

Mentzer Index	*H. pylori*		p-value
	Positive (n = 22)	Negative (n = 22)	
< 13	1 (4.5)	0 (0.0)	1,000
≥ 13	21 (95.5)	22 (100.0)	

Table 4 shows the Mentzer Index assessment. We found that nearly all participants had values consistent with iron deficiency anemia. In the H. pylori-positive group, 21 of 22 children (95.5%) had a Mentzer Index ≥13, while one child (4.5%) had a value below 13. In the uninfected group, all participants (100%) had a Mentzer Index value ≥13. No significant association was observed between H. pylori infection status and Mentzer Index category (p = 1.000). These results indicate that the distribution of Mentzer Index values was similar in both groups and did not differ according to H. pylori infection status.

DISCUSSION

In the present study, half of the enrolled participants were diagnosed with H. pylori infection. Female subjects constituted the majority of the study population, and most infected children belonged to the 10–18-year age group. The predominance of adolescents among infected participants is consistent with previous studies conducted in Indonesia, which reported a higher frequency of H. pylori infection during late childhood and adolescence (Săsăran et al., 2020). The increased prevalence observed in older children may be related to prolonged exposure to environmental risk factors and a longer duration of bacterial colonization compared with younger age groups (Borka Balas et al., 2022).

Most children with H. pylori infection in this study had normal nutritional status. This finding contrasts with reports from several developing countries where infected children were more likely to present with undernutrition or impaired growth (Xu et al., 2022). Differences in socioeconomic background, nutritional intake, healthcare access, and study design may explain these discrepancies. Furthermore, no significant differences were observed between infected and non-infected children regarding age, sex, or nutritional status (Salahi-Niri et al., 2024)v. These findings support previous evidence suggesting that demographic characteristics alone may not adequately predict H. pylori infection in pediatric populations (R. N. Nguyen et al., 2024).

The comparison of hematological profiles revealed no significant differences in hemoglobin concentration between the two groups. Although H. pylori infection has been implicated in the development of iron deficiency through chronic gastric inflammation, impaired iron absorption, and increased iron utilization, the clinical impact on hemoglobin levels appears to vary substantially among pediatric studies (Sağlam & Civan, 2023). Hemoglobin concentration reflects the combined influence of multiple biological processes, including iron availability, erythropoietic activity, nutritional status, and the presence of other underlying disorders (Sağlam & Civan, 2023). Consequently, the absence of a significant difference in hemoglobin levels may reflect the multifactorial nature of anemia rather than the absence of an effect from H. pylori infection itself (Wang et al., 2025).

The present findings are in agreement with several studies that failed to demonstrate a clear association between H. pylori infection and reduced hemoglobin levels in children (Săsăran et al., 2020). One possible explanation is that many participants in both groups may have shared similar nutritional and socioeconomic conditions, resulting in comparable hematological profiles (Fathalizade et al., 2026). In addition, the relatively small sample size may have limited the ability

to detect subtle differences between groups. Therefore, larger studies incorporating iron biomarkers such as serum ferritin, transferrin saturation, and hepcidin may provide a more comprehensive assessment of iron metabolism in infected children (Zhang et al., 2022).

No significant differences were identified in red blood cell count, MCV, MCH, MCHC, or RDW between children with and without H. pylori infection. These erythrocyte indices are commonly used to evaluate iron deficiency and other causes of anemia (Tibasima et al., 2025). However, alterations in these parameters may occur gradually and are influenced by both iron status and inflammatory activity (Najmi et al., 2026). In chronic inflammatory conditions, the hematological profile may not always display the classical pattern of iron deficiency anemia (Liu et al., 2024). Therefore, reliance solely on routine blood indices may be insufficient to distinguish iron deficiency anemia from anemia associated with chronic inflammation (Zhang et al., 2022).

The most notable hematological finding in this study was the significantly higher ESR observed among children with H. pylori infection. This result suggests the presence of a greater systemic inflammatory response in infected participants (Tibasima et al., 2025). The observation is consistent with previous reports indicating that persistent gastric colonization by H. pylori can stimulate the production of inflammatory cytokines and acute-phase reactants (Arqam et al., 2025). Elevated ESR may therefore reflect ongoing mucosal inflammation and systemic immune activation associated with the infection. Nevertheless, the relationship between H. pylori infection and inflammatory markers remains controversial. Some studies have reported no significant differences in ESR between infected and non-infected children, possibly because pediatric infections are often detected relatively early and may not have progressed to severe chronic gastritis (Tibasima et al., 2025).

Compared with adults, children generally exhibit a less intense inflammatory response and a lower degree of gastric mucosal damage (Kato et al., 2022). As a result, systemic manifestations of inflammation may be less pronounced during childhood despite the presence of bacterial colonization (Zhang et al., 2022). Analysis of the Mentzer Index demonstrated that nearly all participants in both groups had values of 13 or higher, indicating a hematological pattern more suggestive of iron deficiency anemia than β-thalassemia trait. However, no significant difference was detected between infected and non-infected children. This finding differs from observations reported in some populations where iron deficiency was more prevalent among children with H. pylori infection. The absence of a significant association in the present study may indicate that factors other than H. pylori infection contributed to altered iron metabolism in both groups .

Several explanations may account for the lack of difference in Mentzer Index values. Iron deficiency and microcytic erythrocyte changes can occur in children with chronic gastritis regardless of H. pylori status. Furthermore, the non-infected group may have included children with H. pylori-negative chronic gastritis, such as autoimmune gastritis or other inflammatory gastric disorders that can also impair iron absorption and lead to iron deficiency. Therefore, the Mentzer Index should be considered a screening indicator of disturbed iron metabolism rather than a marker capable of distinguishing the etiology of gastritis. Additional investigations, including iron studies, inflammatory biomarkers, and endoscopic evaluation, are required to clarify the mechanisms underlying anemia in pediatric patients with gastrointestinal disorders.

The findings of this study suggest that Helicobacter pylori infection in children may be associated with increased systemic inflammatory activity, as reflected by significantly higher ESR values. Although no significant differences were observed in hemoglobin levels, erythrocyte indices, or Mentzer Index between infected and non-infected children, the presence of elevated inflammatory markers highlights the importance of comprehensive hematological evaluation in pediatric patients with suspected or confirmed H. pylori infection. Clinicians should be aware that iron metabolism disturbances may occur even in the absence of overt anemia and that the Mentzer Index alone may not be sufficient to identify the underlying cause of hematological abnormalities. Assessment of

iron status using serum ferritin, transferrin saturation, and other relevant biomarkers may provide additional diagnostic value in selected cases.

Several limitations should be considered when interpreting the results of this study. First, the relatively small sample size may have reduced the statistical power to detect subtle differences in hematological parameters between groups. Second, the cross-sectional design precludes determination of temporal or causal relationships between H. pylori infection and alterations in hematological indices. Third, laboratory markers directly reflecting iron metabolism and inflammatory activity, such as serum ferritin, transferrin saturation, hepcidin, and C-reactive protein, were not available for analysis. Finally, the non-H. pylori group may have included children with other forms of chronic gastritis or gastrointestinal disorders capable of influencing hematological parameters, potentially reducing the ability to detect differences attributable specifically to H. pylori infection. Future studies involving larger populations and more comprehensive laboratory assessments are warranted to further clarify the relationship between H. pylori infection, inflammation, and iron deficiency in children.

CONCLUSION

Children with Helicobacter pylori infection demonstrated significantly higher ESR values than non-infected children, while no significant differences were observed in Mentzer Index or other hematological parameters between the two groups.

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