DOI: 10.30651/jqm.v9i01.21260

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

Research Article

Analysis of Neutrophil, Leukocyte, Lymphocyte, and NLR Cell Profiles in Patients Diagnosed with Chronic Gastritis Affected by *Helicobacter pylori* and Non-*Helicobacter pylori* Infection at Dr. Soetomo Hospital in Surabaya, Indonesia

Nahdah Aulia Aziz[1*], Manik Retno Wahyunitisari[2], Imam Susilo[3]

1) Faculty of Medicine, Airlangga University, Surabaya, Indonesia
2) Department of Microbiology Clinic, Faculty of Medicine, Airlangga University/Dr. Soetomo General Academic Hospital, Surabaya, Indonesia
3) Department of Anatomical Pathology, Faculty of Medicine, Airlangga University/Dr. Soetomo General Academic Hospital, Surabaya, Indonesia

ARTICLE INFO

Submitted : 26 th December 2023
Accepted : 26th November 2024
Published : 25th January 2025

Keywords:
Gastritis, *Helicobacter pylori*, Neutrophil, Leukocyte, Lymphocyte, NLR

Correspondence:
nahdah.aulia.aziz-2020@fk.unair.ac.id

ABSTRACT

Helicobacter pylori (HP) is a prevalent cause of bacterial infections, particularly chronic gastritis in the human body. The diagnosis of gastritis relied on gastric biopsy examination, where inflammation is characterized by an increase in various inflammatory cells, including macrophage, neutrophil, lymphocyte, or plasma cells. Therefore, this research aimed to determine the profiles of neutrophil, leukocyte, lymphocyte, and neutrophil lymphocyte ratio (NLR) in chronic gastritis patients, distinguishing between those with *Helicobacter pylori* and non-*Helicobacter pylori* infection at Dr. Soetomo Hospital in Surabaya. This research adopted a retrospective method, using medical records for chronic gastritis patients at Dr. Soetomo Hospital between 2018 and 2022. The variables analyzed included *Helicobacter pylori* infections and values of neutrophil, leukocyte, lymphocyte, and NLR cells. The obtained data were subjected to analysis using descriptive statistics. The results showed that the majority of participants were females (61.9%), senior high school graduates (52.38%), and aged 45-59 (pre-elderly) (32.14%). In non-*Helicobacter pylori* group, the average values of neutrophil, leukocyte, lymphocyte, and NLR cells were 62.29 (SD = 12.17), 8.155 (SD = 4.02), 29.165 (SD = 12.31), and 3.68 (SD=4.865), respectively. In conclusion, females showed a propensity for chronic gastritis with *Helicobacter pylori*. It was observed that non-*Helicobacter pylori* chronic gastritis tended to have elevated neutrophil and leukocyte values. Meanwhile, due to systemic inflammation, *Helicobacter pylori*-related chronic gastritis tended to show increased lymphocyte and NLR values. *Helicobacter pylori* was associated with conditions such as iron deficiency anemia, cardiovascular disease, diabetes, thyroid disease, and malnutrition.

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

INTRODUCTION

Helicobacter pylori infection, a chronic bacteria affliction in humans, is known to culminate in various gastroduodenal diseases, particularly chronic gastritis, peptic ulcers, primary gastric B-cell lymphoma, and gastric carcinoma(Syam et al., 2015). Gram-negative bacteria have microaerophilic properties and serve as a frequent instigator of bacterial infections, specifically in chronic gastritis and peptic ulcers, and are implicated in gastric malignancies (Rodríguez-García & Carmona-Sánchez, 2016).

Previous reviews explained regional disparities in *Helicobacter pylori* infection rates, with socioeconomic factors posing potential risks associated with living conditions conducive to intrafamilial transmission. Specifically, iatrogenic infection through endoscopy is considered a common occurrence (Crowe, 2019). Developed countries have a prevalence of less than 40% to over 80% while developing countries report higher rates. In developing countries, infection onset often transpires at a young age, whereas in developed countries, children and adolescents are less prone than adults (Sharma et al., 2022). The prevalence of *Helicobacter pylori* infection in Indonesia is comparatively lower than in neighboring countries such as Malaysia (24.3-49%), Thailand (54.1-76.1%), and the Philippines (60%) (Miftahussurur, 2020).

Helicobacter pylori infection is recognized to be a major cause of chronic gastritis in both adults and children. Chronic gastritis includes a spectrum of diseases characterized by inflammation of the gastric mucosa (Yulida et al., 2013). The persistence of the disease can lead to glandular atrophy and intestinal metaplasia of the gastric mucosal epithelium. Various factors contribute to chronic gastritis, with the primary cause being *Helicobacter pylori* infection. According to World Health Organization (WHO), the disease rate in Indonesia is reported to be 40.3%. The prevalence of chronic gastritis attributed to *Helicobacter pylori* exceeds 80%, amounting to 274,396 cases in a population of 238,452,952 (Yulida et al., 2013). A range of examinations is essential to identify bacteria, including endoscopy, culture, histology, rapid urea test, Urea Breath Test (UBT), fecal antigen test, and serology. Additionally, sociodemographic profiles and neutrophil, leukocyte, lymphocyte, and NLR prove beneficial in the diagnostic process. Therefore, this research aims to determine the characteristics and profiles of neutrophil, leukocyte, lymphocyte, and NLR cells in patients with *Helicobacter pylori* and non-*Helicobacter pylori*.

METHODS

This research used a descriptive retrospective method, extracting data from the medical records of chronic gastritis patients at ITKI and the Medical Record Center of Dr. Soetomo Hospital, Surabaya, spanning January 2018 to December 2022. The objective was to outline the characteristics of chronic gastritis patients with *Helicobacter pylori* and non-*Helicobacter pylori* infection, while also explaining the profiles of neutrophil, leukocyte, lymphocyte, and NLR cells. A total of 84 samples were purposively selected based on the inclusion criteria, such as patients with a chronic gastritis diagnosis and exclusion criteria, particularly acute gastritis patients. Sociodemographic details for the samples included age, gender, and education level. Data, including neutrophil, leukocyte, lymphocyte, and NLR profiles were extracted from medical records. Data collection of neutrophil, leukocyte, lymphocyte and NLR profiles was taken on the first day when the patient was admitted to the hospital. All data entered were tabulated and subjected to analysis

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

using descriptive statistics. The characteristics of the samples and cell profiles were described using mean, SD, and percentage values.

This analysis received approval from the ethics committee of Dr. Soetomo Hospital, Surabaya (Ref Number: 1245/LOE/301.4.2/III/2023) on March 1, 2023. The participation consent form contained statements indicating that participants had the option to withdraw from the analysis at any time. Moreover, the collected data were strictly designed for research purposes, and participants' anonymity was diligently preserved. Voluntary consent was obtained after providing participants with a comprehensive explanation.

RESULTS

Characteristics of Participants

84 participants diagnosed with chronic gastritis were identified from electronic medical records at Dr. Soetomo Hospital Surabaya from 2018 to 2022. Table 1 provides a concise overview of participants' characteristics. Specifically, non-*Helicobacter pylori* group predominantly consisted of females (50%). Regarding the education level, the majority (51.19%) in the non-*Helicobacter pylori* group had completed Senior High School, whereas the *Helicobacter pylori* group had the lowest educational attainment, with only 2.38% having completed Elementary School. Private employment was the most common occupation in the non-

Table 1. Characteristics of chronic gastritis patients with *Helicobacter pylori* and non-*Helicobacter pylori* (n=84)

Characteristics	Chronic Gastritis				N	%
	Helicobacter pylori		Non-*Helicobacter pylori*			
	n	%	N	%		
Gender						
- Male	2	2.38	30	35.71	32	38.1
- Female	10	11.9	42	50	52	61.9
Education						
- Not in School	3	3.57	5	5.952	8	9.524
- Elementary School Graduate	2	2.38	9	10.71	11	13.1
- Junior High School Graduate	6	7.14	4	4.762	10	11.9
- Senior High School Graduate	1	1.19	43	51.19	44	52.38
- Association's Degree Graduate	0	0	1	1.19	1	1.19
- Bachelor's Degree Graduate	0	0	9	10.71	9	10.71
- Master's Degree Graduate	0	0	1	1.19	1	1.19

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

Characteristics	Chronic Gastritis				N	%
	Helicobacter pylori		Non-*Helicobacter pylori*			
	n	%	N	%		
Occupation						
- Unemployed	0	0	5	5.952	5	5.952
- Housewife	4	4.76	21	25	25	29.76
- Student	2	2.38	13	15.48	15	17.86
- Entrepreneur	1	1.19	1	1.19	2	2.381
- Farmer	0	0	1	1.19	1	1.19
- Private Employee	4	4.76	25	29.76	29	34.52
- Civil Servant	0	0	3	3.571	3	3.571
- Army/Police	0	0	2	2.381	2	2.381
- Retired	1	1.19	1	1.19	2	2.381
Age						
- 1-5 (toddler)	0	0	3	3.571	3	3.57
- 6-10 (child)	0	0	3	3.571	3	3.57
- 11-19 (adolescent)	2	2.38	10	11.9	12	14.29
- 20-44 (adult)	3	3.57	18	21.43	21	25
- 45-59 (pre elderly)	2	2.38	25	29.76	27	32.14
- >60 (elderly)	5	5.95	13	15.48	18	21.43

Helicobacter pylori group (29. 76%). At the age level, individuals aged 45-59 (pre-elderly) were the most prevalent in non-*Helicobacter pylori* group (29.76%).

Table 2 presents data from 84 chronic gastritis patients: inactive chronic gastritis (74 or 88.1%) and active chronic gastritis (10 or 11.9%). *Helicobacter pylori* infection status showed 12 positive cases (14.29%) and 72 negative cases (85.71%). The mean value for neutrophil cell profiles was significantly higher in non-*Helicobacter pylori* group, registered at 62.29 (SD = 12.17). Similarly, the non-*Helicobacter pylori* group had a higher mean value for the leukocyte variable, reaching 8.155 (SD = 4.02). In lymphocyte and NLR variables, *Helicobacter pylori* group had a higher mean value, measuring 29.165 (SD = 12.31) and 3.68 (SD = 4.865), respectively.

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

Table 2. Profile of neutrophil, leukocyte, lymphocyte, and NLR in chronic gastritis patients with *Helicobacter pylori* and non-*Helicobacter pylori*

Neutrophil, Leucocyte, Lymphocyte, and NLR Profile	Overall (n=84)	Chronic Gastritis	
		Helicobacter pylori	Non *Helicobacter pylori*
Neutrophil (%).(normal=39.80-70.50)			
- Mean	61.58	59.445	62.29
- SD	12.27	13.225	12.17
Leukocyte (µ/L). (normal=(3.37-10.0))			
- Mean	7.89	7.095	8.155
- SD	3.97	2.11	4.02
Lymphocyte (%).(normal=23.1-49.9)			
- Mean	27.59	29.165	26.945
- SD	11.07	12.31	10.805
NLR (%). (normal (<5)			
- Mean	3.13	3.68	3.165
- SD	3.09	4.865	2.24

SD=Standard Deviation

DISCUSSION

The predominant gender group in this research was females, comprising 52 individuals (61.9%), while males accounted for 32 individuals (38.1%). The results aligned with the observation of Nasution, which established a correlation between gender and gastritis incidence. Gender-specific dietary variations, such as strict dieting, irregular eating patterns, and late-night eating, increased stomach acid in females (Raintung et al., 2019). Psychological pressure and susceptibility to stress were additional factors explaining the higher occurrence of gastritis for this particular gender (Monica, 2019). The highest educational attainment was observed among Senior High School graduates, totaling 44 individuals (52.38%). This observation correlated with the results of Widya *et al*. (2018), suggesting that education levels affect the ability of individuals to cope with stress. The higher level was associated with enhanced stress-coping abilities and improved knowledge regarding healthy eating habits (Tussakinah et al., 2018).

Regarding occupation, most chronic gastritis patients were engaged in private employment, constituting 29 individuals (34.52%). This was in line with the observation of Novi *et al*., where 64 individuals (52.5%) were identified with similar occupational backgrounds. The research by Uwa *et al*. (2019) explained the role of work in increasing the risk of gastric disorders. The demands and busyness of work contributed to irregular dietary patterns,

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

leading to stomach disorders. Furthermore, work-related pressures and demands could induce stress, potentially triggering gastric disorders (Uwa et al., 2019).

The most prevalent age group among chronic gastritis patients was 45-59 (32.14%), ranging from a minimum age of 4 to a maximum of 76, with a standard deviation of 20.039. According to Monica (2019), a significant relationship exists between increasing age and alterations in various gastric mucosal defense mechanisms (Monica, 2019). Individuals in the productive age range were prone to experiencing gastritis due to high busyness levels, a lifestyle that might neglect health considerations, and increased susceptibility to stress (Muna & Kurniawati, 2023).

As the primary leukocyte in acute inflammation, neutrophils quickly infiltrate inflammatory sites to combat pathogens through phagocytosis, degranulation, and neutrophil extracellular trapping. *Helicobacter pylori* infection triggered a rapid and continuous influx of neutrophils, succeeded by T cells, B cells, plasma cells, and macrophages. In the stomach, gram-negative bacteria release several chemotactic proteins, attracting neutrophils and lymphocytes. Substances secreted by mononuclear and neutrophil cells induced mucosal inflammation, contributing to gastritis. *Helicobacter pylori*-induced local stomach inflammation and a systemic humoral immune response, marking it as a global issue associated with a high morbidity rate and recognized as a cause of chronic gastritis (Deyuga et al., 2022).

The research conducted by Farah *et al*. showed that the chronic gastritis group with positive *Helicobacter pylori* had a higher average value than the group without gram-negative bacteria. In the observation of Deyuga *et al*. (2022), the accumulation of neutrophils in the intraepithelial gastric mucosa closely correlated with both gastric mucosal damage and the intensity of *Helicobacter pylori* infection (Deyuga et al., 2022). Therefore, a higher degree of gastric mucosal damage resulted in a more significant neutrophil accumulation in the affected area.

Leukocytes or white blood cells (WBC) serve as stable markers of systemic inflammation and contribute to the body's defense against disease-causing antigens (foreign bodies) entering the human body (Iida et al., 2012). Elevated mononuclear cells, triggered by *Helicobacter pylori* infection, stimulated the release of proinflammatory cytokines, thereby resulting in systemic inflammation identified by increased serum leukocyte counts (Kim et al., 2020).

In previous research conducted by Farah and Khamisy (2014), mucosal inflammation resulting from *Helicobacter pylori* infection correlated with the peripheral blood leukocyte count (Farah & Khamisy-Farah, 2014). Lida *et al*. (2012) stated that there was a significant relationship between leucocyte and gastric cancer(Iida et al., 2012). *Helicobacter pylori* infection represented a strong risk factor for gastric cancer development through chronic gastritis. Peripheral blood leukocyte counts served as potential indicators, suggesting the degree of mucosal inflammation induced by gram-negative bacteria. The results showed that leukocyte count could become a useful indicator for estimating the severity of gastric mucosal inflammation.

Chronic inflammation was characterized by increased lymphocyte and plasma cells, indicative of chronic gastritis (Atayan & Hacisalihoglu, 2017). Lymphocytes, integral to the adaptive immune system, include effector cells activated during infections to combat them directly. Additionally, memory cells stored information about previous infections, enabling

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

quicker responses upon reinfection. There were two types of lymphocytes: B lymphocytes produced antibodies to attack bacteria, viruses, and toxins, and T lymphocytes were used to combat cells exposed to viruses or cancer (Prakoeswa, 2020).

The research of Sağlam and Civan (2023) reported decreased lymphocyte levels in patients with positive *Helicobacter pylori(Sağlam & Civan, 2023)*. Meanwhile, another investigation in adults found a significant increase, with the absolute number of lymphocytes in peripheral blood rising significantly with higher *Helicobacter pylori* intensity (Farah & Khamisy-Farah, 2014). Sasaran *et al.* (2020) showed significantly higher lymphocyte numbers in patients with negative bacteria infection compared to positive cases(Săsăran et al., 2020). The result was in line with this present research, where the chronic gastritis group with positive *Helicobacter pylori* had a mean of 29.16 (SD = 12.31), surpassing those without the infection with a mean value of 26.945 (SD =.10.805).

NLR serves as a leukocyte index, offering a simple and safe non-invasive marker for acute inflammation (Boyuk et al., 2020). It was a recently scrutinized indicator used to assess the severity of various diseases, including *Helicobacter pylori* infection and gastric cancer (Deyuga et al., 2022). According to Farah and Khamisy (2014), patients with *Helicobacter pylori* had significantly higher NLR than those with non-*Helicobacter pylori*. Furthermore, the leukocyte index increased in tandem with the severity of gastritis associated with gram-negative bacteria (Farah & Khamisy-Farah, 2014). The research conducted by Sasaran *et al*. (2020) concluded that children with *Helicobacter pylori* had increased NLR and PLR, alongside lower values in cases of non-*Helicobacter pylori(Săsăran et al., 2020)*. Koç and Gedikli, (2022) showed that NLR was higher in patients with positive *Helicobacter pylori* (Koç & Gedikli, 2022).

In line with previous reviews, this present research showed that in the chronic gastritis group with positive *Helicobacter pylori*, the mean NLR was 3.68 (SD = 4.865), higher than the group without the infection with a mean value of 3.165 (SD = 2.24). However, Boyuk *et al*. (2020) reported lower NLR in positive *Helicobacter pylori* patients than in negative cases (Boyuk et al., 2020). Guclu (2017) also stated that NLR was statistically lower in patients with positive *Helicobacter pylori* than in those with negative cases (Guclu & Faruq Agan, 2017).

Thus, the research results show the trend of neutrophil and leukocyte values in non-*Helicobacter pylori* and lymphocyte and NLR values in *Helicobacter pylori* chronic gastritis is due to systemic inflammation. This research examined the latest neutrophil, leukocyte, lymphocyte, and NLR cell profiles in chronic gastritis patients with *Helicobacter pylori* and non-*Helicobacter pylori* at Dr. Soetomo Hospital Surabaya. The investigation faced certain limitations, including incomplete parameter data in the medical records, hindering the input of comprehensive data for further analysis. Additionally, some patients had multiple diagnoses, resulting in impure data for chronic gastritis patients with positive or negative *Helicobacter pylori* infection. The sources of scientific journals and articles related to the analyzed diagnosis also had limitations, posing challenges in finding references to discuss the data results.

CONCLUSION

In conclusion, this research showed a preference for chronic gastritis with *Helicobacter pylori* in the female gender and a propensity for larger values in neutrophil and leukocyte

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

variables in non-*Helicobacter pylori* cases. Additionally, higher lymphocyte and NLR values were observed in *Helicobacter pylori*-related chronic gastritis, suggesting systemic inflammation associated with conditions such as comorbidities observed during chronic gastritis diagnosis.

ACKNOWLEDGEMENT

The authors are grateful to the Rector of Airlangga University, the Dean of the Faculty of Medicine, Airlangga University, and Dr. Soetomo Hospital Surabaya for providing facilities for this research.

REFERENCES

Atayan, Y., & Hacisalihoglu, P. (2017). The correlation between tissue Helicobacter pylori severity and the increase in serum neutrophil/lymphocyte ratio in patients with active chronic gastritis. Biomed. Res, 28, 4874-4877.

Boyuk, B., Saydan, D., Mavis, O., & Erman, H. (2020). Evaluation of Helicobacter pylori Infection, Neutrophil–Lymphocyte Ratio and Platelet–Lymphocyte Ratio in Dyspeptic Patients. Gastroenterology Insights, 11(1), 2-9.

Crowe, S. E. (2019). Helicobacter pylori infection. New England Journal of Medicine, 380(12), 1158-1165.

Deyuga, M. R., Lubis, A. D., Fujiati, I. I., Ramayani, O. R., & Evalina, R. (2022). Relationship between Neutrophil Lymphocyte Ratio in Children with H. Pylori and Non H. Pylori Gastritis. Medicine, Health & Food, 92(1), 10-10.

Farah, R., & Khamisy-Farah, R. (2014). Association of neutrophil to lymphocyte ratio with presence and severity of gastritis due to Helicobacter pylori infection. J Clin Lab Anal, 28(3), 219-223. https://doi.org/10.1002/jcla.21669

Guclu, M., & Faruq Agan, A. (2017). Association of Severity of Helicobacter pylori Infection with Peripheral Blood Neutrophil to Lymphocyte Ratio and Mean Platelet Volume. Euroasian J Hepatogastroenterol, 7(1), 11-16. https://doi.org/10.5005/jp-journals-10018-1204

Iida, M., Ikeda, F., Ninomiya, T., Yonemoto, K., Doi, Y., Hata, J., Matsumoto, T., Iida, M., & Kiyohara, Y. (2012). White blood cell count and risk of gastric cancer incidence in a general Japanese population: the Hisayama study. Am J Epidemiol, 175(6), 504-510. https://doi.org/10.1093/aje/kwr345

Kim, D. H., Son, B. K., Min, K. W., Han, S. K., Na, J. U., Choi, P. C., Kim, H. L., Kwon, M. J., Oh, Y. H., Jung, W. Y., Moon, J. Y., Hong, S., Oh, K. W., & Kim, Y. S. (2020). Chronic Gastritis Is Associated with a Decreased High-Density Lipid Level: Histological Features of Gastritis Based on the Updated Sydney System. J Clin Med, 9(6). https://doi.org/10.3390/jcm9061856

Koç, S., & Gedikli, M. A. (2022). The Role of Neutrophil-Lymphocyte Ratio and Platelet-Lymphocyte Ratios in Predicting H Pylori Positivity and Severity in Patients with Chronic Gastritis. Cumhuriyet Medical Journal, 44(1).

Miftahussurur, M. (2020). Noninvasive Helicobacter pylori Diagnostic Methods in Indonesia. Gut Liver, 14(5), 553-559. https://doi.org/10.5009/gnl19264

Monica, T. (2019). Hubungan Antara Pengetahuan Dan Tingkat Stres Terhadap Kambuh Ulang Gastritis Di Wilayah Kerja Puskesmas Kota Sungai Penuh Tahun 2018. Menara Ilmu, 13(5).

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

Muna, U. L., & Kurniawati, T. (2023). Hubungan Stres dengan Kejadian Gastritis: Literatur Review. Jurnal Ilmu Psikologi dan Kesehatan (SIKONTAN), 1(4), 277-282.

Prakoeswa, F. R. (2020). Peranan Sel Limfosit Dalam Imunulogi: Artikel Review. *Jurnal Sains Dan Kesehatan*, *2*(4), 525-537.

Raintung, E. P., Kaunang, W. P., & Malonda, N. S. (2019). Faktor-faktor yang Memengaruhi Kejadian Gastritis di Puskesmas Ranotana Weru Kota Manado. *EBiomedik*, *7*(2).

Rodríguez-García, J. L., & Carmona-Sánchez, R. (2016). Functional dyspepsia and dyspepsia associated with Helicobacter pylori infection: Do they have different clinical characteristics? *Revista de Gastroenterología de México (English Edition)*, *81*(3), 126-133. https://doi.org/https://doi.org/10.1016/j.rgmxen.2016.06.017

Sağlam, N., & Civan, H. A. (2023). Impact of chronic Helicobacter pylori infection on inflammatory markers and hematological parameters. *Eur Rev Med Pharmacol Sci*, *27*(3), 969-979. https://doi.org/10.26355/eurrev_202302_31190

Săsăran, M. O., Meliţ, L. E., Mocan, S., Ghiga, D. V., & Dobru, E. D. (2020). Pediatric gastritis and its impact on hematologic parameters. *Medicine (Baltimore)*, *99*(35), e21985. https://doi.org/10.1097/md.0000000000021985

Sharma, P. K., Salaria, S., Manrai, M., Srivastava, S., Kumar, D., & Singh, A. R. (2022). Helicobacter pylori infection in non-ulcer dyspepsia: A cross-sectional study. *Medical Journal Armed Forces India*, *78*(2), 180-184. https://doi.org/https://doi.org/10.1016/j.mjafi.2020.11.020

Syam, A. F., Miftahussurur, M., Makmun, D., Nusi, I. A., Zain, L. H., Zulkhairi, Akil, F., Uswan, W. B., Simanjuntak, D., Uchida, T., Adi, P., Utari, A. P., Rezkitha, Y. A., Subsomwong, P., Nasronudin, Suzuki, R., & Yamaoka, Y. (2015). Risk Factors and Prevalence of Helicobacter pylori in Five Largest Islands of Indonesia: A Preliminary Study. *PLoS One*, *10*(11), e0140186. https://doi.org/10.1371/journal.pone.0140186

Tussakinah, W., Masrul, M., & Burhan, I. R. (2018). Hubungan Pola Makan dan Tingkat Stres terhadap Kekambuhan Gastritis di Wilayah Kerja Puskesmas Tarok Kota Payakumbuh Tahun 2017. *Jurnal Kesehatan Andalas*, *7*(2), 217-225.

Uwa, L. F., Milwati, S., & Sulasmini, S. (2019). Hubungan antara stres dan pola makan dengan kejadian gastritis yang terjadi di puskesmas dinoyo. *Nursing News: Jurnal Ilmiah Keperawatan*, *4*(1).

Yulida, E., Oktaviyanti, I. K., & Rosida, L. (2013). Gambaran derajat infiltrasi sel radang dan infeksi Helicobacter pylori pada biopsi lambung pasien gastritis: di RSUD Ulin Banjarmasin tahun 2009-2011. *Berkala Kedokteran*, *9*(1), 51-65.