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Hematological parameters of COVID-19 patients at Jakarta Pondok Kopi Islamic Hospital

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Abstract

Background: The 2019 Corona Virus Disease (Covid-19) has become a pandemic. As of 15 January 2021, in Indonesia there were 896,642 confirmed cases and 25,767 deaths. The purpose of this study is to identify the hematological parameters of COVID-19 patients at Pondok Kopi Islamic Hospital in Jakarta (RSIJ PK) to provide an overview of the hematological parameters that can be used to predict the possibility of a patient being infected with COVID-19. **Methods:** The study adopted a cross-sectional approach, using the database on COVID-19 patients at Pondok Kopi Islamic Hospital. Data variables were categorized and described by frequency and percentage. **Results:** The number of research respondents was 250. The dominant hematological parameters were normal blood leukocytes in 157 patients (62.8%), increased Neutrophil/Lymphocyte Ratio (NLR) (>3.13) in 148 patients (59.2%), low Absolute Lymphocyte Count (ALC) ($<1500/\mu\text{L}$) in 133 patients (53.2%), increased C-Reactive Proteins (CRP) ($>10\text{ mg/L}$) in 171 patients (68.4%), and increased d-dimer ($>0.5\text{ }\mu\text{g/mL}$) in 148 patients (59.2%). There was a significant correlation between age ($p\ 0.028$), comorbid hypertension ($p\ 0.002$), comorbid diabetes ($p\ 0.011$), leukocyte levels ($p\ 0.045$), and ALC levels ($p\ 0.025$), and the severity of the COVID-19 disease. **Conclusions:** Many COVID-19 patients had normal blood leukocyte levels, increased NLR, low ALC, and increased CRP and d-dimer.

Keywords: Covid-19, leukocyte level, NLR, ALC, CRP

Latar Belakang: Penyakit Virus Corona 2019 (Covid-19) telah menjadi pandemi. Hingga 15 Januari 2021, di Indonesia terdapat 896.642 kasus terkonfirmasi dan 25.767 kematian. Tujuan dari penelitian ini adalah untuk mengidentifikasi parameter hematologi pasien COVID-19 di Rumah Sakit Islam Pondok Kopi Jakarta (RSIJ PK) guna memberikan gambaran parameter hematologi yang dapat digunakan untuk memprediksi kemungkinan pasien terinfeksi COVID-19. **Metode:** Penelitian ini menggunakan pendekatan cross-sectional, dengan menggunakan basis data pasien COVID-19 di Rumah Sakit Islam Pondok Kopi. Variabel data dikategorikan dan dideskripsikan berdasarkan frekuensi dan persentase. **Hasil:** Jumlah responden penelitian sebanyak 250 orang. Parameter hematologi yang dominan adalah leukosit darah normal sebanyak 157 pasien (62,8%), Neutrophil/Lymphocyte Ratio (NLR) meningkat ($>3,13$) sebanyak 148 pasien (59,2%), Absolute Lymphocyte Count (ALC) rendah ($<1500/\mu\text{L}$) sebanyak 133 pasien (53,2%), C-Reactive Protein (CRP) meningkat ($>10\text{ mg/L}$) sebanyak 171 pasien (68,4%), dan d-dimer meningkat ($>0,5\text{ }\mu\text{g/mL}$) sebanyak 148 pasien (59,2%). Terdapat korelasi bermakna antara usia ($p\ 0,028$), komorbid hipertensi ($p\ 0,002$), komorbid diabetes ($p\ 0,011$), kadar leukosit ($p\ 0,045$), dan kadar ALC ($p\ 0,025$), dengan derajat keparahan penyakit COVID-19. **Kesimpulan:** Banyak pasien COVID-19 memiliki kadar leukosit darah normal, NLR meningkat, ALC rendah, serta CRP dan d-dimer meningkat.

Kata Kunci: Covid-19, leukocyte level, NLR, ALC, CRP

INTRODUCTION

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, has had a profound impact on global health systems and has led to extensive research efforts to better understand its pathophysiology. Among the many parameters being studied, hematological parameters have emerged as critical indicators of disease severity and progression in COVID-19 patients. Hematological parameters such as lymphocyte count, neutrophil-to-lymphocyte ratio (NLR), D-dimer levels, and platelet counts are essential in assessing the immune response and coagulopathy associated with COVID-19. These parameters are influenced by various factors, including viral load, inflammatory response, and underlying health conditions of the patients. For instance, elevated D-dimer levels are associated with a higher risk of thrombosis, which is a significant concern in COVID-19 patients. The study of these hematological parameters provides valuable insights into the prognosis of the disease and helps guide therapeutic interventions.

The scientific community has made significant strides in understanding the hematological manifestations of COVID-19, with numerous studies highlighting their importance in patient outcomes. For example, Fan et al. (2020) conducted a study on hematological parameters in COVID-19 patients and found that lymphopenia and elevated NLR were common among severe cases, indicating a poor prognosis. Similarly, Liao et al. (2020) identified that patients with severe COVID-19 exhibited significantly higher D-dimer levels compared to those with mild or moderate disease, underscoring the role of coagulopathy in disease progression. Additionally, Cheung et al. (2020) provided a hematologist's perspective on the implications of these parameters, emphasizing the need for close monitoring of blood counts and coagulation markers in COVID-19 patients. These findings are corroborated by numerous other studies that have documented the correlation between hematological abnormalities and COVID-19 severity, making these parameters crucial for the clinical management of the disease.

Despite the progress made in understanding the hematological aspects of COVID-19, there remains a significant gap in the literature, particularly regarding the specific hematological profiles of patients in different geographic regions and healthcare settings. The existing studies have predominantly focused on populations in China, Europe, and North America, with limited data available from Southeast Asia, including Indonesia. This gap is particularly concerning given the high burden of COVID-19 in the region and the potential for regional differences in disease presentation due to genetic, environmental, and healthcare-related factors. The novelty of this research lies in its focus on the hematological parameters of COVID-19 patients at the Jakarta Pondok Kopi Islamic Hospital, a setting that has not been extensively studied in the literature. The urgency of this research is underscored by the need for region-specific data to inform clinical management and public health strategies in Indonesia, a country with one of the highest COVID-19 caseloads globally.

The primary objective of this study is to investigate the hematological parameters of COVID-19 patients at Jakarta Pondok Kopi Islamic Hospital, with the aim of identifying patterns that could inform clinical management and improve patient outcomes. Specifically, the study will analyze parameters such as lymphocyte count, NLR, D-dimer levels, and platelet counts, and assess their correlation with disease severity and outcomes. The findings from this research are expected to have significant implications for the clinical management of COVID-19 in Indonesia, potentially guiding therapeutic decisions and resource allocation in hospitals. Furthermore, this study will contribute to the global body of knowledge on COVID-19, providing insights that could be applicable to other regions with similar demographic and healthcare profiles.

The implications of this research are wide-ranging, with potential impacts on both clinical practice and public health policy. The identification of key hematological markers that predict COVID-19 outcomes could lead to the development of more effective diagnostic tools and treatment protocols, ultimately improving patient care and reducing mortality. Moreover, the findings of this study could inform the design of future clinical trials aimed at testing new therapeutic strategies for managing the hematological complications of COVID-19. In the broader context of public health, this research could contribute to the development of targeted screening programs for high-risk populations, enabling early identification and intervention for those most vulnerable to severe COVID-19.

This research represents a significant advancement in our understanding of the hematological parameters associated with COVID-19 and their impact on patient outcomes. By addressing critical gaps in the existing literature and offering novel insights into the interplay between various hematological markers, this study has the potential to make a substantial contribution to the ongoing efforts to combat the COVID-19 pandemic.

Methods

Study design

This research is a cross-sectional study, using secondary data. The research data will be taken from the medical record database and the hematology laboratory examination results of COVID-19 patients at Pondok Kopi Islamic Hospital in Jakarta.

Study population

Patients confirmed to have COVID-19 using RT PCR from oropharyngeal/nasopharyngeal swabs, treated at Pondok Kopi Islamic Hospital from September to mid-December 2020.

Data collection

Baseline information collected include gender, age, comorbidities, and severity of the COVID-19 disease based on WHO criteria.[3] The parameters of the laboratory results collected include levels of leukocytes, neutrophils, lymphocytes, NLR, ALC, CRP, and d-Dimer.

Data analysis

Data variables were categorized and described by frequency and percentage. Statistical analysis was conducted using the likelihood ratio test. All tests were conducted using SPSS (statistical package for the social sciences) version 26.

Results

General information

The number of research respondents was 250. The basic characteristics of the respondents can be seen in Table 1.

Table 1. Demographic data and basic characteristics of COVID-19 infected respondents

	Low		Moderate		Severe		Critical		TOTAL		P value
	N	%	N	%	N	%	N	%	N	%	
Gender											0.162
Male	3	75	116	53.95	18	75	5	71.43	142	56.8	
Female	1	25	99	46.05	6	25	2	28.57	108	43.2	
Age (years)											0.028
<20	1	25	2	0.93	0	0	0	0	3	1.2	
20-29	1	25	15	6.98	1	4.17	0	0	17	6.8	
30-39	2	50	40	18.60	2	8.33	0	0	44	17.6	

40-49	0	0	52	24.19	5	20.83	1	14.29	58	23.2	
50-59	0	0	63	29.30	4	16.67	2	28.57	69	27.6	
60-69	0	0	27	12.56	9	37.5	2	28.57	38	15.2	
70-79	0	0	16	7.44	2	8.33	2	28.57	20	8	
≥ 80	0	0	0	0	1	4.17	0	0	1	0.4	
Comorbidity											
Hypertension	0	0	63	29.30	14	58.33	5	71.43	82	32.8	0.002
Diabetes	0	0	53	24.65	10	41.67	5	71.43	68	27.2	0.011
COPD	0	0	0	0	1	4.17	0	0	1	0.4	
Asthma	0	0	3	1.39	0	0	0	0	3	1.2	0.823
CVD	0	0	0	0	0	0	0	0	0	0	
Coronary heart disease	0	0	18	8.37	2	8.33	1	14.29	21	8.4	0.809
Congestive heart disease	0	0	11	5.12	1	4.17	1	14.29	13	5.2	0.73
Chronic kidney disease	0	0	22	10.23	3	12.5	2	28.57	27	10.8	0.455
Laboratory											
Leukocytes											
0.045											
▪ Normal (5×10^3 - $10 \times 10^3/\mu\text{L}$)	4	100	136	63.26	14	58.33	3	42.86	157	62.8	
▪ Decreased ($< 5 \times 10^3/\mu\text{L}$)	0	0	32	14.88	1	4.17	0	0	33	13.2	
▪ Increased ($> 10 \times 10^3/\mu\text{L}$)	0	0	47	21.86	9	37.5	4	57.14	60	24	
▪ No data	0	0	0	0	0	0	0	0	0	0	
NLR (neutrophil-lymphocyte ratio)											
0.051											
▪ Normal (≤ 3.13)	3	75	82	38.14	8	33.33	3	42.86	96	38.4	
▪ Increased (> 3.13)	1	25	131	60.93	13	54.17	3	42.86	148	59.2	
▪ No data	0	0	2	0.93	3	12.5	1	14.29	6	2.4	
ALC (absolute lymphocyte count)											
0.025											
▪ Normal ≥ 1500	4	100	94	43.72	10	41.67	5	71.43	113	45.2	
▪ Abnormal < 1500	0	0	119	55.35	13	54.17	1	14.29	133	53.2	
▪ No data	0	0	2	0.93	1	4.17	1	14.29	4	1.6	
CRP (C-reactive protein)											
0.385											
▪ Normal ≤ 10 mg/L	0	0	58	26.98	8	33.33	2	28.57	68	27.2	
▪ Increased > 10 mg/L	4	100	146	67.91	16	66.67	5	71.43	171	68.4	
▪ No data	0	0	11	5.12	0	0	0	0	11	4.4	
D-dimer											
0.805											
▪ Normal ≤ 0.5 $\mu\text{g}/\text{ml}$	1	25	55	25.58	5	20.83	3	42.86	64	25.6	
▪ Abnormal > 0.5 $\mu\text{g}/\text{ml}$	3	75	126	58.60	16	66.67	3	42.86	148	59.2	
▪ No data	0	0	34	15.81	3	12.5	1	14.29	38	15.2	

Characteristics of the respondents' laboratory data

The majority of the respondents' laboratory results showed normal blood leukocyte levels, in 157 patients (62.8%), followed by leukocytosis in 60 patients (24%), and leukopenia in 33 patients (13.2%). An increase in NLR (> 3.13) was found in 148 respondents (59.2%), followed by normal NLR in 96 respondents (38.4%), while 6 respondents (2.4%) had no data on NLR. Low ALC values ($< 1500/\mu\text{L}$) were found in 133 respondents (53.2%), followed by normal ALC values in 113 respondents (45.2%), while 4 respondents (1.6%) had no ALC data. A total of 171 respondents (68.4%) experienced an increase in CRP (> 10 mg/L), followed by normal CRP levels in 68 respondents (27.2%), while no CRP data was found for 11 respondents (4.4%). Increased d-dimer (> 0.5 $\mu\text{g}/\text{ml}$) was found in 148 respondents (59.2%), followed by normal d-dimer levels in 64 respondents (25.6%), while 38 respondents (15.2%) had no d-dimer data.

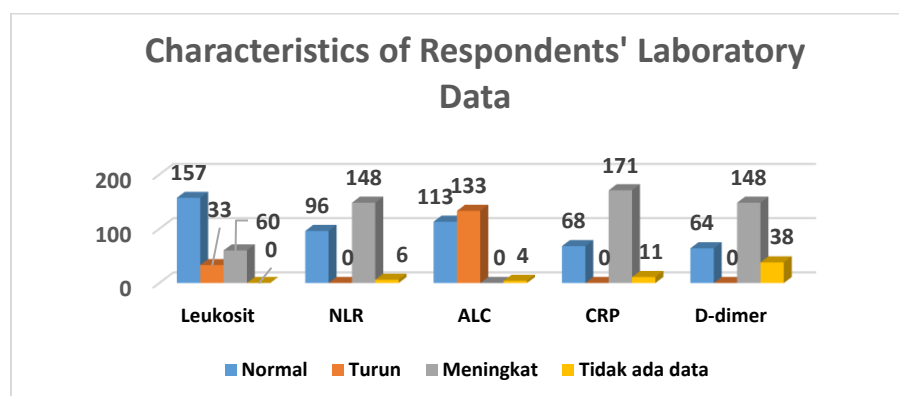


Figure 1. Characteristics of respondents' laboratory data

Table 2. Dominance of respondent characteristics based on disease severity

Parameter	Clinical Severity			
	Low (%)	Moderate (%)	Severe (%)	Critical (%)
Gender	Male 75	Male 53.95	Male 75	Male 71.43
Age	30-39 years 50	50-59 years 29.3 40-49 years 24.19	60-69 years 37.5	≥ 50 years 85.71
Comorbidity	No Comorbidity	Hypertension 29.3 Diabetes 24.65	Hypertension 58.33 Diabetes 41.67	Hypertension 71.43 Diabetes 71.43
Leukocytes	Normal 100	Normal 63.26	Normal 58.33	Lekositosis 57.14
NLR	Normal 75	Increased 60.93	Increased 54.17	Normal 42.86 Increased 42.86
ALC	Normal 100	Decreased 55.35	Decreased 54.17	Normal 71.43
CRP	Increased 100	Increased 67.91	Increased 66.67	Increased 71.43
D-dimer	Increased 75	Increased 58.6	Increased 66.67	Normal 42.86 Increased 42.86

The statistical analysis revealed a significant correlation between age (p 0.028), comorbid hypertension (p 0.002), comorbid diabetes (p 0.011), leukocyte levels (p 0.045), and ALC levels (p 0.025), and the severity of the COVID-19 disease.

DISCUSSION

The majority, or 142 (56.8%), of the research respondents were male. This finding is similar to several other studies, including a study conducted by Xu, et. al. on COVID-19 patients in seven hospitals in Zhejiang Province, China in January 2020, 56% of the respondents of which were male.[4] Research by Huang, et. al in a hospital in Wuhan Province found that 73% of respondents were male.[5] Guan, et. al collected data from 552 hospitals in 30 Chinese provinces, with 58.1% of respondents being male.[6] Wang, et. al observed patients treated at Shongnan Hospital (Wuhan University's hospital) between 1-28 January 2020, and found that 54.3% of patients were male.[7] Young, et. al, conducted observations in four hospitals in Singapore between January-February, finding the same percentages of male and female respondents.[8] Chen, et. al, studied 249 patients treated in a hospital in Shanghai, where 50.6% of respondents were male.[9]

When analyzed according to the severity of the disease, this study found no significant relationship between sex and the severity of the disease. This finding is in accordance with research conducted by Wang, et. al and Huang, et. al.[5,7] However, Liao, et. al, who studied 380 patients at Union Wuhan Hospital, found a correlation between being female and the severity of the disease.[10] Meanwhile, Zang, et. al found a correlation between being male and the severity of the disease.[11]

The median age of RSII PK respondents was 49.9 years, with the largest proportion belonging to the 50-59 year age-group (27.6%), followed by the 40-49 year age-group (23.2%), the 30-39 year age-group (17.6%), and the 60-69 year age-group (15.2%). The over 70 age-group was 8.4%, and under-30 year age-group 8%. These findings are similar to other studies. Guan, et. al conducted a study on 1,099 respondents, with a median age of 47 years, and the largest proportion of respondents between the ages of 15 and 49 years (55.1%), followed by 50-64 years (28.9%), while those aged ≥ 65 tahun consisted of 15.1%.⁶ Huang et. al found a median age of 49 years.[5] Xu, et. al. found a median age of 41 years, with the largest

proportion of respondents being 41-65 years (53%), followed by 19-40 years (40%), and ≤ 18 and ≥ 66 years, each at 3%.⁴ Chen, et. al, found a median age of 51 years, while Young, et. al found a median age of 47 years.[8,9] Wang, et. al found the median age of their 138 respondents to be 56 years.[7]

When analyzed according to the severity of the disease, this study found a significant relationship between age and disease severity. This finding is in accordance with research by Wang, et. al, and Liao, et. al.[7,10] However, research by Huang, et. al found no significant relationship between age and the disease severity.[5]

The three most common comorbidities in RSIJ PK respondents were hypertension (32.8%), diabetes (27.2%), and chronic kidney disease (10.8%). Meanwhile, other comorbidities found were coronary heart disease (8.4%), congenitive heart disease (5.2%), asthma (1.2%), and COPD (0.4%). Hypertension, type 2 diabetes mellitus, cardiovascular disease, and chronic kidney disease are comorbidities commonly found in research on the characteristics of COVID-19 patients. Wang et. al found hypertension to be the most common comorbidity in COVID-19 patients, at 31.2%, followed by cardiovascular disease at 14.5%, diabetes mellitus at 10.1%, malignancies at 7.2%, and cerebrovascular disease at 5.1%, while chronic kidney disease was found in 2.9% of respondents.⁷ Huang, et. al found diabetes to be the most common comorbidity among the respondents of their research at 20%, followed by hypertension at 15%, and cardiovascular disease at 15%.⁵ Xu, et. al. found liver disease to be the main comorbidity at 11%, followed by hypertension at 8%, and diabetes, COPD, cerebrovascular disease, and kidney disease each at 2%.⁴ Guan, et. al. found the main comorbidity to be hypertension at 15%, followed by diabetes at 7.4%, coronary heart disease at 2.5%, hepatitis B at 2.1%, malignancies at 0.9%, and chronic kidney disease at 0.7%.⁶ Chen, et. al. found the main comorbidities to be cardio and cerebrovascular disease at 21.7%, followed by diseases of the endocrine system at 10%, diseases of the digestive system at 3.6%, diseases of the respiratory system at 2%, chronic hepatitis B at 0.8%, and malignancies at 0.4%. [9]

When analyzed according to the severity of the disease, this study found a significant correlation between comorbid hypertension and diabetes and disease severity. Wang, et. al found a significant relationship between comorbid hypertension, diabetes, cardiovascular disease, and cerebrovascular disease, and disease severity.[7] Liao, et. al found a significant correlation between comorbid diabetes and coronary heart disease and disease severity.[10] However, Huang, et. al found no significant correlation between any of the comorbidities examined and disease severity.[5]

Through statistical examinations, this study found a significant relationship between leukocyte and ALC levels and disease severity. Wang, et. al, found a significant correlation between leukocyte, neutrophil, lymphocyte, and d-dimer levels, and the level of disease severity.[7] Liao, et. al, found a significant correlation between leukocyte, neutrophil, lymphocyte, NLR, and d-dimer levels, and the level of disease severity.[10] Huang, et. al found a significant relationship between leukocyte, neutrophil, lymphocyte, and d-dimer levels, and the level of disease severity.[5]

Cheung, et. al collected data on the hematological characteristics of COVID-19 patients from various studies (case series, case reports, and cohorts with more than 20 respondents).[12] A comparison of the results with the results of the respondents from RSIJ PK can be seen in the table below:

Table 3. Hematological parameters of COVID-19 studies [4-7,9,13-21]

Research	No. of Respondents	Median Age (years)	Lymphopenia	Leukopenia	Neutrophilia	Median CRP or >10mg/L	Median D-dimer or >0.5
RSIJ PK	250	49.9	126/246 (51.22%)	33/250 (13.2%)	135/246 (54.88%)	32.73	0.9
Guan, et.al	1099	47	731/879 (83.2%)	330/978 (33.7%)	NA	481/793(60.7%)	260/560 (46.4%)
Huang, et.al	41	49	26/41 (63.4%)	10/40 (25%)	12/40 (30%)	NA	0.5
Chen, et.al	99	56 (mean)	35/99 (35.4%)	9/99 (9.1%)	38 (38.4%)	12	NA
Wang, et.al	138	56	97/135(70.3%)	NA	NA	NA	0.2
Zhu, et.al	32	46	19/32 (59.4%)	7/32 (21.9%)	3/32 (9.4%)	21/32 (65.63%)	3/32 (9.36%)
Zhang, et.al	140	57	104/138 (75.4%)	27/138 (19.6%)	NA	34.2	0.2
Yang, et.al	149	45 (mean)	53/149 (35.6%)	33/149 (22.1%)	6/149 (4%)	82/149 (55.03%)	21/149 (14.09%)
Wan, et.al	135	47	68/135 (50.4%)	28/135 (20.7%)	NA	10.5	0.4
Liu, et.al	137	57	99/137 (72.3%)	51/137 (37.2%)	NA	115/137 (85%)	NA
Chen, et.al	249	51	1.12 (median)	4.71 (median)	NA	12	NA
Zhou, et.al	62	52.8 (mean)	24/30 (80%)	6/30(20%)	NA	27/27 (100%)	NA
Xu, et.al	62	41	26/62 (42%)	19/62 (31%)	2.9 (median)	NA	0.2
Wu, et.al	80	44	34/80 (42.5%)	7/80 (8.8%)	16/80 (20%)	12.39	NA
Zheng, et.al	161	45	42/161 (26.1%)	66 (42%)	NA	17.9	NA

NA: not available

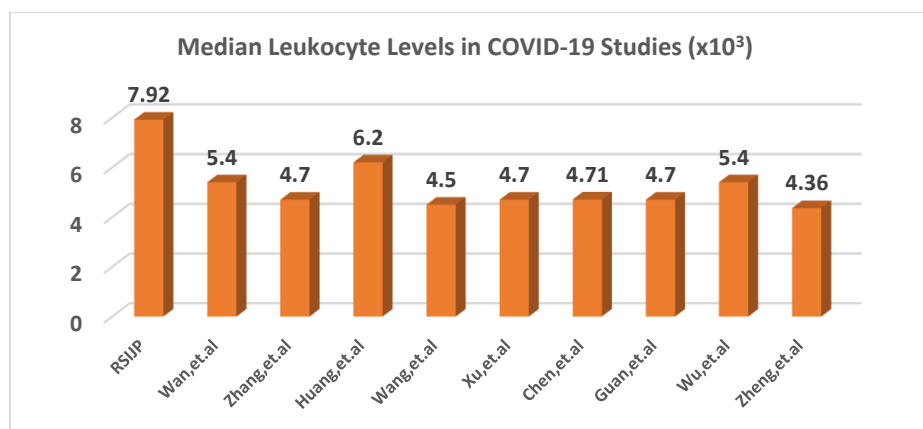


Figure 2. Median leukocytes in various COVID-19 studies

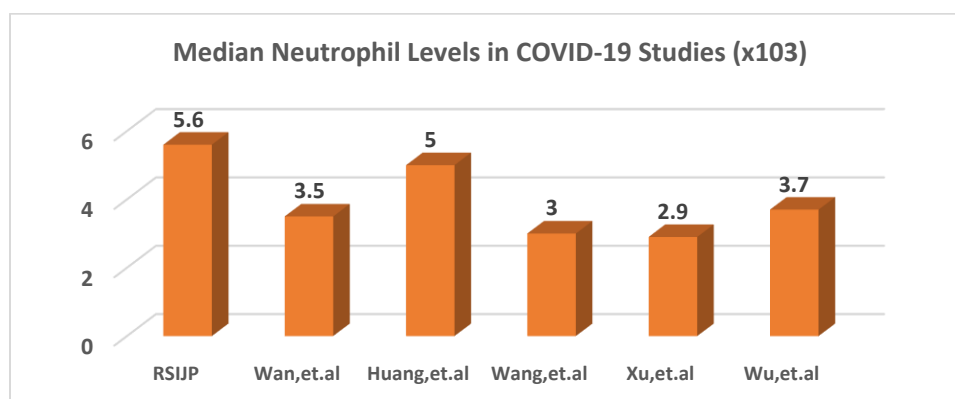


Figure 3. Median neutrophil levels in various COVID-19 studies

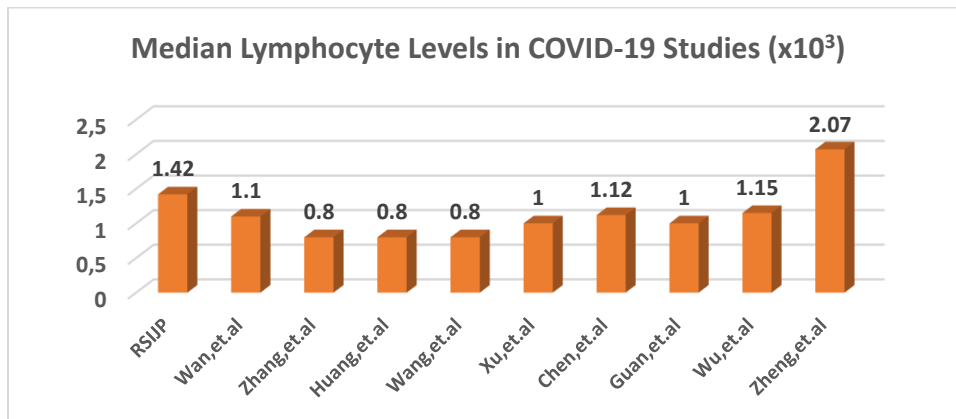


Figure 4. Median lymphocyte levels in various COVID-19 studies

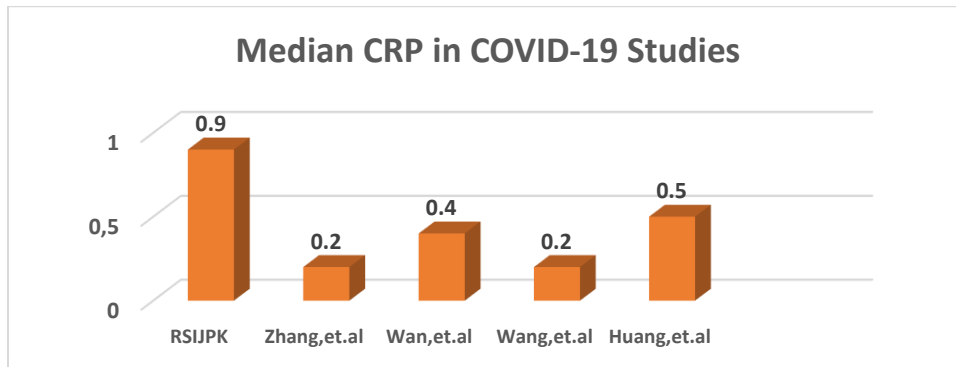


Figure 5. Median CRP in various COVID-19 studies

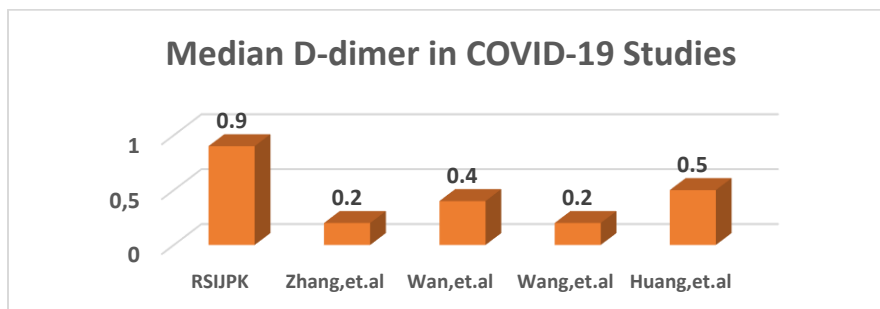


Figure 5. Median CRP in various COVID-19 studies

This study has limitations, including the relatively small number of respondents and incomplete laboratory parameters. Further research is required involving a larger number of respondents and complete laboratory parameters, in order to gain a more precise overview of the hematological parameters that can be used to predict the possibility of patients being infected with COVID-19. The majority of COVID-19 patients in this study had normal blood leukocyte levels, increased NLR, low ALC, and increased CRP and d-dimer.

CONCLUSION

This study on the hematological parameters of COVID-19 patients at Jakarta Pondok Kopi Islamic Hospital has yielded significant insights into the relationship between these parameters and disease severity. The research found that the majority of patients were male, with a median age of 49.9 years, and common comorbidities included hypertension, diabetes, and chronic kidney disease. These demographic and clinical characteristics align with findings from other studies, suggesting a pattern of higher prevalence in males and older age groups. The study also demonstrated a significant correlation between disease severity and certain hematological parameters, including leukocyte count and absolute lymphocyte count (ALC). Elevated levels of these markers were associated with more severe cases of COVID-19, consistent with findings from similar research conducted globally.

The study's findings contribute to a broader understanding of how specific hematological parameters can reflect the severity of COVID-19. Significant relationships were observed between leukocyte and ALC levels and the severity of the disease, supporting the use of these parameters as indicators for monitoring patient progression. These results are in line with prior research, which has highlighted the role of hematological markers in assessing COVID-19 severity. The identification of these parameters as reliable indicators can aid in better patient management and resource allocation, especially in settings with high patient volumes and limited resources.

For future research, it is recommended to expand the study to include a larger and more diverse patient population to validate these findings further. Investigating additional hematological markers and their interactions could provide a more comprehensive understanding of disease mechanisms and improve diagnostic accuracy. Additionally, exploring the impact of various treatment regimens on hematological parameters could offer insights into optimizing therapeutic strategies for COVID-19 patients. Future studies should also consider longitudinal analyses to track changes in hematological parameters over the course of the disease and their correlation with long-term outcomes.

Conflicts of interest

None

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