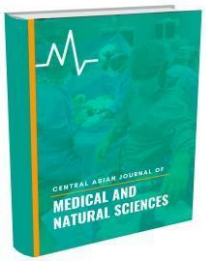

CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES
https://cajmns.centralasianstudies.org/index.php/CAJMNS
*Volume: 05 Issue: 04 | October 2024 ISSN: 2660-4159*

.

*Article*

# Correlation Between Blood Sugar Levels and D-Dimer Levels in Covid-19 Patients at PKU Muhammadiyah Gamping Hospital

**Widiyatmoko A[1]*, Utaminingsih NN[2]**

1, 2 Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta, Indonesia
* Correspondence: aguswidi@umy.ac.id

**Abstract:** The Coronavirus Disease 2019 (COVID-19) can cause fatal outcome. A number of factors, including blood glucose levels, can impact how this disease progresses. One of the test results that is utilized to assess the prognosis of COVID-19 patients is D- dimer. The aim of this study is to ascertain how blood sugar levels affect D-dimer levels in PKU Muhammadiyah Gamping Hospital COVID-19 inpatients. This research is aquantitative analytical observational study with a cross sectional design. The number of samples in this study was 373 samples, consisting of 213 samples of COVID-19 patients with blood glucose <200 mg/dl and 160 samples of COVID-19 patients with blood glucose >200 mg/dL. The sample was obtained using a simple random sampling method. Analysis was applied to determine the correlation between blood sugar levels and D-dimer levels from the two sample groups. This study also measured the D-dimer cut-off point value which was assessed using the ROC curve. Results: No significant correlation was found between blood sugar levels and D- dimer levels in COVID-19 patients hospitalized at PKU Muhammadiyah Gamping Hospital (p>0.05).The cut-off pointvalue of D-dimer in diabetes patients is 1,505 mg/dL with sensitivity of 62,7% and specificity of 63,8% and the risk of death is 2,2 greater in patients with D-dimer levels >1,505mg/dL (RR: 2,217; 95% CI: 1,499- 3,278). Conclusion: Blood sugar and D-dimer levels did not significantly correlate in COVID-19 inpatients. The risk of death in patients with D-dimer levels >1.505 mg/dL was 2.2.

**Keywords:** COVID-19, D-dimer, Blood Glucose Levels.

**Citation:** Widiyatmoko A. Correlation Between Blood Sugar Levels and D-Dimer Levels in Covid-19 Patients at PKU Muhammadiyah Gamping Hospital. Central Asian Journal of Medical and Natural Science 2024, 5(4), 722-728

Received: 10th Agst 2024
Revised: 11th Agst 2024
Accepted: 16th Sept 2024
Published: 28th Oct 2024



## 1. Introduction

The world was shocked by the discovery of a new coronavirus in early 2020, called Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2). This virus causes a disease with symptoms similar to pneumonia which is now better known as Coronavirus Disease (COVID-19). SARS-CoV-2 was first identified in late December 2019 in the city of Wuhan, China. As of February 16, 2020, 51,857 cases have been reported in 25 countries. Due to its rapid spread, the World Health Organization (WHO) declared COVID-19 a pandemic on March 12, 2020. [1]

The first case of COVID-19 was reported in Indonesia on March 2, 2020.1 The latest data recorded by the COVID-19 Handling Task Force (SATGAS COVID-19) until September 26, 2022, as many as 6,423,873 cases have been reported and 158,036 of them are deaths with a mortality rate (MR) of 2.5%. Confirmed COVID-19 cases in the province of Yogyakarta itself are 224,408 or around 3.5% of the total cases in Indonesia. [2]

The course of COVID-19 infection cannot be separated from the angiotensin converting enzyme 2 (ACE-2) which is known to be a receptor for SARS-CoV-2.

Physiologically, ACE-2 is expressed in the lungs, heart, kidneys, and intestines. ACE-2 in the lungs is expressed by alveolar types I and II. When the coronavirus receptor S binds to ACE-2, a structural change occurs that causes fusion between the viral cell membrane and the host cell membrane. The virus then replicates in the upper respiratory tract mucosal epithelium (pharynx and nasal cavity) before moving to the lower respiratory tract and gastrointestinal mucosa, causing moderate viremia.[3]

Hyperglycemia is one of the clinical factors that can worsen the prognosis of COVID-19. Several studies have shown that SARS-CoV-2 infection in patients with hyperglycemia is at higher risk of experiencing cytokine storm syndrome. Cytokine storms occur when the production of cytokines and chemokines that trigger inflammation increases. Under normal circumstances, the innate immune system reaction functions as the body's first line of defense against infection. However, an excessive immune response can damage the human immune system. In COVID-19 patients, the most common clinical manifestation is acute respiratory distress syndrome (ARDS). [3,4]

The mechanism of ARDS in COVID-19 is often associated with hypercoagulability. Systemic inflammatory response syndrome (SIRS), as a result of cytokine storm, causes hypercoagulation and endotheliopathy. Both increase macrothrombosis which initiates thromboembolism in veins and arteries. Microthrombosis can also increase which causes ARDS to multi-organ damage. [5] D-dimer examination is an important laboratory examination in assessing hypercoagulation conditions. D-dimer is the smallest fragment of the fibrinolysis process. An increase in this marker is a sign of hypercoagulation in patients. [6]

## 2. Materials and Methods

This study adapted the type of quantitative analytical observational research with a cross-sectional design. The selection of the research design was based on the goal to observe blood sugar and D-dimer levels in COVID-19 patients without providing intervention. The results of the observations will then be analyzed to determine the two variables where both are observed at the same time to facilitate the research process.

Based on the calculation results, a minimum sample of 222 samples was obtained in this study. The sample was obtained after sorting the medical records of COVID-19 patients at the PKU Mubammadiyah Gamping Hospital which were adjusted to the inclusion and exclusion criteria. This study was conducted in July-September 2023.

## 3. Results

**Blood Sugar Levels**

Blood sugar levels are the concentration of glucose that can be found in the blood. In this study, plasma GDS examination was used which was examined using the Cobas tool with the hexokinase method. Normal plasma GDS values use reference values set based on the consensus of the Indonesian Endocrinology Association (PERKENI) 2021.

**D-dimer**

D-dimer is a cross-degeneration product of fibrin. An increase in D-dimer values indicates hypercoagulation. In this study, D-dimer examination was carried out at the PKU Muhammadiyah Gamping Hospital using the STA Compact Max tool with the Latex Immunoassay method. 2 cc of whole blood was used as a sample which was then mixed with the latest buffer or latex reagent.

**Coronavirus disease-19**

Also known as COVID-19 is an infection with primary symptoms in the respiratory tract Land caused by SARS-CoV-2. The diagnosis of COVID-19 in this study was confirmed using the gold standard PCR.

**Table 1.** Characteristics of Research Subjects

| Characteristics | Total (n =373) | Random blood glucose <200 mg/dL (n =213) | Random blood glucose >200 mg/dL (n =160) |
|---|---|---|---|
| **Age**, Mean ± SD tabun | 53,14 ±7,07 | 52,88 ±7,81 | 53,49 ±5,95 |
| **Sex** | | | |
| Men, N (%) | 200 (53,6) | 118 (55,4) | 82 (51,2) |
| Women, N (%) | 173 (46,4) | 95 (44,6) | 78 (48,8) |
| **Comorbid** | | | |
| Diabetes, N (%) | 159 (42,6) | 43 (20,2) | 116 (72,5) |
| Hypertension, N (%) | 84 (22,5) | 61 (28,6) | 23 (14,4) |
| Cardiovascular, N (%) | 7 (1,9) | 5 (2,3) | 2 (I,3) |
| Stroke, N (%) | 8 (2,l) | 4 (1,9) | 4 (2,5) |
| Lung disease u, N (%) | 5 (1,3) | 5 (2,3) | 0 (0,0) |
| Chronic kidney disease, N (%) | 6 (1,6) | 4 (1,9) | 2 (1,3) |
| Anemia, N (%) | 4 (1,1) | 4 (1,9) | 0 (0,0) |
| Atherosclerosis, N (%) | 2 (0,5) | 2 (0,9) | 0(0,Q) |
| Dengue fever, N (%) | l (0,3) | 1 (0,5) | 0 (0,0) |
| Apendisitis, N (%) | l (0,3) | l (0,5) | 0 (0,0) |
| Without comorbid,N (%) | 96 (25,7) | 83 (39,0) | 160(8,1) |
| **Clinical manifestasion** | | | |
| Systolic pressure, ± SD mmHg | 139,44 ±28,02 | 141,89 ±28,59 | 136,19 ±26,98 |
| Diastolic pressure ±SD mmHg | 81,88 ±16,27 | 83,50 ±16,88 | 79,73 ±15,20 |
| HR, Mean ± SD N/menit | 101,94 ±20,67 | 103,77 ±22,36 | 99,49 ±17,95 |
| RR, Mean ± SD N/menit | 35,10 ±6,27 | 34,74 ±5,84 | 35,58 ±6,79 |
| SpO2, ±SD(%) | 85,58 ±8,40 | 86,18 ±7,64 | 84,79 ±9,28 |
| D-dimer, Mean ± SD mg/I | 2,41 ±3,12 | 2,59 ±3,39 | 2,17 ±2,71 |
| Blood glucose, Mean± SD mg/dL | 204,66 ±115,50 | 125,85 ±30,43 | 309,59 ±102,82 |
| **Outcames** | | | |
| Died, N (%) | 83 (22,3) | 49 (23,0) | 34 (21,3) |
| Healed, N (%) | 290 (77,7) | 164 (77,0) | 126 (78,8) |

The test results showed a significance of correlation study 0.159 in the group of patients with random blood glucose levels <200 mg/ Land 0.416 in the group of patients with random blood glucose levels >200mg/dL. This value is above 0.05 (p <0.05) so it can be interpreted that there is No. significant correlation between blood sugar and D-dimer. The correlation coefficient value in the random blood glucose <200 mg/dL group was 0.097 and 0.065 in the random blood glucose >200 mg/dL group. Both values indicate a very weak relationship. A positive correlation indicates that the higher the blood sugar level, the higher the D-dimer level.

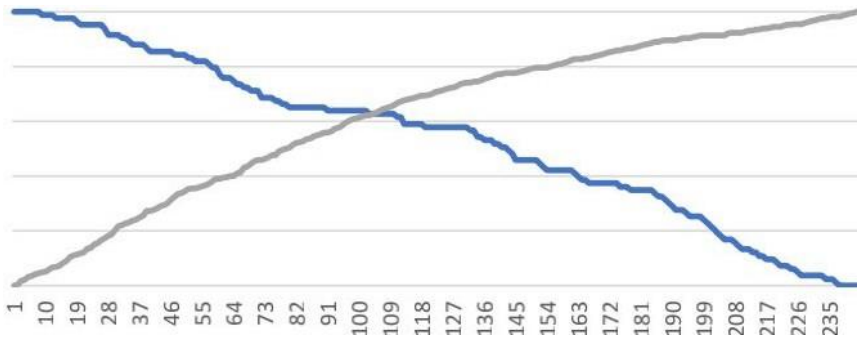


**Figure 1.** The ROC curve test D-dimer Cut-off Point Value and Risk of Death in COVID-19 Patients Due to High D-dimer Levels.

The cut-off point was assessed using the ROC curve test to determine the level of D-dimer levels on the risk of death. The test results obtained a cut-off point value of 1.505 mg/dL with a sensitivity of 62.7% and a specificity of 63.8%.

**Table 2**. D Dimer and Outcome

| *Outcome* | **D-dimer <1,505 mg/dL (n = 216)** | **D-dimer >1,505 mg/dL (n = 157)** | **p** |
|---|---|---|---|
| **Died N** (%) | 31 (14,4) | 52 (33,1) | <0,001* |
| **Not died, N** (%) | 185 (85,6) | 105 (66,9) | |

Relative risk (RR) was calculated to find the chance of death risk in patients with D-dimer levels of >1.505 mg/dL compared to the D dimer group <1.505 mg/dL. The calculation results obtained RR: 2.217 (95% CI: 1.499 – 3.278) which means that patients with D-dimer levels of >1.505 mg/dL have a risk of death 2.2x greater than patients with D-dimer levels <1.505 mg/dL.

## 4. Discussion

Male gender, old age, and history of comorbidities have been widely mentioned as the most common risk factors for COVID-19.[8] Diabetes is one of the comorbidities that has been shown to contribute to increased morbidity and mortality rates through metabolic, microvascular, and macrovascular complications as well as.

Reactive hyperglycemia which is a predictor of COVID-19 severity [9]. Miri et al., (2021) found that D-dimer levels were significantly higher in diabetic patients, meaning that diabetic patients are more likely to experience hypercoagulation.[10] This finding is in contrast to the results of a study which stated that there was no significant correlation between blood sugar levels and D-dimer levels. These results are supported by research by Nafila et al., (2023) on COVID-19 patients with type 2 diabetes at the Sebelah Maret University Hospital which showed no significant relationship between blood glucose and D-dimer levels.[11] Another study by Li et al., (2022) also found that hyperglycemic patients with normal D-dimer did not have a higher risk of experiencing adverse effects in the hospital compared to normoglycemic patients.[12]

Researchers used random blood sugar variables to find a correlation with D-dimer. Hyperglycemia can be influenced by carbohydrate intake and the processes of gluconeogenesis and glycogenolysis [13]. It has been previously known that COVID-19 infection can induce a cytokine storm. During stress, complex feedback interactions between hormones and cytokines result in accelerated liver gluconeogenesis and insulin

resistance. This condition is also called stress hyperglycemia [14]. Other factors, such as pre-existing diabetes, can also affect increased blood sugar levels [15].

Post-admission hypoglycemia in the hospital can occur due to insulin administration. Insulin is the therapy of choice for critical and non-critical hospitalized patients with or without diabetes in hyperglycemic patients.[16] Some people, further insulin administration can cause therapeutic hyperinsulinemia which then progresses to hypoglycemia.[17]

Coagulation disorders are laboratory findings that correlate with the severity of COVID-[19, 18] Increased D-dimer is a sign of excessive coagulation activity and hypertribinolysis. In this study, D-dimer levels in patients with blood glucose <200 mg/dL were higher than D-dimer levels in patients with blood glucose >200 mg/dL. This difference may be due to the increase in D-dimer levels being influenced by many factors. First, D-dimer increases in thromboinflammatory conditions due to viral infections which then cause antithrombotic and anti-inflammatory dysfunction of Endothelial cells. Second, D-dimer increases in hypoxic conditions. Third, increased D-dimer can be influenced by immobilization and the use of ventilation and central venous catheters during hospitalization. Fourth, D-dimer can increase as a result of hyperglycemic stress [19].

Increased D-dimer levels in COVID-19 patients can be aggravated by comorbid factors. In this study, diabetes and hypertension were the most common comorbidities. Studies have shown that there is a relationship between increased D-dimer levels in diabetic patients. Persistent hyperglycemia in diabetic patients causes endothelial dysfunction and inflammation which then contributes to thrombus formation. This process occurs through the oxidative stress pathway and non-enzymatic glycation.[20] Acute hyperglycemia through the oxidative stress pathway increases thrombin formation, while the non-enzymatic glycation pathway causes decreased function of antithrombin III and heparin cofactor II. The imbalance of pro-coagulation, anti-coagulation, and fibrinolysis due to hyperglycemia causes increased coagulation activity.[21] Endothelial dysfunction also occurs in hypertensive patients. Persistent increases in blood pressure cause the vascular wall to be stressed and activate NADPH oxidase. As a result, there is an increase in free radicals that induce chronic inflammation. Furthermore, chronic inflammation characterized by inflammatory cytokine activity causes more fibrinogen production so that coagulation activity will increase.[22] D-dimer can also increase in sepsis, thromboembolism, and malignancy.[23] Studies show that malignancy is a risk factor for thromboembolism in COVID-19 patients which is seen in increased pro-inflammatory markers, fibrinogen, and D-dimer. [24]

Other factors that can affect D-dimer levels are age and gender. D-dimer concentrations increase with age due to increased pro-inflammatory production associated with degenerative processes.[18,25] In men, the risk of thrombosis is greater than in women. This may be because in men the immune response produces more cytokines. However, the study did not find a significant difference in D-dimer levels between the two. [26] D-dimer levels can also be affected by the administration of anticoagulation during hospitalization.

The study found that patients receiving oral anticoagulant therapy had lower D-dimer levels compared to patients who did not receive anticoagulation therapy. The decrease in D-dimer levels during anticoagulation therapy indicates that plasma D-dimer concentration is an indirect marker of reduced coagulation activity.[14]

D-dimer examination is a strong predictor for assessing the prognosis of COVID-19 patients.[27] Therefore, researchers measured the D-dimer cut-off point value to predict the risk of mortality in patients. The measurement results showed that the D-dimer cut-off point value was 1.505 mg/dL with a sensitivity of 62.7% and a specificity of 63.8%. Researchers found that there was a strong relationship between D-dimer levels and mortality. Studies have shown that increasing D-dimer levels during treatment indicate disease severity and risk of death in all patients.[10] In another study, increasing D-dimer levels >2.14 mg/dL had a higher risk of death in the hospital.28 This study also found that the risk of death in patients with D-dimer levels >1,505 mg/dL increased 2.2x greater than in patients with D-dimer levels <1.505 mg/dL.

## 5. Conclusion

Based on the research results, it can be concluded that there is no correlation between blood sugar levels and D-dimer levels in COVID-19 patients at PKU Muhammadiyah Gamping Hospital. An increase in D dimer indicates excessive coagulation activity so that checking D-dimer levels is often done as a predictor of mortality in COVID-19 patients. In this study, the cut-off point value of D-dimer was 1.505 mg/dL with a sensitivity of 62.7% and a specificity of 63.8%. The risk of death in patients with D-dimer levels >1.505 mg/dL was 2.2x higher than in patients with D-dimer levels <1.5050 mg/l.

## 6. Competing Interest

The authors have declared that no competing interests exist

## REFERENCES


1. Alvenus Willim, H., Trixie Hardigaloeh, A., Inda Supit, A., & Handriyani. (2020). Koagulopati pada Coronavirus Disease-2019 (COVID-19): Tinjauan pustaka. lntisari Sains Medis, 11, 749-756.
2. Andreani, F. V., Belladonna, M., & Hendrianingtyas, M. (2018). HubunganAntara Gula Darah Sewaktu dan Puasa dengan Perubahan Skor NIHSS Pada Stroke Iskemik Akut. 7(1).
3. Basundoro, P. A., & Adhipireno, P. (2017). Hubungan Kadar Glukosa Darah terhadap Estimasi Laju Filtrasi GlomeruJus pada Pasien Diabetes Melitus. Jurnal Kedokteran Diponegoro (Diponegoro Medical Journal), 6(2), Article 2. https://doi.org/10.14710/dmj.v6i2.18614
4. Cen, Y., Chen, X., Shen, Y., Zhang, X.-H., Lei, Y., Xu, C., Jiang, W.-R., Xu, H.-T., Chen, Y., Zhu, J., Zhang, L.-L., & Liu, Y.-H. (2020). Risk factors for disease progression in patients with mild to moderate coronavirus disease 2019-A multi-centre observational study. Clinical Microbiology and Infection, 26(9), 1242-1247. https://doi.org/10.1016/j.cmi.2020.05.041
5. Ceriello, A.(2020). Diabetes, D-dimer and COVID-19: The possible role of glucose control. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 14(6), 1987. https://doi.org/10.1016/j.dsx.2020.10.011
6. Chilamakuri, R., & Agarwal, S. (2021). COVID-19: Characteristics and Therapeutics. Cells, 10(2), 206. https://doi.org/10.3390/cells10020206
7. Cruz, P. (2020). Inpatient Hypoglycemia: The Challenge Remains. Journal of Diabetes Science and Technology, 14(3), 560-566. https://doi.org/10.1177/1932296820918540
8. Geetha, H. S., Singh, G., Sekar, A., Gogtay, M., Singh, Y., Abraham, G. M., & Trivedi, N. (2023). Hyperglycemia in COVID-19 infection without diabetes mellitus: Association with inflammatory markers. World Journal ofClinical Cases, 11(6), 1287-1298. https://doi.org/10.12998/wjcc.vl 1.i6.1287
9. Guo, W., Li, M., Dong, Y., Zhou, H., Zhang, Z., Tian, C., Qin, R., Wang, H., Shen, Y., Du, K., Zhao, L., Fan, H., Luo, S., & Hu, D. (2020). Diabetes is a risk factor for the progression and prognosis of COVID-19 Diabetes/Metabolism Research and Reviews, 36(1), e3319. https://doi.org/10.1002/dmrr.3319
10. Hanifah, N. A., J Nugroho Eko Putranto, & Laksrni Wulandari. (2023). D-dimer relation with hypertension and non-hypertension in covid-19 patient. World Journal of Advanced Research and Reviews, 20(2), 1338-1348. https://doi.org/10.30574/wjarr.2023.20.2.2382
11. Hashim Ibrahim Elbashir, I., Kamal Ali Mohamed, H., Adam Essa, M. E., & Seri, A. (2022). Comparison between D-dimer levels in diabetic and non-diabetic positive COVID-19 adult patients: A hospital-based study. Endocrinology, Diabetes & Metabolism, 5(4), e349. https://doi.org/10.1002/edm2.349
12. Intanwati, S. (2020). Peran Pemeriksaan D-Dimer pada COVID-19. Prosiding FK UB, J(l), Article 1.
13. Li, H., Chen, S., Wang, S., Yang, S., Cao, W., Liu, S., Song, Y., Li, X., Li, Z., Li, R., Liu, X., Wang, C., Chen, Y., Xie, F., He, Y., & Liu, M. (2022). Elevated D-dimer and Adverse In-hospital Outcomes in COVID-19 Patients and Synergism with Hyperglycemia. Infection and Drug Resistance, Volume 15, 3683-3691. https://doi.org/10.2147/IDR.S367012

14. Miri, C., Charii, H., Bouazzaoui, M.-A., Laouan Brem, F., Boulouiz, S., Abda, N., Kouisrni, H., Bazid, Z., lsmaili, N., & El Ouafi, N. (2021). D-dimer Level and Diabetes in the COVID-19 Infection. Clinical and Applied Thrombosis/Hemostasis, 27, 107602962110459. https://doi.org/10.1177/10760296211045902
15. Nafila, R. R., Ardyanto, T. D., & Hermawati, B. D. (2023). Hubungan Glukosa Darah Adrnisi dan HbAlc dengan Kadar D-Dimer pada Pasien COVID-19 dengan Diabetes Melitus Tipe 2. Plexus Medical Journal, 2(3), Article 3. https://doi.org/10.20961/plexus.v2i3.558
16. Nakhleh, A., & Shehadeh, N. (2021). Hypoglycemia in diabetes: An update on pathophysiology, treatment, and prevention. World Journal of Diabetes, 12(12), 2036. https://doi.org/10.4239/wjd.v12.i12.2036
17. PERKENI. (2021). Pedoman pengelolaan dan pencegahan diabetes melitus tipe 2 dewasa di INDONESIA - 2021. 119.
18. Rav Acha, M., Taha, L., Turyan, A., Farkash, R., Bayya, F., Karmi, M., Steinmetz, Y., Shaheen, F. F., Perel, N., Hamayel, K., Levi, N., Karameh, H., Tvito, A., Glikson, M., & Asher, E. (2022). D-Dimer as a Prognostic Factor in a Te1tiary Center Intensive Coronary Care Unit. Clinical and Applied Thrombosis/Hemostasis, 28, 10760296221110879. https://doi.org/10.1177/10760296221110879
19. SATGAS COVID-19. (2022). Peta Sebaran. Covid19 Indonesia. https://covid19.go.id/id/peta-sebaran
20. Schouten, H. J., Geersing, G. J., Koek, H. L., Zuithoff, N. P. A., Janssen, K. J. M., Douma, R. A., van Delden, J. J.M., Moons, K. G. M., & Reitsma, J.B. (2013). Diagnostic accuracy of conventional or age adjusted D-dimer cut-off values in older patients with suspected venous thromboembolism: Systematic review and meta-analysis. The BMJ, 346, f2492. https://doi.org/10.1136/bmj .f2492
21. Silaghi-Dumitrescu, R., Patrascu, I., Lehene, M., & Bercea, I. (2023). Comorbidities of COVID-19 Patients. Medicina, 59(8), 1393. https://doi.org/10.3390/medicina59081393
22. Susilo, A., Rumende, C. M., Pitoyo, C. W., Santoso, W. D., Yulianti, M., Herikurniawan, H., Sinto, R., Singh, G., Nainggolan, L., Nelwan, E. J., Chen, L. K., Widhani, A., Wijaya, E., Wicaksana, B., Maksum, M., Annisa, F., Jasirwan, C. 0. M., & Yunihastuti, E.(2020). Coronavirus Disease 2019: Tinjauan Literatur Terkini. Jurnal Penyakit Dalam Indonesia, 7(1), Article. https://doi.org/10.7454/jpdi.v7.415
23. Tang, N., Pan, Y., Xu, C., & Li, D. (2020). Characteristics of emergency patients with markedly elevated D-dimer levels. Scientific Reports, 10, 7784. https://doi.org/10.1038/s41598-020-64853-0
24. Yamashita, Y., Yachi, S., Takeyama, M., Nishimoto, Y., Tsujino, I., Nakamura, J., Yamamoto, N., Nakata, H., Ikeda, S., Umetsu, M., Aikawa, S., Hayashi, H., Satokawa, H., Okuno, Y., Iwata, E., Ogihara, Y., Ikeda, N., Kondo, A., Iwai, T. (2022). Influence of sex on development of thrombosis in patients with COVID-19: From the CLOT-COVID study. Thrombosis Research,213, 173-178. https://doi.org/10.1016/j.thromres.2022.03.023
25. Yang, X., Zhang, R., Jin, T., Zhu, P., Yao, L., Li, L., Cai, W., Mukherjee, R., Du, Fu, X., Xue, J., Martina, R., Liu, T., Pendharkar, S., Phillips, A. R.,Singh, V. K., Sutton, R., Windsor, J A., Deng, L., ... Huang, W. (2022). Stress Hyperglycemia Is Independently Associated with Persistent Organ Failure in Acute Pancreatitis. DigestiveDiseases and Sciences, 67(5), 1879- 1889. https://doi.org/10.1007Is10620-021-06982-8
26. Yao, Y., Cao, J., Wang, Q., Shi, Q., Liu, K., Luo, Z., Chen, X., Chen, S., Yu, K., Huang, Z., & Hu, B. (2020). D-dimer as a biomarker for disease severity and mortality in COVID-19 patients: A case control study. Journal of IntensiveCare, 8(1), 49. https://doi.org/10.ll 86/s40560-020-00466-z
27. Zainul Fatoni, A., & Rakhmatullah, R. (2021). Acute Respiratory Distress Syndrome (ARDS) pada Pneumonia COVID-19. Journal of Anaesthesia and Pain, 2, 11-24.
28. Zavras, P. D., Kabarriti, R., Mehta, V., Goel, S., & Billett, H. H. (2020). Clinical Thrombosis Rate was not Increased in a Cohort of Cancer Patients with COVID-19 [Preprint]. Infectious Diseases (except HIV/AIDS). https://doi.org/10.1101/2020.09.15.20195263