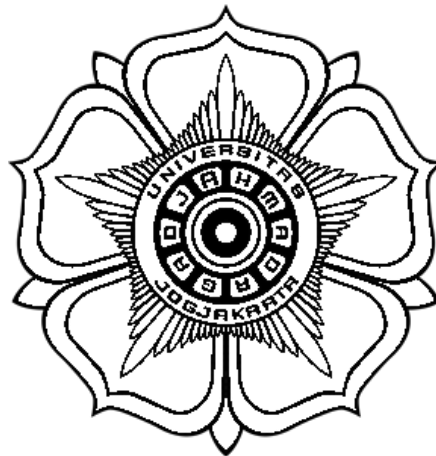


**EVALUASI *PLATELET TO LYMPHOCYTE RATIO* (PLR) SEBAGAI  
PREDIKTOR MORTALITAS PADA PASIEN COVID-19**

**TESIS**

**Untuk memenuhi sebagian persyaratan mencapai derajat Dokter Spesialis I  
Program Studi Patologi Klinik**



**Diajukan oleh:**

**Ika Ridlawati**

17/420574/PKU/16972

**Pembimbing I: Dr. dr. Usi Sukorini, M.Kes., Sp.PK(K)**

**Pembimbing II: dr. Windarwati. M.Sc., SpPK(K)**

**PROGRAM PENDIDIKAN DOKTER SPESIALIS I  
PROGRAM STUDI PATOLOGI KLINIK  
FK-KMK UNIVERSITAS GADJAH MADA  
YOGYAKARTA  
2022**

## DAFTAR PUSTAKA

- Abbas, A., Lichtman, A. and Pillai, S. (2019), *Basic Immunology E-Book: Functions and Disorders of the Immune System*, 5th ed., Elsevier, Philadelphia.
- Asghar, M.S., Khan, N.A., Haider Kazmi, S.J., Ahmed, A., Hassan, M., Jawed, R., Akram, M., *et al.* (2020), "Hematological parameters predicting severity and mortality in COVID-19 patients of Pakistan: a retrospective comparative analysis", *J Community Hosp Intern. Med. Perspect*, Vol. 10 No. 6, pp. 514–520.
- Bikdeli, B., Madhavan, M. V., Gupta, A., Jimenez, D., Burton, J.R., Der Nigoghossian, C., Chuich, T., *et al.* (2020), "Pharmacological Agents Targeting Thromboinflammation in COVID-19: Review and Implications for Future Research", *J Thromb Haemost*, Vol. 120 No. 7, pp. 1004–1024.
- BNPB. (2020), "Peta Sebaran Covid di Indonesia", available at: [www.Covid.go.id](http://www.Covid.go.id) (accessed 20 September 2021).
- Cao, W. and Li, T. (2020), "COVID-19: towards understanding of pathogenesis", *Cell Res*, Vol. 30 No. 5, pp. 367–369.
- Carlos, W.G., Cruz, C.S. Dela, Cao, B., Pasnick, S. and Jamil, S. (2020), "COVID-19 Disease due to SARS-CoV-2 (Novel Coronavirus)", *Am J Respir Crit Care Med*, Vol. 201 No. 4, pp. P7–P8.
- Cevik, M., Kuppalli, K., Kindrachuk, J. and Peiris, M. (2020), "Virology , transmission , and pathogenesis of SARS-CoV-2", *BMJ*, Vol. 2019, pp. 1–6.
- Channappanavar, R., Fehr, A.R., Vijay, R., Mack, M., Zhao, J., Meyerholz, D.K. and Perlman, S. (2016), "Dysregulated Type I Interferon and Inflammatory Monocyte-Macrophage Responses Cause Lethal Pneumonia in SARS-CoV-Infected Mice", *Cell Host Microbe*, Vol. 19 No. 2, pp. 181–193.
- Chaparro, C.M. and Suchdev, P.S. (2019), "Anemia epidemiology, pathophysiology, and etiology in low- and middle-income countries", *Ann N Y Acad Sci*, Vol. 1450 No. 1, pp. 15–31.
- Chen, N., Min, Z., Dong, X., Qu, J., Gong, F., Han, Y., Qiu, Y., *et al.* (2020), "Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study Nanshan", *Lancet*, Vol. 395 No. January, pp. 507–513.
- Dávila-Collado, R., Jarquín-Durán, O., Solís-Vallejo, A., Nguyen, M.A. and

- Espinoza, J.L. (2021), "Elevated monocyte to lymphocyte ratio and increased mortality among patients with chronic kidney disease hospitalized for COVID-19", *J.Pers.Med.*, Vol.11No.3.
- Delshad, M., Tavakolinia, N., Pourbagheri-Sigaroodi, A., Safaroghli-Azar, A., Bagheri, N. and Bashash, D. (2021), "The contributory role of lymphocyte subsets, pathophysiology of lymphopenia and its implication as prognostic and therapeutic opportunity in COVID-19", *Int Immunopharmacol*, Vol. 95.
- Diao, B., Wang, C., Tan, Y., Chen, X., Liu, Y., Ning, L., Chen, L., *et al.* (2020), "Reduction and Functional Exhaustion of T Cells in Patients With Coronavirus Disease 2019 (COVID-19)", *Front Immunol*, Vol. 11 No. May, pp. 1–7.
- Doremalen, van N., Bushmaker, T., Morris, D.H., Holbrook, M.G., Gamble, A., Williamson, B.N., Tamin, A., *et al.* (2020), "Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1", *N Engl J Med*, Vol. 382 No. 16, pp. 1564–1567.
- Du, R.H., Liu, L.M., Yin, W., Wang, W., Guan, L.L., Yuan, M.L., Li, Y.L., *et al.* (2020), "Hospitalization and critical care of 109 decedents with COVID-19 pneumonia in Wuhan, China", *Annals of the American Thoracic Society*, Vol. 17 No. 7, pp. 839–846.
- Eastwood, B.J., Farnen, M.W., Iversen, P.W., Craft, T.J., Smallwood, J.K., Garbison, K.E., Delapp, N.W., *et al.* (2006), "The minimum significant ratio: A statistical parameter to characterize the reproducibility of potency estimates from concentration-response assays and estimation by replicate-experiment studies", *J Biomol Screen*, Vol. 11 No. 3, pp. 253–261.
- Elshazli, R., Toraih, E., Elgaml, A., El-Mowafy, M., El-Mesery, M., Amin, M., Hussein, M., *et al.* (2020), "Diagnostic and prognostic value of hematological and immunological markers in COVID-19 infection: A meta-analysis of 6320 patients", *PloS One*, Vol. 15 No. 8.
- Engelmann, B. and Massberg, S. (2013), "Thrombosis as an intravascular effector of innate immunity", *Nat Rev Immunol*, Vol. 13 No. 1, pp. 34–45.
- Erdogan, A., Can, F.E. and Gönüllü, H. (2021), "Evaluation of the prognostic role of NLR, LMR, PLR, and LCR ratio in COVID-19 patients", *J Med Virol*, Vol. 93 No. 9, pp. 5555–5559.
- Fuji, T., Fujita, S., Kawai, Y., Nakamura, M., Kimura, T., Fukuzawa, M., Abe, K., *et al.* (2015), "Efficacy and safety of edoxaban versus enoxaparin for the prevention of venous thromboembolism following total hip arthroplasty: STARS J-V", *Thromb J*, Vol. 13 No. 1, pp. 1–9.
- Gálvez-Barrón, C., Arroyo-Huidobro, M., Miñarro, A., Añaños, G., Chamero, A.,

- Martín, M., Gris, C., *et al.* (2021), “COVID-19: Clinical Presentation and Prognostic Factors of Severe Disease and Mortality in the Oldest-Old Population: A Cohort Study”, *Gerontology*, pp. 1–14.
- Guan, W., Ni, Z., Hu, Y., Liang, W., Ou, C., He, J., Liu, L., *et al.* (2020), “Clinical characteristics of coronavirus disease 2019 in China”, *N Engl J Med*, Vol. 382 No. 18, pp. 1708–1720.
- Hashem, M.K., Khedr, E.M., Daef, E., Mohamed-Hussein, A., Mostafa, E.F., Hassany, S.M., Galal, H., *et al.* (2021), “Prognostic biomarkers in COVID-19 infection: value of anemia, neutrophil-to-lymphocyte ratio, platelet-to-lymphocyte ratio, and D-dimer”, *Egypt J Bronchol*, Vol. 15 No. 1.
- Holinstat, M. (2017), “Normal platelet function”, *Cancer Metastasis Rev*, Vol. 36 No. 2, pp. 195–198.
- Jiang, Y., Wei, X., Guan, J., Qin, S., Wang, Z. and Lu, H. (2020), “COVID-19 pneumonia: CD8+ T and NK cells are decreased in number but compensatory increased in cytotoxic potential”, *J Clin Immunol*.
- Jose, R.J. and Manuel, A. (2020), “COVID-19 cytokine storm: the interplay between inflammation and coagulation”, *Lancet Respir Med*, Vol. 8 No. 6, pp. e46–e47.
- Julianti, I. (2018), “Pemeriksaan Kadar Darah Rutin Menggunakan Hematology Analyzer”, *Universitas Indonesia*, pp. 6–7.
- Khan, S., Siddique, R., Ali, A., Bai, Q., Li, Z., Li, H., Shereen, M.A., *et al.* (2020), “The spread of novel coronavirus has created an alarming situation worldwide”, *J Infect Public Health*, Vol. 13 No. 4, pp. 469–471.
- Kim, L., Garg, S., O’Halloran, A., Whitaker, M., Pham, H., Anderson, E.J., Armistead, I., *et al.* (2021), “Risk Factors for Intensive Care Unit Admission and In-hospital Mortality Among Hospitalized Adults Identified through the US Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET)”, *Arch Clin Infect Dis*, Vol. 72 No. 9, pp. e206–e214.
- Kuba, K., Imai, Y., Ohto-Nakanishi, T. and Penninger, J.M. (2010), “Trilogy of ACE2: A peptidase in the renin-angiotensin system, a SARS receptor, and a partner for amino acid transporters”, *Pharmacol. Ther.*, Vol. 128 No. 1, pp. 119–128.
- Kumar, S., Thambiraja, T.S., Karuppanan, K. and Subramaniam, G. (2021), “Omicron and Delta variant of SARS-CoV-2: A comparative computational study of spike protein”, *J Med Virol*, pp. 1641–1649.

- Kurniawan, L.B. (2014), “Konfirmasi Apusan Darah Tepi untuk Pseudotrombositopenia”, *Cdk Journal*, Vol. 41 No. 6, pp. 422–424.
- Lang, Z.W., Zhang, L.J., Zhang, S.J., Meng, X., Li, J.Q., Song, C.Z., Sun, L., *et al.* (2003), “A clinicopathological study of three cases of severe acute respiratory syndrome (SARS)”, *Pathology*, Vol. 35 No. 6, pp. 526–531.
- Lardinois, B., Favresse, J., Chatelain, B., Lippi, G. and Mullier, F. (2021), “Pseudothrombocytopenia—a review on causes, occurrence and clinical implications”, *J Clin Med*, Vol. 10 No. 4, pp. 1–19.
- Lee, J.S., Kim, N.Y., Na, S.H., Youn, Y.H. and Shin, C.S. (2018), “Reference values of neutrophil-lymphocyte ratio, lymphocyte-monocyte ratio, platelet-lymphocyte ratio, and mean platelet volume in healthy adults in South Korea”, *Medicine*, Vol. 97 No. 26, pp. 1–5.
- Li, Q., Guan, X., Wu, P., Wang, X., Zhou, L., Tong, Y., Ren, R., *et al.* (2020), “Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus–Infected Pneumonia”, Vol. 382 No. 13, pp. 1199–1207.
- Li, X., Wang, L., Yan, S., Yang, F., Xiang, L., Zhu, J., Shen, B., *et al.* (2020), “Clinical characteristics of 25 death cases with COVID-19: A retrospective review of medical records in a single medical center, Wuhan, China”, *Int J Infect Dis*, Vol. 94 No. 2020, pp. 128–132.
- Lim, S., Bae, J.H., Kwon, H.S. and Nauck, M.A. (2021), “COVID-19 and diabetes mellitus: from pathophysiology to clinical management”, *Nat Rev Endocrinol*, Vol. 17 No. 1, pp. 11–30.
- Liu, J., Li, S., Liu, J., Liang, B., Wang, X., Wang, H., Li, W., *et al.* (2020), “Longitudinal characteristics of lymphocyte responses and cytokine profiles in the peripheral blood of SARS-CoV-2 infected patients”, *EBioMedicine*, Vol. 55.
- Martínez-Pizarro, S. (2020), “Renin-angiotensin system inhibitors in patients with COVID-19”, *Rev Cuba Cardiol Cir Cardiovasc*, Vol. 26 No. 2, pp. 1–2.
- Merad, M. and Martin, J.C. (2020), “Pathological inflammation in patients with COVID-19: a key role for monocytes and macrophages”, *Nat Rev Immunol*, Springer US, Vol. 20 No. 6, pp. 355–362.
- Mo, H., Zeng, G., Ren, X., Li, H., Ke, C., Tan, Y., Cai, C., *et al.* (2006), “Longitudinal profile of antibodies against SARS-coronavirus in SARS patients and their clinical significance”, *Respirology*, Vol. 11 No. 1, pp. 49–53.
- Mubarik, S., Liu, X., Eshak, E.S., Liu, K. and Liu, Q. (2021), “The Association of Hypertension With the Severity of and Mortality From the COVID-19 in the

Early Stage of the Epidemic in Wuhan , China : A Multicenter Retrospective Cohort Study”, *Front Med*, Vol. 8.

Nar, R. and Emekli, D.I. (2017), “The Evaluation of Analytical Performance of Immunoassay Tests by Using Six-Sigma Method”, *J Med Biochem*, Vol. 36 No. 4, pp. 301–308.

Naveed, M., Naeem, M., ur Rahman, M., Gul Hilal, M., Kakakhel, M.A., Ali, G. and Hassan, A. (2021), “Review of potential risk groups for coronavirus disease 2019 (COVID-19)”, *New Microbes New Infect*, Vol. 41, p. 100849.

Onder, G., Rezza, G. and Brusaferro, S. (2020a), “Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy”, *JAMA*, Vol. 323 No. 18, pp. 1775–1776.

Ong, S.W.X., Tan, Y.K., Chia, P.Y., Lee, T.H., Ng, O.T., Wong, M.S.Y. and Marimuthu, K. (2020), “Air, Surface Environmental, and Personal Protective Equipment Contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) from a Symptomatic Patient”, *JAMA*, Vol. 323 No. 16, pp. 1610–1612.

PDPI, PERKI, PAPDI, PERDATIN and IDAI. (2020), *Pedoman Tatalaksana COVID-19 Edisi 3 Desember 2020*, available at: <https://www.papdi.or.id/download/983-pedoman-tatalaksana-covid-19-edisi-3-desember-2020>.

PDS PatKLIn. (2020), “Panduan Tata Laksana Pemeriksaan Rapid test antigen”, *PDS PatKLIn*, pp. 1–11.

Peckham, H., de Grijter, N.M., Raine, C., Radziszewska, A., Ciurtin, C., Wedderburn, L.R., Rosser, E.C., *et al.* (2020), “Male sex identified by global COVID-19 meta-analysis as a risk factor for death and admission”, *Nat Commun*, Vol. 11 No. 1, p. 6317.

Porte, L., Legarraga, P., Vollrath, V. and Aguilera, X. (2020), “Evaluation of a novel antigen-based rapid detection test for the diagnosis of SARS-CoV-2 in respiratory samples”, *Int j Infect Dis*, Vol. 99 No. January, pp. 328–333.

Promptchara, E., Ketloy, C. and Palaga, T. (2020), “Immune responses in COVID-19 and potential vaccines: Lessons learned from SARS and MERS epidemic”, *Asian Pac J Allergy Immunol*, Vol. 38 No. 1, pp. 1–9.

Pyzdek, T. (2009), *The Six Sigma Handbook Chapter 1*, Google Ltd. Irlandia.

Qu, R., Ling, Y., Zhang, Y. hui zhi, Wei, L., Chen, X., Li, X. mian, Liu, X., *et al.* (2020), “Platelet-to-lymphocyte ratio is associated with prognosis in patients with coronavirus disease-19”, *J Med Virol*.



- Rayes, J., Bourne, J.H., Brill, A. and Watson, S.P. (2020), "The dual role of platelet-innate immune cell interactions in thrombo-inflammation", *Res Pract Thromb Haemost*, Vol. 4 No. 1, pp. 23–35.
- Salinas, M., Blasco, Á., Santo-Quiles, A., Lopez-Garrigos, M., Flores, E. and Leiva-Salinas, C. (2021), "Laboratory parameters in patients with COVID-19 on first emergency admission is different in non-survivors: Albumin and lactate dehydrogenase as risk factors", *J Clin Pathol*, Vol. 74 No. 10, pp. 673–675.
- Sanyaolu, A., Okorie, C., Marinkovic, A., Patidar, R., Younis, K. and Desai, P. (2020), "Comorbidity and its Impact on Patients with COVID-19", *SN Compr Clin Med*.
- Sarkar, S., Kannan, S., Khanna, P. and Singh, A.K. (2021), "Role of platelet-to-lymphocyte count ratio (PLR), as a prognostic indicator in COVID-19: A systematic review and meta-analysis", *J Med Virol*, Vol. 94, p. 211–221.
- Semple, J.W., Italiano, J.E. and Freedman, J. (2011), "Platelets and the immune continuum", *Nat Rev Immunol*, Vol. 11 No. 4, pp. 264–274.
- Seyit, M., Avci, E., Nar, R., Senol, H., Yilmaz, A., Ozen, M., Oskay, A., *et al.* (2020), "Neutrophil to lymphocyte ratio, lymphocyte to monocyte ratio and platelet to lymphocyte ratio to predict the severity of COVID-19", *Am J Emerg Med*.
- Seyit, M., Avci, E., Nar, R., Senol, H., Yilmaz, A., Ozen, M., Oskay, A., *et al.* (2021), "Neutrophil to lymphocyte ratio, lymphocyte to monocyte ratio and platelet to lymphocyte ratio to predict the severity of {COVID}-19", *Am J Emerg Med*, Vol. 40, pp. 110–114.
- Shi, Y., Wang, Y., Shao, C., Huang, J., Gan, J., Huang, X., Bucci, E., *et al.* (2020), "COVID-19 infection: the perspectives on immune responses", *Cell Death Differ*, Vol. 27 No. 5, pp. 1451–1454.
- Simadibrata, D.M., Adi, B. and Pandhita, W. (2020), "Platelet-to-lymphocyte ratio , a novel biomarker to predict the severity of COVID-19 patients : A systematic review and meta-analysis", *J Intensive Care Soc*, No. Vi.
- Siqueiraa, J.V.V. de, Almeidaa, L.G., Zicaa, Otávio, B., Bruma, I.B., Barcelób, A. and Galilc, A.G. de S. (2020), "Impact of obesity on hospitalizations and mortality, due to COVID-19: A systematic review", *Obes Res Clin Pract*, Vol. 14 No. 5, pp. 398–403.
- Slota, A.A., Malik, D. and Hall, D. (2020), "Pseudo-Thrombocytosis Caused by Extreme Microcytosis in a Patient with Alpha Thalassemia Trait", *Indian J Hematol Blood Transfus*, Springer India, Vol. 36 No. 4, pp. 779–780.

- Song, H., Kim, H.J., Park, K.N., Kim, S.H., Oh, S.H. and Youn, C.S. (2020), “Neutrophil to lymphocyte ratio is associated with in-hospital mortality in older adults admitted to the emergency department”, *Am J Emerg Med*, , Vol. 40, pp. 133–137.
- Song, H., Seddighzadeh, B., Cooperberg, M.R., W., F. and Huang. (2020), “Expression of ACE2, the SARS-CoV-2 receptor, and TMPRSS2 in prostate epithelial cells”, *Am J Respir Crit*, Vol. 8 No. 2, pp. 851–868.
- Sun, S., Cai, X., Wang, H., Hed, G., Line, Y., Lue, B., Chene, C., *et al.* (2020), “Abnormalities of peripheral blood system in patients with COVID-19 in Wenzhou, China”, *Clin Chim Acta*, Vol. 507 No. January, pp. 174–180.
- Susilo, A., Rumende, C.M., Pitoyo, C.W., Santoso, W.D., Yulianti, M., Herikurniawan, H., Sinto, R., *et al.* (2020), “Coronavirus Disease 2019: Tinjauan Literatur Terkini”, *J Penyakit Dalam Indones*, Vol. 7 No. 1, p. 45.
- Tan, L., Wang, Q., Zhang, D., Ding, J., Huang, Q., Tang, Y.Q., Wang, Q., *et al.* (2020), “Lymphopenia predicts disease severity of COVID-19: a descriptive and predictive study”, *Signal Transduc Target Ther*, Vol. 5 No. 1, pp. 16–18.
- Tay, M.Z., Poh, C.M., Rénia, L., MacAry, P.A. and Ng, L.F.P. (2020), “The trinity of COVID-19: immunity, inflammation and intervention”, *Cell Host Microbe*, Vol. 20 No. 6, pp. 363–374.
- Thachil, J., Cushman, M. and Srivastava, A. (2020), “A proposal for staging COVID-19 coagulopathy”, *Res Pract Thromb Haemost*, Vol. 4 No. 5, pp. 731–736.
- Toledo, S.L. de O., Nogueiraa, L.S., Carvalho, M. das G., Rios, D.R.A. and Pinheiro, M. de B. (2020), “SCoVID-19: Review and hematologic impact Sílvia”, *Clin Chim Acta*, Vol. 510, pp. 170–176.
- Umeres-francia, G. (2021), “Neutrophil to lymphocyte ratio and platelet to lymphocyte ratio as a risk factor for mortality in peruvian adults with chronic kidney disease .”, *Authorea*, pp. 1–9.
- V’kovski, P., Kratzel, A., Steiner, S., Stalder, H. and Thiel, V. (2021), “Coronavirus biology and replication: implications for SARS-CoV-2”, *Nat Rev Microbiol*, Vol. 19 No. 3, pp. 155–170.
- Wang, Tang and Wei. (2020), “Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China”, *J Med Virol*, Vol. 92 No. 4, pp. 441–447.
- Wang, X., Li, X., Shang, Y., Wang, J., Zhang, X., Su, D., Zhao, S., *et al.* (2020), “Ratios of Neutrophil-to-Lymphocyte and Platelet-to-Lymphocyte Predict All-Cause Mortality in Inpatients with Coronavirus Disease 2019 (COVID-



19): A Retrospective Cohort Study in A Single Medical Center”, *Epidemiol Infect*, pp. 1–8.

Waris, A., Din, M., Khalid, A., Lail, R.A., Shaheen, A., Khan, N., Nawaz, M., *et al.* (2021), “Evaluation of hematological parameters as an indicator of disease severity in Covid-19 patients: Pakistan’s experience”, *J Clin Lab Anal*, Vol. 35 No. 6, p. e23809.

WHO. (2020a), “Corona virus (covid 19) Dashboard”, *Wold Health Organization*, available at: <https://covid19.who.int/> (accessed 20 September 2021).

WHO. (2020b), “Clinical management of COVID-19: interim guidance”, *Clinical Management of COVID-19: Interim Guidance*, 1st ed., WHO, Jenewa, pp. 13–17.

Wölfel, R., Corman, V.M., Guggemos, W., Seilmaier, M., Zange, S., Müller, M.A., Niemeyer, D., *et al.* (2020), “Virological assessment of hospitalized patients with COVID-2019”, *Nature*, Vol. 581 No. 7809, pp. 465–469.

Wolff, D., Nee, S., Hickey, N.S. and Marschollek, M. (2021), “Risk factors for Covid-19 severity and fatality: a structured literature review”, *Infection*, Vol. 49 No. 1, pp. 15–28.

Wool, G.D. and Miller, J.L. (2021), “The Impact of COVID-19 Disease on Platelets and Coagulation”, *Pathobiology*, Vol. 60637 No. 88, pp. 15–27.

World Health Organization. (2020), “Laboratory testing for 2019 novel coronavirus (2019-nCoV) in suspected human cases”, *WHO - Interim Guidance*, Vol. 2019 No. January, pp. 1–7.

Wu F, Wang, A Liu, M Wang, Q Chen, J Xia, Sl.Yz.Yx.Jl.Lj.Sl.Hw.Yh. (2020), “Neutralizing Antibody Responses to SARS-CoV-2 in a COVID-19 Recovered Patient Cohort and Their Implications”, *SSRN Journal*.

Wu, Z. and McGoogan, J.M. (2020), “Characteristics of and Important Lessons from the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72314 Cases from the Chinese Center for Disease Control and Prevention”, *JAMA*, Vol. 323 No. 13, pp. 1239–1242.

Yang, A.-P., Liu, J., Tao, W. and Li, H. (2020), “The diagnostic and predictive role of NLR, d-NLR and PLR in COVID-19 patients”, *Int Immunopharmacol*, Vol. 84, p. 106504.

Yang, X., Yu, Y., Xu, J., Shu, H., Xia, J., Liu, H., Wu, Y., *et al.* (2020), “Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study”, *The Lancet Respir Med*, Vol. 8 No. 5, pp. 475–481.

- Yatim, N., Boussier, J., Chocron, R., Hadjadj, J., Philippe, A., Azoulay, C., Khider, L., *et al.* (2021), "Platelet activation in critically ill COVID - 19 patients", *Ann of Intensive Care*, pp. 1–12.
- Yusuf, Z.K. (2010), "Polymerase Chain Reaction (PCR)", *Saintek*, Vol. 5 No. 6.
- Zhao, K., Li, R., Wu, X., Zhao, Y., Wang, T., Zheng, Z., Zeng, S., *et al.* (2020), "Clinical features in 52 patients with COVID-19 who have increased leukocyte count: a retrospective analysis", *Eur J of Clin Microbiol Infect Dis*, Vol. 39 No. 12, pp. 2279–2287.
- Zhao, Y., Zhao, Z., Wang, Y., Zhou, Y., Ma, Y. and Zuo, W. (2020), "Single-Cell RNA Expression Profiling of ACE2, the Receptor of SARS-CoV-2", *Am J Respir Crit*, Vol. 202 No. 5, pp. 756–759.
- Zhu, L., She, Z.G., Cheng, X., Qin, J.J., Zhang, X.J., Cai, J., Lei, F., *et al.* (2020), "Association of Blood Glucose Control and Outcomes in Patients with COVID-19 and Pre-existing Type 2 Diabetes", *Cell Metab.*, Vol. 31 No. 6, pp. 1068-1077.e3.
- Zhu, N., Zhang, D., Wang, W., Li, X., Yang, B., Song, J., Zhao, X., *et al.* (2020), "A novel coronavirus from patients with pneumonia in China, 2019", *N Eng J Med*, Vol. 382 No. 8, pp. 727–733.
- Zou, Z., Yang, Y., Chen, J., Xin, S., Zhang, W., Zhou, X., Mao, Y., *et al.* (2004), "Prognostic Factors for Severe Acute Respiratory Syndrome : A Clinical Analysis of 165 Cases", *Arch Clin Infect Dis*, Vol. 1 No. 100, pp. 483–489.