RESEARCH ARTICLE

The Association of COVID-19 Severity with Laboratory Parameters, Radiologic Findings, Maternal and Neonatal Outcomes in Pregnant Women: A Multicenter Study in Indonesia

Rima Irwinda[1], Muhammad Alamsyah Aziz[2], Muhammad Ilham Aldika Akbar[3], Anak Agung Gede Raka Budayasa[4], Nuswil Bernolian[5], Julian Dewantiningrum[6], Makmur Sitepu[7], Siti Maisuri Tadjuddin Chalid[8], Cut Meurah Yeni[9], John Wantania[10], Mukhamad Nooryanto[11], Rabbania Hiksas[12]

Received on: 20 November 2022; *Accepted on:* 14 December 2022; *Published on:* 11 May 2023

Abstract

Objectives: Severe acute respiratory syndrome-coronavirus 2/COVID-19 infection is still a global concern, with pregnant women are considered as vulnerable population. Until now, the characteristics of pregnant women in Indonesia who are infected with COVID-19, as well as pregnancy and neonatal outcomes, are still unknown. This study aims to obtain national data, which are expected to be useful for the prevention and management of COVID-19 in pregnant women in Indonesia.

Methods: There were 1,427 patients recruited in this retrospective multicenter study. This study involved 11 hospitals in 10 provinces in Indonesia and was carried out using secondary patient data from April 2020 to July 2021. COVID-19 severity was differentiated into asymptomatic-to-mild symptoms and moderate-to-severe symptoms. The collected data include maternal characteristics, laboratory examinations, imaging, pregnancy outcomes, and neonatal outcomes.

Results: Leukocyte, platelets, basophil, neutrophils segment, lymphocytes, monocytes, neutrophil-to-lymphocyte ratio, platelet-to-lymphocyte ratio, alanine aminotransferase (ALT), aspartate aminotransferase (AST), C-reactive protein (CRP), urea, and creatinine were found to be significantly associated with severity differences ($p < 0.05$). Moderate–severe symptoms of COVID-19 also shown to have suggestive pneumonia findings on chest X-ray findings. Patients with asymptomatic-to-mild symptoms had significantly ($p < 0.001$) higher recovery rate, shorter hospital stay, less intensive care unit (ICU) admission, and had more vaginal delivery. Neonates from mother with mild symptoms also had significantly ($p < 0.001$) higher survival rate, higher birth weight, and higher APGAR score.

Conclusion: Several laboratory and radiology components, as well as maternal and neonatal outcomes are related to the severity of COVID-19 in pregnant women in Indonesia

Keywords: COVID-19, Laboratory and radiology findings, Maternal and neonatal outcomes, Pregnancy.

Journal of South Asian Federation of Obstetrics and Gynaecology (2023): 10.5005/jp-journals-10006-2221

Introduction

Pneumonia outbreak due to infection with severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2)/COVID-19 is still a global concern.[1–3] As of July 18, 2022, around 565 million people have been infected with COVID-19 worldwide, with about 6 million deaths.[4] The number of COVID-19 infections in Indonesia continues to increase with a total of 6,159,328 infected people and 156,893 deaths per July 23, 2022.[5] Therefore, research related to COVID-19 is still being developed, not only related to pathophysiology, but also the outcomes caused by COVID-19 infection.

The existence of physiological changes during pregnancy including the cardiorespiratory system in pregnant women increases the risk of easy infection to the possibility of severe symptoms such as respiratory failure.[1–3,6] Although there is no evidence of vertical maternal-to-fetal transmission, the presence of COVID-19 infection can increase maternal and fetal morbidity. Systematic studies have shown that the clinical manifestations of COVID-19 infection in pregnant women vary. As many as 80% of infected pregnant women have no-symptoms to mild–moderate

[1,12]Department of Obstetrics and Gynecology, University of Indonesia, Jakarta Pusat, DKI Jakarta, Indonesia

[2]Department of Obstetrics and Gynecology, Universitas Padjadjaran, Bandung, West Java, Indonesia

[3]Department of Obstetrics & Gynecology, Faculty of Medicine, Universitas Airlangga, Surabaya, Surabaya, Indonesia

[4]Department of Obstetrics and Gynecology, Warmadewa University/ Sanjiwani Hospital, Denpasar, Bali, Indonesia

[5]Department of Obstetrics and Gynecology, RSMH, Palembang, South Sumatera, Indonesia

[6]Department of Obstetrics and Gynecology, Dr. Kariadi Hospital/ Universitas Diponegoro, Semarang, Indonesia

[7]Department of Obstetrics and Gynecology, H. Adam Malik Hospital/ Universitas Sumatera Utara, Medan, Indonesia

[8]Department of Obstetrics & Gynaecology, Hasanuddin University, Makassar, Sulawesi Selatan, Indonesia

[9]Department of Obstetrics and Gynecology, Dr. Zainoel Abidin Hospital/ Universitas Syiah Kuala, Aceh, Indonesia

[10]Department of Obstetrics and Gynecology, RD Kandao Hospital/ Universitas Sam Ratulangi, Manado, Indonesia

symptoms.[1,2] The immune system is critical in the emergence of clinical variation. However, changes in the immune system during pregnancy increase susceptibility to infection and compensate for hypoxia.

Research in various countries show that the risk factors for pregnant women with COVID-19 infection who have severe clinical symptoms include older maternal age, obesity, black and Hispanic races, and have other medical diseases such as diabetes, hypertension, and asthma.[7–9] COVID-19 infection during pregnancy is thought to have an effect on pregnancy complications such as abortion, preeclampsia, fetal death, preterm birth, fetal growth restrictions, cesarean section, and has an effect on poor neonatal outcomes.

Until now, it is not known maternal and laboratory characteristics, and radiologic findings of pregnant women in Indonesia who are infected with COVID-19, as well as pregnancy and neonatal outcomes. This study aims to obtain national data, so as to know the characteristics for COVID-19 infection in pregnancy and its consequences, which are expected to be useful for the prevention and management of COVID-19 in pregnant women in Indonesia.

Methods

This was a retrospective multicenter cohort study, in 1431 patients, involving 11 hospitals in 10 provinces in Indonesia, including Aceh, North Sumatera, South Sumatera, Jakarta, West Java, Central Java, East Java, Bali, North Sulawesi, and South Sulawesi. The study was carried out using secondary patient data from April 2020 to July 2021. All participants had been given an informed consent prior to their inclusion for the study. The inclusion criteria used were pregnant women who were declared infected with COVID-19 as evidenced by polymerase chain reaction (PCR) test. While the inclusion criteria are incomplete data from research subjects.

The data collected in this study are in the form of maternal characteristics (maternal age, gestational age, gravidity, parity, and abortion); the classification of symptoms follows the classification of symptoms according to the Indonesian Ministry of Health; symptoms are classified into three categories:[10]

- Mild symptoms: Patients with symptoms without evidence of viral pneumonia or without hypoxia. Symptoms include fever, cough, fatigue, anorexia, shortness of breath, and myalgia. Other non-specific symptoms such as sore throat, nasal congestion, headache, diarrhea, nausea and vomiting, loss of smell (anosmia), or loss of taste (ageusia) that occur before symptoms are also frequently reported.
- Moderate symptoms: Patients with clinical signs of pneumonia (fever, cough, shortness of breath, rapid breathing) without signs of severe pneumonia including SpO_2 > 93% with room air.
- Severe symptoms: Patients with clinical signs of pneumonia (fever, cough, shortness of breath, rapid breathing) plus one of respiratory rate > 30 breaths/minute, severe respiratory distress, or SpO_2 < 93% on room air.

The laboratory examinations include hemoglobin, leukocytes, platelets, basophils, eosinophils, segment neutrophils, lymphocytes, and monocytes count, neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), aspartate aminotransferase (AST), alanine aminotransferase (ALT), urea, creatinine, C-reactive protein (CRP), and procalcitonin; imaging (thorax X-ray); pregnancy outcomes (overall condition, mode of delivery, and length of hospital stay); neonatal outcomes (overall condition, birth weight, birth height, and APGAR score).

The data that have been collected are verified, cleaned, coded, and tabulated. The data were then analyzed using Statistical Package for the Social Sciences (SPSS) version 25. The normality test was first checked using Kolmogorov–Smirnov test. Normal data distribution was presented as mean ± SD and abnormal data distribution was presented as median (min–max). To find the differences among numeric categories, unpaired *t*-test or Mann–Whitney test was performed. Whereas for categorical data, Chi-square analysis was used.

Results

As of July 2021, there were 2018 cumulative SARS-CoV-2–affected pregnancies reported from 11 hospitals. Of these cases, only 1431 were analyzed and 587 cases excluded due to incomplete data. In total, there were 452 patients with moderate–severe symptoms and 979 patients were with asymptomatic to mild symptoms (Flowchart 1).

Maternal Characteristics

In terms of maternal characteristics, no significant difference was found related to the severity of symptoms. The median of maternal age, gravidity, and parity, even have the same number between those two groups. A complete description of maternal characteristics is shown in Table 1.

Laboratory and Radiologic Parameters

Almost all laboratory parameters have a significant association with COVID-19 severity ($p < 0.05$), with asymptomatic to mild symptoms had a higher value, including leukocytes, platelets, segment neutrophils, monocytes, NLR, PLR, and CRP. Whereas in basophils, AST, ALT, urea, and creatinine, the values were higher in moderate-to-severe symptoms.

In addition to laboratory parameters, there was a statistically significant relationship ($p < 0.001$) on radiographic parameters in the form of a chest X-ray. A suggestive pneumonia result was

[11]Department of Obstetrics and Gynecology, Saiful Anwar Hospital/ Universitas Brawijaya, Malang, Indonesia

Corresponding Author: Rabbania Hiksas, Department of Obstetrics and Gynecology, University of Indonesia, Jakarta Pusat, DKI Jakarta, Indonesia, Phone: +62215703629, e-mail: rabbaniahiksas@gmail.com

How to cite this article: Irwinda R, Aziz MA, Akbar MIA, *et al*. The Association of COVID-19 Severity with Laboratory Parameters, Radiologic Findings, Maternal and Neonatal Outcomes in Pregnant Women: A Multicenter Study in Indonesia. J South Asian Feder Obst Gynae 2023;15(2):199–205.

Source of Support: This study was funded by Indonesian Society of Obstetrics & Gynecology.

Conflict of Interest: None

Ethical Approval: This study has been approved by the Ethical Committee for Research in Humans from the Faculty of Medicine, Universitas Indonesia (KET-286/UN2.F1/ETIK/PPM.00.02/2021). As this was a retrospective study, we extracted only clinically relevant information from medical records with ensuring patient's privacy protection.

Flowchart 1: Sample collection

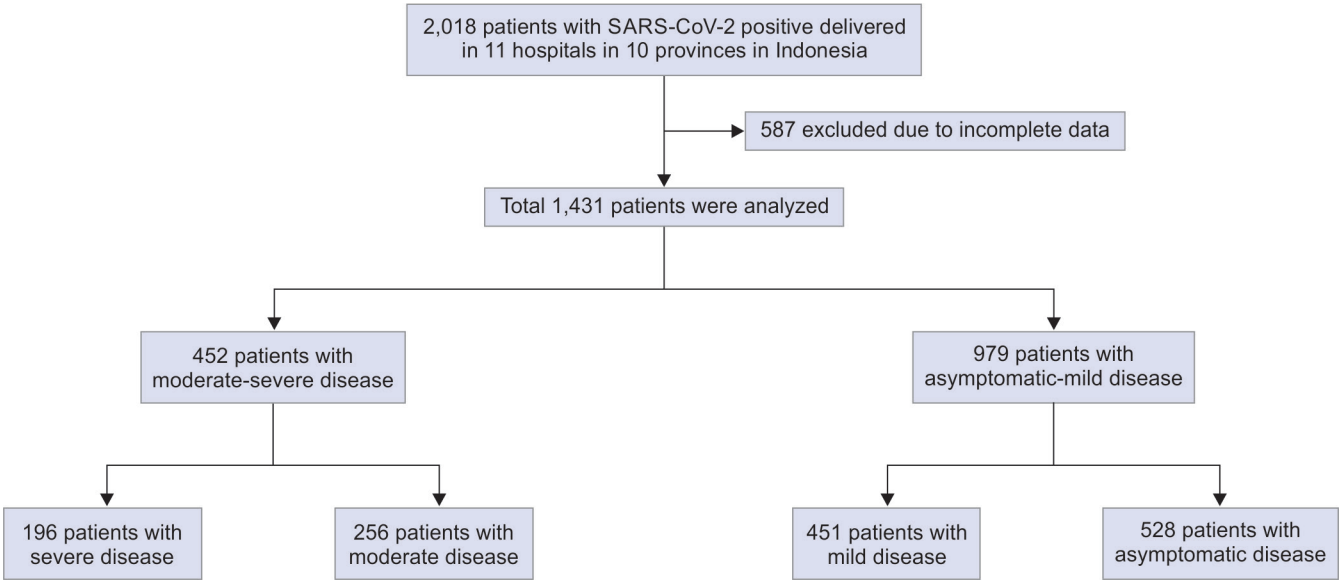

Table 1: Maternal characteristics

	Asymptomatic–mild symptoms	*Moderate–severe symptoms*	*p-value*
Maternal age (*n* = 1,431)	30 (15–49)	30 (16–44)	0.79
Gestational age (*n* = 1,332)	38 (6–43)	36 (7–42)	0.59
Gravidity (*n* = 1,317)	2 (1–12)	2 (0–8)	0.22
Parity (*n* = 1,419)	1 (0–10)	1 (0–5)	0.15
Abortion (*n* = 1,406)	0 (0–9)	0 (0–5)	0.47

Data presented in mean ± SD or median (min–max)

found higher in asymptomatic to mild symptoms (45.7%). As much as 6% patients with moderate-to-severe symptoms had no suggestive pneumonia result. A detailed comparison of laboratory and radiologic parameters to COVID-19 severity is shown in Table 2.

Maternal and Neonatal Outcomes

For maternal outcomes, several components were considered, including the overall health condition of the mother in which almost all participants (79.93%) had a good health condition or could recover after being infected with COVID-19. The participants with moderate-to-severe symptoms had longer hospital stay and higher number of intensive care unit (ICU) admissions compared with patients with asymptomatic to mild symptoms. Patients with mild-or-no symptoms had a higher rate of cesarean delivery than patients with moderate-to-severe symptoms. All components of maternal outcome had a statistically significant ($p < 0.001$) relationship with the degree of symptoms experienced by participants (Table 3).

As for the neonatal outcomes, almost all (94.81%) neonates were born alive to mothers infected with COVID-19, with a greater median body weight at neonates born to mothers with asymptomatic or mild symptoms. All these components of neonatal outcomes had a statistically significant relationship ($p < 0.001$) with the degree of illness of mothers infected with COVID-19 (Table 3).

Numbers of laboratory parameters have shown a significant difference between dead or alive maternal condition ($p < 0.05$). Most of the parameters had a higher value in patients who died. This was similar to what was shown in differences of severity of the symptoms, where most of the laboratory parameters shown higher in more severe cases. However, a suggestive pneumonia in Röntgen thorax showed a higher proportion in patients who were alive (Table 4).

Risk of Morbidity

Related to risk of morbidity and mortality, COVID-19 in pregnancy showed to increase the risk of abnormal liver and renal function, as well as suggestion of pneumonia in Röntgen thorax. It was also increased the risk of maternal death with odds ratio (OR) 8.25, 95% confidence interval (CI) 4.90–13.78 and neonatal death with OR 2.57, 95%CI 1.63–4.03 (Table 5).

Discussion

Our study showed that numbers of laboratory findings were related to the degree of symptoms. First of all was leukocyte level, which found inversely proportional to most studies where the leukocyte value in patients infected with COVID-19 increases. The study conducted by Vakili et al. and Li et al. concluded that the most significant laboratory finding in pregnant women infected with COVID-19 was leukocytosis.[11,12]

Moreover, related to the white blood cells, we found that lymphocyte and monocyte values increased with a significant relationship to the degree of symptoms. This result was in contrast to the study conducted by Ryan et al.[13] and Akhtar et al.,[14] where the lymphocyte values tend to be lower than normal. Patients with COVID-19 had an increase in inflammation in the lungs, thus

Table 2: Laboratory and radiologic parameters related to COVID-19 severity

	Asymptomatic–mild symptoms	*Moderate–severe symptoms*	*p-value*
Laboratory parameters			
Hemoglobin (*n* = 1,426)	11.30 (3.2–16.8)	11.40 (2.7–15.6)	0.95
Leukocytes (*n* = 1,426)	11,400 (1,500–78,600)	10,456 (1,234–49,720)	<0.001
Platelets (*n* = 1,427)	270,000 (12,000–653,000)	221,000 (14,600–1,170,000)	<0.001
Basophils (*n* = 1,358)	0.00 (0–4)	0.20 (0–4)	<0.001
Eosinophils (*n* = 1,354)	0.20 (0–17)	0.2 (0–7.2)	0.39
Segment neutrophils (*n* = 1,335)	81.38 + 7.97	73.03 + 0.69	<0.001
Lymphocytes (*n* = 1,379)	15.00 (0–53.7)	16 (0.2–36.5)	<0.001
Neutrophil-to-lymphocyte ratio (*n* = 1,349)	5.13 (0.93–25.09)	3.42 (1.56–26.46)	0.011
Platelet-to-lymphocyte ratio (*n* = 1,358)	159.61 (5.21–2130.54)	139.16 (4.94–5361.20)	<0.001
Monocytes (*n* = 1,362)	5.98 + 0.13	5.54 + 0.11	<0.001
AST (*n* = 1,143)	22 (5–868)	26 (1–2,135)	<0.001
ALT (*n* = 1,139)	14 (0.7–781)	20 (4–2,174)	<0.001
Urea (*n* = 1,176)	14 (0.2–195)	18 (1.1–263)	<0.001
Creatinine (*n* = 1,174)	0.60 (0.03–130.3)	0.69 (0–13)	<0.001
CRP (*n* = 880)	5.9 (0–252)	1.4 (0–889)	<0.001
Procalcitonin (*n* = 739)	0.08 (0.01–60.37)	0.09 (0.01–106.06)	0.05
Röntgen thorax (*n* = 769)			
Suggestive pneumonia	364 (45.7%)	93 (12.1%)	<0.001
Not suggestive pneumonia	279 (36.2%)	33 (6.0%)	

Data presented in mean ± SD or median (min–max)

Table 3: Maternal and neonatal outcome

	Asymptomatic–mild symptoms	*Moderate–severe symptoms*	*p-value*
Maternal outcomes			
Overall condition (*n* = 1,043)			
Recovered	710 (95.43%)	239 (79.93%)	<0.001
Died	21 (2.82%)	58 (19.39%)	
DAMA	13 (1.75%)	2 (0.68%)	
Length of hospital stay (*n* = 1,103)	5.00 (1–28)	7.00 (0–23)	<0.001
ICU admission (*n* = 888)			
Yes	5 (0.75%)	107 (48.19%)	<0.001
No	661 (99.25%)	115 (51.81%)	
Mode of delivery (*n* = 1,413)			
Vaginal delivery	489 (49.94%)	304 (67.25%)	<0.001
Cesarean section	490 (50.06%)	148 (32.75%)	
Neonatal outcomes			
Overall condition (*n* = 1,109)			
Alive	713 (94.81%)	313 (87.67%)	<0.001
Died	39 (5.19%)	44 (12.33%)	
Birth weight (*n* = 1,082)	2,900 (220–6,300)	2,840 (330–4,800)	<0.001
Birth height (*n* = 936)	48 (22–54)	48 (5–58)	0.53
APGAR score 1′ (*n* = 868)	7 (0–9)	7 (0–9)	<0.001
APGAR score 2′ (*n* = 861)	9 (0–10)	9 (0–10)	<0.001

Data presented in mean ± SD or median (min–max); DAMA, discharged against medical advice

Table 4: Laboratory and radiologic parameters related to maternal outcome

	Maternal condition		
Variables	*Alive*	*Dead*	*p-value*
Laboratory parameters			
Hemoglobin (*n* = 1,426)	11.30 (0.4–16.8)	11.09 (5.6–13.7)	0.028
Leukocytes (*n* = 1,426)	10,900 (1.234–78,600)	11,200 (4,300–38,300)	0.203
Platelets (*n* = 1,427)	245,500 (12,000–1,170,000)	379,000 (248,000–578,000)	0.471
Basophils (*n* = 1,358)	0.1 (0–4)	0.1 (0–3)	0.384
Eosinophils (*n* = 1,354)	0.2 (0–17)	0.2 (0–9.4)	0.942
Segment neutrophils (*n* = 1,335)	86.65 + 12.77	74.48 + 1.81	0.947
Lymphocytes (*n* = 1,379)	15.1 (0–85)	12.5 (2–30)	0.172
Neutrophil-to-lymphocyte ratio (*n* = 1,349)	3.48 (0.93–25.09)	4.53 (3.13–25.38)	0.034
Platelet-to-lymphocyte ratio (*n* = 1,358)	142.47 (5.21–5,361.20)	247.75 (124.76–537.31)	0.815
Monocytes (*n* = 1,362)	5.79 + 0.11	5.46 + 0.32	0.687
AST (*n* = 1,143)	23.00 (1–3516)	57.48 (5–21,352)	<0.001
ALT (*n* = 1,139)	16 (0.7–1201)	24 (5–2,174)	<0.001
Urea (*n* = 1,176)	15 (0–215)	26 (6–263)	<0.001
Creatinine (*n* = 1,174)	0.63 (0.03–130.27)	0.80 (0.00–11.30)	<0.001
CRP (*n* = 880)	3.22 (0.04–252.20)	7.88 (0.05–889)	<0.001
Procalcitonin (*n* = 739)	0.07 (0.01–60.37)	0.72 (0.03–47.19)	<0.001
Röntgen thorax (*n* = 769)			
Suggestive pneumonia	902 (66.71%)	72 (91.13%)	<0.001
Not suggestive pneumonia	450 (33.29%)	7 (8.87%)	

Data presented in mean ± SD or median (min–max)

Table 5: COVID-19 infection in pregnancy is associated with increased risk of morbidity

	Number of participants	*Number of events*	*OR (95% CI)*
Laboratory and radiologic outcomes			
Abnormal liver function test AST	1,143	513	1.98 (1.55–2.53)
ALT	1,139	202	2.08 (1.53–2.83)
Abnormal renal function test, Urea	1,176	873	1.56 (1.17–2.07)
Creatinine	1,174	175	2.12 (1.53–2.94)
Suggestive pneumonia in Röntgen thorax	769	312	2.16 (1.41–3.31)
Maternal outcomes			
Died	1,043	79	8.25 (4.90–13.78)
ICU admission	888	112	93.67 (37.55–233.66)
Cesarean section	1,413	638	2.05 (1.63–2.59)
Neonatal outcomes			
Died	1,109	83	2.57 (1.63–4.03)

lymphocytes that work as pro-inflammatory cells may migrate from blood cells to lung tissue, and result in a deficiency of lymphocyte in blood cells. The difference is, in our study the participants used were much more numerous and more varied because they were taken from various regions in Indonesia. In contrast to the results of our study which found that monocyte levels were dominantly increased, the results of research conducted by Sasson et al. found that all participants had normal monocyte values.[15] Physiologically, in pregnant women, monocyte levels will increase in the first trimester and then decrease with increasing gestational age.[16]

In addition, neutrophil–lymphocyte ratio was higher in patients with severe symptoms. This was consistent with other studies which found increased neutrophil–lymphocyte ratio in pregnant women infected with COVID-19.[11,12] However, our result was different from the study conducted by Lira et al., where no significant difference found between patient's symptoms. However, the number of sample in that previous study was quite low. There were other studies that support our findings, this may increase the possibility of neutrophil–lymphocyte ratio as a useful marker in assessing prognosis in pregnant women with severe symptoms of COVID-19.[17] Our study also found a statistically significant value of a greater platelet–lymphocyte ratio in patients with mild symptoms than in patients with severe symptoms. This result was different from another study where platelet–lymphocyte ratio was slightly higher

in patients with severe symptoms of COVID-19. The difference in total sample number in that study could be one of the reasons as number of cases with severe COVID-19 symptoms which are few, thus the cut-off the points in the article were not so reliable and further studies are still required to confirm our results.[17]

Furthermore, we also found that the liver enzyme values were higher in patients with moderate-to-severe symptoms. This was maybe due to higher rate of liver injury, associated inflammatory responses, hepatic ischemia, drug-induced liver injury, or muscle breakdown.[18] Still, a study by Chen et al. found that an increase in AST and ALT in infected pregnant women by COVID only 44% of the total participants, and others tend to be normal.[19]

C-reactive protein levels were not found to be highly increased in both groups. This was in contrast to most studies where many studies reveal that one of the most common laboratory signs in COVID-19 patients is an increase in CRP, shown by Yoon et al.[20] Although the median of both groups for procalcitonin parameters was similar, the min–max of the value was higher in patients with moderate-to-severe symptoms. This was comparable to the study conducted by Ciapponi et al.[21] A study has shown that procalcitonin correlates with a five times increase in the risk of patients experiencing severe symptoms of COVID-19.[22]

For maternal outcomes, it was found that the overall condition of mothers in our study was dominated by participants who could recover from COVID-19. A study showed that there were about 15% of mothers who died from COVID-19, and most of these mothers had comorbid such as hypertension and diabetes.[21] The higher mortality rate in patients with severe COVID disease was supported by another study.[9] That study also confirmed our result related to higher ICU admission in more severe patients.[9] In general population, there are many factors associated with the need for ICU care such as age, gender, comorbidities, and disease severity, where almost all patients admitted to the ICU in our study were with severe symptoms.[23]

In our study, there were more participants underwent cesarean section than vaginal delivery. Other studies also showed the same results where around 60–80% subjects were born by cesarean section.[24,25] Pregnant women with COVID-19 may experience critical conditions such as respiratory failure, multiple organ dysfunction, thus Cesarean section was highly recommended. Moreover, it was found that the average length of hospital stay of pregnant women infected with COVID-19 was around 5–7 days, which is different from several existing studies. Studies have found that had an average length of hospital stay of about 3 days.[26,27] Those studies had more than 1000 participants with statistically significant results. In addition, the two studies had lower length of hospital stay, data obtained from hospitals in developed countries, namely in the United States and Turkey, which may be associated with different service factors to the patient thus shorten the hospital stay duration.[26,27]

For neonatal outcomes, our study found that only a few neonates died from COVID-19 infection from mothers with mild-to-severe symptoms. This is supported by a collection of systematic reviews made by Ciapponi et al.,[21] where from the 40 studies, the mortality rate of neonates was only around 9.2% of the total participants. Even other study showed no neonatal mortality.[28] Neonatal mortality is related to complications that occur, one of which is the increased risk of neonates being hospitalized in the neonatal intensive care unit (NICU) and lower birth weight.[29] This was also shown in our study where participants with milder symptoms tend to have heavier birth weight.[23] A review conducted by Ciapponi et al.[21] in 11 systematic reviews found that the prevalence of neonates with low birth weight was 40% of the subjects,[23] this is a fairly large number, and the result is supported by a study released by the Lancet Digital Health, where the main complications of pregnant women infected with COVID is having a baby with low birth weight.[23] In our study, the average APGAR score at minute one and two was still considered normal with a score between 7 and 8. A recent study explained that the APGAR score in neonates with mothers who had mild-to-severe and critical symptoms did not have a significant difference and was still within the normal range.[30] The study was supported by research conducted by Stephansson et al.[22] which concluded that there was no difference which is significant between the APGAR score in pregnant women with COVID-19 and normal pregnant women.[22]

In conclusion, there are several laboratory and radiologic components, as well as maternal and neonatal outcomes which have a significant relationship with the severity of COVID-19 in pregnant women in Indonesia. This multicenter data could become an initial step of study, which could be followed by further studies to find a predictor or marker of COVID-19 severity or even death.

Acknowledgments

The authors want to thank all our subjects for their participation in this research project.

Orcid

Rima Irwinda https://orcid.org/0000-0002-6260-6273
Muhammad Alamsyah Aziz https://orcid.org/0000-0002-1785-621
Muhammad Ilham Aldika Akbar https://orcid.org/0000-0002-2003-9282
Anak Agung Gede Raka Budayasa https://orcid.org/0000-0002-8036-8256
Nuswil Bernolian https://orcid.org/0000-0002-5778-0074
Siti Maisuri Tadjuddin Chalid https://orcid.org/0000-0001-8790-4915
Rabbania Hiksas https://orcid.org/0000-0001-8740-3918

References

1. Dashraath P, Wong JLJ, Lim MXK, et al. Coronavirus disease 2019 (COVID-19) pandemic and pregnancy. Am J Obstet Gynecol 2020; 222(6):521–531. DOI: 10.1016/j.ajog.2020.03.021.
2. Rasmussen SA, Smulian JC, Lednicky JA, et al. Coronavirus Disease 2019 (COVID-19) and pregnancy: what obstetricians need to know. Am J Obstet Gynecol 2020;222(5):415–426. DOI: 10.1016/j.ajog.2020.02.017.
3. World Health Organization (WHO). Clinical management of COVID-19: Interim guidance, 2020. https://apps.who.int/iris/bitstream/handle/10665/332196/WHO-2019-nCoV-clinical-2020.5-eng.pdf?sequence=1&isAllowed=y.
4. World Health Organization. WHO Coronavirus (COVID-19) Dashboard. 2022. https://covid19.who.int/.
5. Kementerian Kesehatan Republik Indonesia. Data Sebaran Covid-19 Indonesia. 2022. https://covid19.go.id/.
6. Coronavirus (COVID-19) infection in pregnancy. Royal College of Obstetricians & Gynaecologists; England, London. 2022.
7. Brandt JS, Hill J, Reddy A, et al. Epidemiology of coronavirus disease 2019 in pregnancy: risk factors and associations with adverse maternal and neonatal outcomes. Am J Obstet Gynecol 2021;224(4):389.e1–389.e9. DOI: 10.1016/j.ajog.2020.09.043.
8. Mahase E. Covid-19: pregnant women with virus are more likely to need intensive care, study finds. BMJ 2020;370:m3391. DOI: 10.1136/bmj.m3391.

9. Allotey J, Stallings E, Bonet M, et al. Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. BMJ 2020;370. DOI: 10.1136/bmj.m3320.
10. Kementerian Kesehatan Republik Indonesia. Panduan Pelaksanaan Pemeriksaan, Pelacakan, Karantina, dan Isolasi dalam Rangka Percepatan Pencegahan dan Pengendalian Coronavirus Disease 2019 (COVID-19). Keputuan Menteri Kesehatan Republik Indonesia Nomor HK0107/MENKES/4641/2021; 2021.
11. Vakili S, Savardashtaki A, Jamalnia S, et al. Laboratory Findings of COVID-19 Infection are Conflicting in Different Age Groups and Pregnant Women: A Literature Review. Arch Med Res 2020;51(7):603–607. DOI: 10.1016/j.arcmed.2020.06.007.
12. Li N, Han L, 2 M, Peng M, et al. Maternal and neonatal outcomes of pregnant women with COVID-19 pneumonia: a case-control study. Clin Infect Dis 2020; 71(16):2035-2041. DOI: 10.1093/cid/ciaa352.
13. Ryan GA, Purandare NC, McAuliffe FM, et al. Clinical update on COVID-19 in pregnancy: A review article. J Obstet Gynaecol Res 2020;46(8):1235–1245. DOI: 10.1111/jog.14321.
14. Akhtar H, Patel C, Abuelgasim E, et al. COVID-19 (SARS-CoV-2) infection in pregnancy: a systematic review. Gynecol Obstet Invest 2020;85(4):295–306. DOI: 10.1159/000509290.
15. Mohr-Sasson A, Chayo J, Bart Y, et al. Laboratory characteristics of pregnant compared to non-pregnant women infected with SARS-CoV-2. Arch Gynecol Obstet 2020;302(3):629–634. DOI: 10.1007/s00404-020-05655-7.
16. Samantha, Piekos N, Roper RT, et al. Maternal COVID-19 infection increases risks of preterm birth, low birth weight and stillbirth. EurekAlert [Internet], 2022. https://www.sciencedaily.com/releases/2022/01/220114074513.htm.
17. Lira SC, Espinosa MG. Differences in the neutrophil/lymphocyte ratio and the platelet/lymphocyte ratio in pregnant women with and without COVID-19. Int J Gynaecol Obstet 2021;157(2):296–302. DOI: 10.1002/ijgo.13840.
18. Moon AM, Barritt AS. Elevated liver enzymes in patients with COVID-19: look, but not too hard. Dig Dis Sci 2021; 66(6):1767–1769. DOI: 10.1007/s10620-020-06585-9.
19. Chen L, Li Q, Zheng D, et al. Clinical Characteristics of Pregnant Women with COVID-19 in Wuhan, China. N Engl J Med 2020; 382(25), e100. https://doi.org/10.1056/NEJMc2009226.
20. Yoon SH, Kang J-M, Ahn JG. Clinical outcomes of 201 neonates born to mothers with COVID-19: a systematic review. Eur Rev Med Pharmacol Sci 2020;24(14):7804–7815. DOI: 10.26355/eurrev_202007_22285.
21. Ciapponi A, Bardach A, Comandé D, et al. COVID-19 and pregnancy: an umbrella review of clinical presentation, vertical transmission, and maternal and perinatal outcomes. PLoS One 2021;16(6):e0253974. DOI: 10.1371/journal.pone.0253974.
22. Stephansson O, Pasternak B, Ahlberg M, et al. SARS-CoV-2 and pregnancy outcomes under universal and non-universal testing in Sweden: register-based nationwide cohort study. BJOG 2022; 129(2):282–290. DOI: 10.1111/1471-0528.16990.
23. Figueiro-Filho EA, Yudin M, Farine D. COVID-19 during pregnancy: an overview of maternal characteristics, clinical symptoms, maternal and neonatal outcomes of 10,996 cases described in 15 countries. J Perinat Med 2020;48(9):900–911. DOI: 10.1515/jpm-2020-0364.
24. Han Y, Ma H, Suo M, et al. Clinical manifestation, outcomes in pregnant women with COVID-19 and the possibility of vertical transmission: a systematic review of the current data. J Perinat Med 2020;48(9):912–924. DOI: 10.1515/jpm-2020-0431.
25. Ali Khan M, Khan N, Golam M, et al. COVID-19 infection during pregnancy: a systematic review to summarize possible symptoms, treatments, and pregnancy outcomes. Cold Spring Harbor Laboratory [Internet], 2020. https://doi.org/10.1101/2020.03.31.20049304.
26. Chinn J, Sedighim S, Kirby KA, et al. Characteristics and outcomes of women with COVID-19 giving birth at US Academic Centers during the COVID-19 Pandemic. JAMA Netw Open 2021;4(8). DOI: 10.1001/jamanetworkopen.2021.20456.
27. Sahin D, Tanacan A, Erol SA, et al. Management of pregnant women with COVID-19: A tertiary pandemic center experience on 1416 cases. J Med Virol 2022;94(3):1074–1084. DOI: 10.1002/jmv.27423.
28. Goyal M, Mascarenhas D, Shah J, et al. Perinatal COVID-19 infection and outcomes: a retrospective observational study from a low–middle income setting. J South Asian Feder Obs Gynae 2022;14(4):374–380.
29. Deepa R, Nagesh AK, Thomas A. Perinatal outcomes of COVID-19 in pregnancy in a tertiary care center in south India. J South Asian Feder Obs Gynae 2022;14(6):724–729.
30. Diriba K, Awulachew E, Getu E. The effect of coronavirus infection (SARS-CoV-2, MERS-CoV, and SARS-CoV) during pregnancy and the possibility of vertical maternal-fetal transmission: a systematic review and meta-analysis. Euro J Med Res 2020;25(1):39. DOI: 10.1186/s40001-020-00439-w.