Contents lists available atIOCS

Science Midwifery

journal homepage:www.midwifery.iocspublisher.org

Correlation between clinical severity and chest X-ray grade using the Brixia score in pneumonia patients confirmed with the Delta variant of Covid-19

Anggita Putri Kantilaras[1] , Rifqy Hendrian Pamungkas[2]

[1]Lecturer of the Radiology Department of Medical professional education study program, Faculty of Medicine Health Sciences, Universitas Muhammadiyah Yogyakarta, Indonesia

[2]Medical professional student, Medical professional education study program, Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta, Indonesia

ARTICLE INFO

Article history:

Received Mar 22, 2025
Revised Mar 24, 2025
Accepted Apr 1, 2025

Keywords:

Brixia Score
Chest X-Ray
COVID-19

ABSTRACT

Background: COVID-19 is a disease that attacks the respiratory organs. This disease can be transmitted directly or indirectly through droplets released by an infected individual. The clinical manifestations that appear vary depending on the degree of severity. Chest X-ray is one of the supporting examinations to establish a diagnosis of COVID-19. There are several chest X-ray assessments used to determine the severity of pneumonia in individuals infected with COVID-19, one of them is Brixia Score. The aim of this study is to determine the correlation between the degree of clinical severity and the degree of chest X-ray using Brixia Score in pneumonia patients confirmed with delta variant of COVID-19. Method: This study is an observational study using a correlative analysis method with a cross-sectional research design. Sampling in this study was carried out by non-random consecutive sampling from medical record data at the RSUD Merah Putih Magelang, totaling 38 samples. The statistical analysis used is the Spearman's test. Result: In this study, the correlation coefficient value was 0.851 and $p < 0.05$, which states that there is a strong correlation between the degree of clinical severity and the degree of chest X-ray using Brixia Score. Conclusion: There is a strong correlation between the degree of clinical severity and the degree of chest X-ray using the Brixia Score in pneumonia patients confirmed with delta variant of COVID-19.

This is an open access article under the CC BY-NC license.

Corresponding Author:

Anggita Putri Kantilaras,
Faculty of Medicine Health Sciences,
Jl. Brawijaya, Geblagan, Tamantirto, Kec. Kasihan, Kabupaten Bantul, Daerah Istimewa Yogyakarta 55183, Indonesia
Email: anggita.p.kantilaras@gmail.com

INTRODUCTION

The Since December 2019, there have been several cases of pneumonia with unknown causes in Wuhan, China. Through examination of a patient, a new coronavirus was found from epithelial cells in the human respiratory tract called SARS-CoV-2. This virus is the origin of the coronavirus

disease 2019 (COVID-19) which can be transmitted from human to human(Long et al., 2020). COVID-19 is a disease that attacks the respiratory tract or is known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) which has phylogenetic similarities to SARS-CoV.(Fadli, 2020). Clinical symptoms commonly experienced by infected patients include fever, dry cough, sore throat, and fatigue.(Wu & McGoogan, 2020).

Official global data from the World Health Organization (WHO) states that the number of positive COVID-19 cases in the world is 223,851,538 people with the main mechanism of COVID-19 transmission being transmitted by aerosol droplets from sufferers and through direct contact. Aerosols are likely to be transmitted when people have direct contact with sufferers for a short period of time. The concentration of aerosols in relatively closed spaces will be higher, so that transmission will be easier. In its development, Indonesia has currently been declared a COVID-19 pandemic since March 2020 by the government. The Government of the Republic of Indonesia has reported 2,911,733 people confirmed positive for COVID-19 and there have been 74,920 deaths (CFR: 2.6%) related to COVID-19 reported and 2,293,875 patients have recovered from the disease as of July 2019 (Ministry of Health, 2021).

COVID-19 has undergone various mutations and given rise to a number of variants, with one of the variants being the delta variant. According to WHO, the delta variant is known to have a higher rate of transmission compared to previous variants, and has a tendency for more severe symptoms. In a study conducted by Baj et al, 2020 in the Journal of Clinical Medicine, it was stated that the clinical characteristics that appear in confirmed COVID-19 patients vary depending on the severity of the signs and symptoms experienced by the patient.

Asymptomatic clinical characteristics are characterized by the absence of clinical manifestations of COVID-19 and no changes in the chest X-ray image. Mild clinical characteristics are characterized by clinical manifestations such as fever, dry cough, sore throat and nausea, usually there are also no changes in the chest X-ray image. Moderate clinical characteristics are characterized by clinical manifestations such as pneumonia symptoms, and there are images of Ground Glass Opacity (GGO) and lung consolidation. Severe clinical characteristics are characterized by clinical manifestations such as dyspnea, hypoxia, diarrhea, nausea, vomiting and 50% of the lungs have images of Ground Glass Opacity (GGO) and lung consolidation. Critical clinical characteristics with clinical manifestations of difficulty breathing, severe chest pain, and inability to speak, and on the chest X-ray there are images of bilateral Ground Glass Opacity (GGO), lung consolidation and white out lungs and pulmonary nodules(Baj et al., 2020).

In the process of diagnosing COVID-19, anamnesis and physical examination can be carried out to identify clinical manifestations such as fever, headache, myalgia, rhinorrhea, dyspnea, chest pain, cough, and to find out the patient's travel history, for example from an area with high transmission of COVID-19. In addition, other supporting examinations can also be used. One of the practical supporting examinations to detect abnormalities in the patient's lungs is to perform a chest X-ray.

Radiology, as part of medical science, plays an important role in the screening and diagnosis of pneumonia in general, including COVID-19 pneumonia. Diagnostic evaluation for COVID-19 pneumonia includes exposure history, clinical information, physical examination, radiological examination, namely chest X-ray and/or chest computed tomography (CT) scan and confirmed by reverse transcription polymerase chain reaction (abbreviated RT-PCR).

Thoracic radiology is used in COVID-19 patients starting from diagnosis, monitoring therapy and showing any lung damage that occurs after the patient is declared cured. Chest X-ray is a simple modality that is very useful even though its accuracy is less when compared to chest CT scans. In addition, chest X-rays are widely available in health services, at affordable costs and radiation that is still safe. Not all hospitals in Indonesia have CT scan facilities which are a very sensitive modality when compared to chest X-rays in assessing lung parenchyma including pneumonia.(Suryamin, nd).

There are several assessment methods in Radiology. One of them is the Brixia Score. The multi-region and multi-value Brixia score was designed and implemented in routine reporting by the Radiology Unit 2 ASST Spedali Civili in Brescia(Borghesi & Maroldi, 2020), and then validated for risk stratification in large populations. This system divides the lungs into 6 zones on a frontal thoracic projection (posteroanterior or anteroposterior according to the patient's condition). Furthermore, the assessment of each zone (value 0-3) according to the visible lung abnormalities, value 0: no visible lung abnormalities; value 1: interstitial infiltrate; value 2: interstitial and alveolar infiltrate (interstitial predominance); value 3: interstitial and alveolar infiltrate (alveolar predominance). The total value of the six lung zones is added up with a total value of 0-18. The total value is divided into 4 classifications, Normal (0), Mild (1-6), Moderate (7-12) and Severe (13-18).

According to R. Sharma et al, the Early Stage in confirmed COVID-19 patients shows a Ground Glass Opacity (GGO) picture, the Progressive Stage shows a Multiple GGO picture, Consolidation and reticular spots. The Advance Stage shows a picture of diffuse exudate lesions, with white out lung. Each of the chest X-ray results is influenced by the different clinical characteristics of each patient. Therefore, this study aims to determine whether there is a correlation between the clinical severity of patients and the degree of chest X-ray using the Brixia Score in pneumonia patients confirmed with the delta variant of COVID-19(Borghesi et al., 2020).

The lack of research on the correlation of clinical manifestations with chest X-rays in confirmed COVID-19 patients is the reason researchers conducted the study. Of the several scoring systems created to assess COVID-19 pneumonia, researchers chose the Brixia Score scoring system because this scoring system is considered more detailed by dividing the lungs into 6 zones. The study was conducted at the Merah Putih Regional General Hospital in Magelang. This is because the hospital is a referral site for COVID-19 radiology in Magelang, and the close location makes it easier to access data collection.

RESEARCH METHOD

Research Design

This study is an observational study using a correlative analysis method with a cross-sectional study design to determine the correlation between clinical severity and chest X-ray grade using the Brixia Score in pneumonia patients confirmed with the delta variant of COVID-19.

Research Subject

Population is an equalization area consisting of objects or subjects that have special qualities and characteristics that are formalized by researchers to be studied and then conclusions drawn (Sugiyono, 2016). Population is grouped into target population and accessible population: a) Target Population is part of the population determined by clinical and demographic characteristics (Sastroasmoro, 2011). The target population in this study were all confirmed positive patients with the delta variant of COVID-19 who had undergone chest X-ray examination for COVID-19 pneumonia at the Merah Putih Hospital in Magelang; b) Accessible Population is part of the target population that is limited by place and time which is expected to be applied in the target population and can be reached by researchers(Sastroasmoro, 2022). The accessible population in this study were all confirmed positive patients with the delta variant of COVID-19 who had undergone a COVID-19 chest X-ray examination at the Merah Putih Hospital in Magelang between June 2021 and December 2021.

Sample

Samples are part of a number of characteristics possessed by the population used for research. Samples are also taken from a truly representative and valid population, namely being able to measure something that should be measured (Sujarweni, 2015). The sample in this study was all medical record data and chest X-ray examination results of COVID-19 patients who met the

inclusion and exclusion criteria at the Merah Putih Hospital Magelang in the period from June 2021 to December 2021: a) Inclusion Criteria, namely: 1. Confirmed COVID-19 delta variant patients with positive nasopharyngeal swab RT-PCR results; 2. There is medical record data on clinical symptoms of confirmed COVID-19 patients; 3. There is chest X-ray data with a picture of pneumonia in confirmed COVID-19 patients; 4. Patients purely infected with COVID-19 without comorbid diseases; 5. Adult patients aged 18-60 years. b) Exclusion Criteria, namely: 1. Confirmed COVID-19 patients for whom there is no clinical data from medical records; 2. Confirmed COVID-19 patients who do not have chest X-ray results; 3. COVID-19 patients with chest X-rays showing lung mass; 4. COVID-19 patients with chest X-rays showing fibrosis; 5. COVID-19 patients with chest X-rays showing effusion. Based on this research design, the following formula was used to take samples in this study(Angga Widagdo Wahyu Saputro, 2024)(Artini et al., 2021).

$$n = \left\{\frac{(Z\alpha + Z\beta)}{0{,}5\ln[(1+r)/(1-r)]}\right\}^2 + 3$$

With
α: type I error, 5%, Zα = 1.96.
β: type II error, 10%, Zβ = 1.28
r: correlation coefficient considered meaningful, set at = 0.5

$$n = \left\{\frac{(1{,}96 + 1{,}28)}{0{,}5\ln[(1+0{,}55)/(1-0{,}55)]}\right\}^2 + 3$$

n: 37.7 (rounded to 38).
So the minimum sample size is 38

Location and Time of Research

Research Location, this research was conducted at the Red and White Hospital Magelang. Research Time, the research began in October 2023 to November 2023.

Variables

The dependent variable is the degree of COVID-19 pneumonia using the Brixia Score. The independent variable is the degree of clinical severity of patients confirmed with the delta variant of COVID-19.

The Course of Research

After the ethical clearance was issued, an analysis was conducted on patients with COVID-19 chest X-ray examinations who met the inclusion and exclusion criteria. Sampling was carried out by looking at the patient register data that met the inclusion criteria and then reviewed again to remove samples that were included in the exclusion criteria. The research sample was taken using consecutive non-random sampling, namely all subjects who met the inclusion and exclusion criteria were included in the study. Analyzed regarding the clinical severity of patients confirmed with the delta variant of COVID-19 and the Brixia score, recorded with disguised identification, and continued with data analysis. This study does not require informed consent from patients because this type of research is retrospective. In this study, there was no treatment that was harmful to the subjects studied so that there was no risk of harm to the research subjects. The study will also guarantee the confidentiality of the patient's identity and diagnosis by removing the patient's identity and replacing it with a code.

Research Flow

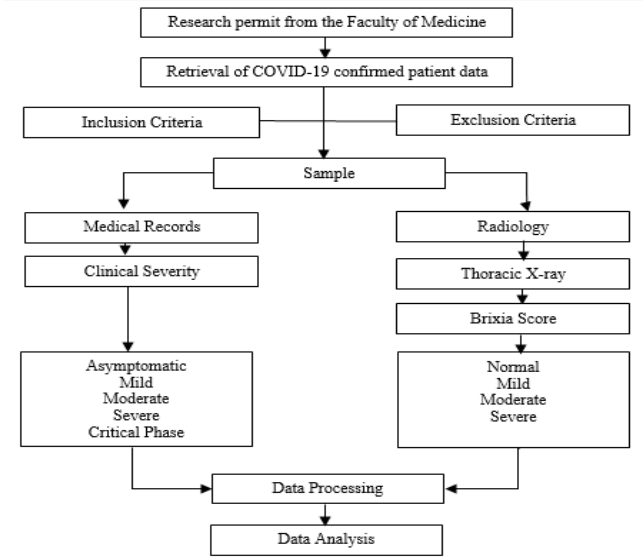

Figure 1. Research flow

Reliability Test

This study used two observers so that the reliability test is a two-observer reliability test (inter-observer) by comparing the results of the analysis of one observer with another. The method for assessing reliability that is often used is by using the kappa value. The perfect kappa value is 1, but this rarely happens. A good kappa value is 0.6 or more.

Data Processing and Analysis

The collected data is ordinal scale data. Therefore, to determine the correlation between variables, a statistical test is carried out using the Spearman correlation test (Dahlan, 2010a). Interpretation of the results of the correlation test is a combination of correlation strength, correlation direction and p value. The correlation strength values are as follows, a value of 0.00 - 0.199 (very weak), a value of 0.20 - 0.399 (weak), a value of 0.40 - 0.599 (moderate), a value of 0.60 - 0.799 (strong), a value of 0.80 - 1,000 (very strong). While the direction of the correlation is divided into two, positive and negative. Positive if the higher the variable A, the higher the variable B. Negative if the higher the variable A, the lower the variable B. A value of $p > 0.05$ indicates that there is no significant correlation between one variable and another. A value of $p<0.05$ indicates that there is a significant relationship between one variable and another. (Dahlan, 2010a)

Research Ethics

To ensure the legality of this research, an Ethical Clearance application will be submitted to the Ethics Commission of the Faculty of Medicine and Health Sciences, UMY.

RESULTS AND DISCUSSIONS

Research result

The research was conducted at the Merah Putih Magelang Regional Hospital starting from October 2023 to November 2023. A total of 38 samples were obtained that met the inclusion and exclusion criteria determined by the author.

1. Descriptive Data

a. Sample Frequency Distribution Based on Gender, the sample frequency distribution of 38 people based on gender is presented in Table 1 as follows:

Table 1. Frequency distribution of samples by gender

No	Gender	*n*	%
1.	Woman	14	36.5
2.	Man	24	63.5
3.	Total	38	100.0

Based on the table above, it can be seen that the sample size is male (63.2%) more than female (36.8%).

b. Sample Frequency Distribution Based on Age, the sample frequency distribution of 38 people based on age is presented in table 2 as follows:

Table 2. Sample frequency distribution by age

No	Age	*n*	%
1.	<25	1	2.6
2.	26-30	1	2.6
3.	31-35	3	7.9
4.	36-40	3	7.9
5.	41-45	9	23.7
6.	46-50	4	10.5
7.	51-55	13	34.2
8.	>55	4	10.5

Based on the table above, it can be seen that the characteristics of the sample based on age are mostly included in the 48-57 year category (51.2%).

c. Clinical Severity Degree of Research Samples

Table 3. Clinical severity of research samples

No.	Clinical Severity Degree	*n*	%
1.	Asymptomatic	1	2.6
2.	Light	14	36.8
3.	Currently	13	34.2
4.	Heavy	9	23.7
5.	Critical	1	2.6
	Total	38	.0

Based on table 3, it is known that the characteristics of the samples based on the degree of clinical severity are mostly mild (36.8%) followed by moderate (34.2%), severe (23.7%) and asymptomatic and critical which have the same number (2.6%).

d. Degree of Chest X-ray Severity based on Brixia Score

Table 4. Degree of severity of chest x-ray*brixia score*

No.	Brixia Score Degree	n	%
1.	Mild	18	47.4
2.	Moderate	12	31.6
3.	Severe	8	21.1
	Total	38	100.0

Based on table 4, it is known that the characteristics of the samples based on the degree of chest X-ray assessed using the Brixia Score were mostly mild (47.4%) followed by moderate (31.6%) and severe (21.1%).

e. Cross Distribution of Clinical Severity Degree to Chest X-ray Degree using Brixia Score.

Table 5. Cross distribution of both variables

Brixia Score Thoracic X-ray Degree	
	%
Asymptomatic	0

Brixia Score Thoracic X-ray Degree	
	%
Clinical Severity Degree	0
	0
Total	21.1

Based on table 5, the most samples are samples that have mild clinical severity with Mild degree on chest X-ray as many as 13 people (34.2%). In samples that have moderate clinical severity, the majority are found to have Moderate degree on chest X-ray as many as 9 people (23.7%). In samples with severe clinical severity, Severe degree on chest X-ray is the most with 7 people (21.1%). Then followed by samples that have asymptomatic and critical clinical severity, each of which is 1 person (2.6%).

2. Data Analytics

a. Reliability Test, inter observer reliability test is used to calculate the number of samples or cases scored the same by both observers. The kappa value is said to be good if >0.6 with p<0.005. The kappa coefficient test was conducted by researchers using the SPSS 25 application and the following results were obtained:

Table 6. Reliability test

	N	Kappa Value
Sample	10	0.808

From the calculation, it can be seen that the result of the kappa coefficient test is 0.808, with this result meaning that the kappa coefficient is 0.808 > 0.6. Thus it can be concluded that there is a similarity of perception between the two assessors. The indicator that the two assessors are consistent is shown by the kappa value approaching 1.

a. Correlation between Clinical Severity Degree and Chest X-ray Degree using Brixia Score, the results of the correlation analysis between clinical severity degree and chest X-ray degree using Brixia Score using Spearman test are presented in table 7, as follows:

Table 7. Spearman correlation test

Variables	N	r	P Value
Clinical Severity Degree Brixia Score Degree	38	0.851	0.000

From the table above, a correlation coefficient value of 0.851 and p <0.05 was obtained, which states that there is a strong correlation between the degree of severity and the degree of chest X-ray using the Brixia Score in pneumonia patients confirmed with COVID-19.

Discussion

1. Characteristics of the Research Sample, in this study, the number of male samples (63.5%) was greater than the number of female respondents (36.5%). Different results were found by (Shang, et al., 2021) who found that the number of female samples (52.6%) was greater than the number of male samples (47.4%). Differences in the immunoregulatory function of the sex hormones estrogen and testosterone, physiological factors, and different lifestyles are thought to play a role in this (Chen, et al., 2020). However, these results are similar to the study by Ariza, et al which stated that the number of male samples (63.3%) was greater than the number of female samples (36.7%)(Ariza et al., 2020). This is related to research conducted by Begley 2020 which states that men have a higher vulnerability than women because their activities tend to be more outside the home than women so that the risk of exposure is higher. In addition, men also have greater risk factors caused by smoking activities(Begley, 2020).

The youngest age of the data obtained was a patient aged 22 years, while the oldest age was 59 years. The age of 51-55 years was the most common age found in this study with a total of

13 people (34.2%). In this study there were 21 samples which were patients aged over 45 years. Different results were found by(Nurhasnanti et al., 2022)which obtained data on patients aged 18-39 years more than elderly patients (>45 years). This is due to the difference in mobility levels between young and elderly ages where young patients tend to have higher mobility, increasing the possibility of contracting COVID-19 infection. The results of this study are in line with research conducted by the Indonesian Ministry of Health in 2021 which stated that the elderly age group (>45) is more susceptible to COVID-19 infection caused by the aging process which has an impact on decreasing the function of various organs in the body, including decreased immunity that does not work as well and as strong as when they were young. Thus, the risk of contracting COVID-19 is high. Moreover, if accompanied by other chronic diseases, it will cause more severe disorders, even leading to death. (Ministry of Health, 2021)(Organization, 2020).

The most common clinical severity found in this study was mild with 14 people (36.8%) followed by moderate with 13 people (34.2%). These results are similar to the study conducted by Baj, et al which stated that confirmed COVID-19 patients with relatively mild clinical characteristics or severity were more common than patients with severe characteristics. In this study, cases with severe degrees were found in 9 people (23.7%) and critical degrees in 1 person (2.6%). This can be associated with age factors, where there is a tendency for more severe infections to occur in people with advanced age. In addition, comorbid diseases or accompanying diseases can also be aggravating factors for the symptoms suffered. (Baj., et al 2020)(Sinaga et al., 2021). However, in this study, it was found that the average patient was over 45 years old with mild clinical severity. This condition may occur due to awareness in patients, who immediately check their health after typical symptoms of COVID-19 appear. This allows medical personnel to handle and treat patients more quickly so that patients do not experience worsening when infected with COVID-19.

The degree of chest X-ray assessed using the Brixia Score most in this study was mild degree as many as 18 (47.4%) followed by moderate degree as many as 12 (31.6%) and severe degree as many as 8 (21.1%). This is similar to the study conducted by (Weinstock, et al., 2020)(Imron, 2019)who received a mild assessment result (30.7%), which is the largest number among other degrees. The higher the Brixia Score value, the more severe the lung condition, which is characterized by the increasing extent of interstitial and alveolar infiltrate lesions. Based on previous studies, it was stated that the chest X-ray image is influenced by clinical manifestations and the presence or absence of comorbid diseases in COVID-19 patients. (Baj., et al 2020)

2. Analytical Data, the results of the correlation analysis between the degree of clinical severity and the degree of chest X-ray using the Brixia Score in COVID-19 pneumonia patients obtained a significance value of 0.000 with a very strong correlation level (0.851). The value obtained interprets that there is a strong correlation between the degree of clinical severity and the degree of pneumonia on chest X-rays assessed using the Brixia Score. Previous research conducted by (Borghesi, 2020)(Mus et al., 2021)showed the same results stating that the severity of clinical characteristics or clinical manifestations would correlate with the increasing assessment of pneumonia using the Brixia Score. There are several similarities in the characteristics of respondents between the results of this study and the study conducted by (Ariza, 2021), including the gender that is mostly male and the age that is mostly elderly, namely over 45 years. The results of other studies conducted(Novitania et al., 2022)also showed the same results, that there was a significant influence between chest X-ray and the severity of the patient, so that with the increasing severity of the patient's clinical condition, the chest X-ray image would worsen. The Brixia Score is intended to systematically assess the severity of pneumonia and its distribution in the lung fields of COVID-19 patients. The Brixia Score is also considered capable of providing a picture of the condition of COVID-19 patients to clinicians.(Latif, 2022). According to the results of the study (Maroldi, et al, 2020), the Brixia Score is considered related to mortality because the value in patients who died had higher

results than other patients. The Brixia Score is considered capable of predicting the patient's prognosis, if there is an increase in the value of three or more in periodic examinations, it can be said that the patient's prognosis will worsen so that hospitalization is required for the patient and consideration of intubation if the condition worsens. The results of the Brixia Score assessment are more than 9 and in subsequent periodic assessments do not fall below 7, then intensive treatment such as the use of a ventilator needs to be considered(Liu et al., 2020).

Examination by CT of the thorax has a higher sensitivity value, which is around 90%.(Fang et al., 2020). In research conducted by(Sharma et al., 2020)which uses thoracic CT modality as the main modality to assess the level of lung damage, obtained positive correlation results between thoracic CT images and clinical manifestations of patients confirmed with COVID-19, in this study it was stated that thoracic CT can be used as a marker of disease progression and as a reference for medical personnel to provide early treatment.

Limitations

This study has limitations/weaknesses, namely: This study uses a thoracic X-ray modality that has a lower sensitivity than thoracic CT. This study is limited because it uses retrospective data, it will use more prospective data, which can provide a more structured and effective assessment of the variables studied.

CONCLUSION

The conclusion of this study is: There is a strong correlation between the degree of clinical severity and the degree of chest X-ray using the Brixia Score in patients with pneumonia confirmed with the delta variant of COVID-19 with a correlation coefficient value ($r = 0.851$) ($p < 0.05$). The higher the results of the chest X-ray assessment using the Brixia Score indicate the worsening prognosis of patients confirmed with COVID-19. Suggestions that can be given related to the results of this study are: This study can be used as a reference for further research by increasing the number of samples and using the thoracic CT modality which is considered more accurate than the thoracic X-ray modality). The results of this study suggest that the Brixia score can be used as a tool in identifying patients with a high risk of worsening conditions, allowing hospitals to allocate ICU beds more efficiently. The results of this study can also be used to improve the training of health workers in assessing COVID-19 radiology findings more accurately and quickly in clinical decision-making. Further research can be conducted involving a larger and more diverse sample to examine the relationship between radiologic findings and clinical progression in different age groups and comorbidity factors.

References

Angga Widagdo Wahyu Saputro, A. (2024). *GAMBARAN MOTIVASI LANSIA HIPERTENSI DALAM MENGONTROL TEKANAN DARAH DI DUKUH KEMBANGAN, DESA MOJOREJO*. Universitas Kusuma Husada Surakarta.

Ariza, R., Messah, A. D., Sinaga, F., Wahyudi, A., Pratama, S. A., & Annisa, I. (2020). Korelasi gambaran radiografi toraks dengan karakteristik klinis pasien terkonfirmasi covid-19. *ARTERI: Jurnal Ilmu Kesehatan*, *2*(1), 15–22.

Artini, P. A., Negara, K. K. K. A., & Darsana, I. W. (2021). Pengaruh Terapi Musik Klasik Mozart Terhadap Tingkat Kecemasan Pada Perawat Di Rumah Sakit Jiwa Provinsi Bali. *Jurnal Berita Ilmu Keperawatan*, *15*(1), 34–42.

Baj, J., Karakuła-Juchnowicz, H., Teresiński, G., Buszewicz, G., Ciesielka, M., Sitarz, R., Forma, A., Karakuła, K., Flieger, W., & Portincasa, P. (2020). COVID-19: specific and non-specific clinical manifestations and symptoms: the current state of knowledge. *Journal of Clinical Medicine*, *9*(6), 1753.

Begley, S. (2020). Which groups are most at risk from the Coronavirus. *Am J [Internet]*.

Borghesi, A., & Maroldi, R. (2020). COVID-19 outbreak in Italy: experimental chest X-ray scoring system for quantifying and monitoring disease progression. *La Radiologia Medica*, *125*(5), 509–513.

Borghesi, A., Zigliani, A., Masciullo, R., Golemi, S., Maculotti, P., Farina, D., & Maroldi, R. (2020). Radiographic severity index in COVID-19 pneumonia: relationship to age and sex in 783 Italian patients. *La Radiologia Medica*, *125*, 461–464.

Fadli, A. (2020). Mengenal covid-19 dan cegah penyebarannya dengan "peduli lindungi" aplikasi berbasis andorid. *Artikel Pengabdian Kepada Masyarakat Jurusan Teknik Elektro*, *2*(1), 1–15.

Fang, Y., Zhang, H., Xie, J., Lin, M., Ying, L., Pang, P., & Ji, W. (2020). Sensitivity of chest CT for COVID-19: comparison to RT-PCR. *Radiology*, *296*(2), E115–E117.

Imron, I. (2019). Analisa pengaruh kualitas produk terhadap kepuasan konsumen menggunakan metode kuantitatif pada CV. Meubele Berkah Tangerang. *Indonesian Journal on Software Engineering (IJSE)*, *5*(1), 19–28.

Latif, O. S. (2022). Sistem Skoring Foto X-Ray Toraks untuk Menentukan Tingkat Keparahan Pneumonia COVID-19. *Cermin Dunia Kedokteran*, *49*(2), 112–115.

Liu, Y., Yang, Y., Zhang, C., Huang, F., Wang, F., Yuan, J., Wang, Z., Li, J., Li, J., & Feng, C. (2020). Clinical and biochemical indexes from 2019-nCoV infected patients linked to viral loads and lung injury. *Science China Life Sciences*, *63*, 364–374.

Long, C., Xu, H., Shen, Q., Zhang, X., Fan, B., Wang, C., Zeng, B., Li, Z., Li, X., & Li, H. (2020). Diagnosis of the Coronavirus disease (COVID-19): rRT-PCR or CT? *European Journal of Radiology*, *126*, 108961.

Mus, R., Thaslifa, T., Abbas, M., & Sunaidi, Y. (2021). Studi literatur: Tinjauan pemeriksaan laboratorium pada pasien COVID-19. *Jurnal Kesehatan Vokasional*, *5*(4), 242.

Novitania, M. P., Wijaya, R. A., & PURWANINGSARI, D. (2022). Hubungan Gambaran Foto Toraks dengan Derajat Keparahan Pasien COVID-19 di RSPAL dr. Ramelan. *Hang Tuah Medical Journal*, *19*(2), 272–280.

Nurhasnanti, A. P., Arif, M., Sarosa, H., Marswita, R. A., & Tjahyadewi, S. (2022). HUBUNGAN USIA DENGAN GAMBARAN FOTO TORAKS PASIEN COVID-19. *Syifa'MEDIKA: Jurnal Kedokteran Dan Kesehatan*, *13*(1), 37–45.

Organization, W. H. (2020). *Use of chest imaging in COVID-19: a rapid advice guide*.

Sastroasmoro, S. (2022). *Dasar-dasar metodologi penelitian klinis*.

Sharma, R., Agarwal, M., Gupta, M., Somendra, S., & Saxena, S. K. (2020). Clinical characteristics and differential clinical diagnosis of novel coronavirus disease 2019 (COVID-19). *Coronavirus Disease 2019 (COVID-19) Epidemiology, Pathogenesis, Diagnosis, and Therapeutics*, 55–70.

Sinaga, F. T. Y., Rusmini, H., Wahyudi, A., Soemarwoto, R. A. S., Messah, A. D. V., & Putri, I. U. (2021). Hubungan Karakteristik Gambaran Radiografi Toraks Distribusi Lesi Paru dengan Prognosis Pasien COVID-19. *ARTERI: Jurnal Ilmu Kesehatan*, *2*(3), 92–98.

Suryamin, R. (n.d.). Modalitas CT-Scan Toraks sebagai Pemeriksaan Penunjang pada COVID-19. *Cermin Dunia Kedokteran*, *48*(1), 398749.

Wu, Z., & McGoogan, J. M. (2020). Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *Jama*, *323*(13), 1239–1242.