Abstract

Background: The mortality risk of the novel coronavirus disease 19 (COVID-19) remains a global concern. Particularly in Indonesia, patients aged 18–59 years have a high risk of death due to COVID-19. In this study, we analysed the determinants of mortality risk among patients with confirmed COVID-19.

Methods: A secondary analysis of data from the Indonesian COVID-19 dashboard, tracking COVID-19 cases from April 2020 to May 2021 was performed. Data of 22,314 patients with COVID-19 aged 18–59 years were analysed using descriptive analysis, chi-square test, and binary logistic regression to obtain adjusted odds ratios (AORs) with 95% confidence intervals (CIs).

Results: Factors associated with confirmed mortality risk among patients aged 18–59 years with COVID-19 included increasing age (AOR = 1.08; 95% CI = 1.07–1.09), hospitalised and on ventilator support (AOR = 130.75; 95% CI = 69.03–247.63), having severe disease (AOR = 15.24; 95% CI = 11.51–20.17), and travelling history (AOR = 1.36; 95% CI = 1.13–1.63).

Conclusions: These findings confirmed that the increasing risk of death due to COVID-19 was associated with increasing age, ventilator support during hospitalisation, developing severe disease, and having a travelling history. This suggests that curative strategies should be strengthened with a focus on improving clinical governance by prioritising patients with the above variables.

Keywords

COVID-19, health risk, middle-aged adult patients, mortality risk, young patients
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Introduction
The novel coronavirus disease 2019 (COVID-19) was declared a global pandemic by the World Health Organization (WHO). The virus that causes COVID-19, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was identified in December 2019 in the Wuhan province of China.1 The virus has since spread rapidly around the world, affecting more than 235 million people by October 2021, and causing approximately 4.8 million deaths, with the highest number of positive confirmed cases in America reaching 90 million. The first case of COVID-19 in Indonesia was detected on 2 March 2020.5 COVID-19 cases in Indonesia had reached approximately 4.2 million, with 143,299 deaths by 27 October 2021. During this period, East Java became the fourth province with the highest number of confirmed cases, having a total of 396,001 positive patients. Among them, 29,464 people died, 365,340 recovered, and 1,197 were in the process of being treated or undergoing self-isolation. Moreover, the case fatality rate from COVID-19 in East Java is known to be the highest in Indonesia, having reached 7.44%.

The national trend of COVID-19 cases in Indonesia shows that adults aged 31–45 years are more prone to infection, followed by young adults aged 19–30 years; however, those ≥ 46 years of age show the highest number of deaths and a low recovery rate.7 These patterns are similar to current trends in both high-income and developing countries, which report as many as 5% more deaths in patients between 20–39 years old, and up to 23% in those between 40–59 years old.3–6 Supporting these findings, several studies in 2021 revealed that the mortality of COVID-19 increases with age, which is considered to be associated with deteriorating health status or pre-existing comorbidities.7–9

In addition to age-related factors, mortality from COVID-19 has also been correlated with other factors, such as gender, comorbidities, and clinical condition.9–11 Many studies have focused on analysing the risk factors for mortality in hospitalised patients,7,12–14 and these were mainly associated with clinical treatment, existing chronic disease(s), type of treatment unit, and complications. However, very few studies have focused on determining the factors associated with mortality from COVID-19 in non-hospitalised patients.

Therefore, the aim of this study was to analyse the predictors of mortality among hospitalised and non-hospitalised patients with COVID-19 in East Java, Indonesia.

Methods
Ethical considerations
The datasets used in this study were analysed after all individual-level identification variables were removed. In addition, it was not possible to identify the residences of any of the subjects; therefore, ethical approval was not required for this study.

Data source
Secondary data analysis from the Indonesian COVID-19 dashboard tracked COVID-19 cases from April 2020 to May 2021 (the peak case period) was performed. Data of all patients with COVID-19 aged 18–59 years were analysed and sorted according to the determinants of mortality risks.

Sample size and sampling
The COVID-19 Task Force of East Java has established a database to compile all data of COVID-19 related cases reported by health facilities since the inception of the pandemic. It is mandatory for health facilities to report COVID-19 related cases through this platform. Reported information included sociodemographic data, particularly age, gender, occupation, case category, address, treatment status, treatment location, date of tracking, treatment outcome, symptoms, diagnosis, comorbidity, travelling history, severity, and history of exposure to a suspected or confirmed case. Because the data relied on the self-reported mechanism from primary health care centres and hospitals, the accuracy and the completeness of data submitted to the platform varies across facilities.

In the present study, purposive sampling of respondents aged 18–59 years was applied. The initial extracted data included 87,162 respondents; however, only respondents with complete data, including sex, treatment status, category of illness, travelling history, and exposure to confirmed cases, were included in the data analysis. After eliminating cases that did not meet the above-mentioned criteria, a sample size of 22,314 was included in this study.

Variables and measurements
The dependent variables in this study were either dying (death) or living (alive). Several patient-related variables, including age, sex (male and female), treatment status, category of illness, and travelling history were considered as
independent variables. All of these variables were chosen as the variables related to mortality of patients with COVID-19. Treatment status was categorised into three categories: non-hospitalised, hospitalised, and hospitalised on a ventilator. The severity of COVID-19, according to the *Diagnosis and Treatment Protocol for COVID-19 (seventh edition)*, is briefly divided into three categories: 1) mild (mild clinical symptoms and undetected signs of pneumonia on CT images); 2) moderate (fever and respiratory symptoms with signs of pneumonia on CT images); 3) severe (any of the following symptoms: (a) respiratory distress and requiring invasive ventilation, (b) pulse oxygen saturation < 93%, or (c) partial pressure of oxygen (PaO2)/oxygen concentration < 300 mmHg).

Travelling history was measured as yes or no, which determined whether a patient had travelled to other cities, and whether the areas were high-risk or not. The classification of areas was granted by the COVID-19 Task Force which was calculated based on the daily confirmed case rate. Exposure to confirmed patients was categorised as either yes or no.

**Statistical analysis**

SPSS 26.0 for Windows (SPSS, Inc., Chicago, IL, USA) was used for statistical analyses. To determine the mortality risk factors in patients aged 18–59 years with COVID-19, we performed univariate analysis, chi-square test, and binary logistic regression to obtain adjusted odds ratios (AORs) and 95% confidence intervals (CIs).

**Results**

The sociodemographic analysis showed that the prevalence of patients aged 18–59 years deaths due to COVID-19 in East Java, Indonesia was 4.8% (1065). The proportion of male and female mortality differed by 1.1%, with male patients (5.3%) having a higher prospect of succumbing to the disease than the female patients (4.2%). In addition, patients who were hospitalised on a ventilator are more likely to die (52.6%). The severity category showed that the more severe the disease is, the more patients tend to die (63.3%). Based on travel history, patients who have a high history of travelling are more likely to die (6.3%), compared to those who have no traveling history.

Furthermore, patients with a history of being in contact with a confirmed COVID-19 case are less likely to die (4.7%). The chi-square test revealed that four independent variables were significant (p < 0.05) in relation to the mortality risk in patients aged 18–59 years caused by COVID-19. Nonetheless, sex, treatment status, severity category, and travel history were significant factors associated with the incidences of COVID-19 deaths. The data are depicted in Table 1.

The determinants of mortality risk among patients aged 18–59 years are shown in the multivariate analysis table (Table 2). According to the data, older patients with COVID-19 were 1.08 times more likely to die than the younger patients with the range aged of 18–59 years. Patients with COVID-19 on ventilators were 130.75 times more likely to die than patients receiving other treatment strategies. The disease category indicated that patients with a severe form of the disease were more likely to die than those with a mild or moderate diagnosis (AOR = 15.24, 95% CI = 11.51–20.17). Based on travel history, patients with a history of travelling prior to symptom onset had a higher (1.36 times) probability of dying from the disease than those without a travel history.

**Discussion**

The present study findings showed that age is associated with mortality from COVID-19, with the older generation being more vulnerable than the younger population. This finding is supported by studies from various countries, including New York, Mexico, and Pakistan. In Mexico, the prevalence of COVID-19 survivors and non-survivors was compared and the findings showed that the majority of the non-survivors were 10 years older than those who survived. The reason for this is that natural immunity and organ function tend to decline gradually with age. In addition, the social factors of adults, such as work activity, habits, and lifestyle might influence their susceptibility to death. Thus, it can be postulated that adult patients with COVID-19 are likely to develop more opportunistic infections, and in turn be at higher risk of mortality than the younger population group.

Patients with COVID-19 who were on ventilator support had a high mortality rate because of reduced pulmonary function. This finding is consistent with that of a study from Pakistan, which reported that 86% of patients that died from COVID-19 required invasive ventilator support. Several countries, states, and provinces reported a high mortality rate in COVID-19 patients on ventilators, including Italy (53.4%), the United Kingdom (67%), New York (88%), and Wuhan (97%). Based on these findings, the use of ventilators in the management of COVID-19 should be aligned with patient symptoms since acute respiratory failure in COVID-19 is unique and poorly understood. This suggests that clinicians must understand the different settings of the ventilator to match disease severity when treating patients with acute respiratory symptoms associated with COVID-19.
Table 1. Sociodemographic information of adult patients (18–59 years old) with COVID-19 (N = 22314).

| Variables                  | Confirmed cases |   |   |   |   |   |   |   |   |
|----------------------------|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                            | Alive           | Died             | p-value ($X^2$)  | N                | %                | N                | %                | N                | %                |
| Sex                        |                 |                  |                  |                  |                  |                  |                  |                  |                  |
| Male                       | 11507           | 94.7%            | 638              | 5.3%             | 0.00* (13.53)    |                  |                  |                  |                  |
| Female                     | 9742            | 95.8%            | 427              | 4.2%             |                  |                  |                  |                  |                  |
| Treatment                  |                 |                  |                  |                  |                  |                  |                  |                  |                  |
| Non-Hospitalised           | 8518            | 99.9%            | 12               | 0.1%             | 0.00** (2760.82) |                  |                  |                  |                  |
| Hospitalised               | 12514           | 93.9%            | 812              | 6.1%             |                  |                  |                  |                  |                  |
| Hospitalised on a ventilator| 217             | 47.4%            | 241              | 52.6%            | 0.00** (3359.39) |                  |                  |                  |                  |
| Severity                   |                 |                  |                  |                  |                  |                  |                  |                  |                  |
| Mild                       | 19044           | 96.8%            | 639              | 3.2%             | 0.00** (119.45)  |                  |                  |                  |                  |
| Medium                     | 2048            | 93.0%            | 155              | 7.0%             |                  |                  |                  |                  |                  |
| Severe                     | 157             | 36.7%            | 271              | 63.3%            |                  |                  |                  |                  |                  |
| Travelling history         |                 |                  |                  |                  |                  |                  |                  |                  |                  |
| Yes                        | 10420           | 93.7%            | 705              | 6.3%             | 0.00** (119.45)  |                  |                  |                  |                  |
| No                         | 10829           | 96.8%            | 360              | 3.2%             |                  |                  |                  |                  |                  |
| Exposed to suspect/confirmed person |       |                  |                  |                  |                  |                  |                  |                  |                  |
| Yes                        | 15032           | 95.3%            | 743              | 4.7%             |                  |                  |                  |                  |                  |
| No                         | 6217            | 95.1%            | 322              | 4.9%             |                  |                  |                  |                  |                  |
| Total                      | 21249           | 95.2%            | 1065             | 4.8%             |                  |                  |                  |                  |                  |

*p < 0.05.  **p < 0.001.

Table 2. Multivariate analysis of adult patients with COVID-19 in East Java Indonesia (N = 22314).

|                      | Confirmed | Sig. | 95% CI            |
|----------------------|-----------|------|-------------------|
|                      | OR        |      |                   |
| Age                  | 1.08      | 0.00** | 1.07–1.09         |
| Sex                  |           |      |                   |
| Female (Ref)         | 1         |      |                   |
| Male                 | 0.98      | 0.80 | 0.85–1.13         |
| Treatment            |           |      |                   |
| Non-hospitalised (Ref) | 1       |      |                   |
| Hospitalised         | 27.69     | 0.00** | 15.42–49.71       |
| Hospitalised and on a ventilator | 130.75 | 0.00** | 69.03–247.639     |
| Category of illness  |           |      |                   |
| Mild (Ref)           | 1         |      |                   |
| Moderate             | 1.36      | 0.00* | 1.10–1.68         |
| Severe               | 15.24     | 0.00** | 11.51–20.17       |
| Travelling history   |           |      |                   |
| No (Ref)             | 1         |      |                   |
| Yes                  | 1.36      | 0.00* | 1.13–1.63         |

OR, odds ratio; CI, confidence interval.  
*p < 0.05.  **p < 0.001.
Patients with severe COVID-19 had a higher probability of dying than those in the moderate and mild categories. Patients with severe illness might have been exposed to SARS-CoV-2 longer than those in the other disease categories, resulting in the development of an inflammatory response.\(^\text{24}\) The progression of disease in patients with severe infection is important in understanding disease prognosis because these patients tend to experience several symptoms, including acute respiratory distress, coagulopathy, acute respiratory failure, and metabolic acidosis.\(^\text{25}\) A study confirmed more patients with severe disease required intensive care and treatment, the lack of which resulted in their death.\(^\text{26}\)

Lastly, the majority of deaths in patients aged 18–59 years with COVID-19 were associated with having a travelling history, meaning that infection from SARS-CoV-2 occurred during travelling. Study findings from research in Iran is in accordance with this observation, in which Iranian women with a travelling history had 8.8% higher infection rate than those who did not travel, especially those who visited high-risk areas.\(^\text{27}\) Other studies concluded that mobility could be a contributing factor in the transmission of COVID-19 among people.\(^\text{28,29}\)

**Limitations**

Since our study used secondary data, the use of specific built-in variables could have led to focus bias. In addition, some individuals who might have developed symptoms and did not report to treatment centres could not be included in the study.

**Conclusions**

Mortality risk from COVID-19 among patients aged 18–59 years has been correlated with various factors, specifically, age, treatment, severity of illness, and travelling history. Reduction in mortality rate might be achieved by enhancing precision treatment and broadening prevention at both clinical and community levels.

**Data availability**

**Underlying data**

The dataset used in this study can be accessed upon request to the East Java Task Force of COVID-19 Program website (https://infocovid19.jatimprov.go.id/). All of the requests should be directed to the task force through the contact at their website (Call Center 1500 117 or e-mail at humas.dinkesjatim@gmail.com) and are subject to the approval of their team. The name of the dataset is East Java COVID-19 data and access to the data would normally be granted by the task force team for research purposes.

**References**

1. Umakanthan S, Sahu P, Ranade AV, et al.: Origin, transmission, diagnosis and management of coronavirus disease 2019 (COVID-19). Postgrad Med J. 2020; 96: 753–758. PubMed Abstract | Publisher Full Text | Reference Source
2. Arisah DN, Mayadewi CA, Diva H, et al.: A spatial-temporal description of the SARSCoV-2 infections in Indonesia during the first six months of outbreak. PLoS One. 2020; 15(12 December): e0243703. PubMed Abstract | Publisher Full Text | Reference Source
3. Chauvin JP, Fowler A, Herrera LN: The Younger Age Profile of COVID-19 Death in Developing Countries. JDB Work Pap Ser. 2020; 1154. Reference Source
4. Laxminarayan R, Wahl B, Dusdal SR, et al.: Epidemiology and transmission dynamics of COVID-19 in two Indian states. Science (80-). 2020; 370(6517) Publisher Full Text
5. Phillip M, Ray D, Subramanian S: Decoding India’s Low Covid-19 Case Fatality Rate. J Hum Dev Capab. 2021; 22(1): 27–51. Publisher Full Text
6. Demombynes G: COVID-19 Age-Mortality Curves are Flatter in Developing Countries. COVID-19 Age-Mortality Curves are Flatter in Developing Countries. World Bank Group; 2020. Reference Source
7. Suresh H, Elayaraj DR, Djasfara BA, et al.: Clinical characteristics and mortality associated with COVID-19 in Jakarta, Indonesia: A hospital-based retrospective cohort study. Lancet Reg Heal - West Pacific. 2021; 9: 100108. Publisher Full Text | Reference Source
8. Bauer P, Brugger J, König F, et al.: An international comparison of age and sex dependency of COVID-19 deaths in 2020: a descriptive analysis. Sci Rep. 2021; 11(1): 19143. PubMed Abstract | Publisher Full Text | Reference Source
9. Biswas M, Rahaman S, Biswas TK, et al.: Association of Sex, Age, and Comorbidities with Mortality in COVID-19 Patients: A Systematic Review and Meta-Analysis. Interiology. 2021; 64(1): 36–47. PubMed Abstract | Publisher Full Text | Reference Source
10. Williamson GJ, Walker AJ, Bhakaran K, et al.: Factors associated with COVID-19-related death using OpenSAFELY. Nature. 2020; 584(7821): 430–436. PubMed Abstract | Publisher Full Text | Reference Source
11. Chilimuri S, Sun H, Alemam A, et al.: Predictors of mortality in adults admitted with COVID-19: Retrospective cohort study from New York City. West J Emerg Med. 2020; 21(4): 779–784. PubMed Abstract | Publisher Full Text | Reference Source
12. Cueto-Manzano AM, Espinol-Bermúdez MC, Hernández-González SO, et al.: Risk factors for mortality of adult patients with COVID-19 hospitalised in an emerging country: A cohort study. BMJ Open. 2021; 11(7): e050321. PubMed Abstract | Publisher Full Text
13. Andrade JA, Muzykovsky K, Truong J: Risk factors for mortality in COVID-19 patients in a community teaching hospital. J Med Virol. 2021; 93(2): 3184–3193. PubMed Abstract | Publisher Full Text
14. Abate SM, Chekol YA, Mantefardo B: Global prevalence and determinants of mortality among patients with COVID-19: A systematic review and meta-analysis. Ann Med Surg. 2021; 64.
15. Albitar O, Balouze R, Ooi JP, et al.: Risk factors for mortality among COVID-19 patients. Diabetes Res Clin Pract. 2020; 166: 108293.
16. Sarfaraz S, Shaikh Q, Saleem SG, et al.: Determinants of in-hospital mortality in COVID-19: a prospective cohort study from Pakistan. PloS One. 2021; 16(S5 May): e0251754.
17. Shaikh FS, Aldhafferi N, Buker A, et al.: Comorbidities and risk factors for severe outcomes in COVID-19 patients in Saudi Arabia: A retrospective cohort study. J Multidiscip Healthc. 2021; 14: 2169–2183.
18. Grasselli G, Greco M, Zanella A, et al.: Risk Factors Associated with Mortality among Patients with COVID-19 in Intensive Care Units in Lombardy, Italy. JAMA Intern Med. 2020; 180(10): 1345–1355.
19. ICNARC: ICNARC report on COVID-19 in critical care. ICNARC COVID-19 Study Case Mix Program. Database. 2021; (February): 1–16.
20. Richardson S, Hirsch JS, Narasimhan M, et al.: Presenting Characteristics, Comorbidities, and Outcomes among 5700 Patients Hospitalized with COVID-19 in the New York City Area. JAMA - J Am Med Assoc. 2020; 323(20): 2052–2059.
21. Yang X, Yu Y, Xu J, et al.: Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. Lancet Respir Med. 2020; 8(5): 475–481.
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