



Factor Related the Use of Respiratory Supports among COVID-19 Patients in Sardjito Hospital Yogyakarta: A Cross-sectional Study

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Abstract

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BACKGROUND: In patients with coronavirus disease-19 (COVID-19), respiratory failure is a serious condition that requires immediate respiratory supports. Various clinical conditions can be determinant factors to the need for used of ventilators.

AIM: The aim of the study was to determine factor related to the used of ventilators among COVID-19 patients transferred to intensive care unit Sardjito Hospital.

METHODS: Using a cross-sectional design, a total of 171 of 300 medical records selected in accordance to the inclusion criteria. Association of each clinical characteristics and outcome variable used contingency coefficient and Spearman rank tests, while multivariate logistic regression model was performed for hypothesis testing. The area under curve (AUC) was test to determine model fit of the logistic approach.

RESULTS: There was a significant correlation between age ($p = 0.004$), blood sugar levels ($p < 0.001$), and oxygen saturation ($p < 0.001$), and the used of ventilator. Patients with hypoxia and severe hypoxia had odds of using ventilation supports 5 times and 114 times (OR = 5.623) and (OR = 114.3). The AUC test indicated that null hypothesis was rejected.

CONCLUSION: The clinical characteristics were associated with age, blood sugar levels, and oxygen saturation. Patients with COVID-19 who admitted to hospital with hypoxia and severe hypoxia increased the odds of the use ventilators.

Introduction

A number of patients infected coronavirus disease-19 (COVID-19) require hospitalization with the main issue of respiratory problems from mild-to-severe and even respiratory failure. Various clinical conditions at the beginning of hospital admission are considered to influence the development of the patient's health and the risk of using a ventilator. COVID-19 is a serious infection that attacks the respiratory system caused by Bat Derived COVID-19. This infection originated in Wuhan, China and spread very quickly throughout the world. The number of confirmed COVID-19 cases on November 9, 2020 in the world was 50,873,771 cases with 1,264,050 deaths, and 35,865,604 recoveries. The number of COVID-19 cases in the world as of December 31, 2020 increased by 83,060,276 with 1,812,046 deaths. Indonesia 743,198 cases recovered 611,097 people and died 22,138 people [1]. Case in Special Region of Yogyakarta with 12,155 confirmed cases, 8175 recovered and 260 deaths [2].

COVID-19 is transmitted through direct contact, droplet, and airborne. To minimize the transmission of

the virus, a simple and practical mitigation measure is by wearing surgical masks as per recommendation by the World Health Organization. This is in line with the previous research [3]. Another preventive measure to protect the virus transmission is performing hand hygiene, particularly in hospital settings where hand hygiene must comply with the nosocomial prevention guidelines [4]. This is to prevent spreading of nosocomial infections that can cause various health issues. One of health problem related to infectious is respiratory infection ranging from mild-to-severe, thus, leading to respiratory failure [5]. Patients with respiratory failure conditions need of respiratory assistance using a ventilator [6].

Data from Medical Record Installation at Dr. RSUP. Sardjito Yogyakarta in 2020, there were 300 COVID-19 patients being treated. Of the 300, the conditions ranged from mild-to-severe respiratory problems. A total of 59 COVID-19 patients at Dr. Sardjito Yogyakarta (19.6%) required ventilator assistance.

Based on this background, the purpose of this study is to analyze the factors that are related and more dominantly influencing COVID-19 patients in the use of ventilators at Dr. RSUP. Sardjito Yogyakarta.

Methods

The type of research is quantitative with a descriptive correlational research design and a cross-sectional method. The research was carried out on July 15, 2021–July 25, 2021 at the Medical Record Installation Dr. Sardjito Yogyakarta starting from data collection, data processing, advisory consultation, and thesis preparation. This study took secondary data from COVID-19 patients in 2020 as many as 171 patient medical records according to the inclusion and exclusion criteria. The number of samples was calculated based on the Slovin formula [5]. The study was carried out after obtaining approval from the Alma Ata University campus and passing the ethical feasibility test from the Ethics Commission of Alma Ata University Yogyakarta with the number: KE/AA/VI/10527/EC/2021 on June 23, 2021, ethically appropriate from the Ethics Commission of Gajah Mada University Yogyakarta number: KE/FK/0832/EC/2021 and a research permit from RSUP Dr. Sardjito Yogyakarta number: LB.02.01/XI.2.2/29402/2001 on July 15, 2021.

Results

Based on Table 1, characteristics of respondents and use of ventilators in COVID-19 patients at RSUP Dr. Sardjito Yogyakarta can be explained from the Table 1, it can be seen that the majority of respondents have male sex as many as 107 people (62.6%), women 64 people (37.4%), using ventilators 38 men (22.2%) and women 15 people (8.8%). The dominating age is 20–60 years as many as 104 people (60.8%), using a ventilator in the 20–60 year age range as many as 27 people (15.8%), not using as many as 77 people (45%). Body mass index at admission (BMI), the majority were at BMI 18.5–24.9 (normal) as many as 94 people (55%), using ventilators at normal BMI as many as 30 people (17.5%), not using 64 people (37.4%). At BMI >27 (obese), 51 people (29.85%) used a ventilator as many as 17 people (9.9%) and 34 people did not use a ventilator (19.9%). Blood pressure at admission was optimal (<120/80 MmHg) as many as 68 people (39.8%), using a ventilator at optimal blood pressure of 20 people (11.7%), not using 48 people (28.1%). Blood sugar levels at admission were at most 60–145 mg/dL (normal) as many as 99 people (57.9%), using ventilators at normal blood sugar levels 20 people (11.7%), not using 79 people (46.2%). The majority of SpO2 values were 95% (normal) as many as 101 people (59.1%), using a ventilator at normal SpO2 as many as 12 people (7%), not using 89 people (52%). The interesting thing here is that 12 patients (7%), with normal SpO2 95% at admission, experienced respiratory failure and required ventilator assistance.

Table 1: The characteristics of respondents and use of ventilators in COVID-19 patients at Dr. RSUP. Sardjito Yogyakarta (n = 171)

| Variables | Not using a ventilator | | Using a ventilator | |
|-----------------------------|------------------------|------|--------------------|------|
| | N | % | n | % |
| Gender | | | | |
| Man | 69 | 40.4 | 38 | 22.2 |
| Woman | 49 | 28.7 | 15 | 8.8 |
| Age group | | | | |
| 0–1 years old | 0 | 0 | 1 | 0.6 |
| 2–10 years old | 0 | 0 | 0 | 0 |
| 11–19 years old | 10 | 5.8 | 0 | 0 |
| 20–60 years old | 77 | 45 | 27 | 15.8 |
| Age>60 years | 31 | 18.1 | 25 | 14.6 |
| Body mass index (BMI) | | | | |
| <18.5 kg/m ² | 5 | 2.9 | 2 | 1.2 |
| 18.5–24.9 kg/m ² | 64 | 37.4 | 30 | 17.5 |
| 25–27 kg/m ² | 15 | 8.8 | 4 | 2.3 |
| >27 kg/m ² | 34 | 19.9 | 17 | 9.9 |
| Blood pressure | | | | |
| <120/80 MmHg | 48 | 28.1 | 20 | 11.7 |
| <130/<85 MmHg | 25 | 14.6 | 12 | 7 |
| 130–139/85–89 MmHg | 19 | 11.1 | 7 | 4.1 |
| 140–159/90–99 MmHg | 17 | 9.9 | 9 | 5.3 |
| 160–179/100–109 MmHg | 5 | 2.9 | 2 | 1.2 |
| ≥180/≥110 MmHg | 4 | 2.3 | 3 | 1.8 |
| Blood sugar levels | | | | |
| Low | 1 | 0.6 | 0 | 0 |
| Normal | 79 | 46.2 | 20 | 11.7 |
| High Normal | 20 | 11.7 | 12 | 7 |
| High | 12 | 7 | 15 | 8.8 |
| Very High | 6 | 3.5 | 6 | 3.5 |
| SpO2 (%) | | | | |
| 95 | 89 | 52 | 12 | 7 |
| 85–94 | 28 | 16.4 | 21 | 12.3 |
| 67–85 | 1 | 0.6 | 17 | 9.9 |
| 66 | 0 | 0 | 3 | 1.8 |

Test of contingency coefficient used to analyze data on nominal and ordinal scale variables, namely, gender and ventilator use. Test Spearman rank used to test data on ordinal scale variables, namely, age, BMI, blood pressure, blood sugar levels, and SpO2 when admitted to COVID-19 patients using a ventilator. The interpretation of the correlation test results is based on the p-value, the strength of the correlation, and the direction of the correlation. The value of the parameter p, if $p < 0.05$, there is a significant correlation between the two variables tested or H_0 is rejected, if $p > 0.05$, there is no significant correlation between the two variables tested or H_0 is accepted. The value of the relationship level is seen in the value of Rho (r) (Table 2).

Table 2: The relationship levels of research variables

| Coefficient Interval/Rho/r | Relationship Level |
|----------------------------|--------------------|
| 0.00–0.199 | Very low |
| 0.20–0.399 | Low |
| 0.40–0.599 | Currently |
| 0.60–0.799 | Strong |
| 0.80–1.00 | Very strong |

Based on Table 2, it can be explained, the direction of the correlation is positive (+), meaning that the greater the value of one variable, the greater the value of the other variable. While the direction of the negative correlation (-) means, the opposite direction is getting bigger.

Based on bivariate analysis Table 3, it can be explained on the gender variable with the use of a ventilator at Dr. Sardjito Yogyakarta obtained $p = 0.098$ ($p > 0.05$). In the age variable with the use of a ventilator at Dr. Sardjito Yogyakarta obtained $p = 0.004$ ($p < 0.05$). On the variable BMI with the use of a ventilator at Dr. RSUP. Sardjito Yogyakarta obtained $p = 0.967$ ($p > 0.05$). On the blood pressure variable with the use of a ventilator at Dr. Sardjito Yogyakarta obtained $p = 0.647$ ($p > 0.05$).

In the variable blood sugar levels at admission with the use of a ventilator at Dr. RSUP. Sardjito Yogyakarta, the results were $p \leq 0.001$ ($p < 0.05$). On the SpO₂ variable at admission with the use of a ventilator at Dr. Sardjito Yogyakarta obtained the results of $p \leq 0.001$ ($p < 0.05$).

Table 3: Affecting COVID-19 patients with the use of ventilators at Dr. RSUP. Sardjito Yogyakarta (n=171)

| Variables | Category | Not using a ventilator | | Using a ventilator | | r-value | p-value |
|-----------------------|-----------------|------------------------|------|--------------------|------|---------|---------|
| | | n | % | n | % | | |
| Gender | Man | 69 | 40.4 | 38 | 22.2 | 0.125 | 0.098 |
| | Woman | 49 | 28.7 | 15 | 8.8 | | |
| Age | 0–1 years old | 0 | 0 | 1 | 0.6 | 0.222 | 0.004 |
| | 2–10 years old | 0 | 0 | 0 | 0 | | |
| | 11–19 years old | 10 | 5.8 | 0 | 0 | | |
| | 20–60 years old | 77 | 45 | 27 | 15.8 | | |
| | Age>60 years | 31 | 18.1 | 25 | 14.6 | | |
| Body mass index (BMI) | <18.5 | 5 | 2.9 | 2 | 1.2 | 0.003 | 0.967 |
| | 18.5–24.9 | 64 | 37.4 | 30 | 17.5 | | |
| | 25–27 | 15 | 8.8 | 4 | 2.3 | | |
| | >27 | 34 | 19.9 | 17 | 9.9 | | |
| Blood Pressure | <120/80 MmHg | 48 | 28.1 | 20 | 11.7 | 0.035 | 0.647 |
| | <130/<85 MmHg | 25 | 14.6 | 12 | 7 | | |
| Blood sugar level | <59 mg/dL | 1 | 0.6 | 0 | 0 | 0.300 | <0.001 |
| | 60–145 mg/dL | 79 | 46.2 | 20 | 11.7 | | |
| | 146–199 mg/dL | 20 | 11.7 | 12 | 7 | | |
| | 200–299 mg/dL | 12 | 7 | 15 | 8.8 | | |
| | ≥300 mg/dL | 6 | 3.5 | 6 | 3.5 | | |
| SpO ₂ (%) | 95 | 89 | 52 | 12 | 7 | 0.561 | <0.001 |
| | 85–94 | 28 | 16.4 | 21 | 12.3 | | |
| | 67–85 | 1 | 0.6 | 17 | 9.9 | | |
| | 66 | 0 | 0 | 3 | 1.8 | | |

Based on Table 4, it can be explained, the OR SpO₂ value at admission to COVID-19 patients 85–94% (Hypoxia) compared to SpO₂ at admission to COVID-19 patients 95% (Normal healthy) was 5.623 (2.389–13.236). The OR SpO₂ at admission to COVID-19 patients 67–85% (severe hypoxia) compared to SpO₂ at admission to COVID-19 patients 95% (normally healthy) was 114.3 (13.66–956.52). The next step is to look at the area under curve (AUC) SpO₂ value when admitted to COVID-19 patients using a ventilator at Dr. RSUP. Sardjito Yogyakarta.

Table 4: The OR SpO₂ on admission to COVID-19 patients

| Variables | Coefficient | SE | Wald | df | p | OR | 95% CI | |
|----------------------|-------------|-------|--------|----|--------|-------|--------|--------|
| | | | | | | | Min | Max |
| SpO ₂ (%) | | | | | | | | |
| 85–94 | 1.727 | 0.437 | 15.634 | 1 | <0.001 | 5.623 | 2.389 | 13.236 |
| 67–85 | 4.739 | 1.084 | 19.115 | 1 | <0.001 | 114.3 | 13.66 | 956.52 |

Based on Table 5, it can be explained, the AUC value is 14.9% (95% CI: 8.2–21.6%). The AUC value is very weak (AUC <60%).

Table 5: The areas under the curve (AUC)

| Area | p | 95% CI | |
|-------|-------|-------------|-------------|
| | | Lower limit | Upper limit |
| 0.149 | 0.000 | 0.082 | 0.216 |

Discussion

The characteristics of respondents and use of ventilators in COVID-19 patients at Dr. RSUP. Sardjito

Yogyakarta from Table 1, it can be seen that the higher COVID-19 infection rate in men is possible because men generally have higher activities outside the home than women, where men work and are associated with active smokers. In active smokers, there is an increase in the expression of the ACE2 receptor, which is the receptor for SARS-COV2 that causes COVID-19 [4]. COVID-19 infection and its higher severity in men than women are also influenced by the hormone testosterone. The hormone testosterone plays a role in predisposing to serious respiratory and systemic disorders in infected patients [6], [7]. This research related to Satria *et al.* in 2020 at Bhakti Dharma Husada Hospital Surabaya in 358 patients infected with COVID-19, 66 patients (18%) died from COVID-19, 60.6% were male [8]. The cohort study conducted by Grasselli *et al.* 2020 on 3988 COVID-19 patients admitted to the intensive care unit (ICU) in Lombardy Italy, 3188 (79.9%) were men [9]. The age of 20–60 years is a productive age where they generally work. Work outside the home requires a person to interact more with other people who may be infected with COVID-19. Thus, those aged 20–60 years have a greater risk of contracting COVID-19 [10].

BMI at admission, the majority were at BMI 18.5–24.9 (normal) as many as 94 people (55%), using ventilators at normal BMI as many as 30 people (17.5%), not using 64 people (37.4%). At BMI >27 (obese), 51 people (29.85%) used a ventilator as many as 17 people (9.9%) and 34 people did not use a ventilator (19.9%). According to the study of Shekar *et al.*, the severity of COVID-19 patients with obesity showed that obese individuals increased the likelihood of being admitted to the ICU by 74%. Patients with obesity also have a higher risk of using a ventilator intermittent mandatory ventilation (IMV) [11], [12]. The blood pressure of COVID-19 patients can be influenced by various clinical conditions. COVID-19 patients who were hospitalized at Dr. the majority of Sardjito had good clinical and hemodynamic conditions. Based on the theory, hypertension is a risk factor for worsening COVID-19 [4]. This study did not look at the comorbid patients, so it is not known whether the patient has comorbid hypertension.

Blood sugar levels at admission were at most 60–145 mg/dL (normal) as many as 57.9%, using ventilators at normal blood sugar levels 11.7%, not using 46.2%. In theory, it is said that diabetes mellitus is a risk factor for infection and comorbidities that can exacerbate COVID-19 infection [3].

COVID-19 patients can experience pulmonary function failure due to excessive cytokine storm causing severe lung inflammation. Pulmonary inflammation caused by an excessive increase in cytokines causes the lungs to secrete excessive mucus in the lungs which causes collapse of the alveoli [4]. The interesting thing here is that 12 patients (7%), with normal SpO₂ 95% at admission, experienced respiratory failure and required ventilator assistance. Based on the theory, COVID-19 patients can experience a sudden worsening of

the condition without warning or what is called silent hypoxemia or there is also what is called happy hypoxia [13].

The bivariate analysis of factors affecting COVID-19 patients with the use of ventilators at Dr. RSUP. Sardjito Yogyakarta from Table 3, it can be explained that there is no statistical relationship between gender and the use of ventilators at Dr. Sardjito Yogyakarta. Based on the correlation coefficient value between sex and the use of ventilators indicates that there is a very weak relationship between sex and the use of ventilators at Dr. RSUP. Sardjito Yogyakarta. The worsening of COVID-19 patients can be influenced by various factors. COVID-19 patients who immediately receive appropriate medical attention can be minimized from falling into respiratory failure conditions and requiring ventilator assistance. The prone position can increase oxygen saturation and prevent the patient from developing hypoxia [14],[15].

In the age variable with the use of a ventilator, which means that there is a statistically significant relationship between age and ventilator use at Dr. Sardjito Yogyakarta. Based on correlation coefficient between age and the use of ventilators at Dr. RSUP. Sardjito Yogyakarta indicates that there is a weak relationship between age and ventilator use at Dr. Sardjito Yogyakarta. Productive age is an age that statistically has a greater risk of contracting COVID-19 so that it has a greater risk of worsening conditions [10].

On the variable BMI with the use of a ventilator at Dr. RSUP. Sardjito Yogyakarta which means that there is no statistical relationship between BMI and the use of ventilators. Based on correlation coefficient value between BMI and the use of ventilators at Dr. RSUP. Sardjito Yogyakarta, this correlation coefficient indicates that there is a very weak relationship between BMI and the use of ventilators at Dr. RSUP. Sardjito Yogyakarta.

According to the research conducted by Simonnet et al., obesity (BMI >30) and severe obesity (BMI >35) were found in 47.6% and 28.2% of cases, respectively. Overall, 68.6% patients required IMV. The proportion of patients requiring IMV increased by BMI category and was greatest in patients with BMI >35 (85.7%) [11]. The investigators assumed that the different study sites had an effect on the outcome regarding patients' BMI. In general, ASIA postures have a normal BMI [14].

On the blood pressure variable with the use of a ventilator at Dr. Sardjito Yogyakarta that there is no statistical relationship between blood pressure and the use of ventilators. Based on the correlation coefficient value between blood pressure and the use of ventilators indicates that there is a very weak relationship between blood pressure and the use of ventilators in Dr. Sardjito Yogyakarta. In line with research conducted by Huang et al., patients with hypertension tend to have a more severe risk of worsening of COVID-19 and a higher risk

of ICU admission to ventilator use than patients who are not hypertensive [16].

In the variable blood sugar levels at admission with the use of a ventilator, the results show that there is a statistically significant relationship between blood sugar levels at admission and the use of ventilators at Dr. Sardjito Yogyakarta. Based on the correlation coefficient value between blood sugar levels at admission and the use of ventilators indicates that there is a weak relationship between blood sugar levels at admission and the use of ventilators at Dr. Sardjito Yogyakarta. Research by Huang et al. stated that plasma blood sugar levels are closely related to the severity of patients with COVID-19. Plasma blood sugar levels as a risk factor in COVID-19 patients are associated with comorbid diabetes mellitus [17]. In a study conducted by Grasselli et al., in 3988, COVID-19 patients admitted to the ICU in Lombardy, Italy, diabetes mellitus was a dangerous risk for COVID-19 patients [9].

On the SpO₂ variable at admission with the use of a ventilator at Dr. Sardjito Yogyakarta which means that there is a statistically significant relationship between SpO₂ at admission and the use of ventilators at Dr. Sardjito Yogyakarta. Based on the correlation coefficient value between SpO₂ at admission and the use of a ventilator shows that there is a moderate relationship between SpO₂ at admission and the use of ventilators at Dr. RSUP. Sardjito Yogyakarta. This is in line with the research of Pan et al., which stated that there was a significant relationship between SpO₂ with worsening of COVID-19 patients and the risk of patient death [18].

Based on the results of multivariate analysis, it was found that the patient's age and SpO₂ at admission were the dominant variables on the use of ventilators in COVID-19 patients at Dr. Sardjito Yogyakarta. The OR SpO₂ value at admission to COVID-19 patients 85–94% (Hypoxia) compared to SpO₂ at admission to COVID-19 patients 95% (Normal healthy) was 5.623 (2.389–13.236). This means that the odds of SpO₂ respondents on admission to COVID-19 patients are 85–94% (Hypoxia) for ventilator use that is 5.623 times the odds of SpO₂ at admission to COVID-19 patients 95% (Normal healthy). The OR SpO₂ at admission to COVID-19 patients 67–85% (severe hypoxia) compared to SpO₂ at admission to COVID-19 patients 95% (normally healthy) was 114.3 (13.66–956.52). This means that the odds of SpO₂ respondents on admission to COVID-19 patients 67–85% (severe hypoxia) for the use of ventilators are 114.3 times the odds of SpO₂ on admission to COVID-19 patients 95% (normally healthy) [19],[20]. Research by Xie et al., hypoxia is closely related to the risk of death of COVID-19 patients [21]. Research by Liang et al. concluded that dyspnea was a predictor of worsening of COVID-19 patients [22]. However, this study also had few limitations such as in collecting research data that there are some incomplete patient medical records, so they cannot be used as

research samples. Incomplete patient medical records according to the research inclusion criteria cannot be included in the study and replaced with other medical records.

Conclusion

Based on research that has been carried out on COVID-19 patients at Dr. Sardjito Yogyakarta who was hospitalized in 2020 can be concluded: Male, age 20–60 years, BMI normal range (18.5–24.9%), optimal blood pressure range (<120/80 mm/Hg), blood sugar level normal range (60–145 mg/dl), and SpO₂ in the normal healthy range (≥95%) are the variables that dominate the characteristics of COVID-19 patients with ventilator use. There is a statistically significant relationship between age, blood sugar levels, and SpO₂ with the use of a ventilator. SpO₂ on admission to COVID-19 patients is the dominant variable in the use of ventilators and is the most significant variable. From this research concluded that SpO₂ of patients on admission is the most significant factor for ventilators usage in COVID-19 patients at Dr. Sardjito Hospital, Yogyakarta.

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