

# The relationship between sequential organ failure assessment (SOFA) score and mortality in COVID-19 patients with ARDS

Setiyawan Setiyawan<sup>1</sup>, Gleryn Viona Octaverlita, Dewi Suryandari<sup>2</sup>

Emergency and Critical Nursing Department, Faculty of Health Sciences, University of Kusuma Husada Surakarta, Surakarta, Indonesia

## Abstract

**Background:** The WHO declared a COVID-19 pandemic on January 30, 2020. Five percent of all patients with coronavirus disease-19 symptoms are emergency and critical cases of ARDS by 49% mortality. The SOFA score is an assessment in intensive care unit patients to determine the level of organ failure.

**Purpose:** The research aimed to determine the relationship between SOFA scores and mortality in coronavirus disease-19 patients with ARDS.

**Methods:** This type of research was quantitative with a retrospective cohort design. The population was coronavirus disease-19 patients with ARDS in the intensive care unit room at RSUD dr. Moewardi in January-September 2021 with 485 people. Eighty-three (83) respondents were selected through the purposive sampling technique. The research instrument used the SOFA scoring sheet.

**Results:** The study on the characteristics of respondents revealed that 57.8% were male, the average age of respondents was 57.31 years and 57.8% with comorbid diseases. The abnormal SOFA scores were 96.4%, 91.6% mortality. The Chi-Square test showed a p-value of 0.018.

**Conclusion:** There is a relationship between SOFA scores and mortality in coronavirus disease-19 patients with ARDS. SOFA score could be used as a predictor of mortality in coronavirus disease-19 patients with ARDS. SOFA score scores can describe the patient's prognosis, because SOFA scores have an assessment of all six organ functions such as respiration (PaO<sub>2</sub> / FiO<sub>2</sub>), blood pressure, creatinine and diuresis, bilirubin, platelets, and GCS, so that it is effective in assessing organ failure.

**Keywords:** ARDS; COVID-19; mortality; SOFA

## Introduction

The severe acute respiratory syndrome coronavirus-2 is the cause of the COVID-19 that can attack animals and humans. In many cases, the COVID-19 virus causes only mild infections, such as the flu. The COVID-19 virus can attack anyone with mild, moderate symptoms, while 5% of them fall in a critical condition, Acute Respiratory Distress Syndrome (ARDS) (Xie et al., 2020). ARDS is an emergency in the respiration system that can occur due to fluid buildup in the alveoli which can result in disruption of oxygen exchange (Rumende & Wijaya, 2019).

In a study conducted in Lombardy, Italy, it was reported that out of 1,591 COVID-19 patients, 920 (58%) were treated in the ICU room which was then sampled for the study. The results showed that 37 patients needed mechanical ventilation intervention and 32 patients died on day 28 (Xie et al., 2020). Based on data in January 2021 at Wisma Atlet Kemayoran Jakarta, it was found that of patients with ARDS, in the first seven days 12% experienced mild ARDS and 16% experienced moderate ARDS which

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#### Corresponding author

**Setiyawan<sup>1</sup>**  
Emergency and Critical Nursing Department, Faculty of Health Sciences, University of Kusuma Husada Surakarta, Surakarta, Indonesia, Postal address: 57136; Phone: +62816675641, E-mail: [etya1025@gmail.com](mailto:etya1025@gmail.com)

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then deteriorated to severe ARDS. ARDS cases were found in 60-70% in patients in the ICU and as many as 94% ended in death. ARDS is a respiratory emergency disease that can cause breathing failure, ARDS is a major factor causing morbidity and mortality in coronavirus disease-19 patients (Yudha et al., 2021).

COVID-19 is one of the leading causes of mortality in the world; a study in the USA shows that >122,300 or 95% of deaths occur due to COVID-19 over a period of one year (Rello et al., 2020). Death prediction in coronavirus disease-19 patients accompanied by ARDS is very important, both clinically and administratively. Predicting the patient's condition can help to monitor the patient's condition and also provide information related to the prognosis of a disease which can be used as an indicator to determine the right therapy in the patient (Yulianto & Indriasari, 2020).

Sequential Organ Failure Assessment (SOFA) is a scoring instrument to assess dysfunction of an organ consisting of six assessment indicators with a score of 0-4 according to the degree of failure. SOFA score assessment includes the respiration system (PaO<sub>2</sub>/FiO<sub>2</sub>), cardiovascular (blood pressure), kidney (creatinine and diuresis), hepar (bilirubin), hematology (platelet count), and neurology (GCS) (Liu et al., 2020). SOFA score is the most commonly used assessment in critical patients, with sepsis (COVID-19) who are mechanically ventilated, and accuracy of SOFA scoring has been recognized by a number of clinicians. Changes in SOFA scores can predict outcomes; patients with a score of ≥2 have a predicted mortality rate of ≥10%. Similar research in Indonesia on this subject is still limitedly reported, so researchers want to know the SOFA score and its correlation with mortality in COVID-19 patients who experience ARDS so as to provide an overview of the relationship between SOFA scores and mortality. In previous studies it has not been specific in patients who experience ARDS (Wulandari et al., 2018). Furthermore, there has not been any literature assessing the validity of the SOFA score from the onset of severe respiratory distress in patients with COVID-19 pneumonia. We presented our novel research on the SOFA score in patients with COVID-19; we used time zero of the onset of severe respiratory distress and looked at the worst SOFA score within 48 hours.

Data on COVID-19 cases at RSUD dr. Moewardi for the January-September 2021 period were 6,263 cases with the number of ARDS cases as many as 485. Meanwhile, the data obtained by researchers from the Medical Record of Public Hospital in Indonesia for the January-September 2021 period showed the mortality rate of patients in the ICU and isolation rooms is still high, with the average patient dying <48 hours after being diagnosed or starting to be treated in the ICU (Medical Record RSUD dr. Moewardi, January-September 2021).

## Materials and Methods

### Design

The study design was a retrospective cohort. The population was coronavirus disease-19 patients with ARDS in the ICU at RSUD dr. Moewardi in January-September 2021.

### Participants and Setting

This research data come from secondary data in the patient's medical record. Coronavirus disease-19 patients with ARDS in the ICU room at RSUD dr. Moewardi during the January-September 2021 period, comprising 485 patients, are the population in this study. The sample in this study was 89 respondents, using purposive sampling technique. Inclusion criteria of the study were patients who were confirmed positive for coronavirus disease-19, coronavirus disease-19 patients with ARDS, and adult patients aged ≥20 years. All SOFA score parameters were filled. Exclusion criterion for the study is incomplete medical peer data.

### Variable

The independent variable in this study is the SOFA score, while the dependent variable is mortality.

### Instruments

The data collection tool used by researchers is the SOFA scoring sheet. Data collection was carried out in the medical record installation room at RSUD dr. Moewardi. When the collected data reaches the number of research samples, data analysis then carried out.

### Data collection

Data were collected using SOFA scoring sheet by the first author in April 2022.

### Data analysis

The data analysis used was a univariate analysis for the categories of sex, age, comorbid diseases, SOFA scores, and mortality. Bivariate analysis used the Chi-Square test to determine the relationship between SOFA scores and mortality in COVID-19 patients with ARDS at RSUD dr. Moewardi. All data were analyzed using SPSS version 26.0.

### Ethical consideration

This research was ethically approved by the Research Ethics Committee of Kusuma Husada University, Surakarta with the number 348/UKH.L.02/EC/III/2022. All documents required for data collection have been approved through informed consent.

## Results

The result of the study based on Table 1 show that most of the respondents are men (57.8%). According

**Table 1. Demographic data for the respondents (n = 83)**

Characteristics of respondents	n (%)
Sex	
Men	48 (57.8)
Women	35 (42.2)
Age (years), Mean $\pm$ SD	57.31 $\pm$ 13.940
Range : 25-89 years old	
Comorbidities	
Exist	48 (57.8)
None	35 (42.2)

**Table 2. Frequency distribution of respondents' characteristics based on SOFA Score and mortality in COVID-19 patients with ARDS**

Variable	n (%)
SOFA Score	
Normal (0-1)	3 (3.6)
Abnormal (2-4)	80 (96.4)
Mortality	
Dead	76 (91.6)
Life	7 (8.4)

**Table 3. Relationship of SOFA Score with Mortality in Coronavirus Disease-19 Patients with ARDS**

	SOFA Score		Mortality		Total	p-value
			Dead	Life		
	0-1	Count	1	2	3	0.018
		% within Sofa	33.3%	66.7%	100.0%	
	2-24	Count	75	5	80	
		% within Sofa	93.8%	6.3%	100.0%	
Total	Count	76	7	83		
	% within Sofa	91.6%	8.4%	100.0%		

to [Susilo et al. \(2020\)](#), the most important factor for men being infected with COVID-19 with ARDS is because the prevalence of men who become active smokers is higher. The outcome of a research conducted by [Liu et al. \(2020\)](#) also claimed that males are more vulnerable and dominate in cases of coronavirus disease-19 with ARDS rather than females. Research conducted by [Putri et al. \(2021\)](#) also stated that males are 28% more at risk of being infected with coronavirus disease-19 with ARDS than females, this is due to different hormones and chromosomes between men and women which allows women to have a stronger immune system than men.

The results of the study based on the SOFA score of the respondents showed that the majority had an abnormal SOFA score (2-24) as much as 96.4%. Research conducted by [Ma and An \(2022\)](#) also explained that the majority of COVID-19 patients had high SOFA scores.

Based on [Table 3](#), the results of the Chi-Square

test, a Fisher exact test was obtained with a p value = 0.018 (p-value <0.05). The results showed that there was a significant relationship between the SOFA score and mortality in coronavirus disease-19 patients with ARDS at RSUD dr. Moewardi. This study is in line with research conducted by [Ganesan et al. \(2021\)](#) that there is a meaningful relationship between SOFA scores and death in coronavirus disease-19 patients. [Khwannimit et al. \(2018\)](#) also added that SOFA score has a high sensitivity in predicting mortality.

## Discussion

Research conducted by [Zeng et al. \(2020\)](#) shows that females have a more preponderant antibody response than males, with the production of these antibodies at the beginning of the phase showing the possibility of immunological processes that can result in a faster recovery from COVID-19 in females

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compared to males.

The average age of the respondents is 57.31 with a minimum or youngest age of 25 years and a maximum age of 89 years. Research conducted by [Elviani et al. \(2021\)](#) states that one of the risk factors for being infected with coronavirus disease-19 with ARDS is the age of >50 years. In a study conducted by [Ramananda and Khomdram \(2020\)](#), it was also explained that the elderly have a prevalence of being two times more vulnerable or at risk of getting infected with coronavirus disease-19. In the study conducted by [Drew and Adisasmita \(2021\)](#), elderly people were found to have a reduced homeostatic reserve function; this happens because, as they get older, it results in the elderly no longer being able to fight infections such as COVID-19.

For frequency distribution based on comorbid diseases, the results showed that the majority of respondents had comorbid diseases (57.8%). A study conducted by [Guan et al. \(2020\)](#) stated that comorbid diseases such as diabetes mellitus, cardiovascular and lungs will result in a bad prognosis in patients infected with coronavirus disease-19. This is in line with research in the field that the majority of coronavirus disease-19 patients have a story of comorbid diseases and have a poor prognosis and end up dying. Research conducted by the Centers for Disease Control and Prevention (CDC) found that 94% of deaths due to coronavirus disease-19 in the United States occur because the patient has a comorbid disease ([Setyarini & Dwiangimawati, 2021](#)).

According to research conducted by [Ferreira \(2015\)](#), patients whose SOFA scores were measured for 48 hours and experienced a significant increase had a mortality rate of >50%, while patients who experienced a decrease in SOFA scores had a mortality rate of 23%, and patients who did not experience a change in SOFA scores had a mortality rate of 31%.

Frequency distribution of respondents' characteristics based on mortality in COVID-19 patients with ARDS shows that the majority of respondents died (91.6%). The study conducted by [S](#) also explained that the complications of COVID-19 with ARDS are indeed very high and cause a poor prognosis and result in a high mortality rate. Based on research conducted by [Nugrahani and Fauzi \(2022\)](#), ARDS is the main factor that causes death in the majority of COVID-19 patients. A study conducted by [Sirvent et al. \(2022\)](#) also said that ARDS in coronavirus disease-19 patients can increase the risk of mortality by up to 28%. This study is also in line with research conducted by [Gujski et al. \(2022\)](#) which stated that COVID-19 patients with ARDS can experience 1.27 times faster death than COVID-19 patients without ARDS.

Data show that most of the coronavirus disease-19 patients with ARDS at RSUD dr. Moewardi have a SOFA abnormal score (2-24). This study is in line with research conducted by

[Zhou et al. \(2020\)](#) which states that SOFA scores in COVID-19 patients do tend to be higher. In a study conducted by [Sari \(2019\)](#), SOFA score scores can describe the patient's prognosis, because they have an assessment of all six organ functions such as respiration (PaO<sub>2</sub> / FiO<sub>2</sub>), cardiovascular (blood pressure), kidneys (creatinine and diuresis), hepar (bilirubin), hematology (platelets), and neurology (GCS) so that it is effective in assessing organ failure, which is the higher the value of the addition of SOFA, the higher the level of organ damage experienced by the patient. According to research conducted by [Kashyap et al. \(2021\)](#), SOFA scores have been shown to be effective in predicting mortality in patients treated in the intensive care unit room.

SOFA scores have six indicators, one of which is respiratory (PaO<sub>2</sub> / FiO<sub>2</sub>) which is one of the indicators of patients in experiencing ARDS and these indicators can also determine the condition of sepsis in coronavirus disease-19 patients ([Timuda et al., 2020](#)). In a study conducted by [Tushar et al. \(2020\)](#), it was stated that respiratory factors are the strongest predictors of patient mortality in the ICU. The incidence of Acute Respiratory Distress Syndrome (ARDS) in coronavirus disease-19 patients mostly has poor output; , death in coronavirus disease-19 patients with ARDS treated in the ICU room ranges from 21-61.5% even up to 94% ([Putra et al., 2021](#)). ARDS is the majority of complications suffered by COVID-19 patients, of which ARDS is the main cause of mortality in coronavirus disease-19 cases ([Tomazini et al., 2020](#)). SOFA score in COVID-19 patients with severe respiratory distress strongly correlates with the initial SOFA score. It is a valuable tool for predicting mortality in COVID-19 patients ([Fayed et al., 2022](#)).

According to the World Health Organization (WHO), coronavirus disease-19 patients who are aggravated with ARDS and comorbid diseases as well as advanced age can be associated with higher mortality rates. This can be measured by SOFA scoring; a SOFA score  $\geq 2$  can be said to have entered sepsis ([Ramananda & Khomdram, 2020](#)). The limitation in this study is that the researchers did not identify in detail the types of comorbidities in COVID-19 patients.

## Conclusion

There is a relationship between the sequential organ failure assessment (SOFA) score and mortality in coronavirus disease-19 patients with ARDS. SOFA scores have the potential to be used as a good instrument to predict mortality in COVID-19 patients with ARDS so that it can assist in determining further interventions in patients so as to increase the cure rate and reduce the mortality rate.

## Declaration of interest

There is no conflict in this research.

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## Data Availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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