

Relationship between SOFA score and length of hospitalization for sepsis patients in the intensive care unit of a single institution



¹Trainee of intensive care fellowship program, Department of Anesthesiology and Intensive Care, Faculty of Medicine, Universitas Indonesia - Cipto Mangunkusumo Hospital, Jakarta, Indonesia;

²Department of Anesthesiology, Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta, Jakarta, Indonesia;

³Department of Anesthesiology and Intensive Care, Faculty of Medicine, Universitas Indonesia - Cipto Mangunkusumo Hospital, Jakarta, Indonesia;

⁴Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta, Jakarta, Indonesia.

*Corresponding author:

Resiana Karnina;
Department of Anesthesiology, Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta, Jakarta, Indonesia;
sublime_dr@yahoo.com

Received: 2023-10-02

Accepted: 2023-12-27

Published: 2024-01-30

Resiana Karnina^{1,2*}, Adhrie Sugiarto³, Sidharta Kusuma Manggala³,
Briliana Yulasutu⁴

ABSTRACT

Introduction: The SOFA score is used to assess the severity of the disease and describe sepsis complications in terms of organ failure in septic patients in the intensive care unit (ICU). Sepsis complications affect the length of stay, causing concern for the family of the patient and increased treatment costs. Therefore, an assessment of organ dysfunction using the SOFA score can predict a prognosis based on the description of complications that occur in patients in the ICU. The current study aimed to determine the relationship between SOFA score and length of stay for sepsis patients at our institution

Methods: This study used an analytical observational research method with a cross-sectional design. The study population consisted of sepsis patients who were treated in the ICU, with a total sampling technique based on the form of medical records. The data collected in this study included age, SOFA score, and length of stay. The data was analyzed using the Spearman correlation test.

Results: This study evaluated 180 samples and found that 96 sepsis patients (53.3 %) had SOFA scores greater than 11. The length of stay was highest in the 3 to 7-day group, with a total of 108 patients (60.0 %). The analysis of the relationship between the SOFA score and the length of stay of sepsis patients in the ICU resulted in a significance value of $p = 0.012$ and a correlation coefficient of 0.628.

Conclusion: A significant positive correlation existed with a moderate association between the SOFA score and the length of stay in sepsis patients in the ICU.

Keywords: *Intensive Care Unit, Length of Stay, Sepsis, SOFA score.*

Cite This Article: Karnina, R., Sugiarto, A., Manggala, S.K., Yulasutu, B. 2024. Relationship between SOFA score and length of hospitalization for sepsis patients in the intensive care unit of a single institution. *Bali Medical Journal* 13(1): 653-656. DOI: 10.15562/bmj.v13i1.4913

INTRODUCTION

Sepsis is a health condition with high morbidity and mortality for patients in the intensive care unit (ICU).¹ This condition is caused by a secondary infection from bacterial, viral, or fungal infections, can result in organ failure, and can affect the occurrence and death rate.² The incidence of sepsis is approximately 535 cases for every 100,000 person-years and is increasing. In-hospital mortality is currently 25–30 %³, and sepsis accounts for the majority of hospital deaths in the USA, with a yearly financial impact of greater than US\$24 billion.⁴ In Indonesia, data from the Minister of Health Indonesia at Cipto Mangunkusumo Hospital indicates that 10.3 % of patients admitted were diagnosed with sepsis, with a mortality rate of 47.8 %.⁵

Organ dysfunction can result from sepsis complications that develop into septic shock, which is an emergency condition; therefore, an assessment of organ dysfunction, the SOFA score, is required.⁶ In addition, the length of stay of a patient in the ICU can cause concern for the family and increase the cost of treatment.⁷ According to a previous study conducted by Setareh et al.⁸ the SOFA score, which assesses the severity of disease in patients in the ICU, can have an impact on the length of stay along with other factors such as the condition of the patient and the type of treatment used. The SOFA score system can be used to predict patient outcomes in ICU. The length of ICU stay was found to be substantially correlated with high SOFA scores and an increasing trend in SOFA scores.⁹

Recently, there has been no study in Indonesia regarding the relationship between SOFA scores and length of stay in sepsis patients in the ICU. By carrying out this study, it is hoped to increase health knowledge, especially in the field of anesthesia, so that it can become a reference for further study. This study aimed to determine the relationship between the SOFA score and the length of stay of septic patients in the ICU of our institution.

METHODS

This study used an analytical observational research method with a cross-sectional design, in which samples were collected and observed and the results were simultaneously measured. This study has been reported in line

with the Strengthening the Reporting of Cohort Studies in Surgery (STROCSS) guidelines¹⁰ and was conducted at Pondok Kopi Islamic Hospital, Jakarta, Indonesia. The sample consisted of all patients treated in the ICU from September 2021 to September 2022. The sampling technique used was total sampling. Secondary data on the medical records of patients were collected, including age, SOFA score, and length of stay. The inclusion criteria included all patients with sepsis who had complete medical records regarding the SOFA score and length of stay in the ICU. The exclusion criteria consisted of patients with suspected non-sepsis and incomplete medical records related to SOFA score and patient length of stay.

Measurements

The age groups classification we use is based on the Ministry of Health of the Republic of Indonesia^{11,12}; the following are: 17–25 (late adolescence), 26–35 (early adulthood), 36–45 (late Adulthood), 46–55 (early elderly), and 56–65 (late elderly). Length of stay is defined as the duration of time that the patient was treated during one episode of care. Sepsis defined as a dysregulated host response to infection results in potentially fatal organ dysfunction, which is known as sepsis. An acute change in the overall SOFA score of more than two points due to infection indicates organ dysfunction. The baseline SOFA score can be assumed to be zero in patients not known to have preexisting organ dysfunction. An overall mortality risk of about 10% is indicated by a SOFA score of ≥ 2 in a general hospital population with suspected infection.¹³

An assessment indicator to determine organ function or description of complications in sepsis patients.¹⁴ SOFA score > 11 , its sensitivity is 100% to predict sepsis¹⁵, and the initial or highest score > 11 was 80%–90% to predict mortality.^{16,17} We divided patients into two groups based on the SOFA score: SOFA scores lower than 11 and SOFA scores greater than or equal to 11. The SOFA score is assessed on days 1, 3, or 7 by a team of intensive care consultants who are familiar with the use of the SOFA score system.

Table 1. Participant characteristics

Variable	n	(%)
Age (years)		
17 – 25	36	20.0
26 – 35	36	20.0
36 – 45	48	26.7
46 – 55	12	6.7
56 – 65	48	26.7
SOFA score		
< 11	84	46.7
≥ 11	96	53.3
Length of stay (days)		
< 3	24	13.3
3 – 7	108	60
> 7	48	26.7

Table 2. The relationship between SOFA score and length of stay

Variable	r_s	p
SOFA score and length of stay	0.628	0.012

Statistical analysis

This study used the Spearman test with SPSS software version 28.0 (Armonk, NY: IBM Corp.) in a bivariate analysis to determine the two variables studied and the relationship between the SOFA score and length of stay.

RESULTS

The following results were obtained based on research conducted using 180 participants with medical records that met the inclusion criteria. Table 1 shows that 48 patients (26.7 %) each were found in the age groups of 36 to 45 years and 56 to 65 years. In the age groups of 17 to 25 years and 26 to 35 years, there were 36 participants each (20 %), and the remaining participants with sepsis constituted a minimum of 12 people (6.7 %) in the age group of 46 to 55 years.

Table 1 shows that 96 patients had SOFA scores greater than or equal to 11 (53.3 %), while 84 people (46.7 %) had SOFA scores lower than 11. In addition, Table 1 reveals the distribution of sepsis patients based on the length of stay, whereby 3 to 7 days was the most common duration, with 108 patients (60.0 %). The group with stays greater than 7 days contained 48 patients (26.7 %), and the remaining 24 people (13.3 %) stayed for fewer than 3 days.

The results of the analysis of the relationship between the SOFA score and the length of stay, after the Spearman

correlation test was carried out for all 180 participants, are shown in Table 2. A significant relationship was found between the SOFA score and the length of stay with a p-value < 0.05 and a correlation coefficient (r_s) of 0.628, which indicates that the relationship between the two variables was strong.

DISCUSSION

A significant positive correlation existed with a moderate association between the SOFA score and the length of stay in sepsis patients in the ICU. Most of the patients were either 36 to 45 years of age or 56 to 65 years of age, with 48 patients (26.7 %) each. In a study conducted by Tewuh et al., the age group of 51 to 60 years had the greatest number of samples, with 4 patients (44.4 %). In older patients, especially those with chronic diseases, changes and decline in physiological functions can occur.¹⁸ Harvard Health Publishing states that the immune response decreases with age; therefore, older adults are more susceptible to infectious diseases¹⁹.

The length of stay of sepsis patients in this study was the greatest in the 3 to 7 days group, which included 108 patients (60.0 %). These results align with those of a previous study conducted by Djuang et al.²⁰, where the highest incidence of sepsis was found in the 3 to 7-day inpatient group with a total of 45 patients (45 %) out of 100 participants. In addition, Yasmina et

al reported that the most hospitalizations were obtained with 29 patients (65.9 %) in the group that stayed longer than 4 days. An increase in the neutrophil-lymphocyte ratio can occur in septic patients, which affects their length of stay.²¹

The relationship analysis using the Spearman correlation test returned a correlation coefficient of 0.628 between the SOFA score and the length of stay of sepsis patients in the ICU of our institution, which indicates that the relationship was strong and that a significant relationship existed between these two variables.

Previous studies have indicated that organ dysfunction and patient length of stay are significantly related. Several factors affect the duration of patient care in the ICU, such as the use of drugs that induce side effects, the existence of comorbidities such as diabetes or hypertension, and a history of chronic diseases. These factors can lead to decreased organ function that causes organ dysfunction, which requires a longer stay due to the need for more intensive care. In contrast, patients with organ dysfunction have a higher risk of death; therefore, the duration of hospitalization can be shortened or reduced if the patient dies.²²

The National Hospital Discharge Survey reports that the length of stay in patients with sepsis is two times longer than that of those treated for other conditions.²² Infectious diseases of the body originating in the respiratory tract are the main cause of sepsis, based on a prospective study at Dr. Saiful Anwar Hospital. In addition, a decreased immune system can affect the incidence of sepsis in the ICU and this impacts the susceptibility of the patient to secondary infections from medical support equipment such as catheters, ventilators, and endotracheal tubes. Sepsis, which results from the response to infection, can cause dysregulation and interfere with tissue perfusion function. This causes the blood to deliver inadequate levels of oxygen and nutrients to the tissues. Organs can experience tissue damage that results in organ failure due to tissue hypoperfusion disorders, and this condition can occur in several organs simultaneously, such as the brain, heart, lungs, kidneys, and liver as a complication of a complex infection

response. The SOFA score can assess the functioning of five organ systems: neurological, cardiovascular, respiratory, renal, and liver, as well as that of the hematological system.²⁰

The results of this study corroborate those of a previous report conducted by Milic et al., whereby the SOFA score and length of stay were significantly correlated, and the relationship was found to be strong with a correlation coefficient of 0.719 in that study.²³ Nevertheless, the limitations of this study were a retrospective single-center study with a small sample size and a lack of adjusting for confounders.

CONCLUSION

This study found a significant positive correlation between the SOFA score and the length of stay for sepsis patients in the ICU, whereby a decrease in organ function resulted in the need for additional intensive care that resulted in a longer stay.

ETHICAL STATEMENT

This study has received ethical clearance from local ethics commission with number No: 299/PE/KE/FKK-UMJ/XI/2022.

CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

FUNDING

No funding or sponsorship.

AUTHOR CONTRIBUTION

RK: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing.

AS: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing.

SKM: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Resources, Validation, Visualization, Writing – original draft,

Writing – review & editing.

BY: Project administration, Resources, Software, Validation, Visualization, Writing – review & editing

ACKNOWLEDGMENTS

We express appreciation to Muhammad Faruk for his contribution to reviewing this original research.

REFERENCE

- Sakr Y, Jaschinski U, Wittebole X, Szakmany T, Lipman J, Namendys-Silva SA, et al. Sepsis in Intensive Care Unit Patients: Worldwide Data From the Intensive Care over Nations Audit. *Open Forum Infect Dis.* 2018;5(12):ofy313.
- Hotchkiss RS, Moldawer LL, Opal SM, Reinhart K, Turnbull IR, Vincent J-L. Sepsis and septic shock. *Nat Rev Dis Primers.* 2016;2:16045.
- Fleischmann C, Scherag A, Adhikari NKJ, Hartog CS, Tsaganos T, Schlattmann P, et al. Assessment of Global Incidence and Mortality of Hospital-treated Sepsis. *Current Estimates and Limitations.* *Am J Respir Crit Care Med.* 2016;193(3):259–72.
- Rudd KE, Johnson SC, Agesa KM, Shackelford KA, Tsoi D, Kievlan DR, et al. Global, regional, and national sepsis incidence and mortality, 1990–2017: analysis for the Global Burden of Disease Study. *The Lancet.* 2020;395(10219):200–11.
- Dharmawan A, Istia MJ, Tan HT, Suparto S, Anastasia MC, Layanto N. The Outcome of Patients with Sepsis at Tarakan Hospital Central Jakarta in 2018. *Muhammadiyah Medical Journal.* 2021;2(2):49.
- Caraballo C, Jaimes F. Organ Dysfunction in Sepsis: An Ominous Trajectory From Infection To Death. *Yale J Biol Med.* 2019;92(4):629–40.
- Toptas M, Sengul Samanci N, Akkoc İ, Yucetas E, Cebeci E, Sen O, et al. Factors Affecting the Length of Stay in the Intensive Care Unit: Our Clinical Experience. *Biomed Res Int.* 2018;2018:9438046.
- Setareh M, Alavi NM, Atoof F. Severity of illness affecting the length of stay and outcomes in patients admitted to intensive care units, Iran, 2019. *J Educ Health Promot.* 2021;10:142.
- Tekade T, Manohar T. Utility of SOFA (Sequential Organ Function Assessment) score to predict outcome in critically ill patients at a tertiary care hospital, Nagpur. *Panacea Journal of Medical Sciences.* 2017;7(3):140–6.
- Mathew G, Agha R, STROCSS Group. STROCSS 2021: Strengthening the reporting of cohort, cross-sectional and case-control studies in surgery. *Int J Surg.* 2021;96:106165.
- Wahyuni OR, Savitri Y, Mulyani SWM, Saputra D, Putra RH, Chandramurti R, et al. Distribution of dense bone island in the jaw through panoramic radiography based on gender and age. *Jurnal Radiologi Dentomaksilofasial Indonesia (JRDI).* 2022;6(3):101.
- Fajar A, Warsingih, Syarifuddin E, Hendarto J, Labeda I, Lusikooy RE, et al. The relationship

- between glycine levels in collagen in the anterior rectus sheath tissue and the onset of indirect inguinal hernia: A cross-sectional study. *Annals of Medicine and Surgery*. 2022;73:103166.
13. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA*. 2016;315(8):801–10.
 14. Lambden S, Laterre PF, Levy MM, Francois B. The SOFA score-development, utility and challenges of accurate assessment in clinical trials. *Crit Care*. 2019;23(1):374.
 15. Kilinc Toker A, Kose S, Turken M. Comparison of SOFA Score, SIRS, qSOFA, and qSOFA + L Criteria in the Diagnosis and Prognosis of Sepsis. *Eurasian J Med*. 2021;53(1):40–7.
 16. Acharya SP, Pradhan B, Marhatta MN. Application of “the Sequential Organ Failure Assessment (SOFA) score” in predicting outcome in ICU patients with SIRS. *Kathmandu Univ Med J (KUMJ)*. 2007;5(4):475–83.
 17. Ferreira FL. Serial Evaluation of the SOFA Score to Predict Outcome in Critically Ill Patients. *JAMA*. 2001;286(14):1754.
 18. Tewuh T, Lalenoh D, Kumaat L. HUBUNGAN SKOR SOFA DENGAN LAMA RAWAT INAP PASIEN SEPSIS PASCA LAPARATOMI DI ICU PERIODE JULI 2012 – SEPTEMBER 2013. *e-CliniC*. 2014;2(2):2–5.
 19. Bajaj V, Gadi N, Spihlman AP, Wu SC, Choi CH, Moulton VR. Aging, Immunity, and COVID-19: How Age Influences the Host Immune Response to Coronavirus Infections? *Front Physiol*. 2020;11:571416.
 20. Djuang MH, Muniro FD, Sanjaya BD, Chiuman L. FAKTOR RESIKO SEPSIS PADA PASIEN LANSIA DI RUMAH SAKIT UMUM ROYAL PRIMA MEDAN SEPSIS RISK FACTORS IN ELDERLY PATIENTS AT ROYAL PRIMA MEDAN GENERAL HOSPITAL. 2022;
 21. Nasution DY, Hamdani I. Hubungan neutrofil limfosit rasio dengan lama rawat inap pada pasien sepsis akibat pneumonia. Universitas Muhammadiyah Sumatera Utara; 2022.
 22. Hatman FA, Semedi BP, Budiono B. Analisis Faktor Risiko terhadap Lama Perawatan Pasien Sepsis yang Meninggal di Ruang Perawatan Intensif RSUD Dr. Soetomo Surabaya. *JAI (Jurnal Anestesiologi Indonesia)*. 2021;13(2):78–87.
 23. Milić M, Goranović T, Holjevac JK. Correlation of APACHE II and SOFA scores with length of stay in various surgical intensive care units. *Coll Antropol*. 2009;33(3):831–5.



This work is licensed under a Creative Commons Attribution