Annals of Medicine and Surgery 76 (2022) 103462

Contents lists available at ScienceDirect

Annals of Medicine and Surgery

journal homepage: www.elsevier.com/locate/amsu

Cross-sectional Study

National early warning score (NEWS) 2 predicts hospital mortality from COVID-19 patients

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ARTICLE INFO

Keywords:
Comorbid disease
COVID-19
Mortality
National early warning score

ABSTRACT

Background: COVID-19 has a high risk of mortality, especially in patients with comorbid diseases such as cardiac disease, type 2 diabetes mellitus, chronic kidney disease, and hypertension. The National Early Warning Score (NEWS) is a tool that helps in identifying changes in patient conditions that require intensive treatment.
Objective: Analyzing NEWS-2 to identify the risk of death in COVID-19 patients.
Methods: This research was conducted from June to July 2020 by using quota sampling. The number of participants in this study was 112 participants (case group = 56 participants and control group = 56 participants). Participants were assessed for NEWS-2 and evaluated for their treatment outcomes. The analysis used in this study was the Chi-squared test and logistic regression with $p < 0.05$.
Results: 45 participants died of having NEWS-2 score >5, and as many as 50 participants showed an improvement in their condition by having NEWS-2 score 5 (OR = 34.091; $p < 0.001$). The accuracy of NEWS-2's assessment of mortality of COVID-19 patients had a sensitivity of 80.4% and a specificity of 89.3%. There were several comorbid diseases that had a significant relationship on mortality of COVID-19 patients such as cardiac disease ($\beta = 5.907$; 1.107–31.527 95% CI; $p = 0.038$), T2DM ($\beta = 3.143$; 1.269–7.783 95% CI; $p = 0.013$), CKD ($\beta = 3.851$; 1.195–12.416 95% CI; $p = 0.024$), and hypertension ($\beta = 2.820$; 1.075–7.399 95% CI; $p = 0.035$).
Conclusion: The NEWS-2 can be used to identify the risk of death of COVID-19 patients.

1. Introduction

The COVID-19 is an infectious disease caused by the SAR-COV-2 virus, which is a single-stranded RNA virus that was first discovered in Wuhan, China in December 2019. On March 11, 2020, WHO announced that COVID-19 had become a worldwide pandemic. On May 25, 2021, the number of confirmed COVID-19 cases in the world reached 168,599,045 cases, with the death toll reaching 3,507,477 cases. In Indonesia, the number of confirmed cases was 1,797,499 cases, the death rate was 49,907 cases and the recovered cases were 1,642,074 cases, while for the province of East Java there were 153,596 confirmed cases with a death rate of 11,230 cases and 140,317 cases recovered [1,2]. The death rate caused by COVID-19 increased from 2020 to May 2021 in the world and Indonesia based on data from the World Health Organization (WHO) [3,4].

The National Early Warning Score (NEWS) is an assessment based on physiology quickly involving vital signs which were originally developed to track and identify the risk of worsening of patients hospitalized in non-intensive care rooms with the aim of initial stabilization and referral to intensive care rooms. The NEWS is often used as an accurate predictor of mortality and ICU admission in non-COVID-19 patients [5]. During the COVID-19 pandemic, tools are needed to quickly and accurately evaluate the condition of COVID-19 patients, so we are interested in using the national early warning score-2 (NEWS 2) on COVID-19 patients [6]. The high mortality of COVID-19 patients in Indonesia made us interested in analyzing the association between NEWS-2 on mortality of COVID-19 patients in Indonesia.

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https://doi.org/10.1016/j.amsu.2022.103462
Received 29 January 2022; Received in revised form 25 February 2022; Accepted 28 February 2022
Available online 8 March 2022

2. Methods

2.1. Participants

Participants in this study were patients diagnosed with COVID-19. Participant criteria included >18 years old, confirmed COVID-19 based on real-time polymerase chain reaction (RT-PCR) [7,8] and X-ray/CT Scan of the thorax [9], did not receive oxygen therapy before, administration of antivirals, anti-inflammatory, anticoagulant, multivitamin, and previous symptomatic therapy, the patient received at least 1 × 24-h treatment and had the comorbid disease. Participant exclusion criteria included pregnant patients, patients who received positive pressure, went into shock, and had mental disorders. Participants and/or guardians had received explanations related to the research objectives, and participants were also required to fill out the consent form provided.

2.2. Methods of study

This study used a retrospective design by collecting data from June to July 2020. The number of participants in this study was 112 participants (case group = 56 participants and control group = 56 participants). The participants were collected using the quota sampling technique. The case group consisted of COVID-19 patients who had undergone treatment for >24 h and died, while the control group consisted of COVID-19 patients who had undergone treatment for >24 h and showed improvement. Our research report used strengthening the reporting of cohort studies in surgery (STROCSS) 2021 guideline [10]. The data in this study used participant characteristic data, NEWS-2 values, and the prognosis of COVID-19 treatment. The prognosis for COVID-19 treatment was dead and alive.

2.3. National early warning score examination

The NEWS-2 is a standard clinical scoring system developed to improve the detection of worsening in acutely ill patients. The tool consists of 6 assessment indicators that include respiratory rate, oxygen saturation, systolic blood pressure, pulse rate, level of consciousness or new confusion, and body temperature. In addition, two points are added for patients requiring supplementary oxygen treatment [6]. The NEWS-2 assessment is categorized into 3, namely low (0–4), middle (5–6), and severe (≥7) [11].

2.4. Statistical analysis

The measurement data were analyzed using IBM SPSS Statistics software version 25.0 (IBM Corp., Armonk, NY, USA) where the data were presented in the form of tables or figures. Statistical analysis used in this study included the Chi-squared test and regression logistic test with $p < 0.05$. The Chi-squared test was used to analyze the relationship between NEWS-2 on mortality of COVID-19 patients. Meanwhile, the regression logistic test was used to analyze the risk factors of comorbid disease on mortality of COVID-19 patients.

3. Results

3.1. Characteristic of participant

The mean age of participants was 51.92 ± 13.07 years, with a median of 53 (43–61) years. The youngest participant and oldest participants were 19 years old and 61 years old, respectively. Most participants were male (66; 58.93%) consisted of 32 in the case group (57.14%) and 34 in the control group (60.71%). Participants showed signs and symptoms of COVID-19 as follows: cough (82.14%), sniffles (47.32%), breathless (91.07%), fever (73.21%), anosmia (8.93%), diarrhea (33.04%), nausea/vomiting (37.5%), and abdominal pain (19.42%; Table 1). The difference in data between the case group and control group could be seen in Table 2.

Table 1
Frequency distribution of characteristic of participant.

Characteristic	COVID-19 Patients	
	Case	Control
Gender		
Male	32 (57.14)	34 (60.71)
Female	24 (42.86)	22 (39.29)
Sign and Symptom		
Cough	43 (76.78)	49 (87.5)
Sniffles	13 (23.21)	40 (71.43)
Breathless	52 (92.86)	50 (89.28)
Fever	44 (78.57)	44 (67.86)
Anosmia	5 (8.93)	5 (8.93)
Diarrhea	13 (23.21)	14 (25.0)
Nausea/vomiting	21 (37.5)	21 (37.5)
Stomach pain	10 (17.86)	12 (21.42)

3.2. Association of national early warning Score-2 on mortality of COVID-19

Most participants with a NEWS-2 score of >5 after undergoing treatment for >24 h died as many as 45 participants (40.18%). Meanwhile, the participants with NEWS-2 score of 5 after undergoing treatment for >24 h experienced improvements as many as 50 participants (44.64%; OR = 34.091; $p < 0.001$). The accuracy of NEWS-2's assessment of mortality of COVID-19 patients had a sensitivity of 80.4%, specificity of 89.3%, a positive predictive value of 88.2%, and a negative predictive value of 82% (Fig. 1).

3.3. Association of comorbid disease on mortality of COVID-19 patient

Some participants had comorbid diseases as follows: cardiac disease (11.61%), type 2 diabetes mellitus/T2DM (42.86%), chronic kidney disease/CKD (22.32), obesity (4.46%), carcinoma (4.46%), autoimmune (2.68%), and hypertension (38.39%). There were several comorbid diseases that had a significant relationship on mortality of COVID-19

Table 2
Comparation of case and control group based on characteristic of participant.

Variable	COVID-19 Patients		*p*
	Case	Control	
Age	50.57 ± 11.29	56.28 ± 14.30	0.002*
Treatment time	17.73 ± 9.16	8.00 ± 6.13	0.005*
GCS	13.96 ± 1.83	14.88 ± 0.93	0.890
Blood pressure			
Systolic	129.00 ± 17.29	128.00 ± 19.59	0.436
Diastolic	78.33 ± 10.53	78.42 ± 9.59	0.574
Pulse	88.93 ± 7.73	110.63 ± 8.75	<0.001**
Respiratory rate	23.60 ± 2.25	26.23 ± 3.47	<0.001**
Temperature	36.57 ± 0.63	36.77 ± 0.72	0.036*
SO2	97.73 ± 0.78	97.56 ± 1.14	0.251
PaO2_FiO2	188.00 ± 134.89	357.00 ± 146,95	<0.001**
MAP	93.00 ± 148.30	95.00 ± 12,08	0.455
Hb	11.80 ± 2.69	13.00 ± 2,69	0.142
Leucocyte	9080.00 ± 5.84	7415.00 ± 4,22	0.083
Platelet	2.25 ± 1.45	2.28 ± 1,09	0.400
NLR	6.88 ± 1.38	4.00 ± 4,99	0.003*
ALC	940.00 ± 802.60	1095.00 ± 485,79	0.051
CRP	12.70 ± 7.88	8.50 ± 13,93	0.202
D-dimer	2330.00 ± 6.17	920.00 ± 2,97	<0.001**
BUN	28.00 ± 44.69	11.50 ± 23,44	<0.001**
SK	1.40 ± 4.80	0.00 ± 4.22	<0.001**
SGOT	54.00 ± 85.47	53.00 ± 49.09	0.415
SPGT	41.00 ± 41.43	42.00 ± 50.48	0.600
PCT	0.35 ± 2.54	0.17 ± 4.97	0.079
blood glucose level	145.00 ± 73.60	123.50 ± 68.35	0.005*

Note: *significant <0.05; **significant <0.001.

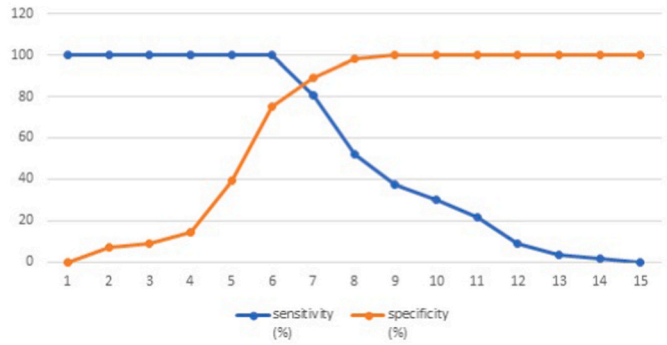

Fig. 1. Cut-off NEWS-2 based on case and control groups of COVID-19 patients.

patients, such as cardiac disease ($\beta = 5.907$; 1.107–31.527 95% CI; $p = 0.038$), T2DM ($\beta = 3.143$; 1.269–7.783 95% CI; $p = 0.013$), CKD ($\beta = 3.851$; 1.195–12.416 95% CI; $p = 0.024$), and hypertension ($\beta = 2.820$; 1.075–7.399 95% CI; $p = 0.035$; Table 3).

4. Discussion

In the current pandemic situation, early identification of patients at risk for severe disease and decision-making is very important in hospital care [6]. The NEWS-2 is recommended to evaluate COVID-19 patients after 24 h of treatment because COVID-19 patients are at risk of developing critical conditions during treatment [12]. Several previous studies also recommended that NEWS-2 could be used to evaluate the clinical condition of COVID-19 patients as NEWS-2 had a good performance of 0.842–0.894 [13]. The tool can help identify the risk of changing patient conditions requiring treatment in the intensive care unit (ICU) [5]. The NEWS-2 is the best assessment for assessing the prognostic of COVID-19 patients compared to several other assessments [6].

Based on several studies, NEWS-2 had succeeded in monitoring the prognosis of COVID-19 patient care to minimize and delay the mortality of COVID-19 patients. The tool can be used to predict the worsening of the condition and death of COVID-19 patients in hospitals, whereas many as 20% of COVID-19 patients treated in hospitals have died [6]. Another study also stated that NEWS-2 is a simple and fast tool in predicting patients over the age of >65 years [14]. The NEWS-2 can also predict patient deterioration quickly and simply in COVID-19 patients who need to get immediate treatment to minimize mortality in COVID-19 patients.

Hypertension increases the risk of mortality for COVID-19 patients, where COVID-19 patients with hypertension are at risk of developing critical conditions 2.6 times compared to patients without hypertension. Meanwhile, the mechanism of hypertension in COVID-19 is caused by SARS-CoV-2 attacking alveolar epithelial cells via angiotensin-converting enzyme 2 (ACE2) [15,16]. The cardiac disease has a similar mechanism as hypertension in terms of increasing the risk of mortality in COVID-19 patients [17,18]. Based on previous studies, CKD increases the risk of mortality for COVID-19 patients by 5.81 times as the level of pro-inflammatory cytokines increases in CKD patients, causing an increase in oxidative stress which ultimately results in an immune-inflammatory response. The resulting immune system damage may increase susceptibility to bacterial and viral infections, and this may be the main reason for the increased risk of pulmonary inflammation [19,20]. Based on previous research, it was stated that T2DM had a significant relationship with the mortality of COVID-19 patients, where T2DM patients infected with COVID-19 had a mortality risk of 1.75 [21].

Comorbid disease in COVID-19 needs to be considered in the use of NEWS-2 so that the monitoring and prognosis of patients in care are monitored and managed effectively and efficiently. There are some limitations in our study such as the study was conducted in a relatively small population, so a multicenter cohort study with a larger population is needed. The data collected were participant medical record data, which were incomplete.

Table 3
Risk factor of mortality in COVID-19 patients.

Comorbid disease	n (%)	β	CI 95%	p
Cardiac disease	13 (11.61)	5.907	1.107–31.527	0.038*
T2DM	48 (42.86)	3.143	1.269–7.783	0.013*
CKD	25 (22.32)	3.851	1.195–12.416	0.024*
Obesity	5 (4.46)	1.742	0.235–12.906	0.587
CA	5 (4.46)	4.765	0.618–36.736	0.134
Autoimmune	3 (2.68)	6.395	0.493–83.005	0.156
Hypertension	43 (38.39)	2.820	1.075–7.399	0.035*

Note: T2DM = type 2 diabetes mellitus; CKD = chronic kidney disease; CA = carcinoma; *significant <0.05.

5. Conclusion

The NEWS-2 can be used as a tool to identify the risk of death in COVID-19 patients. The correlation between NEWS-2 and the mortality of COVID-19 patients requires further research on a larger scale.

Sources of funding

Grant 2020 from Universitas Airlangga, Surabaya, Indonesia (664/UN3.14/PT/2020).

Ethical approval

We have conducted an ethical approval base on Declaration of Helsinki at Ethical Committee in Dr. Soetomo General Academic Hospital, Surabaya, Indonesia.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

All authors contributed toward data analysis, drafting and revising the paper, gave final approval of the version to be published and agree to be accountable for all aspects of the work.

Registration of research studies

1. Name of the registry: Health Research Ethics Coommitee in the Dr. Soetomo General Academic Hospital, Surabaya, Indonesia
2. Unique Identifying number or registration ID: 1957/KEPK/IV/2020.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked):

Guarantor

Usman Hadi.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Declaration of competing interest

The authors have no conflict of interest.

Acknowledgment

Researchers greatly appreciate Joni Wahyuhadi as the director in Dr. Soetomo General Academic Hospital and Nasronudin as the director in Airlangga University Teaching Hospital who has facilitated us in conducting research and Soebagjio Adi Soelistijo for allowing us to get a research grant and facilitating us to collect data in internal medicine wards and intellectual discussion leading to research idea. We would like to thank "Fis Citra Ariyanto".

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.103462.

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