



Journal of Acute Disease

Original Article



jadweb.org

doi: 10.4103/jad.jad_83_24

Impact Factor® 0.5

Prognostic value of CURB–65 and pneumonia severity index (PSI) in COVID–19 pneumonia: A retrospective cohort study

Pankaj Kumar Jain, Varun Kumar, Pranav Kumar Bhat, Manoj Seval✉

Department of General Medicine, Govt. Medical College, Kota, India

ABSTRACT

Objective: To validate a better scoring system between CURB-65 and the pneumonia severity index (PSI) to predict the need for intensive care unit admission and 30-day mortality in patients with COVID-19 pneumonia.

Methods: A retrospective cohort study was conducted on patients in a tertiary care hospital in Kota, Rajasthan. Relevant data about history, and general and systemic examination with laboratory investigations was collected. Patients were categorized into different risk groups for ICU admission and 30-day mortality according to CURB-65 and PSI. Sensitivity, specificity, positive predictive value, negative predictive value, and area under the curve were calculated. Continuous variables, means and percentages were compared using the *t*-test for numerical data and the *Chi*-square test for nominal data.

Results: 100 patients who tested positive for SARS-CoV-2 by RT-PCR were included; 67 were male and 33 were female. 58 patients had severe disease ($\text{SpO}_2 \leq 90\%$) and 30 patients died. CURB-65 had an area under the curve (AUC) of 0.81 for predicting ICU admission, with a sensitivity of 92% and a specificity of 54% for high risk patients. Meanwhile, PSI had an AUC of 0.88, with a sensitivity of 83% and a specificity of 73% in high risk patients. In addition, CURB-65 had an AUC of 0.79 for predicting 30-day mortality, with a sensitivity of 60% and a specificity of 89% in high risk patients. PSI had an AUC of 0.71 for predicting 30-day mortality, with a sensitivity of 90% and a specificity of 46% in high risk patients.

Conclusions: This single-centre retrospective study involving a cohort of COVID-19 patients demonstrates that CURB-65 and PSI are powerful tools for predicting mortality. However, PSI appears to be slightly better at predicting the need for intensive care unit

admission in high-risk patients.

KEYWORDS: COVID-19; CURB-65; Pneumonia severity index; Pneumonia; Mortality

1. Introduction

Novel Corona Virus-19 (COVID-19), the global pandemic of the era, has overburdened the health system in India, also worldwide with increased severity of pneumonia in the modern

Significance

A better scoring system is validated between the pneumonia severity index (PSI) and CURB-65 in predicting the need for intensive care unit admission and 30-day mortality. Our study showed that CURB-65 and PSI are powerful tools for predicting mortality, whereas PSI is slightly better at predicting the need for intensive care unit admission in high-risk patients.

✉To whom correspondence may be addressed. E-mail: drsevalm@gmail.com

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

©2024 Journal of Acute Disease Produced by Wolters Kluwer-Medknow.

How to cite this article: Jain PK, Kumar V, Bhat PK, Seval M. Prognostic value of CURB-65 and pneumonia severity index (PSI) in COVID-19 pneumonia: A retrospective cohort study. J Acute Dis 2024; 13(5): 167-172.

Article history: Received 8 August 2024; Revision 8 August 2024; Accepted 24 October 2024; Available online 29 November 2024

era despite developed infrastructure, technology, and a wide array of treatment options. India experienced two spikes in the number of cases in the year 2021. Many studies conducted globally have proved the role of vaccination in preventing such a rapid increase in the number of positive cases and mortality. Major causes of mortality include shock, multi-organ failure, acute respiratory distress syndrome, acute myocardial infarction, cerebrovascular disease, exacerbation of underlying comorbidities, secondary infections, *etc.*[1].

As compared to other community acquired pneumonia's (CAP), COVID-19 associated pneumonia has shown both increased virulence and transmissibility. CURB-65 and pneumonia severity index (PSI) have been used as prognostic scores in CAP, but their applicability in COVID-19 pneumonia has not been established. The standard protocol which aims at the admission of all RT-PCR-tested positive patients over age 50 years, irrespective of severity has overburdened the available facilities and also increased psychological and socioeconomic problems among the community, further overestimating the crisis.

2. Patients and methods

2.1. Study setting

This retrospective cohort study was conducted from August 2021 to February 2022. 100 patients over the age of 18 years with symptoms of coronavirus disease with RT-PCR positive, admitted to the Medicine Department of Government Medical College &

Attached Hospitals, Kota were included in the study. The sample was collected using a nonprobability convenience sampling technique.

2.2. Ethical consideration

Ethical clearance was not taken as this is a record-based retrospective cohort study. Data was compiled from the hospital records. Patient data was anonymized in this report.

2.3. Data collecting

Data of those patients, who were RT-PCR positive, were collected from the records, regarding demographics, clinical presentation, complications, and laboratory data (complete blood counts, blood urea, serum creatinine, liver function tests), requirement of oxygen, ventilatory support, vasopressor support, and duration of hospital admission. All patient data about general physical & systemic examinations were also collected. Specific emphasis was given to the patient's vitals. The cases were then studied retrospectively to validate the applicability of CURB-65 and PSI scores in prognosticating COVID-19 pneumonia. The study flowchart was shown in Figure 1.

2.4. Statistical analysis

Data was analysed using GRAPHPAD-PRISM (Version 8.4.2) software. Sensitivity, specificity, negative predictive value, positive predictive value, and area under the curve were predicted.

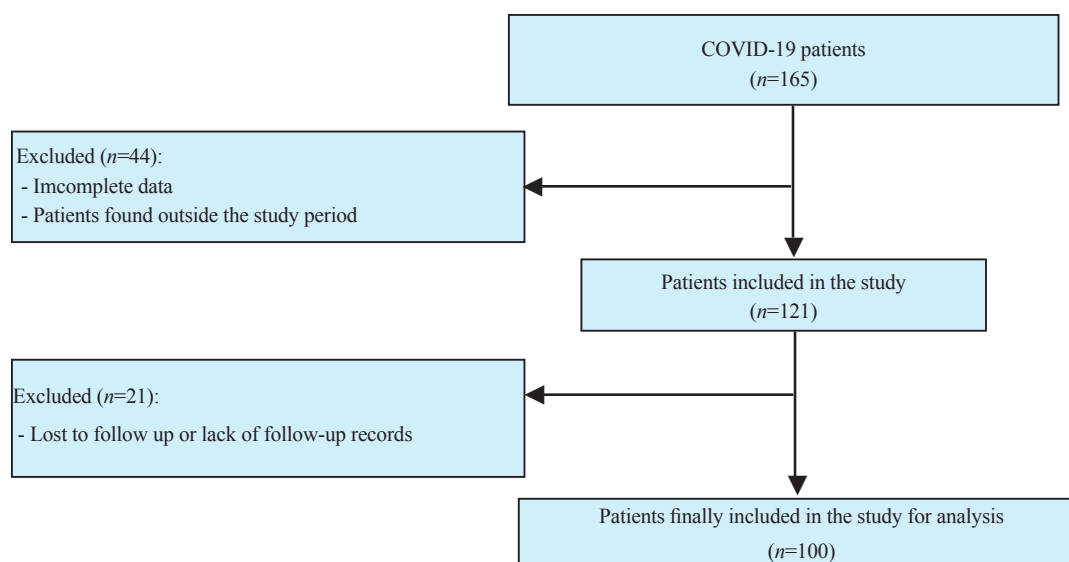


Figure 1. The study flowchart.

Continuous variables, means and percentages were compared using *t*-test for numerical data and the *Chi*-square test for nominal data.

3. Results

Out of 100 patients who tested positive RT-PCR for COVID-19, 33 patients were females and 67 were males all over the age of 18 years. Table 1 represents demographic and clinical data of the survivor ($n=70$) and non-survivor ($n=30$) groups. The average age for the survivor group was (47.0 ± 9.8) years and that of the non-survivor group was (52 ± 5.2) years. Also, the non-survivor group had increased average respiratory rate, pulse rate, blood urea levels, hypoxia, hyponatremia, hyperglycaemia, and increased body temperature compared to the survivor group with ($P=0.01$).

Out of 100 patients admitted, 14 patients were only kept under observation in isolated wards representing the out-patient group, and the rest 86 patients required in-patient care. 28 patients with mild-moderate disease ($\text{SpO}_2\geq94\%$) been admitted to general-wards and 58 patients who presented with severe disease ($\text{SpO}_2\leq90\%$) were admitted in intensive care unit (ICU). All these patients were CURB-65 & PSI scores at presentation after obtaining relevant clinical and laboratory data.

For statistical analysis the CURB-65 group was sub-grouped into a low-risk group (Score 0 & 1), an intermediate-risk group (Score 2), and a high-risk group (Score 3, 4 & 5). PSI was into a low-risk group (Score 1 & 2) and high-risk group (Score 3, 4 & 5).

Table 2 represents statistical data for predicting ICU admission between CURB-65 and PSI score groups. It can be noted that low-risk groups of both score indexes had less sensitivity (CURB-65: 31%, PSI: 11%) but PSI score had better

Table 1. Demographic, clinical and laboratory characteristics of patients ($n=100$).

Variables	Non-survivor group ($n=30$)	Survivor group ($n=70$)
Sex, n		
Female	10	23
Male	20	47
Age, years, mean	52	45
Hospital stay, days, mean	8	13
Respiratory rate, per minute, mean	31	29
Oxygen saturation, %, mean	79	87
Pulse rate, per minute, mean	128	122
Serum urea, mg/dL, mean	49	36
Blood sugar, mg/dL, mean	166	146
Serum Na^+ , mEq/L, mean	129	136
Temperature, $^{\circ}\text{C}$, mean	38	39

specificity (83%) than of CURB-65 (20%) in predicting the need of ICU - admission and also, intermediate risk group of CURB-65 questionable specificity (46%) and sensitivity (69%) with Youden index of only 14%.

The high-risk group of both the scoring systems had better specificity (CURB-65: 54%, PSI: 73%) and sensitivity (CURB-65: 92%; PSI: 83%). Overall, the area under the curve noted in the receiver operator curve (Figure 2) for CURB-65 (AUC: 81%) was lesser than that of PSI (AUC: 88%) at a 95% confidence interval. Therefore, statistically PSI-scoring system performed better in identifying the need for admission to ICU care in COVID-19 pneumonia than CURB-65 scoring system in our study.

Table 2. Predictive parameters for the requirement of ICU admission between CURB-65 and PSI, %.

Parameters		Sensitivity	Specificity	NPV	PPV	AUC
CURB-65 risk group	Low-risk	31	20	26	24	81
	Intermediate	69	46	79	34	
	High-risk	92	54	95	41	
PSI risk group	Low-risk	11	83	64	27	88
	High-risk	83	73	50	93	

AUC: area under the curve; NPV: negative predictive value; PPV: positive predictive value; PSI: pneumonia severity index.

Table 3. Predictive parameters for 30-day mortality between CURB-65 and PSI, %.

Parameters		Sensitivity	Specificity	NPV	PPV	AUC
CURB-65 risk group	Low-risk	17	43	11	55	79
	Intermediate	23	69	24	68	
	High-risk	60	89	69	83	
PSI risk group	Low-risk	10	54	9	58	71
	High-risk	90	46	42	91	

AUC: area under the curve; NPV: negative predictive value; PPV: positive predictive value; PSI: pneumonia severity index.

Table 4. Comparison between comorbidities of survivor and non-survivor group.

Comorbidities	Non-survivors group, % ($n=30$)	Survivors group, % ($n=70$)	χ^2	P
Cardiovascular co-morbidities	26.7	5.7	27.83	≤ 0.001
Hypertension	33.3	22.9		
Diabetes mellitus	20.0	25.7		
Others	6.7	11.4		
Nil	13.3	34.3		

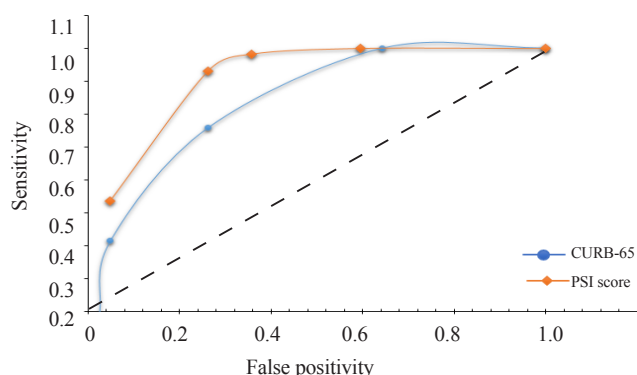


Figure 2. ROC curve for performance prediction of need for ICU admission between PSI and CURB-65 scores.

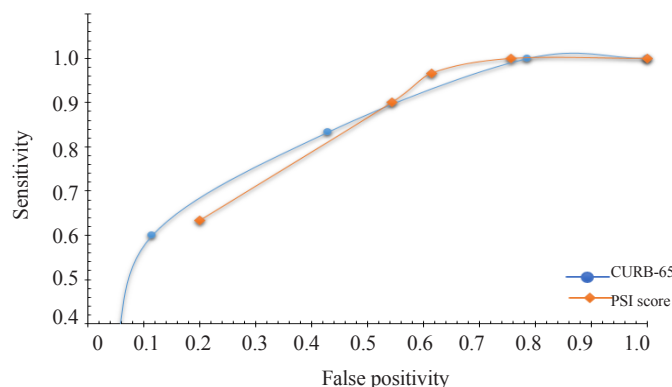


Figure 3. ROC curve for performance prediction of 30-day mortality between PSI and CURB-65 scores.

Table 3 represents screening data in predicting 30 days' mortality between CURB-65 and PSI scoring systems in COVID-19 pneumonia. The low-risk groups of both the scoring systems and the Intermediate risk group of CURB-65 were less sensitive and less specific in predicting COVID-19 pneumonia mortality (values indicated below in Table 4).

The high-risk groups of both CURB-65 and PSI had better sensitivity and specificity (CURB-65: 60% & 88.5%, PSI: 90% & 45.7%) respectively, but overall AUC in the receiver operator curve for CURB-65 scoring system (AUC: 79%) was higher compared to the same of PSI scoring system (AUC: 71%) (Figure 3). Therefore, the CURB-65 scoring system performed better in predicting 30 days' mortality in patients with COVID-19 Pneumonia.

Overall, the non-survivor group had the comorbidities mainly hypertension and cardiovascular disease compared to the survivor group ($P < 0.001$). Acute exacerbation of underlying co-morbidity could also be the cause of death as the PSI scoring system includes underlying co-morbidity in risk classification it can be attributed that the PSI-scoring system performs better in predicting mortality.

4. Discussion

SARS-CoV2 infection can lead to various clinical manifestations in human hosts which are different from the CAP. The commonest causes of mortality are ARDS, AKI, Sepsis, septic shock, and coagulopathy[4,5]. Clinical judgment for the identification of patients with a higher probability of poor outcomes becomes very important in this situation.

In this study, we compared the 2 prognostic scoring systems (CURB-65 and PSI) to predict the need for ICU admission and 30-day mortality in COVID-19 patients. Among the 100 COVID-19-positive patients, 70 patients belong to the survivor group and 30 to

the non-survivor group.

In the high-risk group, we found that the PSI scoring system had better specificity (73 % vs. 54%) compared to CURB-65, whereas CURB-65 has better sensitivity (92% vs. 83%) in predicting the need for ICU admission in COVID-19 patients. Henceforth, the PSI scoring system performed better (AUC of receiver operator curve 88% vs. 81 %) in this matter.

The study was done by Safwat A.M. Eldaboosy, Khalid M, *et al.* in CAP patients and has similar findings (sensitivity of 91% and 97%, specificity of 45 % and 45% for PSI and CURB-65 respectively)[6]. Whereas, Buising *et al.*'s the study suggested both PSI and CURB-65 had equal efficacy (84% & 57%), with CURB-65 being more specific (64% and 45%) in deciding the need for ICU care at the presentation of CAP patients in the emergency department[7]. The data to compare these parameters with other studies in COVID-19 patients is not available. The variation in results may be due to heterogeneity in patient character, hospital admission criteria, or variation in the COVID-19 disease process.

Our study also showed that in the high-risk groups, both CURB-65 and PSI had better sensitivity and specificity (CURB-65: 60% & 88.5%, PSI: 90% & 45% respectively) but overall, AUC in receiver operator curve for CURB-65 scoring system (AUC=79%) was higher compared to the same of PSI scoring system (AUC=71%). Therefore, the CURB-65 scoring system performed better in predicting 30-day mortality in patients with COVID-19 pneumonia.

However, both studies performed poorly in low and intermediate-risk patients in predicting the 30 days' mortality and the need of ICU admission, leading to questionable value in using these scoring systems as a tool for prognosticating the patients. Yann Nguyen *et al.* study in France also had the same result among the patients who had been declared as low risk[8], 20% were requiring ICU care. Zhou *et al.* study in 2020 showed that CURB-65 scores were significantly higher in deceased patients[9]. Liu *et al.* (2020)

compared the PSI scoring system in elderly and young patients and showed that elderly patients had higher scores^[10]. Celal Satıcı *et al.* in Turkey found that a CURB-65 score of more than equal to 2 and a PSI score of more than equal to 4 had a sensitivity of 73% and 80%, specificity of 85 % and 89%, respectively which is similar to our study^[11].

The studies of CURB-65 in CAP patients found that many patients with low CURB-65 scores are not suitable for outpatient treatment because many factors are not incorporated in the score, including hypokalemia, the requirement of oxygen therapy^[12], and it also underestimates the severity of young patients. These limitations might also apply to patients with COVID-19. In addition, COVID-19 is a systemic disease and its severity might be due to exacerbated inflammatory response, cytokine storm, *etc.* which are not taken into account^[13]. Many risk factors including raised D Dimer, Interleukin-6, and cardiovascular risks are not taken into consideration^[14-16].

Thus, we express concern regarding the use of CURB-65 and PSI scores to guide the decision of inpatient and outpatient care although it gives fair results in high-risk patients.

In conclusion, this single-centre retrospective study including a large cohort of COVID-19 patients showed that CURB-65 as well as PSI is a powerful tool for predicting mortality whereas PSI is slightly better in predicting the need of ICU admission in high-risk patients.

Conflict of interest statement

The authors report no conflict of interest.

Funding

There was no extramural funding received for conducting this study.

Data availability statement

The data supporting the findings of this study are available from the corresponding authors upon request.

Authors' contributions

Study concept and design was given by PKJ. Data collection, compilation and statistical analysis was done by VK, PKB. Manuscript preparation was done by MS. Critical revision was done

by all authors.

References

- [1] Elezkurtaj S, Greuel S, Ihlow J, Michaelis EG, Bischoff P, Kunze CA, et al. Causes of death and comorbidities in hospitalized patients with COVID-19. *Sci Rep* 2021; **11**(1): 4263.
- [2] Elmoheen A, Abdelhafez I, Salem W, Bahgat M, Elkandow A, Tarig A, et al. External validation and recalibration of the CURB-65 and PSI for predicting 30-day mortality and critical care intervention in multiethnic patients with COVID-19. *Int J Infect Dis* 2021; **111**: 108-116.
- [3] García Clemente MM, Herrero Huertas J, Fernández Fernández A, De La Escosura Muñoz C, Enríquez Rodríguez AI, Pérez Martínez L, et al. Assessment of risk scores in COVID-19. *Int J Clin Pract* 2021; **75**(12): e13705.
- [4] Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: Summary of a report of 72,314 cases from the Chinese Center for Disease Control and Prevention. *JAMA* 2020; **323**(13): 1239.
- [5] Marchandot B, Sattler L, Jesel L, Matsushita K, Schini-Kerth V, Grunebaum L, et al. COVID-19 related coagulopathy: A distinct entity? *J Clin Med* 2020; **9**(6): 1651.
- [6] Eldaboosy AM, Halima KM, Shaarawy AT, Kanany HM, Elgamal EM, El-Gendi A, et al. Comparison between CURB-65, PSI, and SIPP scores as predictors of ICU admission and mortality in community-acquired pneumonia. *Egypt J Crit Care Med* 2015; **3**: 37-44.
- [7] Buising KL, Thursky KA, Black JF, MacGregor L, Street AC, Kennedy MP, et al. A prospective comparison of severity scores for identifying patients with severe community acquired pneumonia: reconsidering what is meant by severe pneumonia. *Thorax* 2006; **61**(5): 419-424.
- [8] Nguyen Y, Corre F, Honsel V, Curac S, Zarrouk V, Burtz CP, et al. A nomogram to predict the risk of unfavourable outcome in COVID-19: A retrospective cohort of 279 hospitalized patients in Paris area. *Ann Med* 2020; **52**(7): 367-375.
- [9] Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: A retrospective cohort study. *Lancet* 2020; **395**(10229): 1054-1062.
- [10] Liu K, Chen Y, Lin R, Han K. Clinical features of COVID-19 in elderly patients: A comparison with young and middle-aged patients. *J Infect* 2020; **80**(6): e14-e18.
- [11] Satıcı C, Demirkol MA, Sargin Altunok E, Gursoy B, Alkan M, Kamat S, et al. Performance of pneumonia severity index and CURB-65 in predicting 30-day mortality in patients with COVID-19. *Int J Infect Dis* 2020; **98**: 84-89.
- [12] Chalmers JD, Julia R. Can we use severity assessment tools to increase outpatient management of community-acquired pneumonia? *Eur J Intern Med* 2012; **23**(5): 398-406.
- [13] Ye Q, Wang B, Mao J. The pathogenesis and treatment of the 'Cytokine

Storm' in COVID-19. *J Infect* 2020; **80**(6): 607-613.

meta-analysis. *J Infect* 2020; **81**(2): e16-e25.

[14] Chaomin W, Xiaoyan C, Yanping C, Jia'an X, Xing Z, Sha X, et al. Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China. *J Emerg Med* 2020; **180**(7): 934-943.

[15] Fei Z, Ting Y, Ronghui D, Guohui F, Ying L, Zhibo L, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: A retrospective cohort study. *Lancet* 2020; **395**(10229): 1054-1062.

[16] Zheng Z, Peng F, Xu B, Zhao J, Liu H, Peng J, et al. Risk factors of critical and mortal COVID-19 cases: A systematic literature review and

Publisher's note

The Publisher of the Journal remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Edited by Liu JJ