J Nepal Health Res Counc 2025 July-Sept; 23(68): 583-589

Prognostic Utility of the CAUDA 70 score in Acute Exacerbations of COPD

Niraj Bam,[1] Bibek Shrestha,[2] Kapil Khanal,[2] Vibhav Lal[2]

[1]Department of Pulmonology and Critical Care Medicine, Tribhuvan University Teaching Hospital, Kathmandu, Nepal, [2]Department of Internal Medicine, Tribhuvan University Institute of Medicine, Kathmandu, Nepal.

ABSTRACT

Background: Chronic obstructive pulmonary disease is a major cause of morbidity and hospitalization worldwide, and acute exacerbations further increase healthcare burden. Reliable prognostic tools are required to predict outcomes and optimize management. The CAUDA 70 score, based on simple clinical parameters, has been proposed as an accessible bedside predictor. This study aimed to evaluate its prognostic value in patients admitted with acute exacerbations of COPD.

Methods: A hospital-based, observational, cross-sectional study was conducted at Tribhuvan University Teaching Hospital, Nepal. Patients aged ≥40 years with a confirmed diagnosis of COPD were enrolled. Clinical and demographic data were recorded, and patients were stratified by CAUDA 70 scores. Outcomes assessed included ventilatory support, intensive care admission, acute exacerbation and hospital length of stay.

Results: A total of 180 patients with acute exacerbations of COPD (AECOPD) were included in the study. The mean age of participants was 67.16 ± 13.38 years, with 45% males and 55% females. The mean CAUDA 70 score was 1.34 ± 0.475. Significant correlations were observed between the CAUDA 70 score and arterial pH ($r = 0.399$, $p < 0.001$), serum urea ($r = 0.244$, $p = 0.001$), and mMRC score ($r = 0.176$, $p = 0.018$). Higher CAUDA 70 scores were associated with increased need for non-invasive ventilation (NIV) ($\chi^2 = 47.41$, $p < 0.001$), ICU admission ($\chi^2 = 59.4$, $p < 0.001$), and mortality ($\chi^2 = 7.3$, $p = 0.007$). The CAUDA 70 score also predicted longer hospital stays ($p < 0.001$). Mortality occurred in 15% of the cohort.

Conclusions: The CAUDA 70 score effectively predicts the severity of outcomes in AECOPD patients, including NIV requirement, ICU admission, prolonged hospitalization, and mortality. Its simplicity and reliance on readily available clinical and biochemical parameters make it a valuable prognostic tool, particularly in resource-limited settings.

Keywords: Cauda 70; chronic obstructive pulmonary disease; prognosis.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a progressive respiratory disorder characterized by persistent airflow limitation and recurrent exacerbations, which significantly contribute to morbidity, hospitalization, and healthcare burden worldwide.[1] Accurate prognostic tools are essential to stratify risk and optimize management in patients presenting with acute exacerbations of COPD (AECOPD).[2] Several clinical indices, including DECAF and BODE, have been proposed for outcome prediction in COPD, yet their application in routine practice remains limited by complexity or lack of validation across diverse populations.[3]

CAUDA 70 is a six-point scoring system used to predict prognosis in patients of AECOPD. The components of CAUDA 70 are: Confusion, Acidosis (pH <7.35), Urea >7mmol/L, MRC Dyspnoea score >4, Albumin <35g/L, and Age >70 years, with one point assigned to each variable present The recently developed CAUDA 70 score offers a simplified approach, incorporating readily available clinical parameters to predict adverse outcomes in AECOPD.[4] This study aimed to evaluate the predictive value of the CAUDA 70 score in hospitalized patients with COPD, specifically assessing its association with hospital stay, need for ventilation, and intensive care admission.

Correspondence: **Dr Niraj Bam, Department of Pulmonology and Critical Care Medicine, Tribhuvan University Teaching Hospital, Maharajgunj, Kathmandu, Nepal. Email: nirajbam19@gmail.com, Phone: +9779841429072.**

METHODS

This was a hospital-based, observational, cross-sectional study conducted among patients admitted with acute exacerbations of chronic obstructive pulmonary disease (AECOPD). All patients aged ≥40 years with a prior diagnosis of COPD according to GOLD criteria were considered eligible. The study was carried out at Tribhuvan University Teaching Hospital, a tertiary care center in Kathmandu Nepal. Data was collected over a period starting from June to August 2025. Ethical approval was obtained from the Institutional Review Committee (IRC) of Institute of Medicine, Tribhuvan University, with reference number 643 (6-11) E2/081/082.

Patients with confirmed COPD presenting with acute exacerbation, as defined by GOLD, were included. Exclusion criteria were patients with concomitant pulmonary conditions (e.g., bronchiectasis, pulmonary fibrosis, active tuberculosis), severe systemic illnesses influencing prognosis (advanced malignancy, end-stage renal disease), and those unwilling to provide consent.

Using a power analysis tool (G*Power), the following assumptions were made for the calculation.[5]

Effect Size (Cohen's d): Based on previous studies and the nature of the CAUDA 70 score's relationship with clinical outcomes, we assume a medium effect size of 0.5.[6]

Significance Level (α): 0.05

Power (1 - β): 0.80

Test Type: Chi-square test for categorical outcomes (e.g., NIV use, mortality) and Pearson correlation for continuous variables (e.g., association between CAUDA score and pH).

Given these parameters, the sample size required to detect a medium effect size with 80% power at a 5% significance level for the chi-square test is approximately 150-200 participants. Since our study enrolled 180 patients, this falls within the ideal range, providing sufficient power to detect clinically significant associations.

To account for potential non-response or missing data, we apply an inflation factor of 20%. This is a standard adjustment in clinical studies, particularly in retrospective or observational research, where incomplete data may arise due to patient dropouts, missed follow-ups, or incomplete medical records.

Thus, the final sample size after adjusting for potential missing data would be:

Adjusted Sample Size=150(calculated sample size) ×1.2(inflation factor) =180 patients

This adjusted sample size ensures the robustness of the results despite possible data loss, ensuring that the study maintains its statistical power.

Data was entered in Microsoft Excel and analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). The statistical analysis in this study utilized several techniques to assess the relationships between the CAUDA 70 score and clinical outcomes in patients with acute exacerbations of COPD. Descriptive statistics, including means, standard deviations (SD), frequencies, and percentages, were used to summarize the baseline demographic and clinical characteristics of the study population, such as age, gender, comorbidities, and vaccination status. Pearson correlation analysis was employed to evaluate the linear relationships between the CAUDA 70 score and continuous clinical variables such as arterial pH, serum urea, and mMRC dyspnea score. This analysis revealed significant positive correlations, indicating that higher CAUDA 70 scores were associated with more severe biochemical and clinical features. To examine associations between the CAUDA 70 score and categorical outcomes, such as the need for non-invasive ventilation (NIV), ICU admission, and mortality, the study used the Chi-square test. The results showed that higher CAUDA 70 scores were significantly associated with increased risk for these adverse outcomes, underscoring the score's prognostic value. Additionally, while not explicitly mentioned, independent t-tests or ANOVA might have been used to compare the mean CAUDA 70 scores between different groups (e.g., NIV vs. non-NIV or ICU vs. non-ICU), providing further insights into how the score varies across patient subgroups.

Receiver Operating Characteristic (ROC) curve analysis was conducted to assess the ability of the CAUDA 70 score to predict mortality, with the area under the curve (AUC) providing an indication of its discriminative power. The ROC analysis demonstrated that the CAUDA 70 score had a good discriminatory ability in predicting mortality, offering a simple, yet effective tool for clinical prognosis. Although not explicitly stated, linear regression analysis might have been used to examine the relationship between the CAUDA 70 score and continuous variables such as hospital length of stay or ICU length of

stay, further confirming its potential as a predictor of resource utilization and recovery time. Together, these statistical methods validated the predictive value of the CAUDA 70 score and its ability to stratify patients based on their risk of adverse outcomes, offering a useful tool for clinicians managing AECOPD patients.

RESULTS

A total of 180 patients with acute exacerbations of COPD (AECOPD) were included in the study. The mean age of the participants was 67.16 ± 13.38 years, with a median age of 68 years. The cohort consisted of 81 males (45%) and 99 females (55%). (Figure 1)

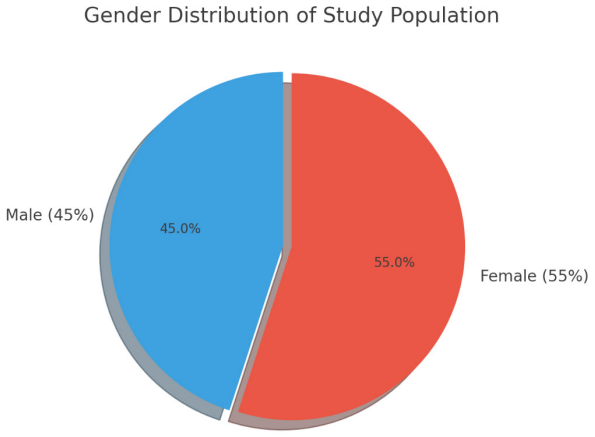

Figure 1. Pie chart showing gender distribution among included participants.

The duration of illness varied, with 107 patients (59.4%) reporting 1–5 years of illness and 73 patients (40.6%) reporting illness duration greater than 5 years. of domiciliary oxygen was reported in 52 patients (28.9%), while the majority (71.1%) did not use long-term oxygen therapy. The mean number of acute exacerbations per year was 1.49 ± 1.11. Comorbidities were common: diabetes and hypertension were each reported in 39 patients (21.7%), while 32 patients (17.8%) had both conditions, and 37 patients (20.6%) had other comorbidities. Thirty-three patients (18.3%) had no documented comorbid illness (Table 1).

Table 1. Baseline Characteristics of the Study Population.

Variables	Outcome
Age (Mean ± SD)	67.16±13.38
Age (Median)	68
Gender (Male/ Female) in n (%)	Male: 81 (45%) Female: 99 (55%)
Duration of illness in n (%)	1-5 years:107 (29.4%) More than 5 years: 73 (40.6%)
Use of Domiciliary Oxygen in n (%)	Yes: 52 (28.9%) No: 128 (71.1%)
Acute exacerbation of COPD (Mean/SD)	1.49/1.11
Comorbidities in n (%)	Diabetes: 39 (21.7%) Hypertension: 39 (21.7%) Both: 32 (17.8%) Others: 37 (20.6%) None: 33 (18.3%)
Variables	Outcome

The mean mMRC dyspnea score was 3.48 ± 1.04, reflecting a predominance of advanced dyspnea in the cohort. The average arterial pH was 7.36 ± 0.07, while mean serum urea and serum albumin levels were 6.39 ± 1.98 mg/dL and 33.82 ± 4.73 g/dL, respectively. The mean CAUDA 70 score across the study population was 1.72 ± 0.89. Non-invasive ventilation (NIV) was required in 101 patients (56.1%), and 87 patients (48.3%) required ICU admission. The mean length of ICU (including HDU) stay was 2.73±4.46 days, and the mean length of total hospital stay was 14.17± 7.7 days. Overall, mortality occurred in 15% of the cohort (n = 27) (Table 2).

Table 2. Clinical Parameters and Risk Indicators.

Clinical Parameter	Sample Size (N)	Mean ± SD	Percentage (%)
Exacerbations	180	1.49 ± 1.116	-
mMRC Score	180	3.48 ± 1.043	-
pH	180	7.36 ± 0.07453	-
Urea (mg/dL)	180	6.39 ± 1.979	-
Albumin (g/dL)	180	33.82 ± 4.7333	-
CAUDA 70 score	180	1.34 ± 0.475	-
Non-Invasive Ventilation (NIV)	180	-	101 (56.1%)
ICU and HDU Admission	180	-	58 (32.2%)
LOS in ICU (Days)	85	2.73±4.46	-
LOS in Hospital (Days)	180	14.17± 7.7	-
Mortality	180	0.15 ± 0.358	-

The CAUDA 70 score demonstrated significant correlations with several clinical and biochemical parameters. Pearson correlation analysis revealed a positive correlation between CAUDA 70 score and arterial pH ($r = 0.399$, $p < 0.001$), serum urea ($r = 0.244$, $p = 0.001$), and mMRC score ($r = 0.176$, $p = 0.018$). Chi-square analysis further showed a significant association of CAUDA 70 score with the need for NIV ($x^2 = 47.41$, $p < 0.001$), ICU admission ($x^2 = 59.4$, $p < 0.001$), and mortality ($x^2 = 7.3$, $p = 0.007$). Patients with higher CAUDA 70 scores were more likely to require ventilatory support, ICU care, and had higher mortality rates. While CAUDA 70 score was not significantly associated with the length of ICU stay ($p = 0.197$), it showed a significant relationship with total hospital stay ($p < 0.001$), indicating that higher scores predicted prolonged hospitalization (Table 3). Although clinically acidosis (lower pH) contributes to a higher CAUDA 70 score, the positive correlation observed statistically likely reflects narrow pH variability and compensatory physiological changes in many patients. Thus, the correlation coefficient direction does not contradict the clinical interpretation that lower pH indicates more severe disease.

Table 3. CAUDA 70 score in relation to different Parameters.

Parameters	CAUDA 70 score		Pearson Correlation	P Value	Pearson Chi-Square	P Value
PH			0.399	0.00		
Urea			0.244	0.001		
mMRC			0.176	0.018		
Non-Invasive Ventilation	Low	High			47.41	0.00
Absent	56	23				
Present	20	81				
Mortality	Low	High			7.3	0.007
Absent	71	5				
Present	82	22				
ICU and HDU	Low	High			59.4	0.00
Absent	100	22				
Present	5	53				
Length of ICU Stay (Mean/SD)	2.73±4.46					0.197
Length of Hospital Stay (Mean/SD)	14.17± 7.7					0.00

Receiver operating characteristic (ROC) curve analysis was performed to evaluate the prognostic accuracy of the CAUDA 70 score in predicting mortality. The ROC curve (Figure 2) demonstrated a favorable discriminative capacity, with the blue curve representing the true positive rate (sensitivity) plotted against the false positive rate (1-specificity). The performance of the CAUDA 70 score exceeded that of a random classifier, as indicated by deviation from the diagonal reference line. The presence of diagonal segments corresponded to ties in classification thresholds. These findings suggest that the CAUDA 70 score is a significant prognostic indicator in patients with AECOPD, with higher scores associated with greater risk of adverse outcomes, including ICU admission and mortality. ROC analysis in this study was performed exclusively to evaluate the discriminatory ability of the CAUDA 70 score for mortality, not for continuous variables such as pH, urea, or mMRC. Although ROC curves for individual biochemical parameters could provide additional prognostic insight, these analyses were beyond the scope of the current study and were not included in the study design.

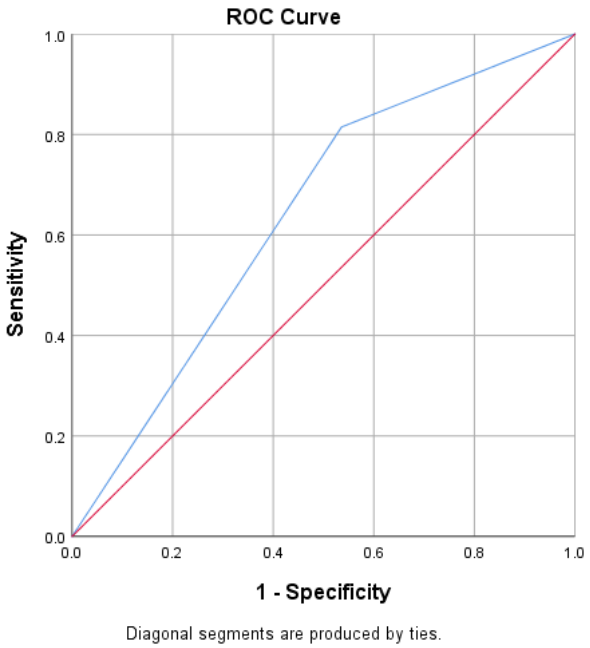

Figure 2. Prediction of CAUDA70 score with respect to Mortality.

Blue Curve: Represents the True Positive Rate (Sensitivity) as a function of the False Positive Rate (1 - Specificity).

Red Curve: Represents the diagonal line, indicating the performance of a random classifier (with no discrimination power).

Diagonal Segments: Produced by ties in classification thresholds.

DISCUSSION

This observational study evaluated the prognostic value of the CAUDA 70 score in patients with acute exacerbations of chronic obstructive pulmonary disease (AECOPD). The findings suggest that the CAUDA 70 score is a significant predictor of adverse clinical outcomes, including the need for NIV, ICU admission, prolonged hospital stay, and mortality. These results highlight the potential of the CAUDA 70 score as a practical and reliable prognostic tool for AECOPD, especially in resource-limited settings. The baseline characteristics of the study cohort showed a mean age of 67.16 ± 13.38 years, which is consistent with the demographic profile of COPD patients reported in other studies. COPD is most prevalent in older adults, with a median age of 68 years in this cohort, reflecting the chronic nature of the disease. Previous studies, such as those by Morena et al. (2023), also found that COPD primarily affects individuals over the age of 65, aligning with our study's findings.[7] The study population included a significant number of female patients (55%), which is notable given the traditionally higher prevalence of COPD among men in many regions. However, in recent years, there has been a shift in gender trends due to factors such as increased smoking rates among women and changing environmental exposures. This is consistent with findings from Gut-Gobert et al. (2019) and Barbagelata et al. (2018), who noted an increasing female prevalence in COPD globally.[8,9] Regarding comorbidities, our study found that 21.7% of patients had diabetes and another 21.7% had hypertension, with 17.8% having both conditions. This finding is consistent with previous studies which have emphasized the high prevalence of comorbidities in COPD patients. Cordeiro et al. (2022) and Mahishale et al. (2015) highlighted that comorbidities such as diabetes and hypertension are prevalent in COPD patients and significantly impact the course of the disease, including exacerbations, hospitalizations, and overall prognosis.[10,11] Our study's findings corroborate these findings and underscore the importance of addressing comorbid conditions in the management of COPD.

In our cohort, the mean mMRC dyspnea score was 3.48 ± 1.04, indicating a predominance of advanced dyspnea among the patients. This aligns with the typical presentation of AECOPD patients, who often experience significant respiratory distress. The mMRC

score is widely used to assess the severity of dyspnea and is known to correlate well with clinical outcomes, such as the need for hospitalization and mortality, as supported by Natori et al. (2016).[12] The biochemical parameters in our study—mean arterial pH (7.36 ± 0.07), serum urea (6.39 ± 1.98 mg/dL), and albumin levels (33.82 ± 4.73 g/dL)—also reflect significant disease severity. Hypoalbuminemia has been widely reported as a predictor of poor outcomes in COPD, including increased risk of exacerbations, longer hospitalization, and mortality. These findings are consistent with those of Nair et al. (2023); Kumar et al. (2018), who validated the prognostic value of CAUDA scores in COPD and found that higher CAUDA scores were strongly associated with adverse outcomes, including mortality.[13,14] Our study further supports these findings by showing that CAUDA 70 scores provide valuable prognostic information in clinical settings, where more complex scoring systems may not be feasible. The significant correlations observed between CAUDA 70 scores and arterial pH ($r = 0.399$, $p < 0.001$), serum urea ($r = 0.244$, $p = 0.001$), and the mMRC score ($r = 0.176$, $p = 0.018$) strengthen the validity of the score. Some also noted that combining clinical and biochemical parameters improves the accuracy of prognostic scoring systems in COPD, which is consistent with our findings.[13] Our study found that a higher CAUDA 70 score was significantly associated with increased mortality ($x^2 = 7.3$, $p = 0.007$), with a mortality rate of 15% in the cohort. This is in line with findings from Sharma et al. (2015), who showed that patients with higher CAUDA scores had a significantly greater risk of mortality due to AECOPD. Moreover, Kumar et al, (2018) demonstrated the utility of CAUDA-based scores in identifying high-risk patients in the early stages of exacerbations, allowing for more targeted interventions to reduce mortality.[14]

Compared with widely used prognostic indices such as DECAF and BODE, CAUDA 70 offers a simpler bedside alternative because it uses routinely available parameters. While DECAF incorporates extended factors such as eosinopenia and chest X-ray findings and BODE includes spirometry and exercise capacity—elements not always feasible in emergency settings—CAUDA 70 may be more practical in resource-limited hospitals like ours. However, because our study did not analyze these indices simultaneously, we cannot directly compare their predictive accuracy. This highlights the need for future multicenter studies evaluating CAUDA 70 alongside established indices. Although CAUDA 70 demonstrated meaningful prognostic associations in our cohort, we acknowledge that our study did not include parallel assessment using other validated indices such as DECAF and BODE. These scores are well-established for predicting outcomes in AECOPD, and a direct comparison would have allowed calculation of relative performance metrics including sensitivity, specificity, and discriminative power. The absence of such comparison is a limitation of our study, and future research should incorporate head-to-head evaluation of CAUDA 70 against standard indices to better define its incremental prognostic value.

The strength of this study lies in its large sample size (n = 180), its detailed clinical data collection, and its ability to validate the prognostic value of the CAUDA 70 score in a clinical cohort. The use of readily available clinical and biochemical parameters makes this score highly practical for routine use in hospitals, particularly in low-resource settings. However, studying is not without limitations. As a single-center study, its findings may not be directly applicable to other populations, especially in different geographical settings. Additionally, as a cross-sectional study, we were unable to track long-term outcomes such as readmission rates or long-term mortality. Future multicenter studies with a longitudinal follow-up design would help to validate the long-term utility of the CAUDA 70 score in AECOPD prognosis.

CONCLUSIONS

The CAUDA 70 score is a valuable prognostic tool in patients with acute exacerbations of COPD, providing crucial information on the severity of disease and the likelihood of adverse outcomes such as NIV requirement, ICU admission, and mortality. Its simplicity and reliance on basic clinical and biochemical parameters make it an ideal tool for use in resource-limited settings. This study reinforces the utility of the CAUDA 70 score in predicting clinical outcomes in AECOPD, offering a practical alternative to more complex scoring systems. Further studies in larger, diverse cohorts, with longitudinal follow-up, are necessary to confirm the robustness of the CAUDA 70 score and to assess its potential for guiding clinical management and improving patient outcomes.

REFERENCES

1. May SM, Li JTC. Burden of chronic obstructive pulmonary disease: Healthcare costs and beyond. Allergy and Asthma Proceedings [Internet]. 2014 Dec 21;36(1):4–10. doi: https://doi.org/10.2500/aap.2015.36.3812

2. Echevarria C, Steer J, Heslop-Marshall K, Stenton S, Hickey P, Hughes R, et al. Validation of the

DECAF score to predict hospital mortality in acute exacerbations of COPD. Thorax [Internet]. 2016 Jan 14;71(2):133–40.doi: https://doi.org/10.1136/thoraxjnl-2015-207775

3. Manchu D, S S V, N VR, Prasad J V, N PK, S PBB, et al. Prediction of outcomes in acute exacerbation of COPD with DECAF score and BAP 65 score in a rural population. International Journal of Research in Medical Sciences [Internet]. 2020 Nov 20;8(12):4296. doi: https://doi.org/10.18203/2320-6012.ijrms20205009

4. K AK, Purna P, Reddy SB, Mohan B, Reddy CR. Assessment of CAUDA 70 Score in acute exacerbation of chronic obstructive pulmonary disease. Indian Journal of Immunology and Respiratory Medicine [Internet]. 2019 Feb 6;3(4):170–3. doi: https://doi.org/10.18231/2581-4222.2018.0042

5. Faul F, Erdfelder E, Lang AG, Buchner A. G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior research methods. 2007 May;39(2):175-91. doi: https://doi.org/10.3758/BF03193146

6. Valladares-Neto J. Effect size: a statistical basis for clinical practice. Revista Odonto Ciência [Internet]. 2018 Dec 30;33(1):84. Available from: https://doi.org/10.15448/1980-6523.2018.1.29437

7. Morena D, Izquierdo JL, Rodríguez J, Cuesta J, Benavent M, Perralejo A, et al. The Clinical Profile of Patients with COPD Is Conditioned by Age. Journal of Clinical Medicine [Internet]. 2023 Dec 9;12(24):7595. doi: https://doi.org/10.3390/jcm12247595

8. Gut-Gobert C, Cavaillès A, Dixmier A, Guillot S, Jouneau S, Leroyer C, et al. Women and COPD: do we need more evidence? European Respiratory Review [Internet]. 2019 Feb 27;28(151):180055. doi: https://doi.org/10.1183/16000617.0055-2018

9. Barbagelata E, Nicolini A, Ambrosino I, Politi C. Gender differences and chronic obstructive pulmonary disease: an update on the literature. Italian Journal of Medicine [Internet]. 2018 Sep 10;12(3):171–9. doi: https://doi.org/10.4081/itjm.2018.987

10. Santos NCD, Miravitlles M, Camelier AA, De Almeida VDC, Maciel RRBT, Camelier FWR. Prevalence and Impact of Comorbidities in Individuals with Chronic Obstructive Pulmonary Disease: A Systematic Review. Tuberculosis & Respiratory Diseases [Internet]. 2022 May 26;85(3):205–20. doi: https://doi.org/10.4046/trd.2021.0179

11. Mahishale V, Angadi N, Metgudmath V, Eti A, Lolly M, Khan S. Prevalence and impact of diabetes, hypertension, and cardiovascular diseases in chronic obstructive pulmonary diseases: A hospital-based cross-section study. Journal of Translational Internal Medicine [Internet]. 2015 Dec 1;3(4):155-60. doi: https://doi.org/10.1515/jtim-2015-0019

12. Natori H, Kawayama T, Suetomo M, Kinoshita T, Matsuoka M, Matsunaga K, et al. Evaluation of the Modified Medical Research Council Dyspnea Scale for Predicting Hospitalization and Exacerbation in Japanese Patients with Chronic Obstructive Pulmonary Disease. Internal Medicine [Internet]. 2015 Dec 31;55(1):15–24. doi: https://doi.org/10.2169/internalmedicine.55.4490

13. Nair R, Mufthah SA, Agnihotri SP, Rajawat GS. Cross Sectional Study on Cauda70 Score and Its Relation With Treatment Outcomes In Acute Exacerbation of Chronic Obstructive Pulmonary Disease at Ird, Sms Medical College, Jaipur. Global Journal for Research Analysis [Internet]. 2023 Oct 15;33–6. doi: https://doi.org/10.36106/gjra/1405981

14. K AK, Purna P, Reddy SB, Mohan B, Reddy CR. Assessment of CAUDA 70 Score in acute exacerbation of chronic obstructive pulmonary disease. Indian Journal of Immunology and Respiratory Medicine [Internet]. 2019 Feb 6;3(4):170–3. doi: https://doi.org/10.18231/2581-4222.2018.0042