



A STUDY ON THE FACTORS CONTRIBUTING TO EARLY READMISSION AFTER ACUTE EXACERBATION IN COPD PATIENTS IN A TERTIARY CARE CENTER IN KERALA- OBSERVATIONAL PROSPECTIVE STUDY

Pulmonary Medicine

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity and mortality worldwide. This study aimed to determine the proportion of early readmissions and identify risk factors for early readmission in COPD patients hospitalized for AECOPD in a tertiary care center in Kerala, India. **Methods:** A prospective observational study was conducted among 140 COPD patients admitted with AECOPD. Socio-demographic, clinical, and treatment data were collected using a pre-designed proforma. Patients were followed up for 30 days post-discharge to assess re-admission status. Risk analysis and regression analysis were performed to identify risk factors. **Results:** The mean age of the participants was 68.9 ± 7.6 years, with a male predominance (81.4%). The readmission rate within 30 days was 34.3%. A higher BODE index score (OR=1.873, 95% CI: 0.967-3.628, $p=0.063$) and 66% of patients had inadequate inhaler technique. The difference was found to be statistically significant and identified as a significant predictor of readmission. Prior hospitalization (OR=0.097, 95% CI: 0.033-0.286, $p<0.001$) was associated with increased readmission. **Conclusion:** One-third of COPD patients had early readmission within 30 days of initial hospitalization for AECOPD. Prior hospitalization, a higher BODE index score, and poor inhaler technique were significant risk factors for early readmission. Pulmonary rehabilitation, vaccination, AEC, CRP, smoking, long-term oxygen therapy, and NIV were not associated with early readmission in this study.

KEYWORDS

AECOPD, Risk factors, BODE index, NIV

INTRODUCTION

Chronic obstructive lung disease (COPD) is heterogeneous group of lung diseases characterized by symptoms of chronic respiratory symptoms secondary to abnormalities in airways like bronchiolitis and/or abnormalities in alveoli like emphysema.¹ These lead to persistent airflow obstruction, which are usually progressive in nature.¹ The estimated global prevalence of COPD is 10.3%, with 391.9 million cases in the age group of 30-79 years in 2019.³ This is expected to increase to 592 million by 2060.⁴ While mortality due to COPD is under-recognized and under-documented, the Global Burden of Disease 2017 report estimates that COPD contributes to 4.2% of all deaths worldwide.² In addition, COPD contributed for 74 million DALY in the same year.⁵ Overall, COPD contributes to disease mortality, morbidity, and disability worldwide. The rising prevalence of COPD due to increased smoking in low-middle-income countries and increased aging in high-income countries, the disease needs to be constantly studied to improve outcomes among these patients.²

GOLD 2025 defines COPD exacerbation (ECOPD) as "An event characterized by dyspnea and/or cough and sputum that worsen over ≤ 14 days, which may be accompanied by tachypnea and/or tachycardia, and is often associated with increased local and systemic inflammation caused by airway infection, pollution, or other insult to the airways."¹² Around 30-50% of COPD patients develop at least one AECOPD per year.⁶ Among them, the short and long term mortalities range from 7.5%-31.9%. Around half of the cases are due to respiratory infections, 10% are due to environmental stimuli, and 30% are due to unknown etiology.⁸ Among the infectious agents, *Streptococcus pneumoniae*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *Haemophilus influenzae* were commonly noted.⁹

A systemic review noted 8.8-26.0% of patients with AECOPD had readmission within 30 days of admission. The incidence increased to 17.5-39.0% at 90 days.¹⁰

Hospital readmission is a healthcare quality indicator.¹¹ Factors like sub-standard care, poor discharge plan, and poor co-ordination of services play a role in re-admission.¹¹ Various risk factors also play an important role in readmission. These factors can be modifiable and non-modifiable risk factors.¹³ Detection and reduction of modifiable and preventable risk factors can reduce readmissions.¹³ It is estimated that 25% of all disease re-admissions are preventable.¹³ Understanding

these factors can help in developing predictor tools and interventions to reduce re-admissions, which help in reducing the disease burden.¹¹ Several factors have been identified as potential predictors of readmission in COPD patients.

Several studies indicate that a number of factors can increase the likelihood of patients being readmitted to the hospital after experiencing an acute exacerbation of COPD (AECOPD). Prior hospitalization before index admission, longer length of hospital stay, prior long term oxygen therapies, household income, socio-economic status, higher co-morbidity rate, older age at diagnosis, severity of COPD, current smoking status, lower body mass index, and frailty are identified as risk factors for readmission in these cases.¹² Various predictor models and machine learning tools are developed to predict readmission and transition to post-discharge transition of care.¹⁴

Material And Methodology

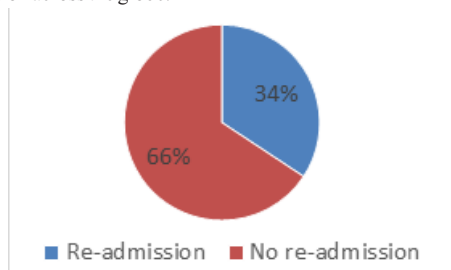
Our study utilized a prospective observational study design and was conducted over a period of one year, from March 2023 to March 2024. The research took place in the Department of Pulmonary Medicine at MES Medical College, Perinthalamana, Kerala, India, identifying it as a single-center study. The participants were 140 Chronic Obstructive Pulmonary Disease (COPD) patients admitted with acute exacerbation of COPD (AECOPD). Inclusion criteria: patients aged above 35 years who had been diagnosed with COPD based on pulmonary function tests and were admitted with acute exacerbation. Exclusion criteria: COPD patients with other co-existing lung diseases (interstitial lung disease, old pulmonary tuberculosis, asthma, malignancy, obstructive sleep apnea, or bronchiectasis).

For data collection, a pre-designed semi-structured questionnaire was used, and details were entered into a proforma. Patients were followed up for 30 days post-discharge to assess their readmission status. The study involved the acquisition of data pertaining to socio-demographic attributes (age, sex, educational attainment, occupational status, annual income), treatment-related factors (medication regimens, hospital length of stay, systemic corticosteroid dosage and duration, intensive care unit admission, home non-invasive ventilation, and oxygen therapy), and individual patient characteristics (pulmonary function test findings, engagement in pulmonary rehabilitation, 6-minute walk test outcomes, oxygen saturation levels, comorbidities, adherence to inhaler therapy, and smoking history). Data analysis was performed using Microsoft Excel and SPSS software, with qualitative

data measured by frequency and percentage, quantitative data by mean and standard deviation, and associations determined using the chi-square test for qualitative variables and Student's t-test for quantitative variables, with a p-value of <0.05 considered statistically significant. Risk analysis and regression analysis were also performed to identify risk factors.

RESULTS

This Observational prospective study included 140 patients hospitalized with acute exacerbation of COPD. Majority of patients were male (81.4%) and belonged to the age group of 60-74 years (72%). These were in conjunction with previous studies (which showed similar socio-demography among patients admitted with COPD.¹⁵ Hence, the study population was representative of the COPD population across the globe.



Graph No.1: Incidence of re-admission in the current study

34.3% participants had re-admission with AECOPD within 30 days of primary admission during the study period. Prior hospitalization was significantly associated with the outcome ($p < 0.05$).

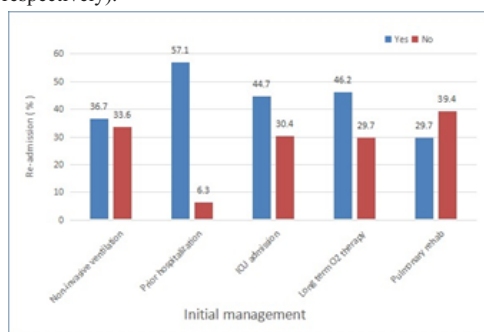
In our study 66% of re-admission patients had inadequate inhaler technique, whereas only 46.7% of patients without re-admission had adequate inhaler technique. This difference was found to be statistically significant ($p = 0.025$). Therefore, inadequate inhaler technique was associated with significant risk of re-admission.

The BODES index showed a trend towards association with the outcome, with a p-value of 0.063, just above the conventional significance threshold of 0.05.

We observed that the absolute eosinophil count (AEC) was higher in patients readmitted to the hospital (median = 70 units) compared to those not readmitted (median = 40 units). However, this difference was not statistically significant.

We found no statistically significant association between readmission and smoking status (current smokers: 35.1%, ex-smokers: 28.6%, non-smokers: 33.3%; $p = 0.885$). Similarly, exposure to air pollution (34% exposed vs. 34.4% non-exposed; $p = 0.966$), kitchen wood smoke (31.9% exposed vs. 35.5% non-exposed), and COVID vaccination (37.3% vaccinated vs. 30.7% non-vaccinated) did not show a significant association with readmission ($p > 0.05$). The initial sputum culture reports (normal growth, *Pseudomonas*, *Streptococcus*, *Acinetobacter*, *Stenotrophomonas*) also showed no significant association with readmission ($p = 0.798$).

The mean duration of hospital stay was comparable between readmission and non-readmission groups (7.0+3.2 days vs. 6.8+2.9 days, respectively).



Graph No.2: Comparison of re-admission among various modes of management during index admission

Table No.1: Binary Logistic Regression Analysis For Readmission Outcome

	Sig.	Exp(B)	95% C.I. for EXP(B)	
			Lower	Upper
BODE Sindex score	.063	1.873	.967	3.628
Prior hospitalization	.000	.097	.033	.286
ICU admission	.586	1.364	.447	4.163
Pulmonary rehabilitation	.080	2.499	.898	6.955
Long term oxygen therapy	.056	.331	.106	1.031
Kitchen wood smoke	.182	2.022	.719	5.690
Vaccination	.942	.966	.386	2.418
Air pollution	.599	1.320	.469	3.712
Age	.421	.975	.917	1.037
Hypertension	.147	2.222	.756	6.534
Diabetes	.489	1.511	.469	4.865
CAP	.336	.382	.054	2.715
Coronary artery disease	.767	.839	.263	2.680
PAH	.331	2.034	.486	8.516
Charlson index	.614	1.223	.560	2.669
Compliance	.217	.498	.164	1.507

DISCUSSION

Chronic obstructive pulmonary disease is a public health problem, and is the seventh leading cause of disability worldwide.¹⁸ Our study aimed to study the proportion of readmission with AECOPD and to recognize the risk factors associated with readmission, so that future strategies can be planned to reduce these events.

Our study noted that 34.1% of the patients who were admitted with COPD had readmission within 30 days of COPD. This was higher than the systemic review by Ruan H et al, where the readmission rate was 13% (95% CI: 0.09–0.18) within 30 days of follow, which progressed to 25% (95% CI: 0.17–0.33) within 60 days of follow up.²⁰ Hence, studying the risk factors for readmission and their implementation to reduce the readmission rate is of importance.

Our study assessed the role of co-morbidities as individual factors and as indices (Charlson co-morbidity index score) in re-admission with AECOPD. The most common co-morbidities noted were hypertension, coronary artery disease, diabetes mellitus and pulmonary artery disease. Similar results were noted in a systemic review by Santos NCD et al.²² In addition, Deniz et al noted that 73.1% of AECOPD cases had one or more co-morbidities.¹⁶

Around two-third of admitted cases were ex-smokers, and around one-third were exposed to air pollution and kitchen wood smoke. However, our study didn't find any association between them and re-admission. In contrast, Wang G et al noted that non-smokers were at reduced risk of exacerbation.¹⁷ Ding Q et al noted that smoking is an independent risk factor for emphysema, but not a risk factor for acute exacerbation.¹⁸

Prior hospitalization was associated with increased risk of re-admission (RR: 9.0, 3.4–23.6). Previous studies (Chow R et al¹⁹) have noted similar results. This recognizes the need for repeated admissions in patients with AECOPD, which will further impact on the cost and quality of life of patients and family members.

Our study didn't find significant association for re-admission with initial management like non-invasive ventilation, steroid therapy, steroid on discharge, ICU admission, long term oxygen therapy, and pulmonary rehabilitation. Jo YS et al noted that prior ICU admission reduced the risk of re-admission.²⁰ Chow R et al noted that long term oxygen therapy and home oxygen therapy reduced the risk of re-admission.¹⁹

Higher incidence of re-admission was noted with increased steroid use. However, this difference was not significant ($p = 0.064$) in this study. Alshehri S et al and Chow R et al noted that long term steroid therapy is better than short term therapy for reduction of re-admissions.²¹

A significant association was observed between suboptimal inhaler technique and increased rates of hospital readmission (RR: 1.73, 95% CI: 1.1–2.8). Consequently, systematic training and ongoing assessment of inhaler technique are recommended to foster improved

medication adherence.²²

The study noted higher BODE index score among patients with readmission ($p < 0.05$). Li CL et al noted that BODE index was associated with number and duration of hospitalization in COPD cases.²³

CONCLUSIONS

Around one-third (34.3%) of COPD patients had early readmission within 30 days of initial hospitalization for acute exacerbation. The study identified higher BODE index score, poor inhaler technique and prior hospitalization increased the risk of early readmission. Long-term oxygen therapy, co-morbidities, smoking history, air pollution exposure, and socio-economic status were not significantly associated with early readmission in this study population. BODES index, poor inhaler compliance, and prior hospitalization can be a useful predictor of readmission.

REFERENCES:

1. Celli B, Fabbri L, Criner G, et al. Definition and Nomenclature of Chronic Obstructive Pulmonary Disease: Time for Its Revision. *Am J Respir Crit Care Med*. 2022;206(11):1317-1325. doi:10.1164/rccm.202204-0671PP
2. Venkatesan P. GOLD COPD report: 2025 update. *Lancet Respir Med*. 2024;12(1):15-16. doi:10.1016/S2213-2600(23)00461-7
3. Adenloye D, Song P, Zhu Y, et al. Global, regional, and national prevalence of, and risk factors for, chronic obstructive pulmonary disease (COPD) in 2019: a systematic review and modelling analysis. *Lancet Respir Med*. 2022;10(5):447-458. doi:10.1016/S2213-2600(21)00511-7
4. Boers E, Barrett M, Su JG, et al. Global Burden of Chronic Obstructive Pulmonary Disease Through 2050. *JAMA Netw Open*. 2023;6(12):e2346598. Published 2023 Dec 1. doi:10.1001/jamanetworkopen.2023.46598
5. GBD 2017 Causes of Death Collaborators. Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980-2017: a systematic analysis for the Global Burden of Disease Study 2017 [published correction appears in *Lancet*. 2019 Jun 22;393(10190):e44] [published correction appears in *Lancet*. 2018 Nov 17;392(10160):2170]. *Lancet*. 2018;392(10159):1736-1788. doi:10.1016/S0140-6736(18)32203-
6. Hurst JR, Vestbo J, Anzueto A, et al. Susceptibility to exacerbation in chronic obstructive pulmonary disease. *N Engl J Med*. 2010;363(12):1128-1138. doi: 10.1056/NEJMoa0909883
7. Cao Y, Xing Z, Long H, et al. Predictors of mortality in COPD exacerbation cases presenting to the respiratory intensive care unit. *Respir Res*. 2021;22(1):77. Published 2021 Mar 4. doi:10.1186/s12931-021-01657-4
8. Sapey E, Stockley RA. COPD exacerbations. 2: aetiology. *Thorax*. 2006 Mar;61(3):250-8. doi: 10.1136/thx.2005.041822. PMID: 16517585; PMCID: PMC2080749.
9. Connors AF Jr, Dawson NV, Thomas C, Harrel Jr FE, Desbiens N, Fulkerson WJ et al. Outcomes following acute exacerbation of severe chronic obstructive lung disease. The SUPPORT investigators (Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatments) [published correction appears in *Am J Respir Crit Care Med* 1997 Jan;155(1):386]. *Am J Respir Crit Care Med*. 1996;154(4 Pt 1):959-967. doi:10.1164/ajrccm.154.4.88875
10. Alqahtani JS, Njoku CM, Bereznicki B, et al. Risk factors for all-cause hospital readmission following exacerbation of COPD: a systematic review and meta-analysis. *Eur Respir Rev*. 2020;29(156):190166. Published 2020 Jun 3. doi:10.1183/16000617.0166-2019
11. CMS Office of Minority Health. Impact of Hospital Readmissions Reduction Initiatives on Vulnerable Populations. Baltimore, MD: Centers for Medicare & Medicaid Services; September 2020
12. Van Walraven C. Proportion of hospital readmissions deemed avoidable: a systematic review. *CMAJ*. 2011;183(7):E391-E402.
13. Press VG, Myers LC, Feemster LC. Preventing COPD Readmissions Under the Hospital Readmissions Reduction Program: How Far Have We Come? *Chest*. 2021 Mar;159(3):996-1006. doi: 10.1016/j.chest.2020.10.008.
14. Hunter LC, Lee RJ, Butcher I, et al. Patient characteristics associated with risk of first hospital admission and readmission for acute exacerbation of chronic obstructive pulmonary disease (COPD) following primary care COPD diagnosis: a cohort study using linked electronic patient records. *BMJ Open*. 2016;6(1):e009121. Published 2016 Jan 22. doi:10.1136/bmjopen-2015-009121
15. Fernández-García S, Represas-Represas C, Ruano-Raviña A, Fernández-García A, González-Montaos A, Priegue-Carrera A, Pérez-Ríos M, Fernández-Villar A. Sociodemographic and Clinical Variables Related to the Overburden of the Informal Caregivers of Patients Hospitalized for Chronic Obstructive Pulmonary Disease Exacerbations. *Int J Chron Obstruct Pulmon Dis*. 2021 Apr 20;16:1119-1126. doi: 10.2147/COPD.S301637
16. Deniz S, Sengul A, Aydemir Y, Celdir Emre J, Ozhan MH. Clinical factors and comorbidities affecting the cost of hospital-treated COPD. *Int J Chron Obstruct Pulmon Dis*. 2016;11:3023-30
17. Wang G, Ma A, Zhang L, Guo J, Liu Q, Petersen F, Wang Z, Yu X. Acute exacerbations of chronic obstructive pulmonary disease in a cohort of Chinese never smokers goes along with decreased risks of recurrent acute exacerbation, emphysema and comorbidity of lung cancer as well as decreased levels of circulating eosinophils and basophils. *Front Med (Lausanne)*. 2022 Aug 10;9:907893. doi: 10.3389/fmed.2022.907893
18. Ding Q, Li J, Xu S, Gao Y, Guo Y, Xie B, Li H, Wei X. Different Smoking Statuses on Survival and Emphysema in Patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease. *Int J Chron Obstruct Pulmon Dis*. 2022 Mar 5;17:505-515. doi: 10.2147/COPD.S346456.
19. Chow R, So OW, Im JHB, Chapman KR, Orchanian-Cheff A, Gershon AS, et al. Predictors of Readmission, for Patients with Chronic Obstructive Pulmonary Disease (COPD) - A Systematic Review. *Int J Chron Obstruct Pulmon Dis*. 2023 Nov 18;18:2581-2617. doi: 10.2147/COPD.S418295
20. Jo YS, Rhee CK, Kim KJ, Yoo KH, Park YB. Risk factors for early readmission after acute exacerbation of chronic obstructive pulmonary disease. *Ther Adv Respir Dis*. 2020 Jan-Dec;14:1753466620961688. doi: 10.1177/1753466620961688
21. Alshehri S, Alalawi M, Makeen A, Jad A, Alhuwaysi A, Alageeli M, Alshibani M. Short-Term Versus Long-Term Systemic Corticosteroid Use in the Acute Exacerbation of Chronic Obstructive Pulmonary Disease Patients. *Malays J Med Sci*. 2021 Feb;28(1):59-65. doi: 10.21315/mjms2021.28.1.8
22. Ong KC, Earnest A, Lu SJ. A multidimensional grading system (BODE index) as predictor of hospitalization for COPD. *Chest*. 2005 Dec;128(6):3810-6. doi: 10.1378/chest.128.6.3810

23. Li CL, Lin MH, Chen PS, Tsai YC, Shen LS, Kuo HC, Liu SF. Using the BODE Index and Comorbidities to Predict Health Utilization Resources in Chronic Obstructive Pulmonary Disease. *Int J Chron Obstruct Pulmon Dis*. 2020 Feb 19;15:389-395. doi: 10.2147/COPD.S234363.