

Association of Cardiovascular Disease and Its Subtypes with Prognosis in Hospitalized Patients with AECOPD: A Retrospective Cohort Study

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Objective: Cardiovascular diseases (CVDs) are common in patients hospitalized with acute exacerbation of chronic obstructive pulmonary disease (AECOPD), yet the prognostic impact of specific CVD subtypes remains unclear.

Methods: This retrospective study included 977 patients with AECOPD admitted to Hebei Yanda Hospital. Baseline characteristics were compared between patients with and without CVDs. After adjustment for relevant potential confounders identified in the univariable analysis, multivariable logistic regression assessed associations with adverse in-hospital outcomes, and Cox proportional hazards models evaluated one-year readmission. Additional analyses were performed for CVD subtypes-heart failure (HF), ischemic heart disease (IHD), atrial fibrillation (AF), and stroke-and across clinical subgroups.

Results: Among the included patients, 341 (34.9%) had CVDs. These patients were older and had higher heart rate, blood pressure, inflammatory markers, and lower hemoglobin and lymphocyte ($P < 0.05$). After multivariable adjustment, CVDs were associated with adverse in-hospital outcomes (adjusted OR 1.43, 95% CI 1.05–1.94, $P = 0.023$) and a higher risk of 1-year readmission (adjusted HR 1.57, 95% CI 1.21–2.05, $P = 0.001$). Subtype analyses showed that HF and IHD were significantly associated with adverse in-hospital outcomes, while HF and AF predicted higher 1-year readmission risk ($P < 0.05$). Kaplan-Meier curves showed a higher readmission risk in patients with CVDs ($P < 0.001$). These associations were generally consistent across subgroups, with a significant interaction observed only for HF in patients younger than 70 years.

Conclusion: CVDs were common and were associated with worse in-hospital outcomes and higher 1-year readmission risk. CVD subtypes should be considered in risk stratification and clinical management. Further studies with more detailed treatment and follow-up data are needed to better define the role of CVD-specific management in improving outcomes.

Keywords: acute exacerbation of chronic obstructive pulmonary disease, cardiovascular diseases, prognosis

Introduction

Population ageing has been accompanied by a growing prevalence of multimorbidity, which has become an important challenge for healthcare systems worldwide.¹ Cardiovascular disease, malignant neoplasms, and chronic respiratory diseases, particularly chronic obstructive pulmonary disease (COPD), are among the leading contributors to this burden.² COPD is a chronic airway disease characterized by persistent airflow limitation and remains the third leading cause of death worldwide. Its prolonged clinical course is often accompanied by considerable symptom burden and multiple comorbidities, which further complicate acute management and worsen prognosis.³

Cardiovascular diseases (CVDs) have received particular attention in COPD because of their shared risk factors and prognostic relevance and their prevalence in this population has been reported to range from 30% to 50%.^{4,5} However, the impact of CVDs on adverse clinical outcomes remains uncertain, with inconsistent findings across studies. Cui et al found that coexisting coronary artery disease was not associated with readmission or mortality within 30 days after

discharge in AECOPD patients,⁶ whereas another recent study linked cardiovascular and cerebrovascular comorbidities to increased in-hospital mortality and readmission risk.⁷ Meanwhile, CVDs has been considered as an overall comorbidity burden or composite condition, whereas the prognostic implications of specific CVD subtypes remain less well defined.⁸ This limitation may reduce the precision of risk stratification and make it more difficult to guide targeted management in those patients, given that different cardiovascular conditions may vary substantially in clinical presentation, treatment priorities, and prognostic significance.⁹

Therefore, this retrospective cohort study aimed to characterize the prevalence and clinical features of CVDs in patients hospitalized with AECOPD and to evaluate their associations with in-hospital outcomes and one-year readmission. We further evaluated CVD subtypes, including heart failure (HF), ischemic heart disease (IHD), atrial fibrillation (AF), and stroke, to assess whether their associations with patient outcomes differ. A better understanding of both overall CVD burden and subtype-specific prognostic patterns may help refine risk stratification and support more individualized management in hospitalized patients with AECOPD.

Materials and Methods

Study Design and Study Population

This retrospective cohort study included patients hospitalized with AECOPD in the Department of Respiratory and Critical Care Medicine at Hebei Yanda Hospital between January 2020 and December 2024. The inclusion criteria were as follows: (1) age ≥ 40 years; and (2) Confirmed diagnosis of AECOPD, defined as an event characterized by dyspnea and/or cough and sputum that worsen over < 14 days.^{10,11} Exclusion criteria were: (1) Other pulmonary comorbidities, such as asthma or asthma-COPD overlap, bronchiectasis, and interstitial lung disease; (3) Severe non-pulmonary comorbidities, such as advanced malignancy, end-stage renal or hepatic failure; (4) incomplete clinical or follow-up data. Only the first hospitalization record was included for patients with multiple AECOPD admissions during the study period. After applying the inclusion and exclusion criteria, the last included patient was discharged in November 7, 2024.

Cardiovascular comorbidities were identified based on ICD-10 codes recorded in discharge diagnoses. HF (I50.1-I50.9), IHD (I20.0-I25.9), AF (I48.0-I48.2), and stroke (I61-I63) were selected as exposures in this study. All ICD-10-based diagnoses were further reviewed by a cardiologist (Da Huang).

This study was conducted according to the principles of the Declaration of Helsinki and was approved by the Ethics Committee of Hebei Yanda Hospital (2025-07-003), and the need to obtain written informed consent was waived due to its retrospective nature. All patient data were anonymized, and strict confidentiality measures were implemented throughout the study.

Data Source

Data were obtained from the electronic medical record system of Hebei Yanda Hospital. The dataset included baseline demographic information, comorbidities, history of acute exacerbations within the previous year, and laboratory parameters such as complete blood count and serum biochemical tests, and information on in-hospital treatments, including antibiotics, expectorant, inhaled corticosteroids, and systemic corticosteroids.

Adverse In-Hospital Outcome and Follow-Up

The clinical outcomes included in-hospital mortality, requirement for non-invasive ventilation (NIV) or invasive mechanical ventilation (IMV), transfer to the intensive care unit (ICU), hospitalization cost, and length of stay (LOS). An adverse in-hospital outcome was defined as the occurrence of any of the following events: in-hospital death, use of IMV, ICU admission, or a prolonged hospitalization (LOS ≥ 14 days). Post-discharge follow-up data were used to record the time from discharge to first readmission or the readmission status within 1 year after discharge, with readmission records retrieved from the provincial healthcare database.

Statistical Analysis

Categorical variables were expressed as counts and percentages, and group comparisons were performed using the chi-square test or Fisher's exact test. Continuous variables with a normal distribution were expressed as mean $\pm$ standard deviation (SD) and compared using the independent-samples *t* test; non-normally distributed data were presented as median (interquartile range, IQR) and compared using the Mann–Whitney *U*-test or Kruskal–Wallis test.

Univariable and multivariable logistic regression analyses were applied to identify factors associated with adverse in-hospital outcomes in AECOPD patients with CVDs. Cox proportional hazards models were used to assess the predictive value of CVDs for readmission within one year after discharge. Kaplan–Meier survival analysis was conducted to estimate and compare readmission-free survival between groups. All statistical analyses were performed using R software (version 4.3.3). A two-tailed *P* value < 0.05 was considered statistically significant.

Results

Baseline Characteristics

A total of 1678 patients aged ≥ 40 years who were hospitalized with AECOPD between 2020 and 2024 were initially screened (Figure 1). Among them, 261 individuals were excluded because the current hospitalization represented a readmission, leaving 1417 patients with a first admission eligible for further assessment. Among them, 196 patients with asthma, interstitial lung disease or other pulmonary comorbidities, 68 with major non-pulmonary diseases, and 176 lacking complete follow-up or clinical data were excluded. Finally, 977 patients were included in the final analysis, comprising 341 (34.9%) patients with CVDs and 636 (65.1%) without CVDs.

Compared with patients without CVDs, those with CVDs were older ($P < 0.001$) and had a higher proportion of current smokers and hypertension ($P < 0.05$). They also showed significantly higher heart rate, blood pressure, white blood cell and neutrophil, whereas hemoglobin and lymphocyte were lower compared with patients without CVDs ($P < 0.05$). No significant differences were observed in other baseline characteristics (Table 1). During hospitalization, 91.0% of patients received

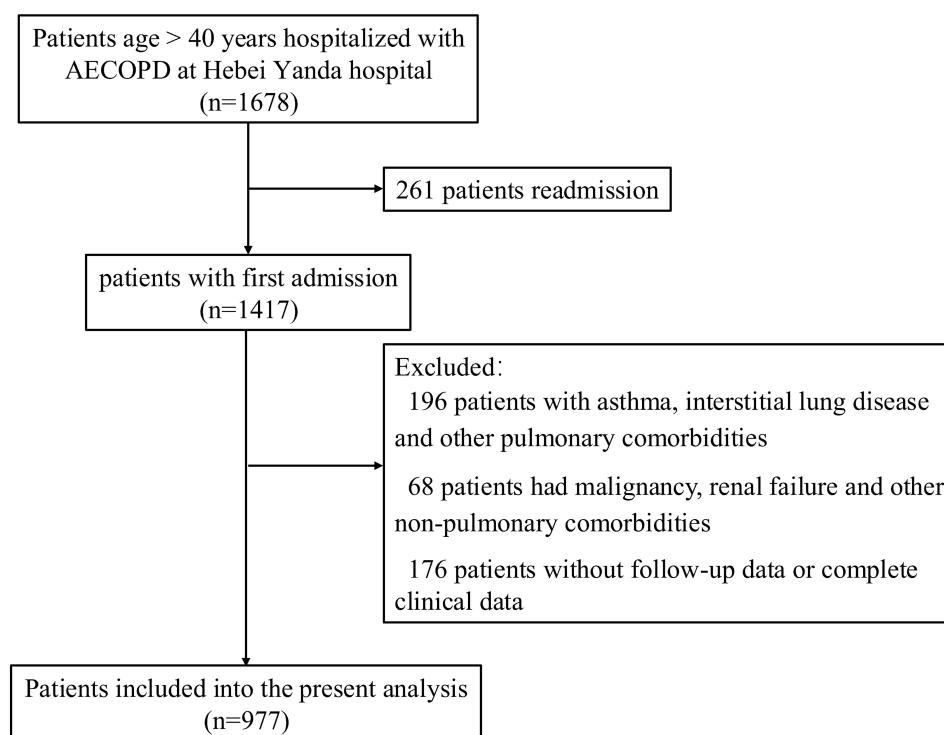


Figure 1 Study flow.

Table 1 Comparison of Baseline Characteristics Between AECOPD Patients with and without CVDs

Variables	Total (n=977)	Non-CVDs Group (n = 636)	CVDs Group (n = 341)	P value
Age, years	70.3±8.9	69.0±8.9	72.8±8.6	<0.001
Male, n (%)	710 (72.7)	471 (74.1)	239 (70.1)	0.210
BMI, kg/m ²	23.6±3.6	23.5±3.6	23.6±3.7	0.730
Smoking status, n (%)				<0.001
Non-smoker	316 (32.3)	241 (37.9)	75 (22.0)	
Former smoker	424 (43.4)	277 (43.6)	147 (43.1)	
Current smoker	237 (24.3)	118 (18.6)	119 (34.9)	
AECOPD in the previous year, n (%)	147 (15.0)	92 (14.5)	55 (16.1)	0.548
Type 2 diabetes mellitus, n (%)	192 (19.7)	115 (18.1)	77 (22.6)	0.109
Hypertension, n (%)	330 (33.8)	198 (31.1)	132 (38.7)	0.021
Heart rate, rate/minute	93.0±17.0	91.0±16.0	96.0±17.0	<0.001
Systolic blood pressure, mmHg	130.5±20.9	129.1±20.7	133.1±21.2	0.004
Diastolic blood pressure, mmHg	78.8±9.2	78.2±8.6	79.8±10.0	0.012
Laboratory tests				
White blood cell, ×10 ⁹ /L	9.8 (8.1–12.3)	9.5 (7.7–11.9)	10.4 (8.6–12.9)	<0.001
Hemoglobin, g/L	131 (118–146)	132 (120–146)	129 (115–145)	0.012
Neutrophil, ×10 ⁹ /L	6.5 (4.8–8.7)	6.3 (4.7–8.6)	6.8 (5.3–9.5)	0.006
Lymphocyte, ×10 ⁹ /L	1.23 (0.87–1.68)	1.29 (0.92–1.75)	1.08 (0.80–1.53)	<0.001
Eosinophil, ×10 ⁹ /L	0.15 (0.11–0.19)	0.14 (0.10–0.20)	0.16 (0.12–0.19)	0.914
Alanine aminotransferase, U/L	18 (13–25)	18 (13–25)	17 (12–24)	0.159
Aspartate aminotransferase, U/L	20 (17–25)	20 (17–26)	19 (16–25)	0.061
Creatinine, μmol/L	65.8 (55.2–77.4)	64.7 (54.8–76.8)	66.9 (56.6–79.1)	0.058
Blood urea nitrogen, mmol/L	6.0 (4.8–7.2)	5.9 (4.7–7.4)	6.1 (5.0–6.9)	0.952
Treatment, n (%)				
Antibiotic	889 (91.0)	581 (91.4)	308 (90.3)	0.675
Expectorant	826 (84.5)	531 (83.5)	295 (86.5)	0.249
Inhaled corticosteroids	824 (84.3)	546 (85.8)	278 (81.5)	0.090
Systemic corticosteroids	260 (26.6)	161 (25.3)	99 (29.0)	0.239

Abbreviations: AECOPD, acute exacerbation of chronic obstructive pulmonary disease; CVDs, cardiovascular diseases; BMI, body mass index.

antibiotics, 84.5% received expectorants, 84.3% received inhaled corticosteroids, and 26.6% received systemic corticosteroids. There were no significant differences in in-hospital treatment between the CVD and non-CVD groups ($P > 0.05$).

In-Hospital Outcomes and One-Year Readmission

Patients with CVDs experienced significantly worse in-hospital outcomes compared with those without CVDs. The CVDs group had higher in-hospital mortality (4.1% vs 0.6%, $P < 0.001$), greater use of non-invasive ventilation (15.2% vs 9.4%, $P = 0.008$), increased ICU admissions (6.5% vs 2.5%, $P = 0.004$), and longer hospitalization duration (median 13 vs 12 days, $P < 0.001$). They were also more likely to stay ≥ 14 days and had higher total hospitalization costs ($P < 0.001$). Moreover, one-year readmission was markedly more frequent in patients with CVDs (35.5% vs 20.6%, $P < 0.001$) (Table 2).

Association Between CVDs and Adverse In-Hospital Outcomes

In univariate analyses, CVDs were significantly associated with adverse in-hospital outcomes (OR: 1.36, 95% CI: 1.81–2.39, $P < 0.001$). Age, current smoking, prior-year AECOPD, Type 2 diabetes mellitus, heart rate, white blood cell count, neutrophils, hemoglobin, lymphocytes, and BUN were also associated with adverse outcomes (Supplementary Table 1). Considering potential multicollinearity between total leukocyte count and neutrophils, white blood cell count was removed from the subsequent multivariable model. After adjustment for confounders, CVDs remained an independent predictor of adverse in-hospital outcomes (OR: 1.43, 95% CI: 1.05–1.94, $P = 0.023$) (Supplementary Table 2).

Table 2 Comparison of In-Hospital Outcomes and Readmission Between AECOPD Patients with and without CVDs

Variables	Total (n=977)	Non-CVDs Group (n = 636)	CVDs Group (n = 341)	P value
Mortality	18 (1.8)	4 (0.6)	14 (4.1)	<0.001
NIV, n (%)	112 (11.5)	60 (9.4)	52 (15.2)	0.008
IMV, n (%)	17 (1.7)	9 (1.4)	8 (2.3)	0.421
ICU, n (%)	38 (3.9)	16 (2.5)	22 (6.5)	0.004
Length of stay, days	12 (10–15)	12 (9–14)	13 (11–16)	<0.001
Length of stay ≥14 days, n (%)	254 (25.5)	105 (16.5)	96 (28.3)	<0.001
Total hospitalization cost	16,811 (12,779–24,437)	16,022 (12,398–21,981)	19,157 (13,415–28,764)	<0.001
Adverse in-hospital outcome, n (%)	304 (31.1)	169 (26.6)	135 (39.6)	<0.001
Readmission within 1 year, n (%)	252 (25.8)	131 (20.6)	121 (35.5)	<0.001

Abbreviations: AECOPD, acute exacerbation of chronic obstructive pulmonary disease; CVDs, cardiovascular diseases; NIV, Non-invasive ventilation; IMV, invasive mechanical ventilation; ICU, intensive care unit.

Cox Regression Analysis of the Association Between CVDs and Readmission

In univariate Cox analyses, the presence of CVDs was significantly associated with a higher risk of 1-year readmission (HR = 1.84, 95% CI: 1.44–2.36, $P = 0.001$). Older age, current smoking, higher heart rate, lower lymphocyte count and a history of AECOPD in the previous year were also significant predictors ([Supplementary Table 3](#)). In the multivariate model adjusting for age, sex, smoking status, prior AECOPD, heart rate, and lymphocyte count, CVDs remained an independent risk factor for readmission (HR = 1.57, 95% CI: 1.21–2.05, $P = 0.001$) ([Supplementary Table 4](#)).

Differential Impact of Cardiovascular Disease Subtypes on In-Hospital Outcomes and One-Year Readmission in Patients with AECOPD

As shown in [Tables 3](#) and [4](#), HF (OR = 1.83, 95% CI: 1.23–2.72, $P = 0.003$) and IHD (OR = 1.60, 95% CI: 1.08–2.35, $P = 0.017$) were significantly associated with a higher risk of adverse in-hospital outcomes. In contrast, AF and stroke were not significantly related to in-hospital outcomes ($P > 0.05$). Regarding 1-year readmission, HF (HR = 1.42, 95% CI: 1.03–1.97, $P = 0.031$) and AF (HR = 1.45, 95% CI: 1.01–2.11, $P = 0.044$) were associated with elevated readmission risk. However, neither IHD nor stroke demonstrated significant associations with readmission within one year ($P > 0.05$).

Kaplan–Meier analysis showed that AECOPD patients with CVDs had a significantly higher 1-year readmission probability than those without CVDs (log-rank $P < 0.0001$) ([Figure 2](#)). Subgroup analyses further demonstrated that HF

Table 3 Association of Cardiovascular Disease Subtypes with Adverse In-Hospital Outcomes Among Patients with AECOPD

Variables	Total (n = 977)	Non-Adverse Outcome (n = 673)	Adverse Outcome (n = 304)	OR (95% CI)	P
HF					0.003
Non	849 (86.9)	602 (89.5)	247 (81.3)	Reference	
Yes	128 (13.1)	71 (10.5)	57 (18.8)	1.83(1.23–2.72)	
AF					0.429
Non	891 (91.2)	621 (92.3)	270 (88.8)	Reference	
Yes	86 (8.8)	52 (7.7)	34 (11.2)	1.21(0.74–1.96)	
IHD					0.017
Non	837 (85.7)	593 (88.1)	244 (80.3)	Reference	
Yes	140 (14.3)	80 (11.9)	60 (19.7)	1.60(1.08–2.35)	
Stroke					0.419
Non	918 (94.0)	639 (94.9)	279 (91.8)	Reference	
Yes	59 (6.0)	34 (5.1)	25 (8.2)	1.26(0.71–2.22)	

Notes: Adjusted for age, sex, smoking status, AECOPD in the previous year, Type 2 diabetes mellitus, heart rate, hemoglobin, neutrophil, blood urea nitrogen, and lymphocyte count.

Abbreviations: AECOPD, acute exacerbation of chronic obstructive pulmonary disease; OR, odds ratio; CI, confidence interval; HF, Heart Failure; AF, Atrial Fibrillation; IHD, Ischemic Heart Disease.

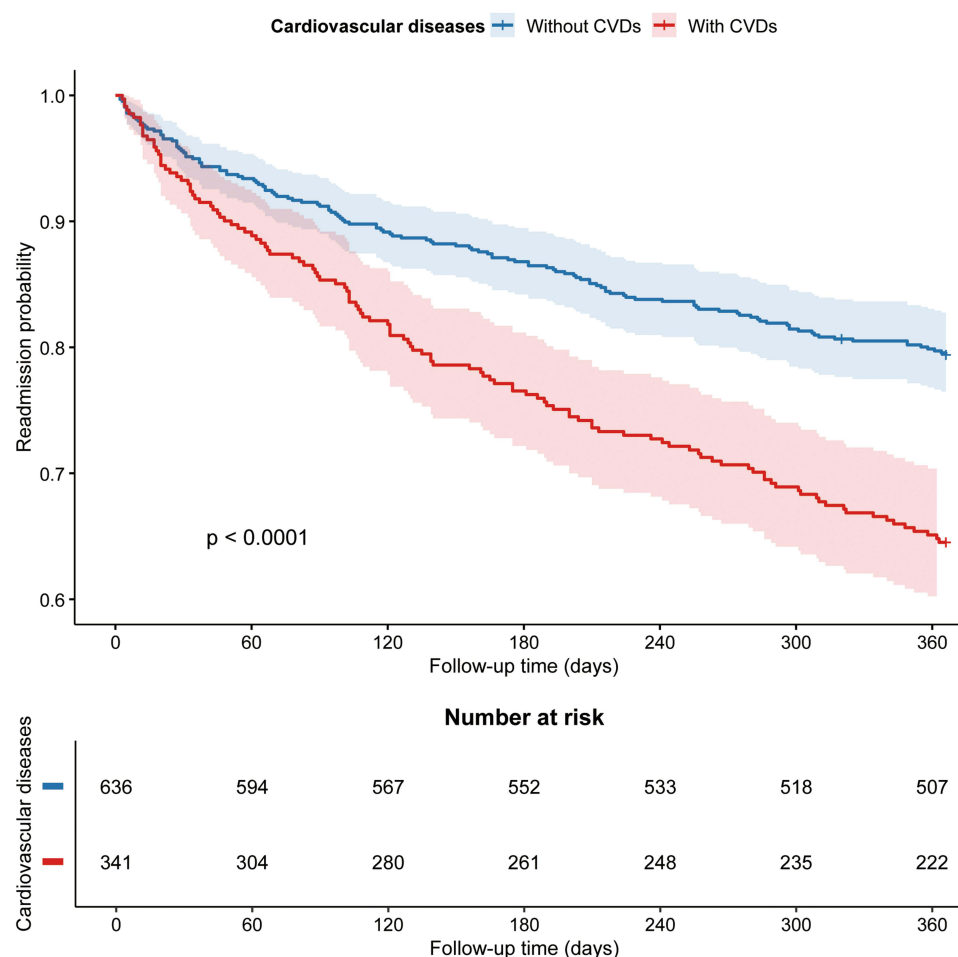
Table 4 Association of Cardiovascular Disease Subtypes with Readmission Among Patients with AECOPD

Variables	Total (n = 977)	Non-Readmission (n = 725)	Readmission (n = 252)	HR (95% CI)	P
HF					
Non	849 (86.9)	644 (88.8)	205 (81.3)	Reference	0.031
Yes	128 (13.1)	81 (11.2)	47 (18.7)	1.42 (1.03–1.97)	
AF					
Non	891 (91.2)	674 (93.0)	217 (86.1)	Reference	0.044
Yes	86 (8.8)	51 (7.0)	35 (13.9)	1.45 (1.01–2.11)	
IHD					
Non	837 (85.7)	627 (86.5)	210 (83.3)	Reference	0.906
Yes	140 (14.3)	98 (13.5)	42 (16.7)	0.98 (0.69–1.38)	
Stroke					
Non	918 (94.0)	686 (94.6)	232 (92.1)	Reference	0.311
Yes	59 (6.0)	39 (5.4)	20 (7.9)	1.26 (0.80–2.01)	

Notes: Adjusted for age, sex, smoking status, AECOPD in the previous year, heart rate, and lymphocyte count.

Abbreviations: HF, Heart Failure; AF, Atrial Fibrillation; IHD, Ischemic Heart Disease.

and AF were the major contributors to this increased risk, with both groups showing markedly faster declines in readmission-free survival ($P < 0.05$). In contrast, IHD and stroke did not show significant differences in readmission risk compared with patients without these conditions ($P > 0.05$) ([Supplementary Figure 1](#)).

**Figure 2** Kaplan–Meier Curve of 1-Year Readmission in AECOPD Patients with and without CVDs.

Subgroup Analyses

For one-year readmission, the associations of CVDs, HF, and AF were also consistent across most subgroups. A significant interaction was observed for HF by age (P for interaction = 0.024) and AECOPD in the previous year (P for interaction = 0.038), with stronger associations observed in patients <70 years and among those without AECOPD in the previous year. Other subgroup comparisons showed no significant interactions (P for interaction > 0.05) ([Supplementary Table 5](#)).

Discussion

This real-world retrospective study comprehensively evaluated the clinical characteristics of hospitalized patients with AECOPD complicated by CVDs and further examined the impact of CVDs and their subtypes on adverse in-hospital outcomes and one-year readmission. Our findings demonstrated that CVDs were common among patients with AECOPD and were independently associated with both increased in-hospital risk and a higher likelihood of all-cause readmission within one year. HF, IHD, and AF showed distinct prognostic patterns, with HF and IHD contributing mainly to in-hospital risk while HF and AF were more strongly associated with long-term readmission.

AECOPD were major events in the natural course of COPD and represent a leading cause of hospitalization and mortality worldwide.¹² CVDs were common among patients experiencing AECOPD, with epidemiological studies in populations reporting CVDs prevalence rates ranging from 25% to nearly 70%.³ For instance, Hu et al reported substantial proportions of chronic heart failure (27.7%), coronary heart disease (30.3%), and AF (19.5%) among patients with severe exacerbations.¹³ Our cohort also showed a high burden of cardiovascular comorbidities (34.9%). Moreover, cardiovascular-related deaths account for up to 30% of all mortality in COPD patients, a proportion comparable to deaths from respiratory causes,¹⁴ underscoring the critical role of CVDs in determining prognosis among patients.

The pathophysiological link between COPD and CVDs is multifactorial. In addition to shared risk factors—such as smoking, oxidative stress, and systemic inflammation—both conditions interact through overlapping biological pathways that mutually aggravate disease progression.^{15,16} Smoking is a key contributor to both emphysema and atherosclerosis, and prior studies have shown that long-term smokers (>20 years) may still reduce their cardiovascular risk within five years after cessation (adjusted HR: 0.83; 95% CI: 0.69–1.00).¹⁷ In our cohort, however, current smoking remained more prevalent among patients with CVDs than among those without, indicating continued exposure to tobacco-related cardiovascular harm even during hospitalization for AECOPD. This pattern further highlights the importance of smoking cessation as a central component in the management of AECOPD patients with cardiovascular comorbidities.

In our cohort, CVDs were significantly associated with adverse in-hospital outcomes in patients admitted with AECOPD, including prolonged LOS and a higher need for NIV in our cohort. This finding is consistent with another domestic study including 98,127 hospitalized patients with AECOPD, in which prolonged hospitalization was more common among those with cardiovascular comorbidity. In that study, LOS ≥ 14 days occurred in 24.46% of patients with cardiovascular comorbidity, compared with 17.26% of those without cardiovascular or cerebrovascular comorbidity, and cardiovascular comorbidity remained an independent predictor of prolonged stay (adjusted OR 1.29, 95% CI: 1.23–1.35).⁷ Previous study also shown that, among patients hospitalized for severe AECOPD, those with concomitant HF required NIV more frequently than those without HF (58% vs 31%, $P=0.0001$).¹⁸

Coexisting CVDs may reduce cardiopulmonary reserve, making patients more prone to pulmonary congestion, impaired gas exchange, and intolerance to respiratory stress, thereby increasing the need for more intensive ventilatory support. At the same time, coexisting CVDs may complicate in-hospital management and delay recovery, ultimately contributing to prolonged hospitalization.¹⁹

Accumulating evidence suggests that coexisting CVDs contributes to burden of patients hospitalized for AECOPD.²⁰ In a real-world cohort of AECOPD patients, concomitant HF was associated with higher hospitalization rates (95.6% vs 78.9%, $P < 0.001$) and a 42% increase in mean 1-year healthcare costs (ratio of means, 1.42; 95% CI, 1.24–1.63; $P < 0.001$).²¹ Similarly, arrhythmia has also been linked to greater healthcare utilization and economic burden in patients with COPD.²² Accordingly, optimized management of cardiovascular events may not only reduce direct and indirect healthcare costs, but also potentially decrease the occurrence of AECOPD and the related risk of hospitalization and longer hospital stay.¹⁹

However, most earlier studies have evaluated CVDs as a single aggregated comorbidity, without differentiating the prognostic impact of specific cardiovascular subtypes such as HF, AF, IHD, or stroke, and the existing evidence regarding subtype-specific effects remains heterogeneous.⁷ In our cohort, HF and IHD were the predominant contributors to poor in-hospital outcomes, whereas AF and stroke did not exhibit independent associations with short-term prognosis. These differences likely reflect the distinct pathophysiological interactions between each subtype and AECOPD. HF and IHD exert direct adverse effects on cardiopulmonary physiology during exacerbations—HF leads to pulmonary congestion, elevated right ventricular afterload, impaired respiratory muscle perfusion, and diminished cardiac reserve, while IHD increases susceptibility to hypoxemia and systemic inflammatory responses that precipitate myocardial ischemia.^{5,23}

Beyond hospitalization, CVDs were also independent predictors of one-year readmission, with subtype analyses identifying HF and AF as the main contributors to long-term risk. Patients with HF often exhibit persistent systemic congestion, impaired cardiopulmonary reserve, and chronic low-grade inflammation, all of which weaken physiological resilience after discharge and increase susceptibility to recurrent respiratory deterioration.²⁴ Likewise, AF is frequently associated with autonomic imbalance, and fluctuating hemodynamics, which may reduce tolerance to respiratory stressors and contribute to adverse clinical outcomes in patients with COPD.²⁵ In our study, stroke was not significantly associated with either in-hospital outcomes or 1-year readmission, in contrast to some previous reports.²⁶ This discrepancy may partly reflect the heterogeneity of stroke, as some patients had remote minor events with little residual impairment, whereas others had substantial neurological deficits. Functional consequences such as dysphagia, impaired mobility, and dependence in activities of daily living are strongly linked to pneumonia;²⁷ therefore, combining these patients into a single category may have diluted the risk associated with more severe cerebrovascular sequelae.

More timely cardiovascular evaluation and optimized management during hospitalization may have potential clinical importance in those patients. β -blocker therapy during hospitalization was not associated with higher risks of in-hospital mortality, late mechanical ventilation, or 30-day readmission in patients with AECOPD who had cardiovascular indications, supporting the view that indicated cardioselective β -blockers should not necessarily be withheld during exacerbations.²⁸ Among patients with confirmed HFrEF, only 54.5% received both an ACE inhibitor and a β -blocker, and coexisting heart failure was associated with higher mortality during follow-up.²⁸ More recently, the pilot randomized SCATECOPD trial provided preliminary interventional evidence that a structured cardiac assessment during AECOPD admission substantially increased new cardiac diagnoses (73.7% vs 19.0%), initiation of new cardiac treatments (56.1% vs 8.6%), and achievement of optimal therapy at discharge (74% vs 34%), with a favorable, though non-significant, trend toward fewer major adverse cardiovascular events at 1 year (10.5% vs 17.2%).²⁹ These findings suggest that more proactive cardiovascular evaluation and treatment during AECOPD hospitalization may be clinically beneficial; however, further prospective multicenter studies with more comprehensive clinical, management, and functional data are warranted to validate and extend these observations.

Despite its strengths, including a large sample size and real-world design, this study has several limitations. First, this was a single-center retrospective study, which may limit the generalizability of the findings to other regions or healthcare settings. However, the large sample size and real-world nature of the cohort still provide valuable insights into the clinical impact of CVDs among patients with AECOPD. Second, although readmission records could be retrieved across hospitals within the provincial healthcare database, rehospitalizations outside the province may not have been fully captured, and the lack of post-discharge mortality and functional status data may have further limited the comprehensiveness of long-term outcome assessment. Nevertheless, the relatively large real-world cohort and the availability of one-year readmission data may still offer useful clinical insight into the prognostic impact of coexisting CVD in patients hospitalized for AECOPD. Finally, the study did not capture information on in-hospital cardiovascular managements, including diuretic titration, rate or rhythm control strategies for AF, which may have influenced clinical outcomes. Further prospective cohort studies are therefore warranted to better clarify the role of cardiovascular management in patients hospitalized for AECOPD.

Conclusions

CVDs were common among patients hospitalized with AECOPD and were associated with worse in-hospital outcomes and a higher risk of 1-year readmission. Different cardiovascular subtypes showed distinct associations with short-term and long-term prognosis. These findings support the importance of incorporating cardiovascular comorbidities into risk stratification and clinical management during AECOPD hospitalization. Further prospective studies with more detailed treatment and follow-up data are warranted to clarify the impact of CVD-specific management on outcomes.

Abbreviations

COPD, chronic obstructive pulmonary disease; CVDs, cardiovascular diseases; AECOPD, acute exacerbations of chronic obstructive pulmonary disease; IHD, ischemic heart disease; HF, heart failure; AF, atrial fibrillation; NIV, non-invasive ventilation; IMV, invasive mechanical ventilation; ICU, intensive care unit, hospitalization cost; LOS, length of stay; SD, standard deviation; IQR, interquartile range.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable requests.

Ethical Approval and Informed Consent

This study was approved by the Ethics Committee of Hebei Yanda Hospital (2025-07-003). The requirement for written informed consent was waived by the Ethics Committee because the study used de-identified retrospective clinical data.

Consent for Publication

All authors have read and approved the final version of the manuscript and consent to its publication.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors have no competing interests to declare for this work.

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