

Impact of Chronic Obstructive Pulmonary Disease on Mortality Rates After Hip Pertrochanteric Fracture: A Nationwide Population-Based Cohort Study

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Purpose: Hip fractures are a major public health concern, especially among older adults. Chronic obstructive pulmonary disease (COPD) is a famous comorbidity that can increase post-fracture outcomes. This retrospective population-based cohort study evaluated the impact of COPD on mortality and contralateral hip fracture risk following pertrochanteric fracture.

Patients and Methods: We included patients diagnosed with pertrochanteric fracture (ICD-10-CM S72.1) between January 1, 2016, and December 31, 2022, from Taiwan's National Health Insurance Research Database. Mortality risk was assessed using Cox proportional hazards models, adjusted for sex, age, and Charlson Comorbidity Index (CCI) score. Contralateral hip fracture risk was estimated using competing risk analysis with death as a competing event. Subgroup analyses were stratified by sex, age, and CCI group.

Results: After adjustment, COPD was significantly associated with higher 1-year mortality (AHR: 1.12, 95% CI: 1.06–1.19, $p < 0.0001$). Conversely, COPD patients had a lower 1-year incidence of contralateral hip fracture compared with non-COPD patients (3.12% vs 4.40%; adjusted subdistribution HR: 0.70, 95% CI: 0.61–0.81, $p < 0.0001$). Similar patterns were observed across all subgroups.

Conclusion: COPD is an independent predictor of increased 1-year mortality after pertrochanteric fracture. The observed reduction in contralateral fracture risk likely reflects the competing risk of early mortality. These findings suggest that elderly patients with COPD should pay more attention in post-hip fracture management with personalized rehabilitation strategies.

Keywords: pertrochanteric fracture, hip fracture, chronic obstructive pulmonary disease, real-world database, mortality, contralateral fracture

Introduction

Hip fractures are a major public health issue, particularly among the elderly, due to the association with increased morbidity, mortality, and considerable healthcare costs.^{1,2} Globally, patients with hip fractures will rise annually to 2.6 million by 2025 and 4.5 million by 2050,³ and Asia's proportion will increase from 26% in 1990 to 45% by 2050.⁴ Hip fractures currently rank among the top ten causes of global disability and impose enormous direct and indirect costs.⁵ In Taiwan, the incidence rates of hip fractures among individuals aged over 50 years in 2015 were 209.1 per 100,000 person-years for males and 293.9 per 100,000 person-years for females.⁶ Previous studies have indicated that pertrochanteric fractures represented more than half of all hip fracture cases,^{7,8} which are typically caused by low-energy falls in individuals with underlying osteoporosis or other conditions compromising bone integrity.

Multiple risk factors contribute to both the incidence and poor outcomes of hip fractures. These include advanced age,⁹ frailty,¹⁰ and chronic medical conditions such as chronic obstructive pulmonary disease (COPD),¹¹ cardiovascular disease,¹² and

diabetes.¹³ Understanding these risk factors is important for developing effective preventive strategies. It also plays a key role in optimizing outcomes through early intervention, timely surgical management, and coordinated post-fracture rehabilitation.

Among comorbidities, COPD is a particularly concerning factor that significantly worsens post-hip fracture prognosis.^{14,15} In Taiwan, estimates derived from national survey data suggest the true prevalence of COPD falls within the 5% to 6% range.¹⁶ Patients with COPD face increased post-operative mortality, driven by a complex interplay of physiological and clinical challenges. Pulmonary complications, including pneumonia and respiratory failure, are common due to postoperative immobilization and pre-existing respiratory compromise.¹⁷ Additionally, many COPD patients are affected by frailty and malnutrition, which contribute to sarcopenia and impede functional recovery.^{18,19} This impaired mobility frequently culminates in long-term disability or death. Several studies in Taiwan also have investigated the relationship between COPD and hip fractures.²⁰ National hip-fracture incidence was 649 per 100,000 person-years in the COPD cohort and 369 per 100,000 person-years among controls.²¹

Despite existing research on the relationship between COPD and hip fractures, data specifically addressing post-fracture mortality in COPD patients remain limited. Moreover, few large-scale, population-based studies have focused on a common and clinically significant subtype of hip fractures, pertrochanteric fractures. Therefore, the aim of this retrospective population-based cohort study was to investigate the impact of COPD on mortality rates following pertrochanteric fracture.

Materials and Methods

Data Source

This retrospective, population-based cohort study used a claims data from the National Health Insurance Research Database (NHIRD), which covers over 99% of the population in Taiwan from a single-payer population insurance program. The NHIRD included the diagnosis and procedure codes of outpatient and inpatient, medication prescriptions, and associated medical expenditures. The diagnosis codes were based on the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM). The procedure codes are identified using the International Classification of Diseases, Tenth Revision, Procedure Coding System (ICD-10-PCS). For research purposes, NHIRD is managed by the Health and Welfare Data Science Center (HWDC) to integrate health-related databases. All databases in HWDC were under a deidentified and anonymized format. Due to the secondary data study and de-identified information in the dataset, the IRB waived the requirement for individual informed consent. The study protocol was followed to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for this observational research study. This study was conducted in compliance with the ethical standards and guidelines of the 2013 revision of the Declaration of Helsinki and the International Ethical Guidelines for Health-related Research Involving Humans developed by the Council for International Organizations of Medical Sciences (CIOMS) in collaboration with the World Health Organization. The study protocol was approved by the Institutional Review Board of Chi Mei Medical Centre (IRB: 11407–013). Informed consent was also waived by the Institutional Review Board of Chi Mei Medical Centre owing to the use of secondary data and the absence of personal information in the study.

Study Design and Population

Due to NHIRD included detailed longitudinal health records, a retrospective cohort study design was used in this study. Patients who aged 65 years or older diagnosed with pertrochanteric fracture, identified using the ICD-10-CM code S72.1, between January 1, 2016, and December 31, 2022, were included in the initial cohort. A total of 84,415 patients were identified. The exclusion criteria were patients with prior hip fractures, indeterminate laterality, or incomplete information. Therefore, 7269 patients were excluded due to insufficient data to determine the laterality of the fracture, and an additional 18,711 patients were excluded due to a history of other types of fractures prior to the pertrochanteric fracture. After applying exclusion criteria, 58,135 patients remained eligible for analysis. The final study cohort consisted of 6664 patients with a diagnosis of COPD (ICD-10-CM : J40-J44) and 51,471 patients without COPD, who served as the control group. All patients were followed for one year from the index date of the pertrochanteric fracture diagnosis to assess outcomes, mortality and contralateral hip fracture (Figure 1).

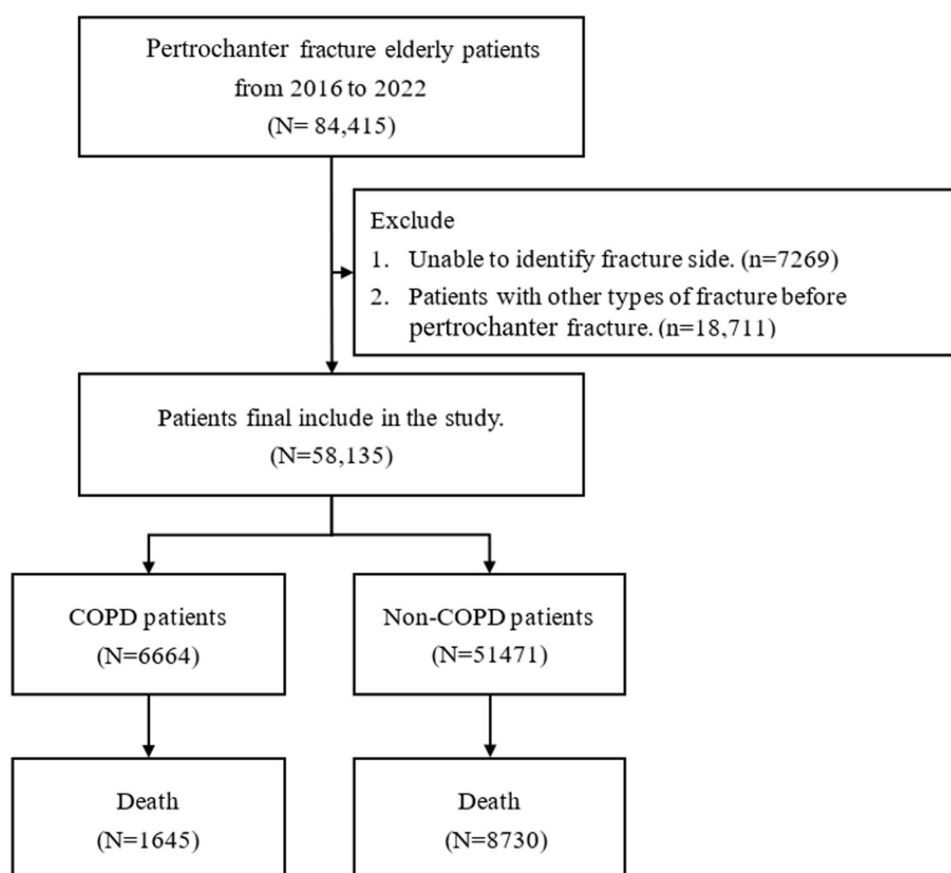


Figure 1 Flowchart of study subjects' selection.

Measurements and Outcome

Baseline information among pertrochanteric fracture patients included sex, age, and Charlson Comorbidity Index (CCI). The CCI score was calculated based on diagnoses recorded within one year before the date of the new-onset pertrochanteric fracture. The CCI was identified using ICD-10-CM codes to quantify the burden of comorbidities, and CCI was also used for risk adjustment in the analysis.^{22,23} Patients were categorized into three levels of disease severity according to their CCI scores: none (CCI=0), mild (CCI=1–2), and severe (CCI≥3).

The primary outcome of the study was all-cause mortality within one-year, and the secondary outcome was contralateral hip fracture. Contralateral hip fracture was identified by laterality information in the third decimal place of the ICD-10-CM diagnosis code, where “1” and “4” denote the right side and “2” and “5” denote the left side. Patients were classified as having a contralateral fracture if a hip fracture occurred on the opposite side compared with the index pertrochanteric fracture during the follow-up period. The ICD-10-CM codes used to identify contralateral hip fractures were S72.0X1, S72.0X4, S72.1X1, S72.1X4, S72.2X1, and S72.2X4 for the right side, and S72.0X2, S72.0X5, S72.1X2, S72.1X5, S72.2X2, and S72.2X5 for the left side. Cases with unspecified laterality were excluded to avoid misclassification. The mortality was based on the death-of-cause records within the HWDC.

Statistical Analysis

The distribution between pertrochanteric fracture patients with COPD and those without was estimated using Pearson's chi-squared test for categorical variables and Student's *t*-test for continuous variables. The trends in incidence of mortality and contralateral hip fracture between pertrochanteric fracture patients with COPD and those without were plotted with the Kaplan–Meier method, and differences were compared using the Log rank test. The risk of mortality was expressed as hazard ratios (HRs) with 95% confidence intervals (CIs), calculated using the Cox proportional hazards

model after adjusting for potential confounding variables. The Schoenfeld residuals test was used to assess whether the proportional hazards assumption of the Cox proportional hazards model was satisfied. Additionally, the model's goodness-of-fit was evaluated using the Akaike Information Criterion (AIC). Similarly, for the competing risk analysis of contralateral hip fracture, the Fine-Gray subdistribution hazards model, with death from any cause defined as a competing event, was used to estimate subdistribution HR (HR^{SD}) with 95% CIs. Additionally, a subgroup analysis stratifying pertrochanteric fracture patients based on sex, age groups, and CCI groups was conducted. All statistical analyses were performed in SAS 9.4 for Windows (SAS Institute, Inc., Cary, NC, USA). Kaplan–Meier curves were plotted in STATA version 12 (Stata Corp., College Station, TX, USA). Statistical significance was set at 0.05 (two-tailed).

Results

Table 1 presented the baseline characteristics of patients aged over 65 years with pertrochanteric fractures, stratified by the presence or absence of chronic obstructive pulmonary disease (COPD). A total of 58,135 patients were included in the analysis, of 6664 (11.5%) patients with COPD and 51,471 (88.5%) without. Patients with COPD were older, more likely to be male, and had higher comorbidity scores compared to non-COPD patients. Interestingly, despite these risk factors, they had a lower incidence and longer time to development of contralateral hip fractures within one year.

The Kaplan–Meier survival curve illustrated the 1-year survival probability of pertrochanteric fracture patients aged over 65 years between patients with COPD and those without (**Figure 2**). This trend demonstrated that patients with COPD have a significantly higher mortality rate than non-COPD patients following pertrochanteric fractures (Log rank test: $p < 0.0001$). After adjusting for sex, age, and CCI score, COPD was significantly associated with increased 1-year mortality following pertrochanteric fracture (AHR: 1.12, 95% CI: 1.06–1.19, $p < 0.0001$). Subgroup analyses also indicated that this association presented similar results across multiple strata. Patients with COPD had higher one-year mortality compared with those without, including males (AHR: 1.13, 95% CI: 1.06–1.21, $p = 0.0003$), females (AHR: 1.12, 95% CI: 1.01–1.23, $p = 0.0261$), patients aged 65–74 years (AHR: 1.26, 95% CI: 1.11–1.42, $p = 0.0003$), patients

Table 1 Baseline Information Between Pertrochanteric Fracture Patients Who Aged Over 65 Years with COPD and Those Without

	Overall (N=58135)	Non-COPD (N=51471)	COPD (N=6664)	p-value
Sex				
Male	21238(36.53)	17035(33.1)	4203(63.07)	<0.0001
Female	36897(63.47)	34436(66.9)	2461(36.93)	
Age group				
65-69	4760(8.19)	4473(8.69)	287(4.31)	<0.0001
70-74	15819(27.21)	14385(27.95)	1434(21.52)	
75-80	13687(23.54)	12064(23.44)	1623(24.35)	
>80	23869(41.06)	20549(39.92)	3320(49.82)	
CCI score, mean±SD	1.56±1.88	1.55±1.87	1.64±1.89	0.0001
CCI group				
0	21813(37.52)	19470(37.83)	2343(35.16)	<0.0001
1-2	22818(39.25)	20159(39.17)	2659(39.9)	
3 more	13504(23.23)	11842(23.01)	1662(24.94)	
Outcome				
Death within 1 year	10375(17.85)	8730(16.96)	1645(24.68)	<0.0001
Time to death, mean±SD	0.36±0.30	0.36±0.30	0.39±0.30	0.0002
Contralateral fractures within 1 year	2472(4.25)	2264(4.4)	208(3.12)	<0.0001
Time to contralateral fractures, mean±SD	0.24±0.28	0.23±0.27	0.29±0.30	0.0088

Abbreviations: COPD, Chronic Obstruction Pulmonary Disease; CCI, Charlson Comorbidity Index; SD, standard deviation.

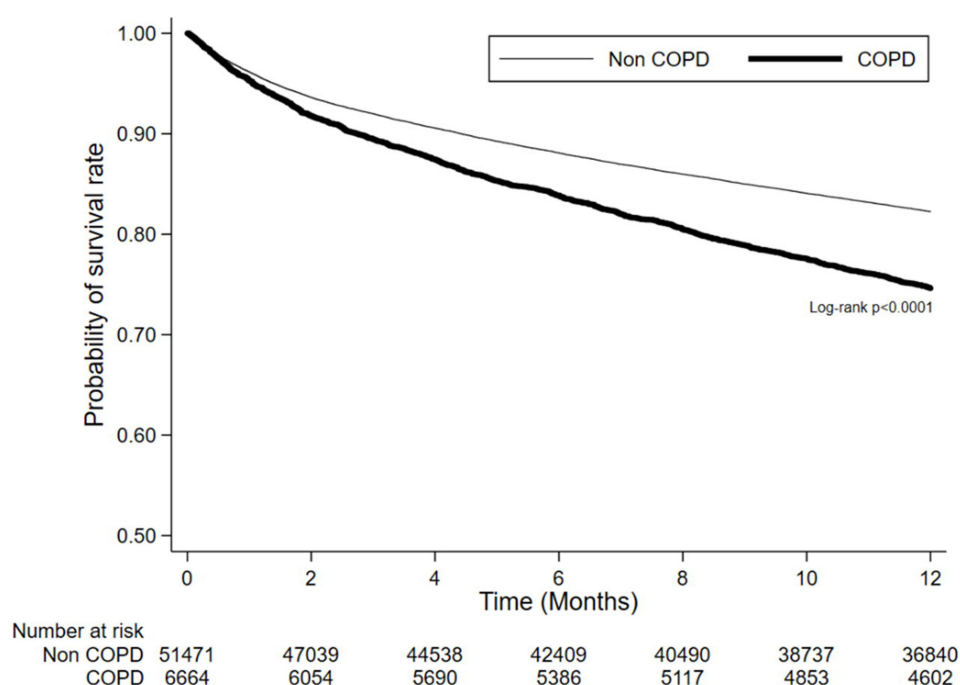


Figure 2 The trend of mortality risk between COPD and non-COPD among patients aged over 65 years with pertrochanteric fractures.

aged more than 75 years (AHR: 1.10, 95% CI: 1.03–1.17, $p=0.0026$), and patients with moderate comorbidity (CCI=1-2, AHR: 1.22, 95% CI: 1.12–1.33, $p<0.0001$). The proportional assumption was not violated due to the assessment of Schoenfeld residuals test ($p>0.05$) (Table 2).

Figure 3 show the cumulative incidence curves of contralateral hip fracture, and it indicated that a lower contralateral hip fracture in COPD patients compared with non-COPD patients (Log rank test, $p<0.0001$). Additionally, patients with

Table 2 Overall and Subgroup Analysis of Mortality Risk Between COPD and Non-COPD Patients Stratified by Sex, Age Groups, and CCI Categories

	COPD		Non-COPD		Crude HR (95% CI)	p-value	AHR* (95% CI)	p-value
	Overall	Death Within 1 Year	Overall	Death Within 1 Year				
Overall	6664	1645(24.68)	51471	8730(16.96)	1.48(1.40–1.55)	<0.0001	1.12(1.06–1.19)	<0.0001
Sub-group								
Sex								
Male	4203	1196(28.46)	17035	3799(22.3)	1.28(1.20–1.37)	<0.0001	1.13(1.06–1.21)	0.0003
Female	2461	449(18.24)	34436	4931(14.32)	1.26(1.14–1.39)	<0.0001	1.12(1.01–1.23)	0.0261
Age group								
65-74	1721	297(17.26)	18858	2051(10.88)	1.59(1.41–1.79)	<0.0001	1.26(1.11–1.42)	0.0003
≥75	4943	1348(27.27)	32613	6679(20.48)	1.35(1.27–1.43)	<0.0001	1.10(1.03–1.17)	0.0026
CCI group								
0	2343	463(19.76)	19470	2601(13.36)	1.49(1.35–1.64)	<0.0001	1.09(0.98–1.20)	0.1054
1-2	2659	685(25.76)	20159	3257(16.16)	1.62(1.50–1.76)	<0.0001	1.22(1.12–1.33)	<0.0001
3 more	1662	497(29.9)	11842	2872(24.25)	1.25(1.13–1.37)	<0.0001	1.04(0.94–1.15)	0.4404

Note: *adjusted by sex, age groups, and CCI groups.

Abbreviations: COPD, Chronic Obstruction Pulmonary Disease; CCI, Charlson Comorbidity Index; HR, hazard ratio; CI, confidence interval.

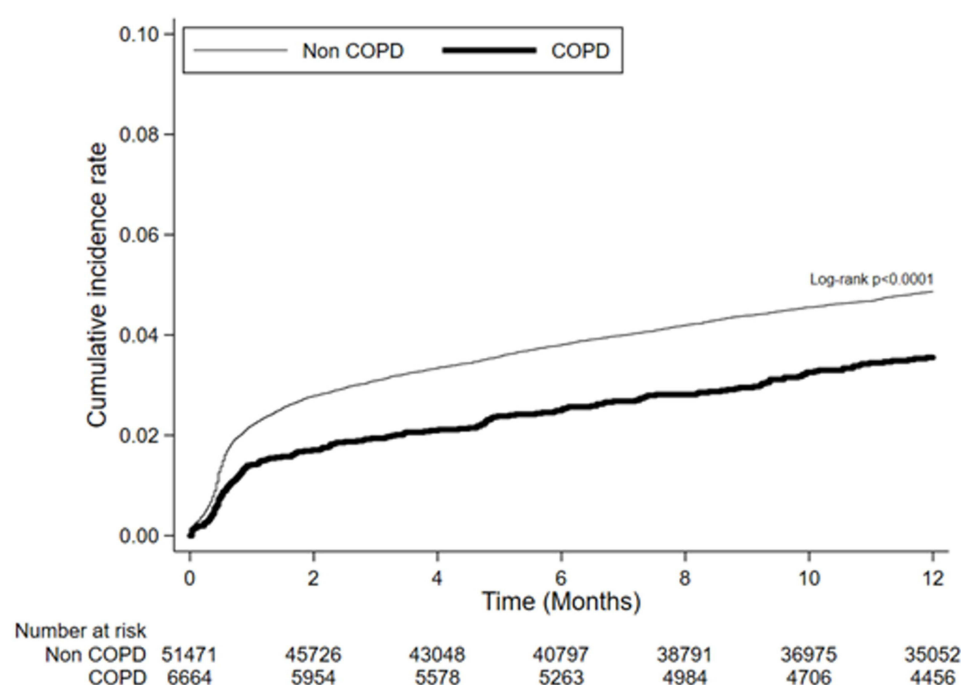


Figure 3 The trend of contralateral fracture risk between COPD and non-COPD among patients aged over 65 years with pertrochanteric fractures.

COPD had a significantly lower 1-year incidence of contralateral hip fracture than non-COPD patients (3.12% vs 4.40%; AHR^{SD}: 0.70, 95% CI: 0.61–0.81, $p < 0.0001$) after considering of death from any cause as competing event and adjusting for sex, age, and CCI score. In the subgroup analysis, sex, age groups, and the classification of CCI score also presented a protective effect of COPD compared with those without, with subdistribution hazard ratios ranging from 0.61 (95% CI: 0.48–0.78) to 0.77 (95% CI: 0.62–0.96) (Table 3).

Discussion

Recovery following hip fracture is often protracted in patients with COPD.²⁴ The presence of respiratory symptoms, particularly exertional dyspnea, can significantly impede early mobilization and limit engagement in postoperative rehabilitation protocols.²⁵ A study by Chen et al identified obstructive pulmonary disease as an independent risk factor for postoperative respiratory failure in elderly patients undergoing hip fracture surgery, highlighting the vulnerability of this patient population to respiratory complications.²⁶ Additionally, research by Tian et al demonstrated that respiratory disease significantly increases the risk of perioperative acute heart failure in older hip fracture patients, underscoring the impact of pulmonary comorbidities on cardiac outcomes.²⁷ Furthermore, a study by Li et al reported that COPD is an independent risk factor for perioperative paroxysmal atrial fibrillation in elderly patients with hip fractures, indicating the complex interplay between pulmonary and cardiac complications in this demographic.²⁸

Our study found that patients with COPD exhibited a higher mortality rate following pertrochanteric fractures compared to those without COPD. The increased mortality observed in COPD patients following pertrochanteric fractures results from a complex interplay of respiratory compromise, systemic inflammation, and multimorbidity that creates substantial perioperative risk. Diminished respiratory reserve predisposes these patients to pulmonary complications including pneumonia and respiratory failure,^{26,29} while the systemic inflammatory nature of COPD impairs wound healing and increases susceptibility to multiorgan dysfunction.^{30,31} The high prevalence of malnutrition in COPD patients further compounds surgical risk, with studies demonstrating up to approximately a 3.7-fold higher one-year post-fracture mortality.³² A population-based cohort study in Denmark found that patients with COPD had a 60–70% increased risk of death after hip fracture compared to those without COPD, with a one-year mortality rate approximately 3–5 times greater than in controls without hip fracture.³³ Similarly, a Japanese nationwide inpatient database study reported that COPD

Table 3 Overall and Subgroup Analysis of Contralateral Fractures Risk Between COPD and Non-COPD Patients Using Competing Risk Model, Stratified by Sex, Age Groups, and CCI Categories

	COPD			Non-COPD			Crude HR ^{SD} (95% CI)	p-value	AHR ^{SD} *(95% CI)	p-value
	Overall	Contralateral Fractures	Death	Overall	Contralateral Fractures	Death				
Overall Sub-group	6664	208(3.12)	1589(23.84)	51471	2264(4.4)	8413(16.35)	0.69(0.60–0.80)	<0.0001	0.70(0.61–0.81)	<0.0001
Sex										
Male	4203	137(3.26)	1158(27.55)	17035	702(4.12)	3670(21.54)	0.78(0.65–0.93)	0.0066	0.76(0.63–0.92)	0.0037
Female	2461	71(2.89)	431(17.51)	34436	1562(4.54)	4743(13.77)	0.62(0.49–0.79)	<0.0001	0.61(0.48–0.78)	<0.0001
Age group										
65-74	1721	52(3.02)	286(16.62)	18858	771(4.09)	1977(10.48)	0.73(0.55–0.96)	0.0242	0.74(0.56–0.98)	0.0366
≥75	4943	156(3.16)	1303(26.36)	32613	1493(4.58)	6436(19.73)	0.67(0.57–0.79)	<0.0001	0.69(0.58–0.81)	<0.0001
CCI group										
0	2343	71(3.03)	444(18.95)	19470	881(4.52)	2513(12.91)	0.65(0.51–0.83)	0.0005	0.65(0.51–0.83)	0.0006
1-2	2659	88(3.31)	665(25.01)	20159	861(4.27)	3137(15.56)	0.76(0.61–0.94)	0.0129	0.77(0.62–0.96)	0.0210
3 more	1662	49(2.95)	480(28.88)	11842	522(4.41)	2763(23.33)	0.66(0.49–0.88)	0.0047	0.67(0.50–0.90)	0.0076

Note: *adjusted by sex, age groups, and CCI groups. Using competing risk analysis.

Abbreviations: COPD, Chronic Obstruction Pulmonary Disease; CCI, Charlson Comorbidity Index; HR, hazard ratio; CI, confidence interval.

patients with hip fractures had an in-hospital mortality rate of 7.4%, higher than that of COPD patients with other types of fractures.¹⁴ Surgical treatment was associated with lower mortality compared to conservative treatment.¹⁴ In addition to COPD, several factors such as advanced age, higher comorbidity burden, and male sex have been associated with increased post-hip fracture mortality.^{34,35} Consistently, our subgroup analyses demonstrated higher mortality association among these groups in this study.

Interestingly, the analysis revealed a significantly lower rate of contralateral hip fractures among patients with COPD. Several factors may contribute to this finding. First, increased post-fracture mortality in COPD patients may reduce the time window during which a subsequent fracture could occur. Second, in light of the established association between COPD and osteoporosis,³⁶ patients with COPD may be more likely to receive targeted secondary prevention measures, including pharmacologic interventions and structured fall prevention strategies. Third, COPD-related functional limitations, including reduced mobility due to dyspnea, may lead to early adoption of assistive devices and greater avoidance of high-risk activities, thereby decreasing fall risk.^{37,38}

This study presented the evidence of the association between COPD and hip fracture outcomes using population-based data from Taiwan. Furthermore, our findings demonstrate that COPD was independently associated with increased post-fracture mortality and a lower risk of contralateral hip fracture in elderly patients with COPD. The paradoxical finding of reduced contralateral hip fracture rates among COPD patients likely reflects the competing risk of mortality, where patients succumb to complications before experiencing subsequent fractures. These findings highlight the critical importance of identifying COPD as a high-risk comorbidity in hip fracture management protocols. Mitigating the fall risk in COPD patients necessitates a multifactorial strategy that focuses on three key areas: first, implementing pulmonary rehabilitation centered on targeted balance and strength training;³⁹ second, conducting systematic medication reviews to reduce the burden of fall-risk increasing drugs;⁴⁰ third, optimizing co-morbidities alongside environmental modifications to prevent injurious falls. Clinicians should prioritize comprehensive risk stratification for COPD patients presenting with hip fractures. Evidence emphasizes the importance of early surgery,⁴¹ careful optimization of COPD and comorbidities, multimodal pulmonary care and analgesia, early mobilization, and the adoption of orthogeriatric multidisciplinary care models.⁴² Strategies aimed at improving bone health and preventing future fractures are equally important for long-term outcomes in this vulnerable population.

Several limitations should be considered in this study. First, this retrospective cohort study used claims data from the NHIRD, so the accuracy of diagnoses depended on ICD-10-CM coding may have potential misclassification or over-diagnosis bias. However, the spirometry test may be generally used by healthcare facilities, especially for elderly hospitalized patients. Therefore, the study likely captured the majority of COPD cases diagnosed within the healthcare system, although some underdiagnosis in outpatient cannot be excluded. Second, the database lacked detailed clinical information, including of smoking history, body mass index, pulmonary function test results, the use of home oxygen therapy, history of hip replacement, the presence of physical disability, and laboratory parameters. The absence of these variables may have limited the adjustment for all potential confounders in the statistical analysis. Third, the severity of COPD, such as GOLD stage, which is typically categorized based on post-bronchodilator FEV1, could not be directly assessed in this study. Additionally, the frequency and severity of acute exacerbations of COPD (AECOPD) could not be assessed due to this information was unavailable in the claims database. Since AECOPD episodes may affect post-operative outcomes and mortality risk,^{43,44} future studies should include the related clinical data to further evaluate this association. Finally, since only hospitalized patients with COPD were included in this study, the possibility of selection bias cannot be excluded. Despite these limitations, the large sample population and standardized data collection in the NHIRD still could show the generalizability of our results.

Conclusions

Elderly patients with COPD and hip fractures show higher peri operative and one-year mortality. Considering of pre operative evaluation, including spirometry, symptom assessment, and pulmonary rehabilitation, coupled with timely surgical intervention and multidisciplinary orthogeriatric care, can reduce complications and improve survival. Future research should focus on developing targeted interventions to improve survival outcomes in this vulnerable population. These findings provide essential evidence for evidence-based guidelines in managing hip fractures among patients with chronic obstructive pulmonary disease.

Ultimately, this research emphasizes the imperative for personalized medicine approaches that consider the complex interaction between COPD and orthopedic outcomes.

Data Management and Sharing

The data have been sourced from the Taiwan Nation Health Insurance Database and Taiwan Cancer Registry. The data are available with permission from the Taiwan Health and Welfare Data Science Centre: <https://dep.mohw.gov.tw/DOS/cp-5119-59201-113.html> (accessed 10 August 2025). Restrictions apply to the availability of these data, which were used under license for this study.

Ethics Approval and Consent to Participate

This study was conducted in compliance with the ethical standards and guidelines of the 2013 revision of the Declaration of Helsinki and the International Ethical Guidelines for Health-related Research Involving Humans developed by the Council for International Organizations of Medical Sciences (CIOMS) in collaboration with the World Health Organization. The study protocol was approved by the Institutional Review Board of Chi Mei Medical Centre (IRB: 11407-013). Informed consent was also waived by the Institutional Review Board of Chi Mei Medical Centre owing to the use of secondary data and the absence of personal information in the study.

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Disclosure

The authors report no conflicts of interest in this work.

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