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Relationship between acute kidney injury and mortality in patients with chronic obstructive pulmonary disease; a systematic review and meta-analysis

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ABSTRACT

Introduction: Chronic obstructive pulmonary disease (COPD) is recognized as the third leading cause of death globally. On the other hand, patients with COPD who have comorbidities have increased length of hospital stay, mortality, and healthcare costs. Therefore, the aim of this study was to investigate the association between acute kidney injury (AKI) and mortality risk in patients with COPD.

Materials and Methods: This study was designed the assistance of the PRISMA guideline. To achieve this, data were searched and collected from Cochrane, Scopus, Web of Science, Embase, and PubMed databases, as well as the Google Scholar search engine, up to January 1, 2026. The authors used STATA 14 software for statistical analysis of the data.

Results: In general, higher mortality rates are observed in patients with AKI and COPD compared to patients with COPD without AKI (OR: 3.30, 95% CI: 2.40, 4.53). In China (OR: 4.13, 95%: 1.72, 9.94), UK (OR: 1.80, 95% CI: 1.60, 2.02), USA (OR: 2.36, 95% CI: 2.12, 2.63), and Italy (OR: 3.85, 95% CI: 2.87, 5.15), patients with COPD and AKI had higher mortality compared to patients with COPD and without AKI. Additionally, the risk of mortality in patients with COPD and AKI whose mean age was less than 75 years (OR: 2.09, 95% CI: 1.67, 2.62) was lower than in patients who were 75 years or older (OR: 2.91, 95% CI: 1.80, 4.71).

Conclusion: Patients with AKI and COPD face higher mortality rates than patients without AKI, and these rates rise with increasing age. Geographically, the highest mortality rate was reported in China.

Registration: This study has been compiled based on the PRISMA checklist, and its protocol was registered on the PROSPERO (ID: CRD420261294995).

Meta-analysis

Implication for health policy/practice/research/medical education:
Patients with chronic obstructive pulmonary disease (COPD) who developed acute kidney injury (AKI) had a higher risk of mortality compared to those without AKI. This finding suggests that AKI can significantly worsen the condition of COPD patients.

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Introduction

Chronic obstructive pulmonary disease (COPD) is recognized as the third leading cause of death globally. Approximately 400 million people worldwide are affected by COPD—a common respiratory disease (1). In 2019, the World Health Organization (WHO) reported that 213.23 million people globally have COPD, with 3.3 million deaths attributed to the disease, accounting 6% of all global deaths (2). Of course, the of COPD varies across different of the world: from 5% to 17% (3).

Acute exacerbation of COPD increases morbidity and mortality (4-6). On the other hand, mortality, hospital stay duration, and healthcare costs for patients with COPD with comorbid conditions rise (7). One of the major healthcare challenges includes chronic kidney disease (CKD) with a global prevalence of 9.5% (8). CKD, as a

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progressive kidney disease, causes a decrease in kidney function in people, which then leads to end-stage renal disease, in which patients with end-stage kidney failure also require dialysis or a kidney transplant for treatment (9). Another of these diseases is acute kidney injury (AKI). During AKI, kidney function declines rapidly within a few hours or days (10). Acute kidney injury has a high clinical burden, with patient mortality being one of these (11,12), Various studies have shown that patients hospitalized for acute exacerbation of COPD with AKI had higher mortality compared to patients without AKI (12,13).

Objectives

The current study aimed to investigate the relationship between AKI and mortality in COPD patients.

Materials and Methods

Study design

This meta-analysis study evaluated the relationship between AKI and mortality in COPD patients, and its review protocol, developed in accordance with the PRISMA guidelines (14), was registered in the PROSPERO (International Prospective Register of Systematic Reviews) website.

Search strategy

The Cochrane, Scopus, Web of Science, Embase, and PubMed databases, as well as the Google Scholar search engine, were systematically searched up to January 1, 2026, without restrictions on time or geographical location. The search was conducted using keywords such as 'COAD', 'acute kidney injury', 'COPD', 'acute renal injury', 'chronic obstructive pulmonary diseases', and 'chronic airflow obstruction'. Boolean operators (AND, OR) were applied to combine terms and enhance the sensitivity and specificity of the search. Additionally. Manual searching was performed by screening the reference lists of the included studies (See Supplementary file 1).

PECO Framework

- **Population:** Studies that investigated the relationship between AKI and mortality in COPD patients.
- **Exposure:** People with AKI.
- **Comparison:** Patients without AKI.
- **Outcomes:** Mortality in patients with COPD.

Inclusion and exclusion criteria

This review includes articles that assessed the relationship between AKI and mortality in patients with COPD. Studies were excluded if they did not provide sufficient data for quantitative synthesis, were published in non-credible or non-peer-reviewed sources, appeared as duplicate records, failed to meet the required quality standards during appraisal, case report studies, review studies, or were presented for which full-text access could not be obtained despite contacting the authors were excluded.

Quality assessment

Two researchers independently assessed the methodological quality of the studies. They used the Newcastle-Ottawa Scale (NOS) to do this (15). This instrument consists of nine criteria, each evaluated through a star-based scoring system. Studies earning six or more stars were considered to have sufficient methodological robustness and were therefore eligible for inclusion in this article.

Data extraction

Two researchers designed a form in consultation with each other and, based on the same form, extracted data from the articles separately such as the first author's name, study location and year, Total number of participants, study design, comparison group, effect estimates related to the mortality in COPD patients associated with AKI, participants' age, and other relevant clinical or methodological variables.

Statistical analysis

For the quantitative synthesis, the logarithm of the hazard ratio (HR), risk ratio (RR), and odds ratio (OR) were used to harmonize effect estimates across articles. Fixed-effects and random-effects models were used for low heterogeneity and moderate to high heterogeneity, respectively. The authors used STATA 14 software for statistical analysis of the data. Additionally, for each statistical test, if the *P* value was less than 0.05, it was considered significant.

Results

After completing the search process, 871 references were found. Of these, 435 references that were repeatedly indexed in different databases and were considered duplicates were removed. In the screening phase, 436 articles were reviewed and 193 of them were removed based on the review of abstract information. The full text of a further 243 articles was evaluated, but access to 17 of them was not possible, leaving 226 articles, of which 218 were removed based on other exclusion criteria (Figure 1). In total, 613,168 participants were assessed in eight observational studies, the details of which are presented in Table 1.

Primary outcome

Among patients with COPD, those with AKI experienced a higher mortality rate compared to patients without AKI (OR: 3.30, 95% CI: 2.40, 4.53). This finding suggests that AKI significantly increases the risk death in COPD patients (Figure 2).

Subgroup analysis

In patients with COPD, those with AKI had higher mortality rates compared to without AKI in China (OR: 4.13, 95% CI: 1.72, 9.94), UK (OR: 1.80, 95% CI: 1.60,

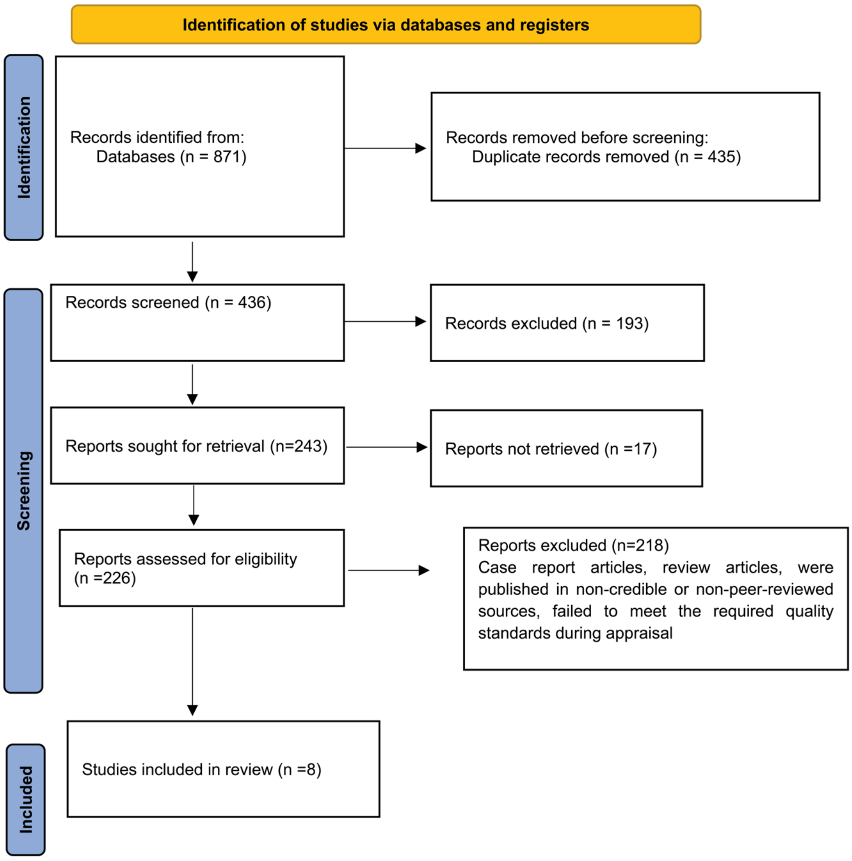

Figure 1. The PRISMA flowchart of study selection.

202), the USA (OR: 2.36, 95% CI: 2.12, 2.63), and Italy (OR: 3.85 95% CI: 2.87, 5.15). Therefore, the highest mortality rates observed in China, Italy, USA, and UK, respectively (Figure 3).

In terms of age, mortality rates increased in patients below the age of 75 (OR: 2.09, 95% CI: 1.67, 2.62) and in patients aged 75 and above (OR: 2.91, 95% CI: 1.80, 4.71). The above results demonstrated that with increasing age in COPD patients, the risk of mortality in patients with AKI was higher compared to patients without AKI (Figure 4).

Table 1. Basic information about the articles reviewed

References	Country	Duration of study	Sample size	Mean age (year)	Patients	Risk of mortality	Low limit	Up limit
Barakat MF, 2015 (13)	UK	2004-2012	189561	64	AKI	1.80	1.61	2.03
Wan X, 2020 (16)	China	between Jan 2014 and Jan 2017	1768	77	AKI stage 1	1.92	1.11	3.33
					AKI stage 2	2.14	1.16	3.96
					AKI stage 3	6.06	3.46	10.62
Chen D, 2021 (17)	China	January 2014 to Jan 2017	1647	78	AKI	8.99	3.58	22.55
Chi C, 2025 (18)	USA	between 2008 and 2019	2609	72.7	AKI	2.07	1.6	2.69
Fabbian F, 2016 (11)	Italy	between Jan 1, 2000 and Dec 31, 2013	7073	76.7	AKI	3.84	2.87	5.15
Wang X, 2020 (19)	China	between Jan 2011 and Sep 2016	2897	75.29	Community-acquired AKI	2.50	1.24	5.03
					Hospital-acquired AKI	21.59	14.95	31.19
Morcos Z, 2025 (20)	USA	from 1 Jan 2016 to 1 Jan 2021	405845	69.97	AKI	2.41	2.29	2.54
Cao CC, 2018 (12)	China	from Jan 2014 to Jan 2017	1768	77	Hospital-acquired AKI	1.70	1.03	2.81

AKI: Acute kidney injury.

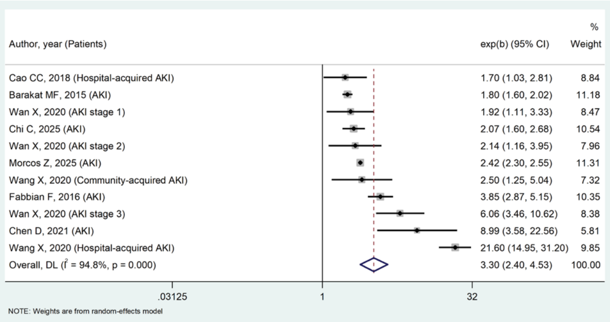

Figure 2. Forest plot showing the association between AKI and risk of mortality in patients with COPD.

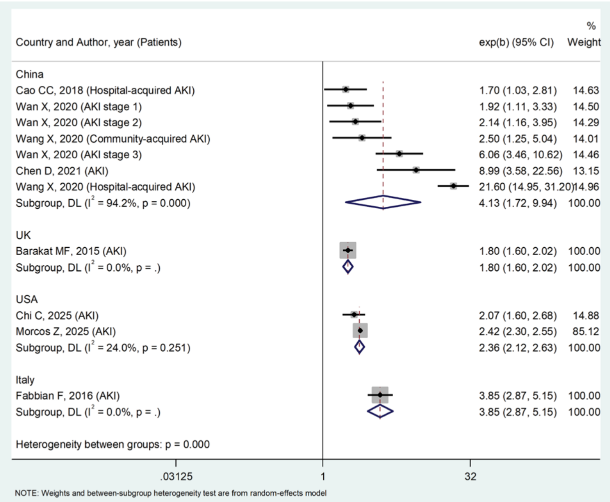

Figure 3. Forest plot showing the association between AKI and risk of mortality in patients with COPD by country.

Secondary outcome

Figure 5 shows that in COPD patients, the mortality rate in those with CKD was not significantly different from those without CKD (OR: 1.14, 95% CI: 0.95, 1.36). Thus, presence of CKD as a comorbidity does not increase the risk of mortality COPD patients.

Additional analysis

The meta-regression diagram showed that the mortality rate of COPD patients with AKI did not show a significant increase over the last 10 years (P = 0.946) (Figure 6).

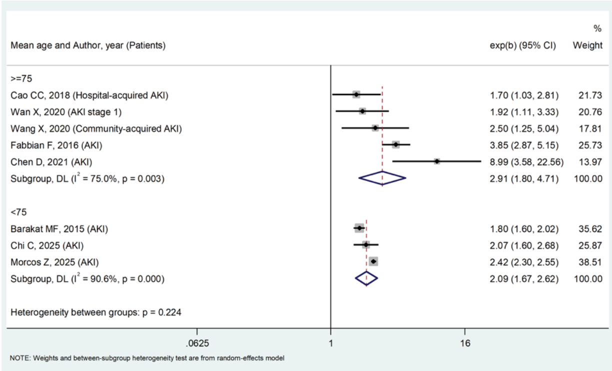

Figure 4. Forest plot showing the association between AKI and risk of mortality in patients with COPD by mean age.

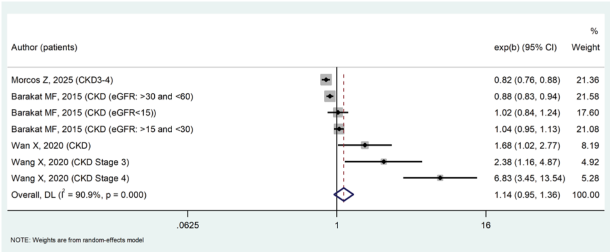

Figure 5. Forest plot showing the association between CKD and risk of mortality in patients with COPD.

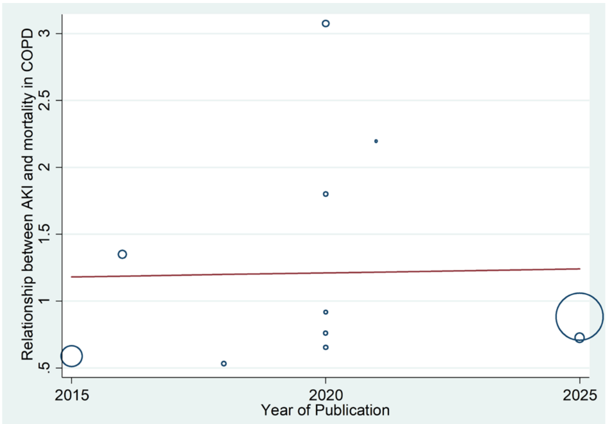

Figure 6. Meta-regression plot of the association between AKI and risk of mortality in patients with COPD by year of publication.

Discussion

In this meta-analysis, the mortality risk among patients with both COPD and AKI was three times higher than those without AKI. In addition, in reviewing the studies in this meta-analysis, we concluded that the highest mortality rates in COPD patients with AKI were reported in China, Italy, the United States, and the United Kingdom, respectively. Therefore, the Chinese were at higher risk of death than other countries. Also, the older the patients, the higher the risk of death.

According to the meta-analysis study by Charkviani et al, patients with acute respiratory distress syndrome and AKI had a higher in-hospital mortality rate than patients without AKI (RR: 1.93, 95% CI: 1.71, 2.18) (21). In another meta-analysis conducted by Xing and colleagues' results showed that AKI is a poor prognostic factor (OR: 2.75, 95% CI: 2.45,3.08) and doubles the mortality of patients with pulmonary embolism. However, CKD was not a poor prognostic factor in these patients (OR: 1.94, 95% CI: 0.99, 3.81) (22). The impact of kidney disease on mortality among patients with respiratory infections was examined by Su et al, in a meta-analysis study. The results showed that mortality from any cause in kidney patients is twice as high as in those without kidney disease. (RR: 1.96, 95% CI: 1.48, 2.59) (23). The previous meta-analysis by Hansrivijit et al showed that the presence of AKI, in COVID-19 patients significantly increases mortality rates (OR: 13.33, 95% CI: 4.05, 43.91) (24). The results of the meta-analysis by Ning et al suggest that AKI in patients with cirrhosis increases in-hospital mortality risk (OR: 5.92, 95% CI: 4.10, 8.57) and 90-day mortality risk (OR: 4.34, 5% CI: 3.16, 5.97) (25). According to the meta-analysis conducted by Pickering and colleagues on patients with acute coronary syndrome, mortality in patients with AKI was higher than in patients without AKI (RR: 4.1, 95% CI: 3.3, 5.0) (26). In another meta-analysis study by Pickering et al, a significant association was found between AKI related to cardiac-pulmonary bypass and early mortality (RR: 4.0, 95% CI: 3.1, 5.2) (27). The above studies were consistent with the current study in terms of study type and the results of the above studies confirmed the results of the current study. Because in our study, AKI was also a risk factor for increasing the risk of mortality in patients with COPD. However, there was no significant association between CKD and the risk of mortality in patients with COPD.

In a cohort study by Morcos et al, the association between AKI and mortality in patients with COPD exacerbation was investigated. The results showed that AKI significantly increased mortality risk in these patients (OR: 2.41, 95% CI: 2.29, 2.54) (20). A cohort study by Chi and colleagues revealed that in patients with COPD who developed AKI, the 30-day mortality rate from any cause was higher. These findings suggest that AKI may pose more significant risks to COPD patients (HR: 2.07, 95% CI: 1.60, 2.69) (18). The cohort study by Chen et al showed that AKI increases in-hospital mortality risk in patients with acute exacerbation of COPD (OR: 39.13, 95% CI: 17.02, 89.97) (17). Additionally, the study conducted by Fabbian and colleagues demonstrated the impact of AKI on in-hospital mortality among patients with COPD. The results indicated that AKI acts as a predictor of mortality in elderly patients with multiple comorbidities. The study suggests that focusing on renal status alongside the management of respiratory diseases can help improve treatment outcomes and reduce mortality in this patient group (OR: 3.84, 95% CI: 2.87, 5.15) (11). Moreover, the cohort study conducted by Barakat et al showed that patients who experienced both COPD exacerbation and AKI simultaneously had a 1.80-fold (RR: 1.80, 95% CI 1.61, 2.03) increased adjusted mortality risk in the first six months after exacerbation (13). The studies conducted were consistent with the current research. In this study, by combining the results of various observational studies, it was found that patients with COPD who had AKI experienced higher mortality rates.

Conclusion

Patients with COPD who developed AKI had a higher risk of mortality compared to those without AKI. This finding suggests that AKI can significantly worsen the condition of COPD patients. Based on findings, AKI is recognized as a significant risk factor in increasing mortality rates of patients with COPD. With increasing age, the mortality rate of patients with COPD accompanied by AKI is also on the rise. This finding indicates that advanced age is one of the risk factors for this disease and its complications. In this analysis, China showed the highest mortality rate based on location. Therefore, there may be a relationship between the nationality of the patients and their increased mortality, which requires further investigation, as the number of studies reviewed was small.

Limitations of the study

In this study, we faced several limitations: the number of studies examined was limited, analysis of results based on gender was not possible, and the published studies did not have sufficient geographic diversity.

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Authors' contribution

Conceptualization: Zahra Habibi Dastenae.
Data curation: Zahra Habibi Dastenae, Parisa Javadian.
Formal analysis: Parisa Javadian.
Investigation: Parisa Javadian.
Methodology: Zahra Habibi Dastenae.
Project administration: Zahra Habibi Dastenae.
Resources: Parisa Javadian.
Supervision: Zahra Habibi Dastenae, Parisa Javadian.
Validation: Zahra Habibi Dastenae, Parisa Javadian.
Visualization: Zahra Habibi Dastenae, Parisa Javadian.
Writing–original draft: Zahra Habibi Dastenae, Parisa Javadian.
Writing–review & editing: Zahra Habibi Dastenae, Parisa Javadian.

Conflicts of interest

The authors declare that they have no competing interests.

Ethical issues

This study has been compiled based on the PRISMA checklist, and its protocol was registered on the PROSPERO website (ID: CRD420261294995). Besides, ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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None.

Supplementary files

Supplementary file 1 includes the search strategies used in Cochrane, Scopus, Embase, and PubMed databases.

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