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Acute Kidney Injury in COVID-19 Patients: A Meta-Review of Systematic Studies

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Abstract

The global impact of the COVID-19 pandemic has been widespread, and acute kidney injury (AKI) is a significant risk among individuals infected with SARS-CoV-2. This systematic review combines the findings of several systematic reviews on the incidence of AKI in COVID-19 patients. The review adhered to the PRISMA guidelines and conducted an extensive search of databases, including OVID, the Cochrane Library, EMBASE, ProQuest, PubMed, ScienceDirect, Scopus, and Web of Science until March 17, 2021. A random-effects meta-analysis was used to assess the overall prevalence of AKI and its associated mortality, with a 95% confidence interval. Out of the studies analyzed, 15 systematic reviews were included, including 265,162 patients. A total of 24,277 (9.15%) COVID-19 patients experienced AKI. The random-effects model showed that the overall incidence of AKI in these patients was 1% (95% CI: 1%-2%, $I^2 < 1\%$, $P < 0.001$). The AKI-associated mortality was 64% (95% CI: 44%-83%, $I^2 = 99.32\%$, $P < 0.001$). These results suggest that AKI is a frequent complication among COVID-19 patients. Early diagnosis and treatment of AKI and its underlying causes should be a priority in the management of patients with COVID-19-associated AKI.

Keywords: COVID-19, Kidney disease, AKI, Systematic review, Renal failure

Introduction

Coronaviruses are a type of single-stranded RNA virus known to cause various infections in humans and animals [1]. The emergence of COVID-19 led to widespread global disruption [2]. Clinical comparisons indicate that individuals infected with SARS-CoV-2 often develop pneumonia-like symptoms accompanied by diffuse alveolar damage, which can progress to acute respiratory distress syndrome (ARDS). Common early symptoms include fever, cough, and fatigue, while additional manifestations such as dyspnea, diarrhea, hemoptysis, sputum production, and lymphopenia have also been reported [3].

Transmission of SARS-CoV-2 occurs primarily through direct contact with an infected individual or indirectly via respiratory droplets expelled during coughing or sneezing [4]. Additionally, touching contaminated surfaces with a sufficient viral load can lead to infection [5].

COVID-19 has been shown to affect multiple organs, including the liver, kidneys, and gastrointestinal system [6]. Studies suggest that factors such as advanced age, obesity, and pre-existing medical conditions may contribute to higher mortality rates among infected individuals [6].

Individuals with weakened immune systems, such as HIV patients, pregnant women, the elderly, diabetics, and those on long-term immunosuppressive therapy, are more susceptible to coronavirus infections, often leading to multi-organ complications [7]. SARS-CoV-2 infection

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significantly increases the likelihood of developing acute kidney injury [8]. While the precise mechanism behind COVID-19-associated AKI remains unclear, it is thought to be linked to multi-organ failure and shock, which can trigger acute tubular necrosis [8]. Indicators of AKI in COVID-19 patients include high blood urea nitrogen (BUN), increased baseline serum creatinine, hematuria, and proteinuria [9].

Renal replacement therapy (RRT) is frequently used in cases of acute kidney injury and has proven effective in lowering inflammatory cytokine levels [10]. Research indicates that AKI commonly develops in COVID-19 patients during hospitalization, with a higher prevalence among critically ill individuals or those with pre-existing health conditions. A cohort study involving 99 critically ill COVID patients found that 42.9% developed AKI, with most cases classified as KDIGO stage III AKI [11]. Additionally, a study on hospitalized patients in New York City revealed that COVID-19 patients had a greater likelihood of AKI, along with an increased need for intensive care, mechanical ventilation, and renal replacement therapy, compared to non-COVID-19 patients [12]. Clinical findings suggest that AKI is an independent risk factor for mortality in COVID-19 cases [13]. Studies have also reported that seriously ill AKI patients with coronavirus face a heightened risk of death, with mortality rates ranging between 8% and 23% [14, 15].

Research has shown that COVID-19 patients with acute kidney injury (AKI) face significantly high in-hospital mortality rates, with 62% for stage I, 77% for stage II, and 80% for stage III AKI cases [16]. A systematic review of systematic reviews offers a comprehensive perspective on pre-existing evidence, allowing for a more extensive examination of key problems related to the subject [17, 18]. These reviews play a crucial role in evidence-based decision-making, as they are considered a high level of compiled evidence [19, 20].

The growing number of systematic and general reviews in the healthcare field has made them an important part of modern research [21]. However, the rapid increase in published reviews has also resulted in an overwhelming volume of information, making it challenging for clinicians and policymakers to identify and extract relevant findings [22-24]. Given the variability in scope and quality among reviews, a systematic review of systematic reviews is essential for synthesizing and comparing findings from multiple sources. This approach ensures that critical insights are consolidated into a single, comprehensive document, facilitating informed decision-making [17, 25].

Numerous systematic reviews have examined the AKI in COVID-19 patients. However, there remains a need for a comprehensive summary that can assist clinicians in promptly recognizing symptoms and clinical patterns that contribute to renal failure in these patients. Given the abundance of systematic reviews on this subject, the logical next step is to consolidate and analyze the existing research.

This study is driven by the necessity to summarize a systematic review of systematic reviews, bringing together all available evidence on the occurrence of AKI in COVID-19 patients since the beginning of the pandemic. By compiling and structuring this information, this review aims to equip healthcare professionals and decision-makers with a well-organized resource that can support more informed clinical and policy decisions.

Materials and Methods

This review was conducted following the PRISMA guidelines [26].

Search strategy

A structured and thorough electronic search was performed across multiple academic databases, including ScienceDirect, OVID, Cochrane Library, Scopus, EMBASE, ProQuest, PubMed, and Web of Science. The search covered all relevant studies available up to March 17, 2021.

The search key terms included combinations of key phrases such as “COVID-19” AND “Acute Kidney Injury” AND “Systematic Reviews,” “SARS-CoV-2” AND “Acute Kidney Injury” AND “Systematic Reviews,” “COVID-19” AND “AKI” AND “Systematic Reviews,” “SARS-CoV-2” AND “AKI” AND “Systematic Reviews,” “COVID-19” AND “Kidney” AND “Systematic Reviews,” “SARS-CoV-2” AND “Kidney” AND “Systematic Reviews,” “COVID-19” AND “Renal Diseases” AND “Systematic Reviews,” and “SARS-CoV-2” AND “Renal Diseases” AND “Systematic Reviews”. These terms were used in different combinations to ensure a comprehensive retrieval of relevant studies.

Data extraction

Two researchers individually searched the data, and any discrepancies were resolved through consensus. The primary focus of data extraction was the incidence of acute kidney injury in coronavirus patients. To systematically skim titles and abstracts before selecting full-text articles, the PICOS framework was applied:
Patient: Only individuals diagnosed with COVID-19
Intervention: Need for renal replacement therapy (RRT)
Control: COVID-19 patients who did not develop AKI
Outcome: Survival or mortality due to AKI
Study Type: Systematic reviews, including meta-analysis
Predetermined inclusion and exclusion criteria were used to ensure consistency in the selection process.

Eligibility criteria

The study included systematic reviews that were about the incidence of AKI among COVID-19 patients. However, articles such as abstracts, letters, interim reports, case reports, and general reviews were not considered. Additionally, studies that lacked significant clinical data on AKI incidence or presented challenges in data extraction were excluded from the review.

Quality assessment

The selected studies underwent qualitative evaluation using a measurement tool to assess systematic reviews 2 [27]. This tool consists of 16 assessment questions that classify reviews based on critical and non-critical domains, determining the overall confidence in their findings.
A review was rated as “high confidence” if it exhibited one or no not-critical weaknesses.
It was deemed “moderate confidence” if there were no critical weaknesses but multiple non-critical ones.
“Low confidence” was assigned if a review had at least one critical weakness, regardless of non-critical weaknesses.
A review was categorized as “critically low confidence” if it contained multiple critical weaknesses, regardless of the number of non-critical weaknesses.

Data analysis

A descriptive approach was used to analyze the extracted data. Categorical variables were summarized using percentages and counts. A random-effects meta-analysis was conducted to determine the overall incidence of AKI in COVID-19 patients and the associated mortality rates, with 95% confidence intervals.
To evaluate statistical heterogeneity among the systematic reviews, I^2 statistics were applied:
$I^2 < 25\%$: Insignificant heterogeneity
$25\% \leq I^2 \leq 50\%$: Low heterogeneity
$50\% \leq I^2 \leq 75\%$: Moderate heterogeneity
$I^2 > 75\%$: High heterogeneity [28, 29]
A random-effects model (REM) was used when heterogeneity exceeded 50% [29]. Statistical significance for this study was set at $P < 0.05$.

Results and Discussion

Study Characteristics

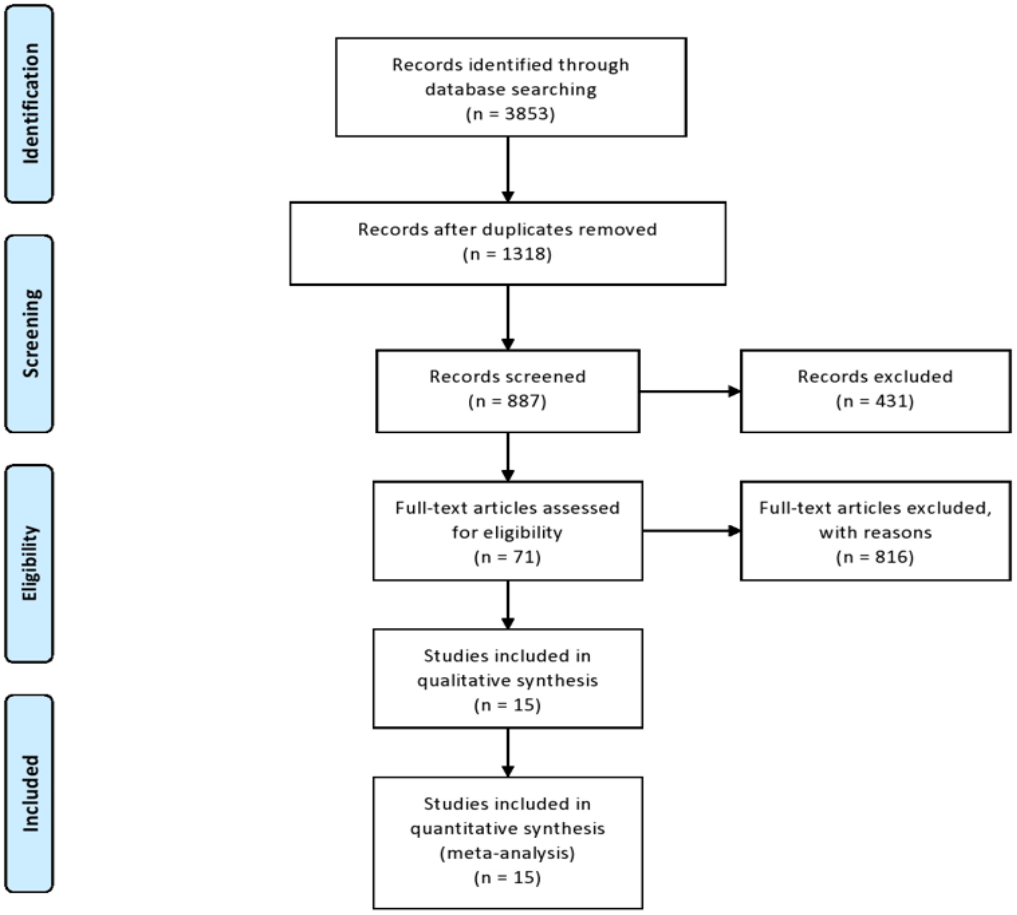

Figure 1. PRISMA chart showing selection criteria of systematic reviews on the incidence of AKI in COVID-19 patients

Table 1. General characteristics of the 15 systematic reviews on the incidence of AKI in COVID-19 patients

Authors	Publication date	No. of articles	No. of patients	Study period	Types of studies	Comorbidities	Subgroup analysis	Reference
Fabrizi *et al.*	15 December 2020	39	25566	1 December 2019 to 30 June 2020	Systematic review and meta-analysis	Yes	Yes	[30]
Bajwa *et al.*	15 June 2020	5	1098	1 December 2019 to 13 April 2020	Systematic review	Yes	Yes	[31]
Bennett *et al.*	23 September 2020	45	14358	-	Systematic review	Yes	No	[32]
Chan *et al.*	27 May 2020	21	3714	Up to 8 April 2020	Systematic review and meta-analysis	No	No	[33]
Fu *et al.*	2 September 2020	142	49048	1 December 2019 to 29 May 2020	Systematic review and meta-analysis	No	Yes	[34]
Imam *et al.*	24 July 2020	21	58	Up to 6 May 2020	Systematic review	Yes	No	[35]
Lin *et al.*	10 November 2020	79	49692	1 January 2020 to 15 May 2020	Systematic review and meta-analysis	No	Yes	[36]
Oliveira *et al.*	9 October 2020	21	15536	Up to 25 May 2020	Systematic review and meta-analysis	Yes	Yes	[37]

Potere *et al.*	2 July 2020	44	14866	Up to 20 April 2020	Systematic review and meta-analysis	Yes	Yes	[38]
Shao *et al.*	31 July 2020	40	24527	Up to 20 June 2020	Systematic review and meta-analysis	Yes	Yes	[39]
Xu *et al.*	5 February 2021	22	16199	1 January 2020 to 1 June 2020	Systematic review and meta-analysis	No	Yes	[40]
Yang *et al.*	18 June 2020	24	4963	December 2019 to May 2020	Systematic review and meta-analysis	No	Yes	[41]
Yang *et al.*	3 November 2020	51	21531	Up to 25 July 2020	Systematic review and meta-analysis	No	Yes	[42]
Zheng *et al.*	4 September 2020	25	10554	Up to 30 July 2020	Systematic review and meta-analysis	No	Yes	[43]
Zhou *et al.*	30 November 2020	58	13452	Up to 16 June 2020	Systematic review and meta-analysis	No	Yes	[44]

The initial search **(Figure 1)** yielded a total of 3,853 articles. After removing duplicated articles and skimming titles and abstracts, only 71 articles met the eligibility criteria for full-text review, as outlined in the PRISMA flowchart. After conducting a thorough full-text analysis, a total of fifteen reviews **(Table 1)** were deemed suitable for inclusion, representing 265,162 COVID-19 patients.

The systematic reviews incorporated data from various study designs, including observational studies, clinical trials, retrospective and prospective cohort studies, case reports, case series, and cross-sectional studies. A significant portion of these reviews focused on patient populations from China, while a smaller number included data from patients in other countries. The primary objective of these reviews was to analyze the incidence of AKI in COVID-19 patients.

All authors unanimously agreed on the final selection of studies, adhering strictly to the predefined eligibility criteria for inclusion and exclusion.

Using the AMSTAR-2 tool, most of the reviews were classified under the "critically low" confidence category due to multiple critical weaknesses in addressing essential study domains. Additionally, three reviews were categorized as "low confidence" as they failed to meet one critical domain requirement.

Only one study achieved a "high confidence" rate as it successfully addressed all critical and non-critical domains, making its findings thorough and reliable. Further details on the assessment of qualities are outlined in **Table 2**.

Table 2. Quality rates of the reviews were assessed using the AMSTAR-2 tool

Reference	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Remarks
Fabrizi *et al.* [30]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes	Critically low
Bajwa *et al.* [31]	Yes	No	No	Yes	No	No	No	No	No	No	N/A	N/A	No	No	N/A	Yes	Critically low
Bennett *et al.* [32]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	N/A	N/A	No	Yes	N/A	Yes	Critically low
Chan *et al.* [33]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	No	Yes	Critically low
Fu *et al.* [34]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Low
Imam *et al.* [35]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	N/A	Yes	No	N/A	Yes	Low
Lin *et al.* [36]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	No	Yes	Critically low
Oliveira *et al.* [37]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	No	Yes	Critically low

Potere *et al.* [38]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Low
Shao *et al.* [39]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes	Critically low
Xu *et al.* [40]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes	Critically low
Yang *et al.* [41]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	No	Yes	Critically low
Yang *et al.* [42]	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	No	Yes	Critically low
Zheng *et al.* [43]	Yes	No	No	No	No	No	No	Yes	No	No	Yes	No	No	No	No	No	Critically low
Zhou *et al.* [44]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	High

Clinical features of the patients

Three systematic reviews covering a total of 29,282 patients provided insights into the most frequently observed symptoms. Fever was the most commonly reported symptom, affecting 15,691 patients (53.58%) across three studies. Cough followed closely, occurring in 13,551 patients (46.27%), while shortness of breath was noted in 9,130 patients (31.17%).

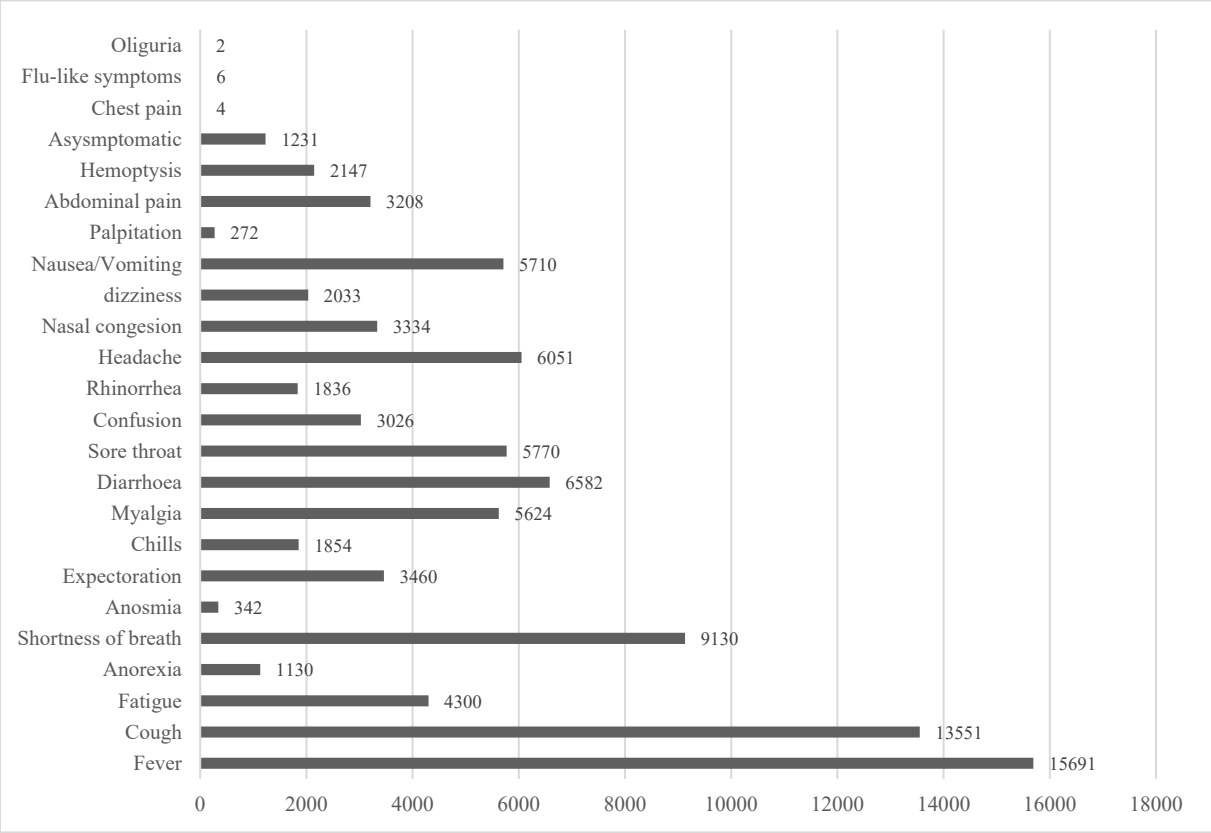

Figure 2. Clinical characteristics of COVID-19 patients

Other frequently observed symptoms included fatigue (29.28%), myalgia (39.01%), and diarrhea (45.65%), each reported in two studies. Some patients also experienced anorexia (7.83%), chills (12.86%), sore throat (40.02%), and nasal congestion (23.22%). Additionally, expectoration (24.09%) was identified in one study. Further details on these clinical characteristics are illustrated in **Figure 2**.

Prevalence of comorbidities among patients

Findings from seven systematic reviews indicated that hypertension was the most prevalent comorbidity, affecting 26,039 out of 96,009 patients (27.12%). Diabetes was the second most common condition, occurring in 16,666 patients (17.35%), followed by cardiovascular diseases, which were identified in 12,959 patients (13.49%).

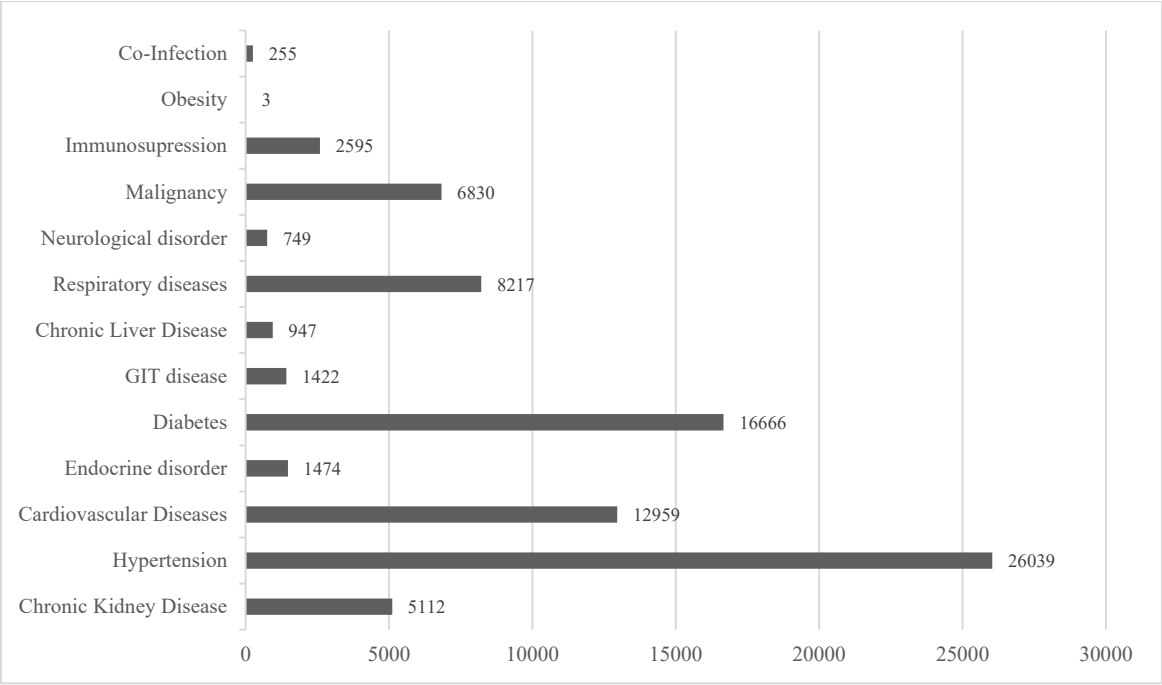

Figure 3. Prevalence of comorbidities in COVID-19 patients

The cardiovascular conditions reported included heart failure, myocardial injury, myocarditis, venous thrombosis, arrhythmia, and cardiogenic shock. The distribution of other comorbidities observed in these seven systematic reviews is summarized in **Figure 3**.

Table 3. Incidence and mortality of AKI in coronavirus patients

Reference	No. of patients	Incidence of AKI	No. of AKI patients	Mortality with AKI	Overall mortality
Fabrizi *et al.* [30]	25566	0.154	39	-	-
Bajwa *et al.* [31]	1098	6	66	62	234
Bennett *et al.* [32]	14358	12.6	1809	-	1177
Chan *et al.* [33]	3714	7.58	282	61	-
Fu *et al.* [34]	49048	10.5	5150	-	-
Imam *et al.* [35]	58	34.1	18	-	11
Lin *et al.* [36]	49692	10.6	5267	-	1403
Oliveira *et al.* [37]	15536	12.3	1911	1280	-
Potere *et al.* [38]	14866	6	892	-	1687
Shao *et al.* [39]	24527	10	2453	-	1990
Xu *et al.* [40]	16199	10	1620	-	-

Yang *et al.* [41]	4963	4.5	224	-	372
Yang *et al.* [42]	21531	12.3	2649	-	-
Zheng *et al.* [43]	10554	6.5	686	-	1273
Zhou *et al.* [44]	13452	9	1211	875	10882

Incidence and mortality of AKI in coronavirus patients

A total of 24,277 patients (9.15%) were diagnosed with AKI across the systematic reviews, as detailed in **Table 3**. Analysis using the random effect models determined that the overall rate of AKI was 1% (95% CI: 1%-2%), with heterogeneity ($I^2 < 1\%$, $P < 0.001$), as illustrated in **Figure 4**.

Only four systematic reviews provided data on mortality among COVID-19 patients who developed AKI. Results revealed that 65.66% (n = 2,278) of these patients succumbed to the condition. When adopting the random effect model, the mortality rate due to AKI in Coronavirus patients was found to be 64% (95% CI: 44%-83%), with significant heterogeneity ($I^2 = 99.32\%$, $P < 0.001$), as shown in **Figure 5**.

The highest reported AKI incidence was 34.1% in a review focusing exclusively on kidney emigrates [35] Also, the highest AKI-related mortality rate was 67.01% (n = 1,280), as displayed by one review [37]. However, when considering overall mortality among COVID-19 patients, the rate was 13.32% (n = 20,370) based on findings from 11 systematic reviews.

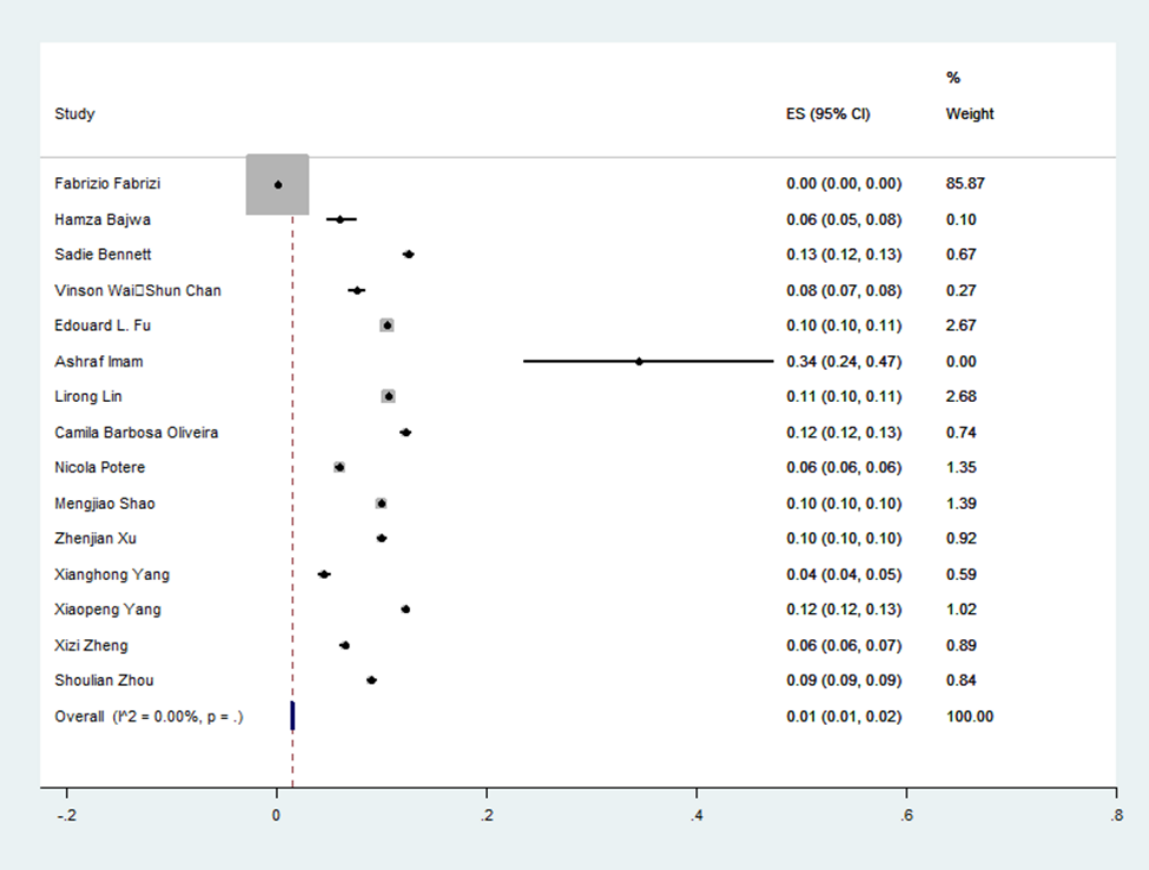

Figure 4. Forest plot highlighting the incidence of AKI in COVID-19 patients

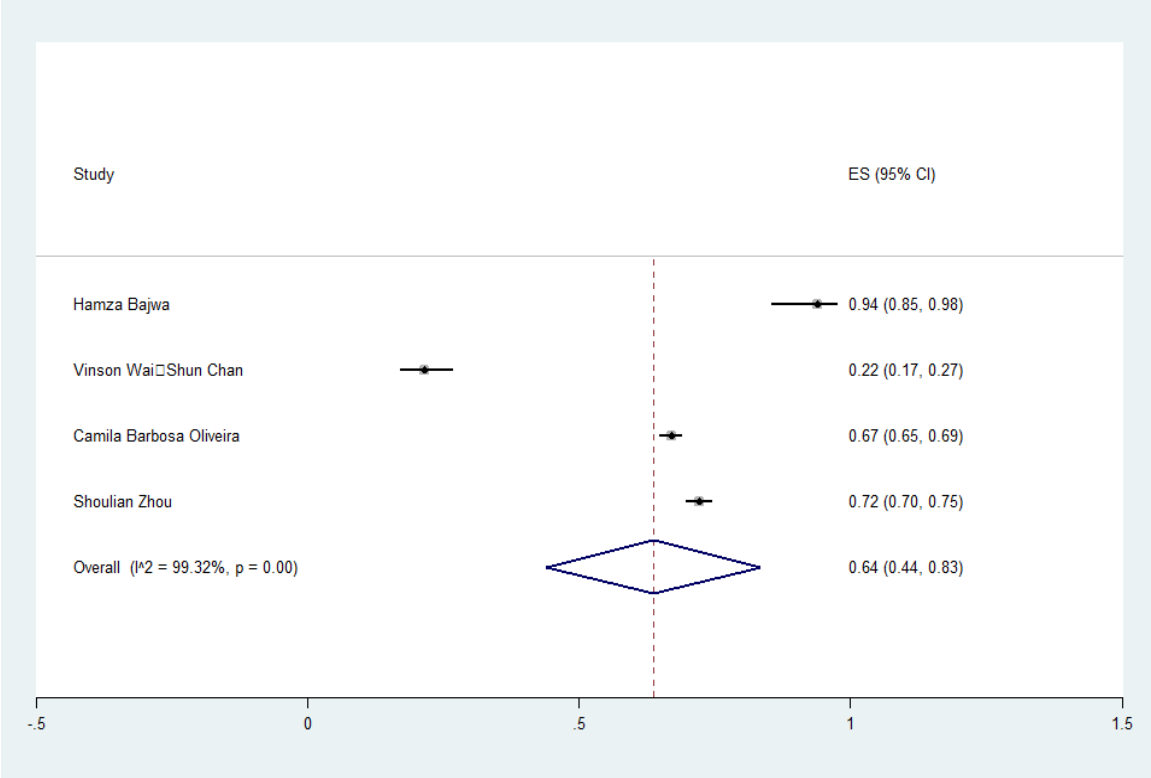

Figure 5. Forest plot highlighting mortality associated with AKI in COVID-19 patients

Significance and quality considerations of this review

This systematic review of systematic reviews is the first to comprehensively assess the incidence of AKI in Coronavirus patients, compiling evidence from 15 reviews on the subject. While the majority of these reviews were categorized as critically low quality, this classification is largely due to the AMSTAR-2 tool's emphasis focus on the standard of reporting rather than the methodology itself [27, 45].

The AMSTAR-2 tool does not evaluate the rationale or objective behind doing a systematic review but instead prioritizes factors like protocol registration before the review process [27]. This heavy reliance on reporting criteria may not fully reflect the scientific validity of the included studies. Therefore, we recommend that readers interpret the quality ratings with caution and not allow them to undermine confidence in the findings presented in this study.

Our study revealed that AKI is a prevalent complication among COVID-19 patients. However, the precise pathophysiological mechanism behind its occurrence remains unclear. It is widely believed that several factors contribute to an increased risk of AKI in COVID-19 patients, including pre-existing conditions such as diabetes mellitus, hypertension, and cardiovascular diseases, as well as hypovolemic states, exposure to nephrotoxic drugs and contrast media, all of which can lead to the injury of pre-renal acute kidney [46].

ACE2 (Angiotensin-Converting Enzyme-2) functions as the primary receptor for SARS-CoV-2, and the widespread distribution across multiple organs, particularly the kidneys, suggests the virus's potential for multi-organ involvement. After binding to ACE2, the S-protein of the virus is cleaved by TMPRSSs, facilitating viral entry into host cells [47]. The co-expression of ACE2 and TMPRSSs in podocytes and proximal tubule cells makes these renal structures particularly vulnerable, reinforcing the idea that the kidneys are a key target for SARS-CoV-2 infection. Since podocytes and proximal tubule cells play essential roles in reabsorption, filtration, and excretion, their damage can significantly contribute to AKI. Studies suggest that podocytes are more susceptible to viral attack than proximal tubule cells, further implicating direct cytopathic effects of the virus in AKI development [48].

Another proposed mechanism involves hypoperfusion, microvascular thrombosis, and an excessive immune response, commonly referred to as a cytokine storm, which may also contribute to AKI alongside direct viral cytopathy [46]. Additionally, complications such as ARDS (acute respiratory distress syndrome), increased intrathoracic pressure, and severe hypoxemia have been linked to kidney injury, as these conditions can directly damage renal cells [49]. Furthermore, disruptions in the RAAS (Renin-Angiotensin-Aldosterone System) caused by COVID-19 can lead to inflammation, fibrosis, and vasoconstriction at the renal level, further exacerbating the risk of AKI [50].

Cough, shortness of breath, fever, and fatigue emerged as the most frequently reported symptoms in the review. These pneumonia-like manifestations can be particularly severe, posing a significant threat to elderly individuals, those with multiple underlying health conditions, or immunocompromised patients [51]. A considerable proportion of patients analyzed in the study had multiple coexisting conditions, with diabetes mellitus, hypertension, and various cardiovascular diseases being the most common. The presence of these comorbidities is strongly linked to higher COVID-19-related mortality, and the elevated fatality rate observed in this study further supports this association. Patients who have undergone kidney transplants are particularly vulnerable due to their dependence on immunosuppressive therapies, which weaken their immune system and increase their susceptibility to infections [52]. Despite the limited number of systematic reviews included in this study, the mortality rate among AKI patients was alarmingly high, emphasizing the devastating impact of the pandemic on this subgroup. The AKI-related mortality rate of 67% reported in this review aligns with findings from a systematic review conducted by Oliveira *et al.* [37].

The systematic review of systematic reviews highlighted that AKI is a common complication in COVID-19 patients and is linked to a significantly high mortality rate. The findings underscore the importance of targeting modifiable risk factors for AKI through different diagnostic and therapeutic approaches. Clinicians should prioritize strategies such as minimizing exposure to nephrotoxic medications and effectively managing hypoxemia in COVID-19 patients. Additionally, ensuring proper fluid resuscitation in volume-responsive patients, alongside vasopressor support when necessary, may help mitigate fluid imbalances [53]. Early assessment of kidney function through urine and serum testing at the initial stages of coronavirus infection could enhance the rate of treatment success and lower the likelihood of AKI progression [36].

While a specific treatment for AKI in COVID-19 patients has yet to be established, existing management strategies should focus on addressing the underlying factors contributing to AKI. In this regard, the use of immunomodulatory and antiviral therapies that do not pose nephrotoxic risks may be beneficial in the treatment of COVID-19-associated AKI [46]. For patients who fail to respond to conservative treatment measures, Continuous Renal Replacement Therapy (CRRT) could be considered, particularly for those experiencing persistent volume overload and refractory hypoxemia despite standard interventions [39]. Early use of hemodynamic stability and blood volume regulation should be a priority for high-risk patients to maintain adequate renal perfusion pressure and improve overall outcomes [54].

This review holds significant value for multiple reasons. First, it consolidates and compares findings from previously published systematic reviews regarding the incidence of AKI. Second, it offers an independent assessment of studies that have explored similar research questions, providing a broader perspective on the topic. Third, by summarizing existing evidence, this review not only presents the current understanding of AKI incidence but also identifies gaps where further research is needed. Fourth, the insights presented here can serve as a valuable resource for clinicians and urologists worldwide, aiding them in decision-making processes and refining clinical decision-support systems. Fifth, this review is purpose-driven, with a clear and focused objective designed to address a single research question effectively. Lastly, given the variability in findings across multiple systematic reviews, this review compiles and synthesizes those results into a unified, comprehensive document. By offering a consolidated overview, it enables healthcare professionals to develop targeted interventions for managing AKI in COVID-19 patients.

However, results should be interpreted with consideration of certain limitations. One notable constraint is the relatively small number of reviews included. To achieve a more complete understanding of AKI development in COVID-19 patients, additional systematic reviews are needed. Another limitation is the

geographic concentration of the data, as most of the included reviews relied on patient information from China, potentially overlooking regional variations in AKI manifestations associated with COVID-19. Additionally, the possibility of finding bias cannot be ruled out, as the systematic reviews analyzed were not suitable for key confounding factors. Despite these challenges, this study provides a well-rounded summary of existing systematic reviews on COVID-19-associated AKI. The insights derived from this analysis can aid clinicians and urologists in making informed decisions, ultimately improving the management and treatment of AKI in patients with COVID-19.

Conclusion

In conclusion, acute kidney injury (AKI) is a significant and concerning complication in COVID-19 patients, contributing to severe outcomes. This study revealed a high incidence of AKI among coronavirus patients, with a notable increase in mortality linked to the condition. Timely and careful clinical assessment of AKI, alongside addressing its underlying causes, should be a central focus for clinicians managing AKI in COVID-19 cases.

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Ethics Statement: None

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