Meta-analysis

Comorbidity-related risk factors for acute respiratory distress syndrome in sepsis patients: A systematic review and meta-analysis

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Abstract

Background. Acute respiratory distress syndrome (ARDS) presents a significant challenge in the management of sepsis, with various comorbidities potentially influencing its development. Understanding the impact of these comorbidities is crucial for improving patient outcomes.

Objectives. This meta-analysis was conducted to investigate the relationship between various comorbidities and the development of ARDS in patients with sepsis, with the aim of improving understanding and management of this condition.

Materials and methods. The study included adult sepsis patients from 8 studies, totaling 16,964 participants. Risk of bias was assessed using the Newcastle–Ottawa scale (NOS), and the data analysis was performed and reported as pooled odds ratios (ORs) computed using a random-effects model. Heterogeneity and publication bias were assessed using the I^2 statistic and Doi plots with the Luis Furuya-Kanamori (LFK) index, respectively.

Results. Chronic obstructive pulmonary disease was significantly associated with an increased risk of ARDS (OR: 1.43, 95% confidence interval (95% CI): 1.02–2.01). Other comorbidities showed no significant associations: diabetes mellitus (DM) (OR: 0.88, 95% CI: 0.69–1.11), hypertension (HTN) (OR: 0.86, 95% CI: 0.56 to 1.34), coronary artery disease (CAD) (OR: 0.95, 95% CI: 0.86–1.06), congestive heart failure (CHF) (OR: 1.08, 95% CI: 0.61 to 1.90), chronic kidney disease (CKD) (OR: 0.89, 95% CI: 0.65–1.22), chronic liver disease (CLD) (OR: 1.13, 95% CI: 0.61–2.09), and cancer (OR: 0.90, 95% CI: 0.59–1.35). Additional analyses indicated moderate-to-high heterogeneity and some evidence of publication bias.

Conclusions. Chronic obstructive pulmonary disease is a notable risk factor for ARDS in sepsis patients, suggesting the need for enhanced surveillance and management in this group. Further research is necessary to understand the mechanisms and explore other potential ARDS risk factors in sepsis.

Key words: COPD, ARDS, sepsis, meta-analysis

Background

Acute respiratory distress syndrome (ARDS) is a severe, life-threatening medical condition characterized by rapid onset of widespread inflammation in the lungs.[1] This syndrome is a major cause of morbidity and mortality in critically ill patients, particularly in those with sepsis.[2] Sepsis, a systemic response to infection, can lead to multiple organ failure, including respiratory failure manifesting as ARDS.[3] The interplay between sepsis and ARDS is complex and multifaceted, with a variety of factors influencing the progression from sepsis to ARDS.

In recent years, the medical community has increasingly recognized the role of comorbidities in the development and outcome of ARDS among septic patients.[4] Comorbidities such as diabetes mellitus (DM), hypertension (HTN), chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD), coronary artery disease (CAD), chronic liver disease (CLD), congestive heart failure (CHF), and cancer have been identified as significant contributors to the susceptibility and severity of ARDS.[5] These comorbid conditions may alter the host response to infection and inflammation, potentially exacerbating the pathophysiological processes underlying ARDS.[4,5]

The pathogenesis of ARDS in septic patients is a subject of intense research. It is known to be dependent on a complex interplay of inflammatory mediators, endothelial and epithelial injury, and dysregulated immune responses.[6] In this milieu, comorbidities add another layer of complexity. For instance, DM can impair immune function, while chronic lung diseases like COPD alter baseline pulmonary function, potentially predisposing patients to more severe forms of ARDS when they develop sepsis.[7,8]

The presence of comorbidities can also influence the clinical management and outcomes of ARDS. These patients often require more intricate care strategies, balancing the management of their acute critical illness with the ongoing treatment of their chronic conditions. This intersection of acute and chronic diseases poses significant challenges in clinical decision-making and resource allocation in intensive care units (ICUs).

Additionally, an appreciation of the role of comorbidities in ARDS pathogenesis is essential for the development of targeted therapeutic strategies. The current management of ARDS is primarily supportive, with mechanical ventilation being a cornerstone of therapy.[9] However, patients with significant comorbidities may benefit from more tailored approaches that address both the acute and chronic aspects of their illness.

The intersection of ARDS and sepsis, compounded by the presence of comorbidities, represents a complex clinical challenge. Understanding the role of comorbidities in the development of ARDS among septic patients is not only crucial for elucidating the pathophysiology of this condition but also for improving its prognosis. A systematic review and meta-analysis of the existing literature on this topic should provide valuable insights into how these comorbidities influence the risk and outcomes of ARDS in sepsis. It will also enhance our understanding of the interactions between chronic health conditions and acute critical illnesses like ARDS. This understanding is vital for clinicians and researchers alike, as it has the potential to inform clinical practice and shape future research directions. A systematic analysis should also identify gaps in the current knowledge, guiding future research efforts. Hence, the purpose of this review is to synthesize the available evidence on the impact of various comorbidities on the risk of developing ARDS in patients with sepsis. We aim to provide a thorough and nuanced understanding of how comorbidities influence the risk and progression of ARDS in sepsis, ultimately contributing to better patient outcomes in this critically ill cohort.

Objectives

This review was done with an objective to determine the comorbidity related risk factors associated with ARDS in patients with sepsis.

Methods

Eligibility criteria

Study population

The inclusion criteria were as follows: adult participants (aged 18 years and older) who were diagnosed with sepsis and subsequently developed ARDS. The focus was specifically on populations with documented comorbidities such as DM, HTN, COPD, CKD, CAD, CLD, CHF, and cancer.

Exposure and comparison

This review analyzed studies that examined the impact of various comorbidities on the development of ARDS in sepsis patients. The comparison was made between patients with and without these specific comorbidities.

Outcome measures

The primary outcomes of interest were the incidence of ARDS in sepsis patients with comorbidities.

Study design

Included studies encompassed a range of designs: observational studies (prospective/retrospective cohort, case-control and cross-sectional analytical studies) relevant to the topic.

Information sources and search strategy

A thorough search strategy was implemented, utilizing databases such as PubMed, Scopus, Cochrane Library, Google Scholar, ScienceDirect, and Web of Science. Key search terms included combinations of "sepsis," "acute respiratory distress syndrome," "comorbidities," "diabetes mellitus," "hypertension," "COPD," "chronic kidney disease," "coronary artery disease," "chronic liver disease," "congestive heart failure," "cancer," and related terms. The search timeframe extended from January 1954 to December 2023, with no language restrictions.

Selection process

Two reviewers independently screened the studies, beginning with an assessment of titles, abstracts and key terms. Full-text articles were then reviewed for a more detailed assessment. Any disagreements were resolved through discussion and consensus. The selection process was documented in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines.

Data collection process and data items

Data were extracted by the lead researcher, detailing study characteristics, participant demographics, study setting, and methodology. The data included the author, year of publication, country, study design, ARDS criteria, study participant details, mean age, gender distribution, quality assessment-related characteristics, number of participants with each comorbidity, outcomes measured, exposure details, and follow-up duration. A secondary reviewer verified the extracted data for accuracy.

Study risk of bias assessment

To ensure the credibility and reliability of the included studies, an assessment of the risk of bias was meticulously conducted using the Newcastle–Ottawa scale (NOS).[10] The NOS is a widely recognized tool specifically designed for evaluating the quality of observational studies.

Two independent researchers employed the NOS to evaluate the studies. Each researcher independently scored the studies, and discrepancies were resolved through discussion and consensus. This dual-assessment approach was adopted to enhance the objectivity and reduce the potential for bias in the review process. The NOS operates on 3 broad criteria:

Selection of the study groups: This criterion assesses the method of selecting the study participants, aiming to determine if the subjects and controls are representatively and appropriately chosen. It considers factors such as case definition, case representativeness, control selection, and control definition.

Comparability of the groups: This aspect of the NOS focuses on the comparability of the study groups, based on the design or analysis.

Ascertainment of the exposure or outcome: For case-control studies, this involves evaluating the method of ascertaining exposures, such as whether it was through secure records or self-reports. For cohort studies, it examines the method of ascertaining outcomes, including the independence of the outcome assessment and the length and adequacy of the follow-up.

Each study is judged in these categories using a star system, which indicates the quality of the study's methodology in each specific category. The maximum number of stars a study can receive is 9, with 4 stars allocated for "selection", 2 for "comparability" and 3 for "ascertainment of exposure or outcome". A study with a higher number of stars (7–9) is considered to have a lower risk of bias; 4–6 stars indicate a moderate risk of bias; and less than 4 indicates a higher risk of bias.

Effect measures and synthesis methods

Statistical software and version

Statistical analysis was conducted using Stata software v. 14.2 (Stata Corp., College Station, USA). This advanced statistical package allowed for detailed and accurate data analysis, crucial for the integrity of our study.

Methodology for analyzing binary outcomes

Given that all outcomes in this study were binary, we calculated the combined odds ratio (OR) along with a 95% confidence interval (95% CI). This was derived from the event frequencies observed in both the intervention and control groups, providing a comparative analysis of the efficacy of the interventions.

Model selection and variance method

A random-effects model was chosen for this analysis, incorporating the inverse variance method.[11] This approach was essential to account for the variability present across the studies included in our review.

Heterogeneity assessment techniques

To assess heterogeneity, or the degree of variation in the results among the different studies, a multifaceted approach was employed. The initial step involved a visual examination of forest plots to check for overlaps in confidence intervals. Then, χ^2 tests were used to detect the presence of heterogeneity. Finally, I^2 statistic was used to quantify the percentage of total variation across studies that is due to heterogeneity rather than chance.

Additionally, a sensitivity analysis was conducted to determine the influence of individual studies on the overall meta-analysis results. This step was crucial to ensure the stability and reliability of the meta-analysis.

Publication bias assessment tools

A funnel plot was created for all outcomes. Asymmetry of this plot was used as an indication of the presence of publication bias. We also utilized the Doi plot and the Luis Furuya-Kanamori (LFK) index to detect and quantify potential publication bias.[12] According to the LFK index, values ranging from –1 to +1 indicated an absence of publication bias (showing perfect symmetry). Values between –1 to –2 or +1 to +2 suggested minor asymmetry, while values less than –2 or greater than +2 signified major asymmetry, indicating a higher likelihood of publication bias.[12]

Results

Search results

In total, our search across the PubMed, Scopus, Cochrane Library, Google Scholar, ScienceDirect, and Web of Science databases yielded 1,632 potentially relevant studies. Upon an initial review of titles and abstracts, 78 studies were identified as potentially meeting our inclusion criteria. Subsequent in-depth examination of these full-text articles led to the final selection of 8 studies that were deemed suitable for inclusion in our analysis (Fig. 1).[8,13–19]

Characteristics of the studies included

The studies originated from multiple countries, including the USA, Japan, China, and South Korea, reflecting a global perspective on the issue. The sample size across these studies ranged considerably, from as few as 125 participants in the smallest study to as many as 11,566 participants in the largest. In total, we cumulatively analyzed data from 16,964 sepsis patients. Regarding the criteria for ARDS diagnosis, all included studies employed recognized definitions, with 7 studies using the Berlin definition and 1 study using the American European Consensus Conference criteria. The mean age of participants in these studies varied, ranging from 55 to 73 years. As for the assessment of study quality and risk of bias, 6 studies were categorized as having a low risk of bias, while 2 studies were determined to have a moderate risk of bias (Table 1).

Diabetes mellitus and the risk of ARDS in sepsis patients

Seven studies (including 16,953 sepsis patients) compared the risk of ARDS between DM and non-DM patients. Pooled OR was 0.88, with a 95% CI between 0.69 and 1.11

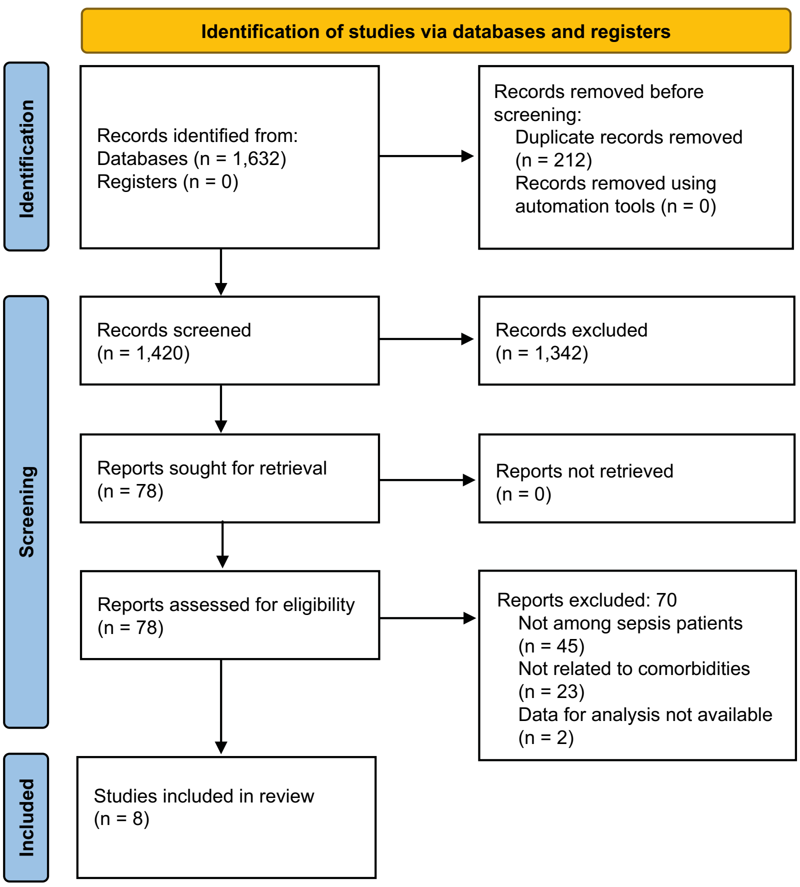

Fig. 1. Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) flowchart

Table 1. Characteristics of the included studies (n = 8)

Study	Country	Study design	Sample size	Participants	ARDS criteria	Mean age [years]	Male/female (%)	Risk of bias
Shi et al., 2022[8]	China	retrospective	529	sepsis patients admitted to intensive care unit	meeting the Berlin definition of ARDS	ARDS = 66 no ARDS = 70	ARDS = 75/25 non-ARDS = 66/34	moderate
Iriyama et al., 2020[13]	Japan	secondary analysis of prospective	594	adult patients with severe sepsis caused by non-pulmonary infection	meeting the Berlin definition on the 1st or 4th day of screening	ARDS = 70 no ARDS = 72	ARDS = 60/40 non-ARDS = 56.8/43.2	low
Li et al., 2020[14]	China	prospective	150	patients with sepsis who attended Cangzhou Central Hospital	meeting the Berlin definition of ARDS	ARDS = 60.6 no ARDS = 55.5	ARDS = 66/34 non-ARDS = 65/35	low
Mikkelsen et al., 2013[15]	USA	retrospective	778	adults with severe sepsis presenting to emergency department	meeting the Berlin definition of ARDS	ARDS = 55 no ARDS = 57	ARDS = 50/50 non-ARDS = 54/46	low
Nam et al., 2019[16]	South Korea	retrospective	125	patients with septic bacteremia presenting to intensive care unit	meeting the Berlin definition of ARDS	ARDS = 65 no ARDS = 73	ARDS = 54.5/45.5 non-ARDS = 53.4/46.6	moderate
Seethala et al., 2017[17]	USA	prospective	2,534	septic adult patients presenting to the emergency department or being admitted for high-risk elective surgery	meeting the Berlin definition of ARDS	ARDS = 54.9 no ARDS = 58.8	ARDS = 60.3/39.7 non-ARDS = 50.6/49.4	low
Xu et al., 2023[18]	China	retrospective	11,566	sepsis patients admitted to intensive care unit	meeting the Berlin definition of ARDS	ARDS = 66.09 no ARDS = 63	ARDS = 59.9/40.1 non-ARDS = 60.2/39.8	low
Gong et al., 2005[19]	USA	prospective	688	sepsis patients admitted to intensive care unit	American-European Consensus Conference criteria for ARDS	ARDS = 65 no ARDS = 67	ARDS = 54/46 non-ARDS = 61/39	low

ARDS – acute respiratory distress syndrome.

(p = 0.27) among sepsis patients (Fig. 2). While heterogeneity was moderate with an I^2 value of 55.3%, a significant χ^2 p-value of 0.04 was obtained. The Doi plot (Supplementary Fig. 1) and funnel plot (Supplementary Fig. 2) showed major asymmetry, with the LFK index value equaling –2.22. This confirms the presence of publication bias.

Hypertension and the risk of ARDS in sepsis patients

Three studies (including 1,432 sepsis patients) compared the risk of ARDS between HTN and non-HTN patients. Pooled OR was 0.86, with a 95% CI of 0.56–1.34 (p = 0.52) (Fig. 3). The heterogeneity was moderate, with an I^2 value of 38.1% and a nonsignificant p-value of 0.20. The funnel plot (Supplementary Fig. 3) showed asymmetry, indicating the possibility of publication bias.

Chronic obstructive pulmonary disease and the risk of ARDS in sepsis patients

Six studies (including 13,742 sepsis patients) compared the risk of ARDS between COPD and non-COPD patients. Pooled OR was 1.43, with a 95% CI of 1.02–2.01, indicating the significant risk of ARDS among sepsis patients with COPD, compared to sepsis patients without COPD (p = 0.04) (Fig. 4). The heterogeneity was low, with an I^2 value of 23.6% and a nonsignificant χ^2 p-value of 0.26. The funnel plot (Supplementary Fig. 4) and Doi plot (Supplementary Fig. 5) showed major asymmetry, with an LFK index value equaling –4.39. This confirms the presence of publication bias.

Coronary artery disease and the risk of ARDS in sepsis patients

Five studies (including 13,592 sepsis patients) compared the risk of ARDS between CAD and non-CAD patients. Pooled OR was 0.89, with a 95% CI of 0.65–1.22 (p = 0.39) (Fig. 5) The heterogeneity was low, with an I^2 value of 31.6% and a nonsignificant χ^2 p-value of 0.19. The funnel plot (Supplementary Fig. 6) and Doi plot (Supplementary Fig. 7) showed major asymmetry, with an LFK index value equaling –6.15. This confirms the presence of publication bias.

Congestive heart failure and risk of ARDS in sepsis patients

Two studies with 1,372 sepsis patients have compared the risk of ARDS between CHF and non-CHF patients. Pooled OR was 1.08, with a 95% CI of 0.61–1.90 (p = 0.80;

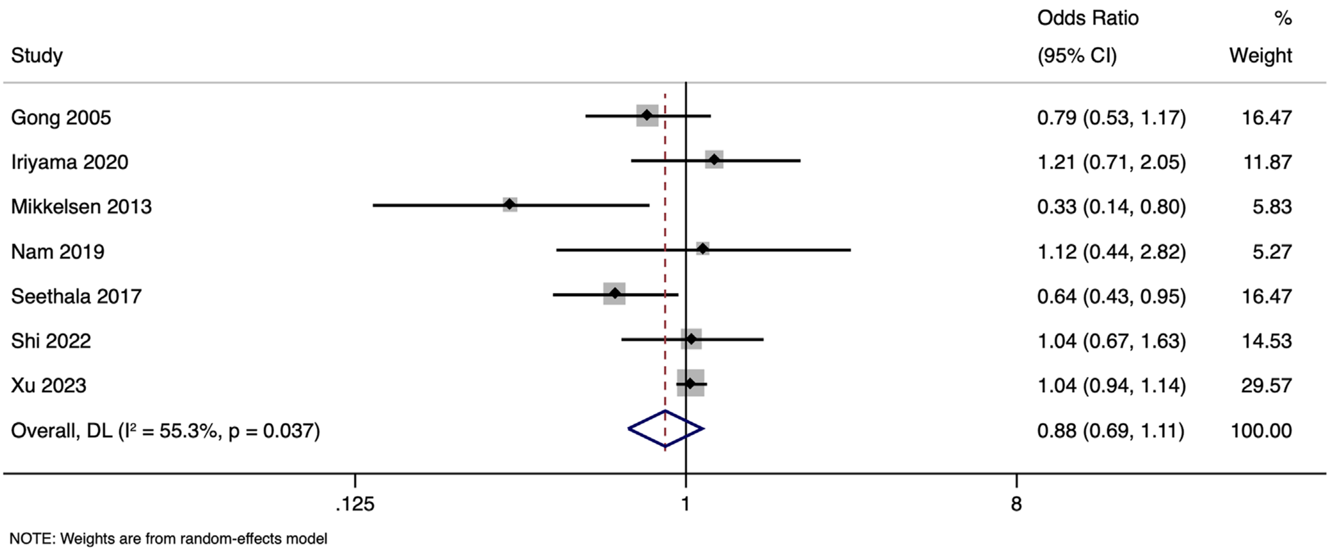

Fig. 2. Forest plot showing the association between diabetes mellitus and acute respiratory distress syndrome (ARDS) among sepsis patients

DL – DerSimonian and Laird approach; 95% CI – 95% confidence interval; OR – odds ratio.

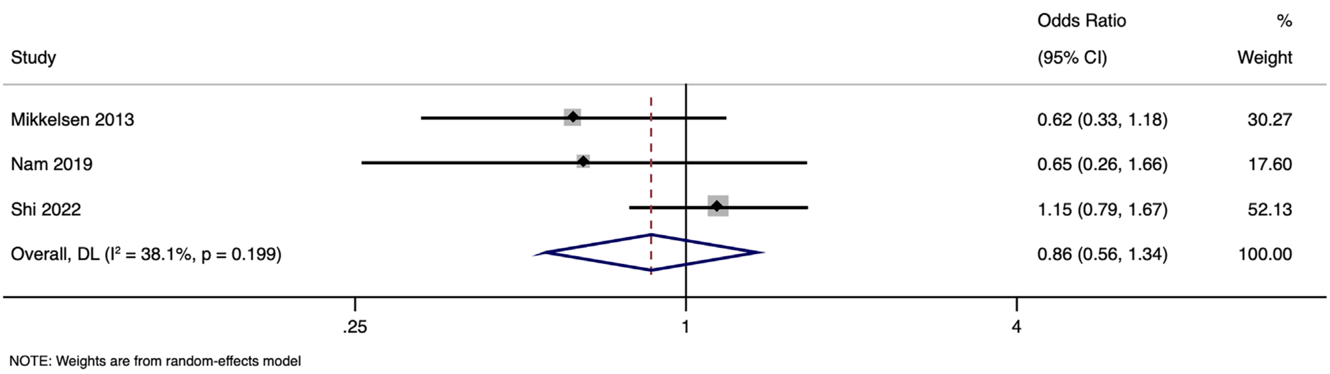

Fig. 3. Forest plot showing the association between hypertension and acute respiratory distress syndrome (ARDS) among sepsis patients

DL – DerSimonian and Laird approach; 95% CI – 95% confidence interval; OR – odds ratio.

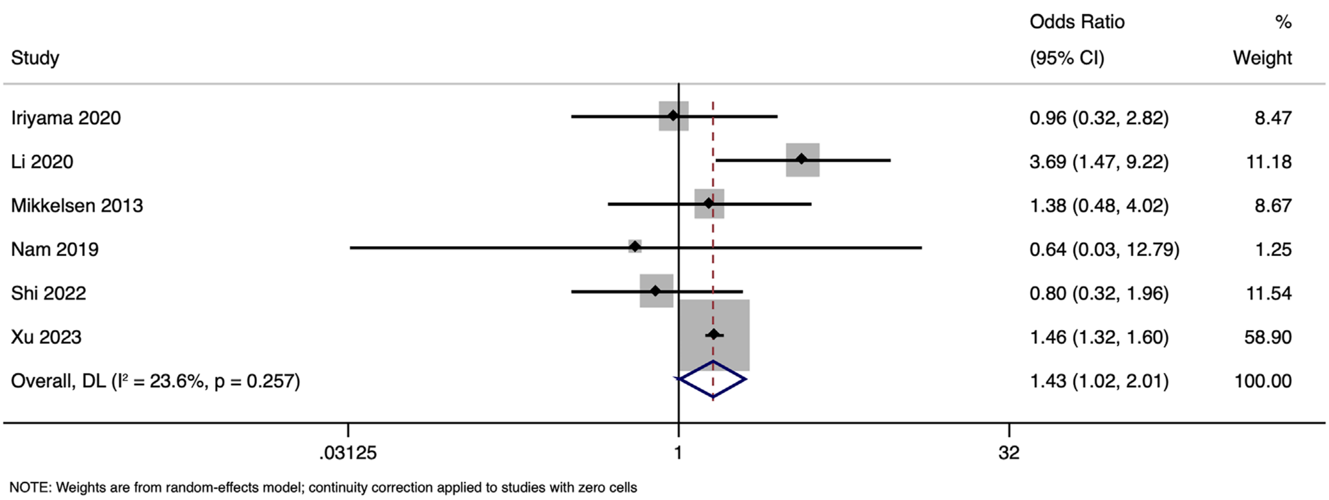

Fig. 4. Forest plot showing the association between chronic obstructive pulmonary disease and acute respiratory distress syndrome (ARDS) among sepsis patients

DL – DerSimonian and Laird approach; 95% CI – 95% confidence interval; OR – odds ratio.

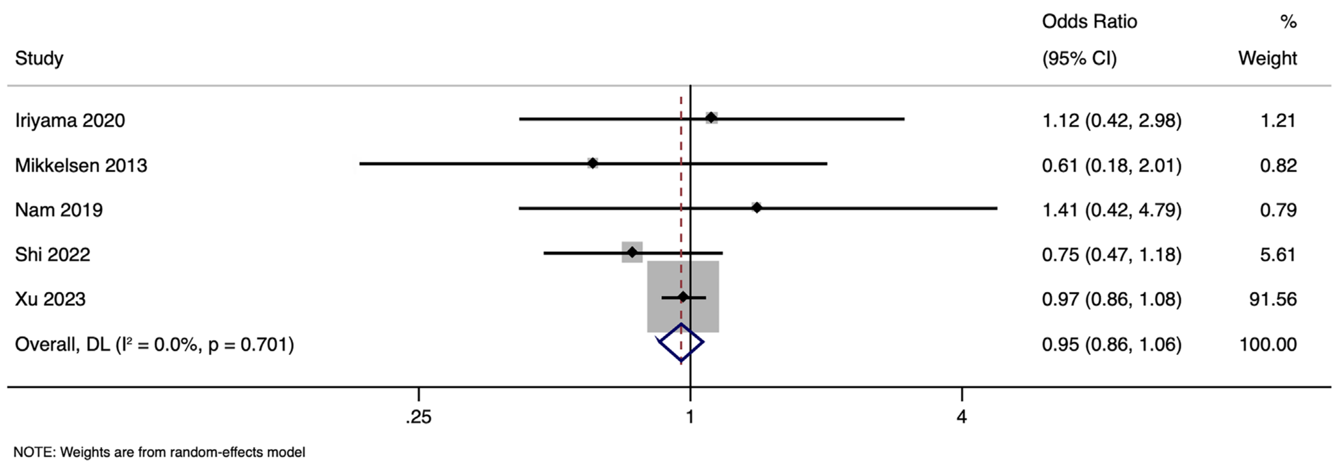

Fig. 5. Forest plot showing the association between coronary artery disease and acute respiratory distress syndrome (ARDS) among sepsis patients

DL – DerSimonian and Laird approach; 95% CI – 95% confidence interval; OR – odds ratio.

Fig. 6). No heterogeneity was found with an I^2 value of 0%. Funnel plot (Supplementary Fig. 8) showed major asymmetry during publication bias assessment.

CKD and risk of ARDS in sepsis patients

Seven studies with 14,430 sepsis patients have compared the risk of ARDS between CKD and non-CKD patients. Pooled OR was 0.89, with a 95% CI of 0.65 to 1.22 (p = 0.39; Fig. 7). Low heterogeneity was found with an I^2 value of 31.6%, with a nonsignificant χ^2 p-value of 0.19. Funnel plot (Supplementary Fig. 9) and Doi plot (Supplementary Fig. 10) showed major asymmetry with an LFK index value of –6.15. This confirms the presence of publication bias.

Chronic liver disease and the risk of ARDS in sepsis patients

Five studies (including 13,776 sepsis patients) compared the risk of ARDS between CLD and non-CLD patients. Pooled OR was 1.13, with a 95% CI of 0.61–2.09 (p = 0.70) among sepsis patients (Fig. 8). The heterogeneity was high, with an I^2 value of 73.7% and a significant χ^2 p-value of 0.004. The funnel plot (Supplementary Fig. 11) and Doi plot (Supplementary Fig. 12) showed major asymmetry, with an LFK index value equaling –7.35. This confirms the presence of publication bias.

Cancer and risk of ARDS in sepsis patients

Five studies (including 13,592 sepsis patients) compared the risk of ARDS between cancer and non-cancer patients. Pooled OR was 0.90, with a 95% CI of 0.59–1.35 (p = 0.70) (Fig. 9). The heterogeneity was moderate-to-high, with an I^2 value of 68.4% and a significant χ^2 p-value of 0.01. The funnel plot (Supplementary Fig. 13) and Doi plot (Supplementary Fig. 14) showed major asymmetry, with an LFK index value equaling –5.26. This confirms the presence of publication bias.

Additional sensitivity analysis

Leave-one-out sensitivity analysis did not demonstrate any notable alterations in terms of either the magnitude or the direction of the associations observed. This robustness check, which involved sequentially removing each study from the meta-analysis and reassessing the overall effect, showed consistent results. The absence of significant

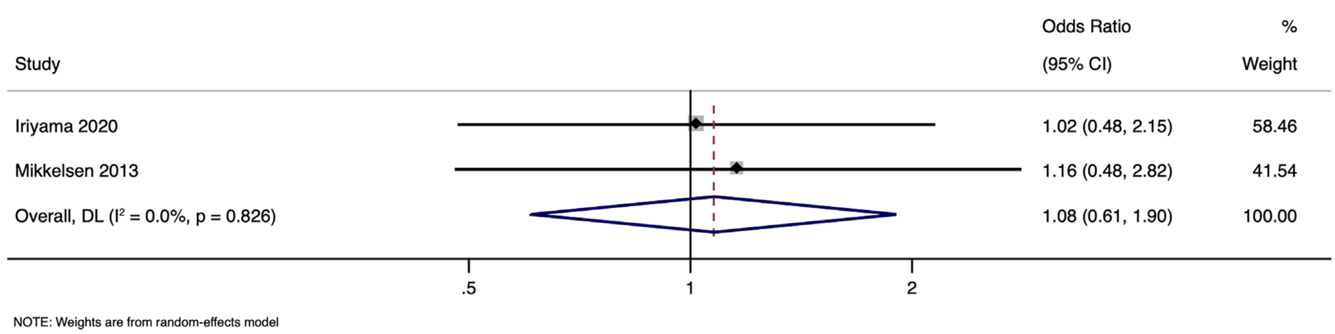

Fig. 6. Forest plot showing the association between congestive heart failure and acute respiratory distress syndrome (ARDS) among sepsis patients

DL – DerSimonian and Laird approach; 95% CI – 95% confidence interval; OR – odds ratio.

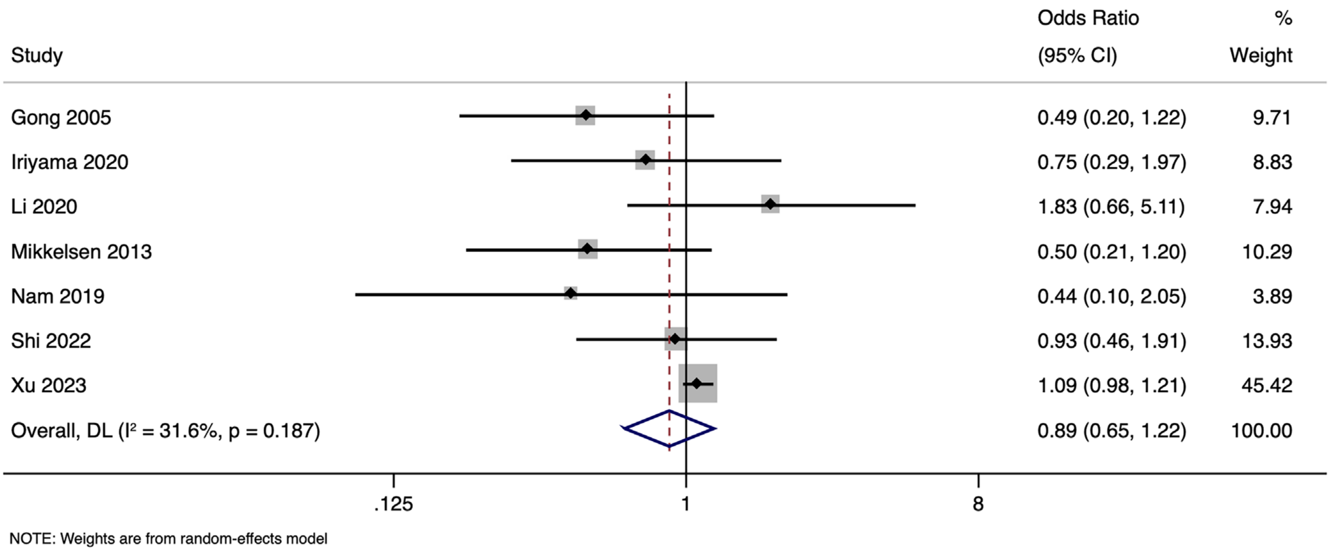

Fig. 7. Forest plot showing the association between chronic kidney disease and acute respiratory distress syndrome (ARDS) among sepsis patients

DL – DerSimonian and Laird approach; 95% CI – 95% confidence interval; OR – odds ratio.

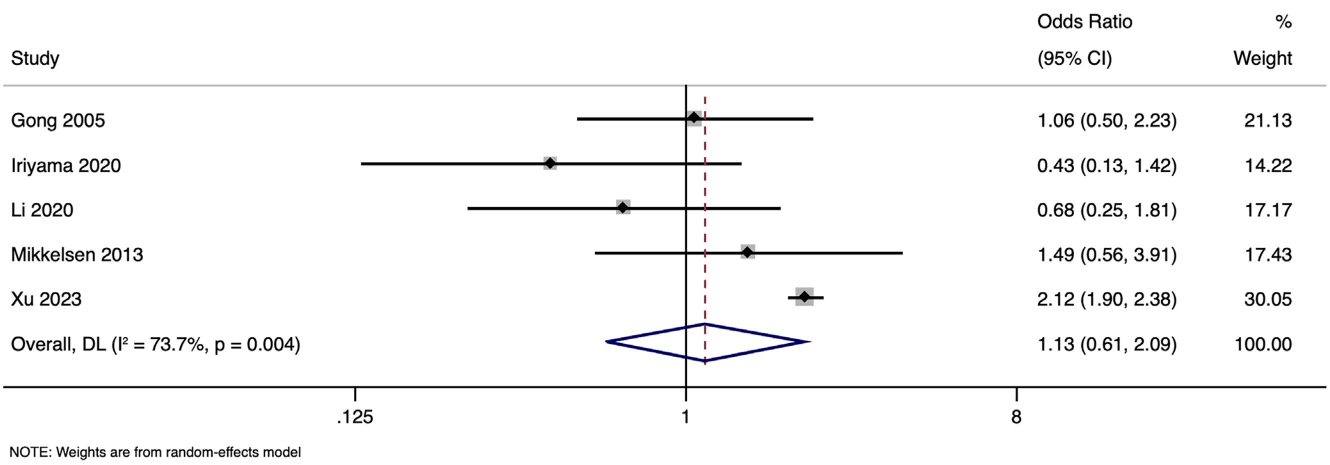

Fig. 8. Forest plot showing the association between chronic liver disease and acute respiratory distress syndrome (ARDS) among sepsis patients

DL – DerSimonian and Laird approach; 95% CI – 95% confidence interval; OR – odds ratio.

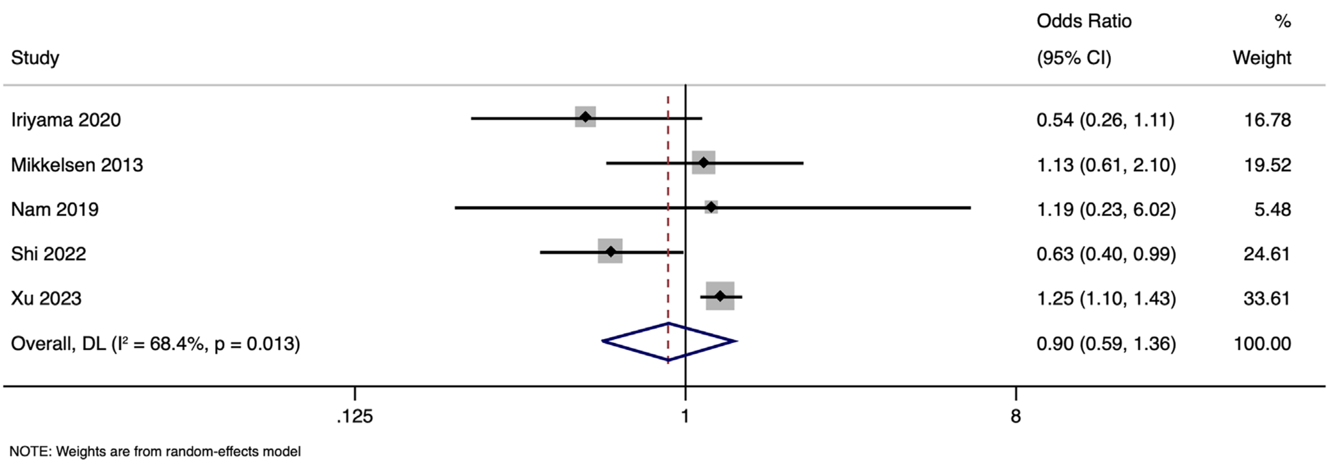

Fig. 9. Forest plot showing the association between cancer and acute respiratory distress syndrome (ARDS) among sepsis patients

DL – DerSimonian and Laird approach; 95% CI – 95% confidence interval; OR – odds ratio.

changes upon the exclusion of individual studies confirms the stability and reliability of the observed associations in our analysis.

Discussion

Our comprehensive review assessed the relationship between various comorbidities and the risk of developing ARDS in sepsis patients. The comorbidities evaluated included DM, HTN, COPD, CAD, CHF, CKD, CLD, and cancer. Among these, COPD was the only comorbidity that showed a significant association with an increased risk of ARDS in sepsis patients, with a pooled OR of 1.43. In contrast, other comorbidities such as DM, HTN, CAD, CHF, CKD, CLD, and cancer did not show a significant association with the development of ARDS in this patient population.

These findings add to the existing body of research on ARDS risk factors in sepsis patients. A previous review reported mixed results regarding the impact of comorbidities on ARDS development.[20] In fact, some studies have suggested that comorbidities like DM and HTN may be associated with a lower risk of ARDS,[15,17] potentially due to the protective effects of certain medications used in these conditions. However, our analysis did not find a statistically significant association, which may be attributed to variations in study designs, populations and methodologies.

The significant association between COPD and ARDS risk in sepsis patients aligns with previous research indicating that preexisting pulmonary diseases may predispose patients to more severe lung injury when faced with a systemic inflammatory condition like sepsis.[8,21] The differential impact of comorbidities on ARDS development in sepsis patients offers valuable insights into the complex pathophysiology of ARDS. Understanding these interactions is crucial for developing targeted therapeutic strategies. The absence of significant associations with certain comorbidities may also point to different underlying mechanisms of lung injury or protective factors that warrant further investigation.

The pathogenesis behind the increased risk of ARDS in sepsis patients with COPD could be attributed to several factors. Chronic obstructive pulmonary disease is characterized by chronic inflammation and structural changes in the lungs, which could exacerbate the pulmonary response to sepsis.[22] Additionally, COPD patients often have a compromised immune response, making them more susceptible to severe infections and complications.[22]

For other comorbidities, the lack of significant association might be influenced by various mechanisms. For instance, in DM, hyperglycemia-related immune dysfunction could potentially balance the risk of developing ARDS.[7] Similarly, in conditions like HTN and CAD, the chronic use of medications such as ACE inhibitors and statins might offer some protective effect against ARDS development.[23]

One of the main strengths of this study is its comprehensive approach, including a wide range of comorbidities and a large sample size. The use of rigorous statistical methods, such as the random-effects model and sensitivity analyses, also adds to the robustness of our findings. None of the studies had a higher risk of bias, further enhancing the credibility of the findings. The main limitation of the review is that a substantial amount of data was obtained from a single study.[18] However, our additional sensitivity analysis demonstrated no significant differences in the estimates for any of the outcomes.

The findings of this study have important clinical implications. Understanding the comorbidities associated with an increased risk of ARDS in sepsis patients can aid in risk stratification and personalized management strategies. Particularly, the identification of COPD as a significant risk factor highlights the need for careful monitoring and possibly more aggressive treatment in sepsis patients with this comorbidity. This result also calls for a multidisciplinary approach involving pulmonologists and intensivists to optimize patient outcomes. In contrast, for comorbidities where no significant association was found, such as DM and HTN, our findings suggest that the current standard of care in sepsis management remains appropriate, although overall, they do underscore the need for individualized patient care.

Future research should focus on further elucidating the mechanisms behind the relationship between different comorbidities and ARDS risk in sepsis patients. There is also a need for more standardized, large-scale studies to confirm these findings, and explore the impact of other potential risk factors. Longitudinal studies examining the long-term outcomes of ARDS in sepsis patients with various comorbidities would also be valuable. The integration of biomarkers that assess the risk of ARDS in sepsis patients is another promising area of research. Identifying specific biomarkers associated with ARDS risk in the presence of various comorbidities could enhance early diagnosis and allow for more targeted interventions. Therefore, prospective studies investigating the role of inflammatory, genetic and other biomarkers in predicting ARDS in sepsis patients are needed.

Limitations

There are several limitations to consider. The presence of publication bias, as indicated by the Doi plot and LFK index in some comorbidities, suggests that our results should be interpreted with caution. Additionally, the variability in study designs, populations and definitions of comorbidities across the included studies might have influenced the outcomes. The moderate-to-high heterogeneity observed in some analyses also underscores the need for more standardized research in this area.

Conclusions

Among the various comorbidities studied, only COPD significantly increased the risk of ARDS in sepsis patients. This underscores the complexity of ARDS pathogenesis and highlights the importance of considering individual patient characteristics, including comorbidities, in the management of sepsis. These findings provide valuable insights for clinicians in the risk assessment and treatment planning for sepsis patients.

Supplementary files

The Supplementary materials are available at https://doi.org/10.5281/zenodo.13203473. The package includes the following files:

Supplementary Fig. 1. Doi plot for DM and risk of ARDS in sepsis patients.

Supplementary Fig. 2. Funnel plot for DM and risk of ARDS in sepsis patients.

Supplementary Fig. 3. Funnel plot for HTN and risk of ARDS in sepsis patients.

Supplementary Fig. 4. Funnel plot for COPD and risk of ARDS in sepsis patients.

Supplementary Fig. 5. Doi plot for COPD and risk of ARDS in sepsis patients.

Supplementary Fig. 6. Funnel plot for CAD and risk of ARDS in sepsis patients.

Supplementary Fig. 7. Doi plot for CAD and risk of ARDS in sepsis patients.

Supplementary Fig. 8. Funnel plot for CHF and risk of ARDS in sepsis patients.

Supplementary Fig. 9. Funnel plot for CKD and risk of ARDS in sepsis patients.

Supplementary Fig. 10. Doi plot for CKD and risk of ARDS in sepsis patients.

Supplementary Fig. 11. Funnel plot for CLD and risk of ARDS in sepsis patients.

Supplementary Fig. 12. Doi plot for CLD and risk of ARDS in sepsis patients.

Supplementary Fig. 13. Funnel plot for Cancer and risk of ARDS in sepsis patients.

Supplementary Fig. 14. Doi plot for cancer and risk of ARDS in sepsis patients.

Data availability

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

Consent for publication

Not applicable.

Use of AI and AI-assisted technologies

Not applicable.

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