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A Bibliometric Analysis of Pneumothorax Research: Global Trends, Hotspots, and Future Directions

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Abstract: Background: Pneumothorax is a potentially life-threatening condition that continues to present important challenges in emergency medicine, pulmonology, and thoracic surgery. Over recent decades, scientific interest in pneumothorax has increased substantially due to advances in diagnostic imaging, minimally invasive surgery, and critical care management. This study aimed to evaluate the global research landscape of pneumothorax through a comprehensive bibliometric analysis. **Methods:** A bibliometric analysis was conducted using publications retrieved from Scopus, Web of Science, and PubMed databases. Articles and review papers published in English between January 2000 and December 2025 were included. Data regarding publication year, authors, institutions, countries, journals, citations, and keywords were extracted and analyzed. Bibliometric indicators including annual publication trends, citation analysis, H-index values, co-authorship networks, co-citation analysis, and keyword co-occurrence mapping were evaluated using VOSviewer and CiteSpace software. **Results:** A total of 6,842 publications related to pneumothorax were identified. Annual scientific output demonstrated a continuous increase, particularly after 2015, with the highest publication activity observed between 2020 and 2023. The United States, China, Japan, and the United Kingdom were the leading contributors in terms of publication count and citation impact. The most productive institutions included the Mayo Clinic, Harvard Medical School, and the University of Tokyo. Major research hotspots included spontaneous pneumothorax, video-assisted thoracoscopic surgery (VATS), pleurodesis, mechanical ventilation-associated pneumothorax, and COVID-19-related pneumothorax. Visualization analyses revealed expanding international collaboration networks and emerging interest in artificial intelligence-assisted imaging and ultrasound-guided diagnosis. **Conclusion:** Global pneumothorax research has grown substantially over the past two decades, reflecting increasing clinical and scientific interest in this field. Minimally invasive surgical approaches, critical care-related pneumothorax, and advanced imaging technologies have emerged as major research priorities. This bibliometric study provides a comprehensive overview of the intellectual structure, research trends, and future directions of pneumothorax research and may guide future multidisciplinary investigations and evidence-based clinical practice.

Keywords: Pneumothorax; Bibliometric analysis; Video-assisted thoracoscopic surgery; VATS; Thoracic surgery; Research trends; Scientific output; Citation analysis; Artificial intelligence; COVID-19; Mechanical ventilation; Ultrasound-guided diagnosis.

INTRODUCTION

Pneumothorax is a potentially life-threatening condition characterized by the accumulation of air in the pleural cavity, resulting in partial or complete lung collapse [Light RW. 2013]. It may occur spontaneously, traumatically, or secondary to underlying pulmonary diseases such as chronic obstructive pulmonary disease, tuberculosis, cystic fibrosis, and malignancy [MacDuff, A. *et al*., 2010]. Despite advances in diagnostic imaging and therapeutic interventions, pneumothorax continues to represent a significant challenge in emergency medicine, pulmonology, and thoracic surgery due to its recurrence, morbidity, and occasional mortality. Over recent decades, the increasing global burden of respiratory diseases and improvements in minimally invasive surgical techniques have stimulated substantial scientific interest in pneumothorax research [Tschopp, J. M. *et al*., 2015; Hallifax, R. J. *et al*., 2018].

The rapid growth of scientific publications has made it difficult for researchers and clinicians to comprehensively evaluate the evolution of knowledge within this field. Bibliometric analysis provides a quantitative and systematic method for assessing research productivity, citation patterns, collaborative networks, influential authors, institutions, journals, and emerging research trends [Donthu, N. *et al*., 2021; Aria, M., & Cuccurullo, C. 2017]. Such analyses are valuable for identifying research hotspots, guiding future investigations, and understanding the intellectual structure of a scientific discipline [Chen, C. 2006].

In recent years, novel topics including video-assisted thoracoscopic surgery (VATS), ultrasound-guided diagnosis, mechanical ventilation-associated pneumothorax, and COVID-19-related pneumothorax have gained increasing attention in the literatüre [Van Eck, N., & Waltman, L. 2010]. However, a comprehensive bibliometric evaluation of global pneumothorax research remains limited. Therefore, this study aims to analyze the worldwide scientific output on pneumothorax, identify major contributors and influential publications, and explore current trends

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and future directions in this evolving research area. The following section will present the methods and statistical analysis employed in this study.

METHODS

This bibliometric study was designed to evaluate the global scientific output, collaboration patterns, and research trends related to pneumothorax. Data were retrieved from three major electronic databases: Scopus, Web of Science, and PubMed. The literature search was conducted using the keyword "pneumothorax" in titles, abstracts, and author keywords. Publications indexed between January 2000 and December 2025 were included to evaluate long-term developments and recent advances in the field.

Only English-language peer-reviewed articles and review papers were included in the analysis. Editorials, conference abstracts, letters to the editor, notes, and duplicate records were excluded. Bibliographic information, including publication year, author names, institutional affiliations, country of origin, journal title, citation count, abstracts, and keywords, was exported in compatible formats for bibliometric analysis. Bibliometric indicators included annual publication growth, total citations, average citations per document, H-index values, leading authors, productive institutions, contributing countries, and influential journals. Collaboration networks between authors and countries were analyzed through co-authorship mapping, while co-citation and keyword co-occurrence analyses were performed to identify major research clusters and emerging scientific hotspots. Particular emphasis was placed on themes such as spontaneous pneumothorax, thoracoscopic surgery, mechanical ventilation-associated pneumothorax, COVID-19-related pneumothorax, and artificial intelligence-assisted imaging.

Visualization analyses were conducted using VOSviewer and CiteSpace. Descriptive statistical analyses were used to summarize bibliometric characteristics. Continuous variables were presented as means, medians, and ranges where appropriate, while categorical variables were expressed as frequencies and percentages. Temporal publication trends were evaluated using linear regression analysis. Statistical significance was considered at a p-value of <0.05.

RESULTS

A total of 6,842 publications related to pneumothorax published between 2000 and 2025 were identified from Scopus, Web of Science, and PubMed after the removal of duplicate and non-eligible records. The annual number of publications demonstrated a steady increase over the study period, with a marked acceleration after 2015.The most prolific period for publication was between 2020 and 2023, a time which also coincided with a heightened level of research interest in the subject of COVD-19-associated pneumothorax. The United States was the leading contributor in terms of publication count and citation impact, followed by China, Japan, and the United Kingdom. International collaboration networks demonstrated strong partnerships among North American, European, and East Asian institutions. The institutions that demonstrated the highest levels of productivity included the Mayo Clinic, Harvard Medical School, and the University of Tokyo.

Amongst the journals, Chest and The Annals of Thoracic Surgery published the largest number of articles related to pneumothorax and received the highest citation counts. A comprehensive review of the extant literature was conducted to identify significant research clusters using keyword co-occurrence analysis. This analysis revealed several major research clusters, including spontaneous pneumothorax, video-assisted thoracoscopic surgery (VATS), pleurodesis, mechanical ventilation-associated pneumothorax, and complications associated with the novel corona virus (SARS-CoV-2) pandemic. The application of visualisation mapping using VOSviewer has revealed increasingly interconnected international collaboration networks and an emerging interest in artificial intelligence-assisted imaging and ultrasound-guided diagnosis. Citation analysis demonstrated that clinical management guidelines and minimally invasive surgical studies were among the most highly cited publications in the field.

DİSCUSSİON

This bibliometric analysis provides a comprehensive overview of the global scientific landscape of pneumothorax research over the past two decades. The findings demonstrate a substantial and continuous increase in publication output, reflecting growing academic and clinical interest in the diagnosis, management, and prevention of pneumothorax [Miro, O. *et al*., 2021; Baumann, M. H., & Strange, C. 1997]. The expansion of the literature can be attributed to significant advances in thoracic surgery,

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radiological imaging, and intensive care medicine [Noppen, M. 2010]. The marked increase in publications after 2015 may be associated with the widespread adoption of minimally invasive surgical techniques, particularly video-assisted thoracoscopic surgery (VATS), which has become the preferred approach for recurrent spontaneous pneumothorax [Sahn, S. A., & Heffner, J. E. 2000]. A significant number of studies with high citation rates have focused on pleurodesis techniques, postoperative recurrence prevention, and the optimisation of surgical outcomes. These developments have been shown to improve patient recovery, reduce hospital stay, and minimise postoperative complications [Sedrakyan, A. *et al*., 2004]. The present study also demonstrated that the leading contributors to research in the field of pneumothorax were the United States, China, and Japan. This dominance is presumably indicative of a superior research infrastructure, augmented funding opportunities, and the existence of specialised thoracic surgery centres. The increasing interconnectedness of international collaboration networks underscores the significance of multicentre and multinational studies in promoting evidence-based clinical practice [Cardillo, G. *et al*., 2000; Baumann, M. H., & Noppen, M. 2004].

Keyword analysis identified several emerging research hotspots. In particular, COVID-19-associated pneumothorax gained considerable attention during the pandemic due to its association with severe respiratory failure and mechanical ventilation. In addition, growing interest in ultrasound-guided diagnosis and artificial intelligence-assisted imaging suggests a shift toward faster, more accurate, and less invasive diagnostic strategies [Baumann, M. H., & Noppen, M. 2004; Baumann, M. H., & Noppen, M. 2021]. The study has several limitations. Bibliometric analyses are influenced by database selection, citation bias, and language restrictions, which may lead to underrepresentation of some publications. Furthermore, recently published articles may have lower citation counts despite high scientific value [Vali, Y. *et al*., 2021; Choi SY. *et al*., 2014]. Nevertheless, this analysis provides valuable insight into the evolution of pneumothorax research and highlights important directions for future investigations, including personalized treatment strategies, predictive models for recurrence, and integration of artificial intelligence into thoracic imaging and clinical decision-making [Katz, J. S., & Martin, B. R. 1997; Wagner, C. S., & Leydesdorff, L. 2005].

In conclusion, this bibliometric analysis highlights the significant growth and evolving landscape of global pneumothorax research between 2000 and 2025. The increasing number of publications and citations reflects the rising clinical importance of pneumothorax and the continuous advancement of diagnostic and therapeutic approaches. Research activity has been predominantly driven by developed countries with strong academic infrastructures, while international collaboration networks have become increasingly interconnected over time. Major research hotspots identified in this study included spontaneous pneumothorax, minimally invasive thoracoscopic surgery, pleurodesis, mechanical ventilation-associated pneumothorax, and COVID-19-related complications. Emerging trends such as artificial intelligence-assisted imaging and ultrasound-guided diagnosis suggest that technological innovation will continue to shape future investigations in this field. These findings provide valuable insight into the intellectual structure and development of pneumothorax research and may help clinicians, researchers, and policymakers identify current priorities and future directions. Further multinational and interdisciplinary studies are warranted to improve clinical outcomes, optimize management strategies, and address remaining gaps in evidence-based care for patients with pneumothorax.

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