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REVIEW

A Bibliometric Analysis of Pulmonary Function Testing in Differentiating Asthma From COPD: Trends, Impact, and Emerging Research Areas

Noor Al Khathlan[1], Lama Omar Badghish[1], Hanin Hamed Alrehaili[2], Khalid Hamoud Olayan Al Luhaybi[2], Moayed Abdullah Alnakhli[3], Abdulhadi Jameel Alotaibi[4]

[1]Department of Respiratory Care, College of Applied Medical Sciences, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia; [2]Department of Respiratory Care, Saudi German Hospital, Madinah, Saudi Arabia; [3]Department of Respiratory Care, Al Hammadi Hospitals, Riyadh, Saudi Arabia; [4]College of Medicine, Vision Colleges, Riyadh, Saudi Arabia

Correspondence: Abdulhadi Jameel Alotaibi, College of Medicine, Vision Colleges, Riyadh, Saudi Arabia, Email Ahadijalotaibi@gmail.com

Background: Distinguishing between asthma and chronic obstructive pulmonary disease (COPD) remains a clinical challenge due to overlapping symptoms and pulmonary function test (PFT) results. Accurate differentiation is crucial for effective treatment and optimal patient care. This study employs bibliometric analysis to assess research trends, impact, and emerging areas in the use of PFTs for differentiating asthma from COPD.

Methods: A systematic search was conducted in the Web of Science Core Collection, including both asthma- and COPD-related terms to reflect clinical overlap, identifying publications from 1989 to November 2024. Data were analyzed using VOSviewer, CiteSpace, Excel, and Biblioshiny to evaluate publication trends, influential authors, key research themes, and international collaboration networks.

Results: The analysis included 241 original research and review articles. Research activity increased significantly after 2006, peaking in 2022. The United States and England were the leading contributors, with major academic institutions and AstraZeneca playing key roles. Keywords such as "spirometry", "diagnosis", and "bronchodilator response" emerged as major research trends. Co-citation analysis identified the European Respiratory Journal as the most influential source.

Conclusion: Bibliometric analysis highlights a growing body of research emphasizing the role of PFTs in differentiating asthma from COPD. While spirometry remains the gold standard, recent trends show increasing interest in novel diagnostic approaches. Further studies are needed to refine diagnostic criteria and improve clinical decision-making. Our findings underscore the novelty of this bibliometric analysis in mapping global research dynamics and highlight potential clinical implications for refining diagnostic strategies in asthma and COPD.

Keywords: bibliometric analysis, asthma, chronic obstructive pulmonary disease, pulmonary function testing, trends

Introduction

Asthma, as defined by the Global Initiative for Asthma (GINA), is a chronic inflammatory lung disease marked by intermittent respiratory symptoms (dyspnea, wheezing, cough, and chest tightness) with variable airway obstruction, often triggered by allergens and typically diagnosed early in life. The Global Initiative for Chronic Obstructive Lung Disease (GOLD) defines COPD as a progressive respiratory disease characterized by airflow limitation, chronic or recurrent cough (with or without sputum), and dyspnea, primarily due to prolonged exposure to noxious particles such as tobacco smoke, with diagnosis usually occurring after age 40.[1,2] Recent updates to the GOLD definition emphasize not only the traditional features of airflow limitation and symptom burden but also the concept of impaired lung regeneration and the need for a more nuanced classification system. This evolving perspective highlights that COPD is not merely a disease of chronic airflow obstruction, but one linked to failed tissue repair and broader systemic consequences.[3,4] Diagnosis relies on medical history, symptom assessment, and pulmonary function tests (PFTs), particularly spirometry.[2]

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A bronchodilator reversibility test follows when an obstructive pattern is detected.[5,6] However, distinguishing between asthma and COPD in adults is challenging for primary care physicians, with diagnostic difficulties reported in up to 19.8% of obstructive disease cases.[7] Overlapping symptoms and PFT results contribute to this challenge.[8] While asthma is traditionally associated with reversible obstruction and COPD with irreversible obstruction, some COPD patients exhibit significant reversibility.[9]

Accurate differentiation is crucial for treatment selection.[8,9] Inhaled corticosteroids (ICS) are effective for asthma but offer limited benefits in COPD, reducing exacerbations by 20–25% in severe cases without improving lung function or mortality.[10,11] Long-acting bronchodilators are the primary COPD treatment, with ICS reserved for frequent exacerbations or high blood eosinophils.[12] Misdiagnosing COPD as asthma and using ICS monotherapy can be risky.[13] Bibliometric analysis evaluates scientific literature to identify patterns, trends, and research impact. It systematically examines authorship, geographic contributions, institutional influence, and publishing trends, offering insights into the evolution of a field.[14,15]

This study conducts a bibliometric analysis of research on the diagnostic differentiation of asthma and COPD in primary care. By mapping publication trends, citation dynamics, and collaboration networks, it aims to highlight influential studies, key contributors, and research gaps, guiding future advancements in diagnosis and healthcare practices.

Methods

Data Collection

A search was conducted on November 11, 2024, using the Web of Science Core Collection, a reliable and extensive database encompassing over 12,000 esteemed publications, to gather information on published article.[16–18] The search strategy utilized a variety of keywords, including “Pulmonary Function Testing”, “PFT”, “Spirometry”, “Respiratory Function Tests”, “Asthma”, “Bronchial Asthma”, “Asthmatic Disease”, “COPD”, “Chronic Obstructive Pulmonary Disease”, “Chronic Obstructive Lung Disease”, “Airflow Obstruction, Chronic”, “Chronic Airflow Obstructions”, “Differentiation”, “Diagnosis”, “Comparison”, and “Discrimination”, to enhance precision and relevance. Although the primary focus of this study was COPD, asthma-related articles were also included. This decision was intentional, as pulmonary function testing is often applied in both conditions due to their overlapping clinical features and the shared role of spirometry and related modalities in differential diagnosis. Including asthma literature ensures a comprehensive evaluation of the use of pulmonary function tests across obstructive airway diseases, avoids selection bias, and reflects real-world clinical practice where distinguishing COPD from asthma remains a diagnostic challenge. The initial search yielded 1,085 papers. After excluding book chapters, editorials, conference papers, letters, and pre-publication articles, the final dataset included 241 (Figure 1). It should be noted that this study relied exclusively on the Web of Science Core Collection. While this ensured methodological consistency, it may have excluded relevant articles indexed only in Scopus, PubMed, or Google Scholar. This limitation means that certain influential studies may not have been captured, potentially narrowing the representation of the full research landscape.

Only original research and review articles were included due to their rigorous peer-review processes, which ensure the scientific credibility and value of the studies. Other types of literature, such as conference proceedings, editorials, and books, were excluded because they typically lack the same level of peer review or indexing, potentially affecting the consistency and reliability of citation trends in bibliometric analyses. Retracted papers were also excluded to maintain the integrity of the dataset, as they no longer represent valid scientific contributions. Additionally, non-English publications were excluded because the bibliometric software tools used are optimized for processing English-language text. This limitation ensured consistency and accuracy in the analysis by focusing solely on English-language papers.

Data Screening

To ensure the quality and relevance of the included studies, a comprehensive screening process was conducted. The titles, abstracts, and keywords of all retrieved publications were carefully reviewed. When the relevance or quality of a study was unclear based on these criteria, the full text was examined. This rigorous approach ensured that only studies

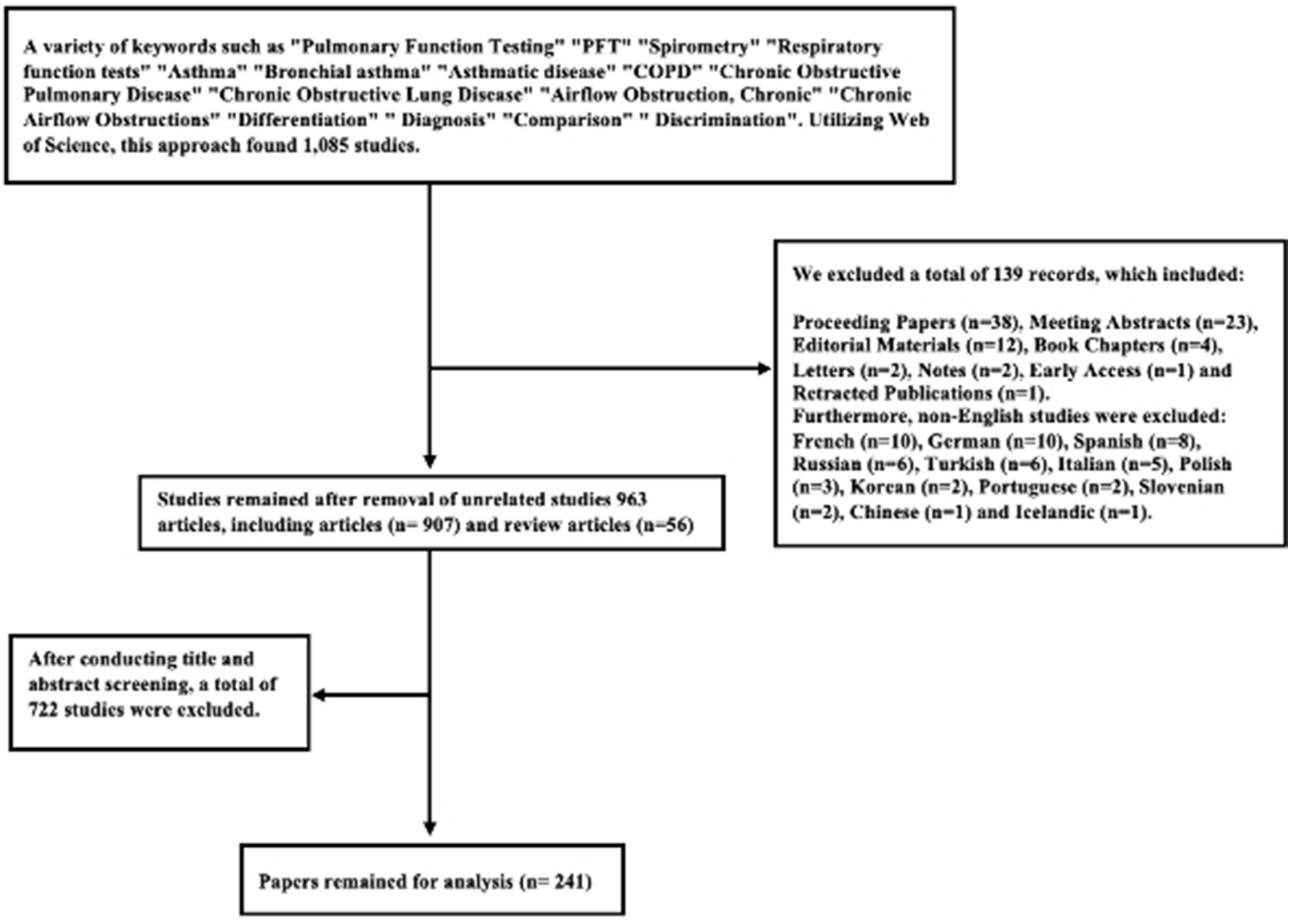

Figure 1 Study Selection Process.

specifically related to pulmonary function testing for differentiating asthma from COPD were included, maintaining the focus and integrity of the analysis.

Data Analysis

We utilized VOSviewer, CiteSpace, and Biblioshiny (R Bibliometrix package) to analyze the relevant documents downloaded from the Web of Science Core Collection. The data was then converted into plain text and CSV formats for further processing. VOSviewer, developed by the Center for Science and Technology Studies at Leiden University in the Netherlands, is a powerful tool for scientometric network analysis. It excels in generating network maps and visually representing connections within scholarly literature. Using VOSviewer, we created network diagrams to illustrate co-citation, co-occurrence, citation, and bibliographic coupling among publications, journals, authors, research institutions, countries, and keywords.[19–21]

CiteSpace, another key tool in our analysis, is a Java-based application that integrates scientometric and data visualization techniques to explore citation networks. This approach helps uncover the dynamics, structure, and distribution patterns of scientific knowledge through detailed knowledge maps. By applying advanced data mining algorithms and comprehensive information analysis, CiteSpace enables researchers to identify significant developments, influential studies, and emerging research trends in academic discourse.[22]

Biblioshiny, a web-based graphical user interface for the Bibliometrix R package, further facilitated our bibliometric analysis. This intuitive tool allowed us to perform various tasks, including network analysis, descriptive data exploration, and bibliometric network visualization.[23]

Results

Publication Trend

The journey of research on pulmonary function testing for distinguishing asthma from COPD has been gradual yet impactful. Between 1989 and 2005, only a few studies were published each year, reflecting the early stages of interest in this field. Starting around 2006, there was a noticeable increase in research activity, with a steady rise in publications through 2017. Milestones during this period include peaks like 12 studies in 2012 and 26 studies in 2016, signaling growing attention to this important clinical topic. The years 2018 to 2023 saw some fluctuation in publication numbers, with 32 studies published in 2022, the highest recorded so far. However, the slight decline to 15 studies in both 2023 and 2024 may be attributed to the time required for ongoing studies to be completed and published. This trend highlights the evolving focus on pulmonary function testing as a valuable tool for better understanding and managing asthma and COPD (Figure 2).

The research on pulmonary function testing for differentiating asthma from COPD has shown remarkable growth over the years. In the early stages, progress was slow, with only 2 cumulative publications recorded in 1989, and this number increased to just 11 by 2005. During this time, research activity was sporadic, with several years passing without any new contributions.

However, starting in 2006, the field experienced steady growth, reaching 79 cumulative publications by 2015. This marked the beginning of a more sustained interest in this critical topic. From 2016 onward, research output surged significantly, reflecting the rising importance of pulmonary function testing in clinical practice. By 2024, the cumulative total had reached 240 publications, showcasing a substantial increase in attention and advancements in this field (Figure 3).

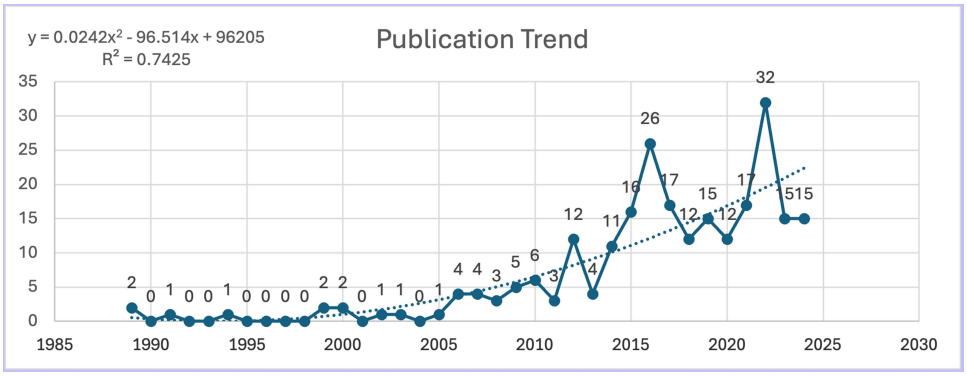

Figure 2 Trends in publication regarding pulmonary function testing for differentiating asthma from COPD.

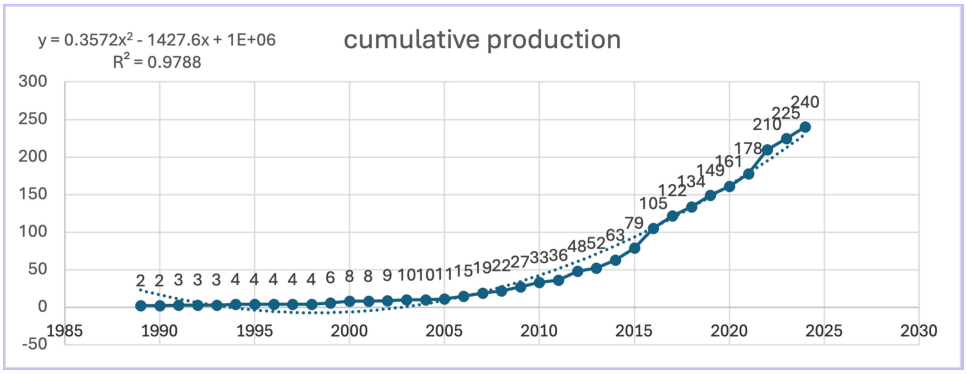

Figure 3 Cumulative publications regarding pulmonary function testing for differentiating asthma from COPD.

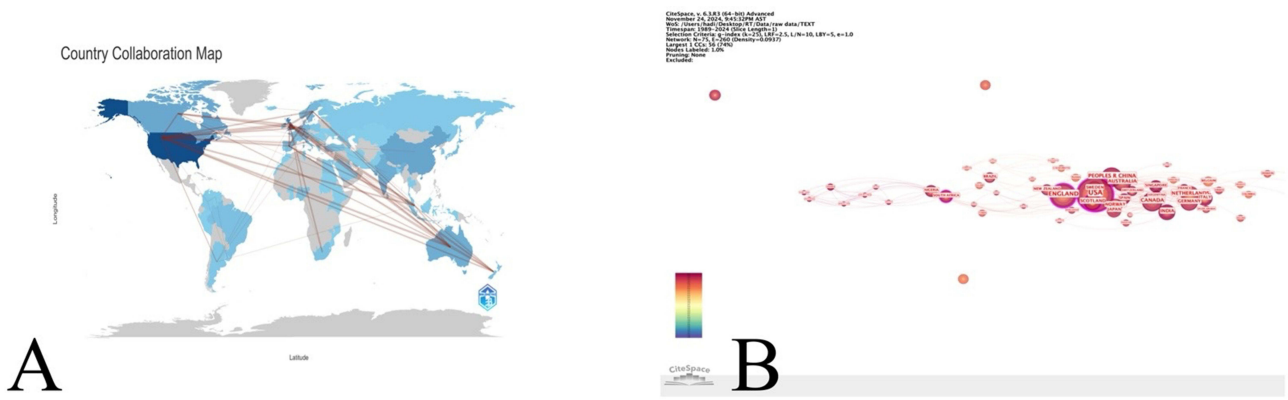

Figure 4 (**A**) Countries collaboration in the field of pulmonary function testing for differentiating asthma from COPD. (**B**) Countries with the highest centrality in the field of pulmonary function testing for differentiating asthma from COPD.

Countries and Institutions

The examination of global contributions in the field of pulmonary function testing for differentiating asthma from COPD revealed that researchers from 75 countries have collaborated in this area (Figure 4A). Among the top contributors, the United States led with a remarkable output (n=61), followed by England (n=33), demonstrating their strong focus on this research domain. China and Canada each made notable contributions (n=18), while Australia and the Netherlands also showed significant involvement (n=15 each). Additionally, India (n=14), Norway (n=12), and both Germany and Scotland (n=11 each) contributed valuable insights to advance this important area of study (Table 1).

The top ten countries in terms of centrality are presented in Table 1. England emerged as the country with the highest centrality (0.28), followed by the USA (0.25). Other countries with notable centrality values included South Africa (0.18), Scotland (0.12), and France (0.10). The Netherlands (0.09), Australia (0.08), Nigeria (0.08), Russia (0.08), and Canada (0.06) also played significant roles in maintaining the cohesion and influence of the research network (Table 1). Figure 4B illustrates the collaborative network among countries, highlighting central nodes such as England and the USA, which acted as significant centers of collaboration. Figure 5 depicts the collaboration strength among different countries.

Regarding institutions, AstraZeneca led with (11) publications, followed by the University of Toronto, UiT The Arctic University of Tromsø, and Imperial College London, each contributing (9) publications. Harvard University and the

Table 1 Top 10 Countries by Number of Publications and Top 10 Countries by Centrality

Rank	Country	Number of Publications	Country	Centrality
1	United States of America	61	England	0.28
2	England	33	United States of America	0.25
3	People's Republic of China	18	South Africa	0.18
4	Canada	18	Scotland	0.12
5	Australia	15	France	0.10
6	Netherlands	15	Netherlands	0.09
7	India	14	Australia	0.08
8	Norway	12	Nigeria	0.08
9	Germany	11	Russia	0.08
10	Scotland	11	Canada	0.06

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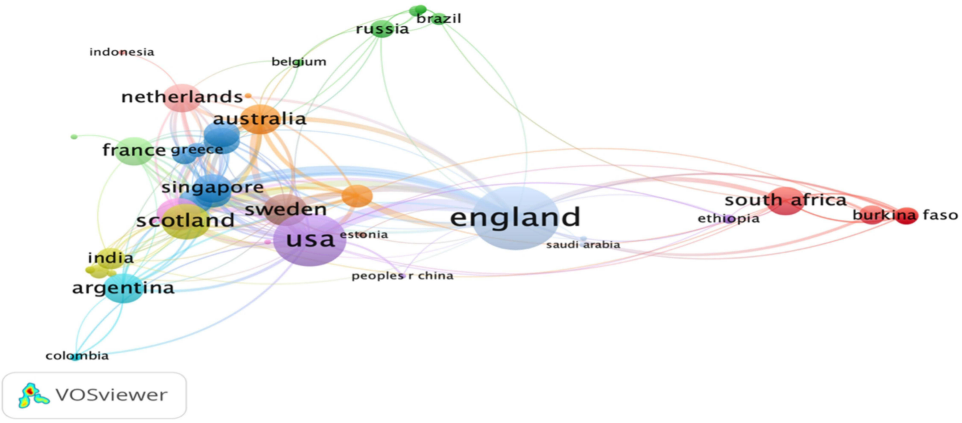


Figure 5 Network visualization of the countries in the field of pulmonary function testing for differentiating asthma from COPD.

University of Sydney both produced (7) works, alongside the University of Aberdeen. The Woolcock Institute of Medical Research contributed (6) publications, while both CIBERES and McGill University had (5) each (Table 2 and Figure 6). Figure 7 illustrates the collaboration strength among different institutions.

Journals and Co-Cited Journals

The bibliometric analysis identified 115 journals publishing on pulmonary function testing for differentiating asthma from COPD. The International Journal of Chronic Obstructive Pulmonary Disease led with 20 publications, followed by Respiratory Medicine with 10 articles and BMC Pulmonary Medicine and CHEST, each contributing 9 publications. Other significant sources included NPJ Primary Care Respiratory Medicine with 8 articles, ERJ Open Research and Respiration, each with 7 publications, Respiratory Care with 6, and both COPD-Journal of Chronic Obstructive Pulmonary Disease and the European Respiratory Journal with 5 articles each. Figure 8 illustrates the top ten journals in the field of pulmonary function testing for differentiating asthma from COPD.

The co-citation analysis revealed that the European Respiratory Journal had the highest number of citations, with 794. This was followed by CHEST with 630 citations and the American Journal of Respiratory and Critical Care Medicine with 623 citations. Thorax received 377 citations, while Respiratory Medicine and the International Journal of Chronic

Table 2 Top 10 Institutions by Number of Publications

Rank	Institutions	Number of Publications
1	AstraZeneca	11
2	University of Toronto	9
3	UiT The Arctic University of Tromso	9
4	Imperial College London	9
5	Harvard University	7
6	University of Sydney	7
7	University of Aberdeen	7
8	Woolcock Institute of Medical Research	6
9	CIBERES	5
10	McGill University	5

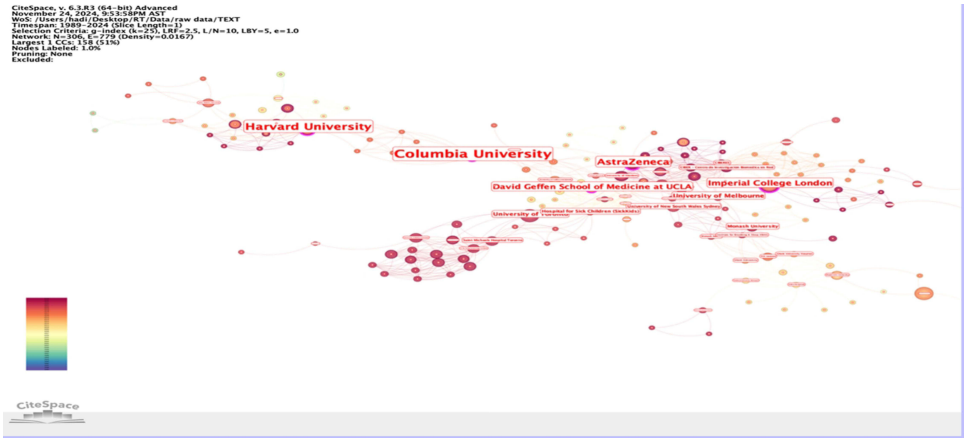
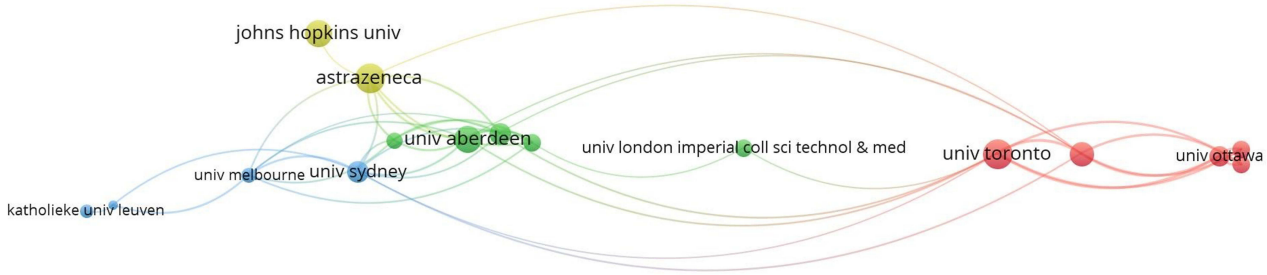


Figure 6 Institutions with the highest centrality in the field of pulmonary function testing for differentiating asthma from COPD.



VOSviewer

Figure 7 Network visualization of the institutions in the field of pulmonary function testing for differentiating asthma from COPD.

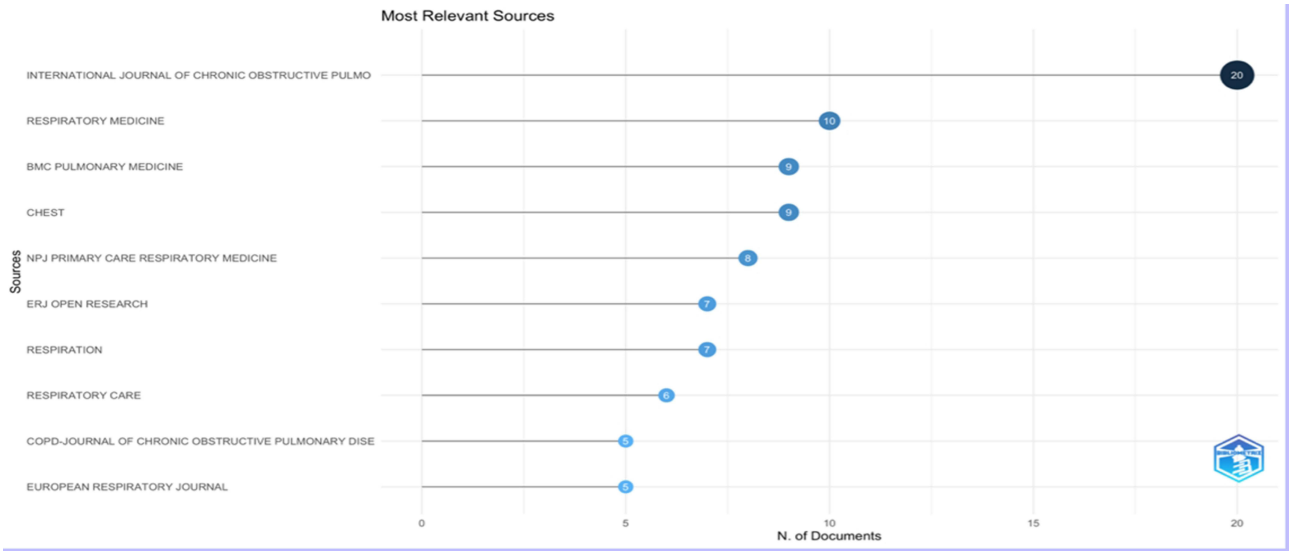


Figure 8 Top 10 journals in the field of pulmonary function testing for differentiating asthma from COPD.

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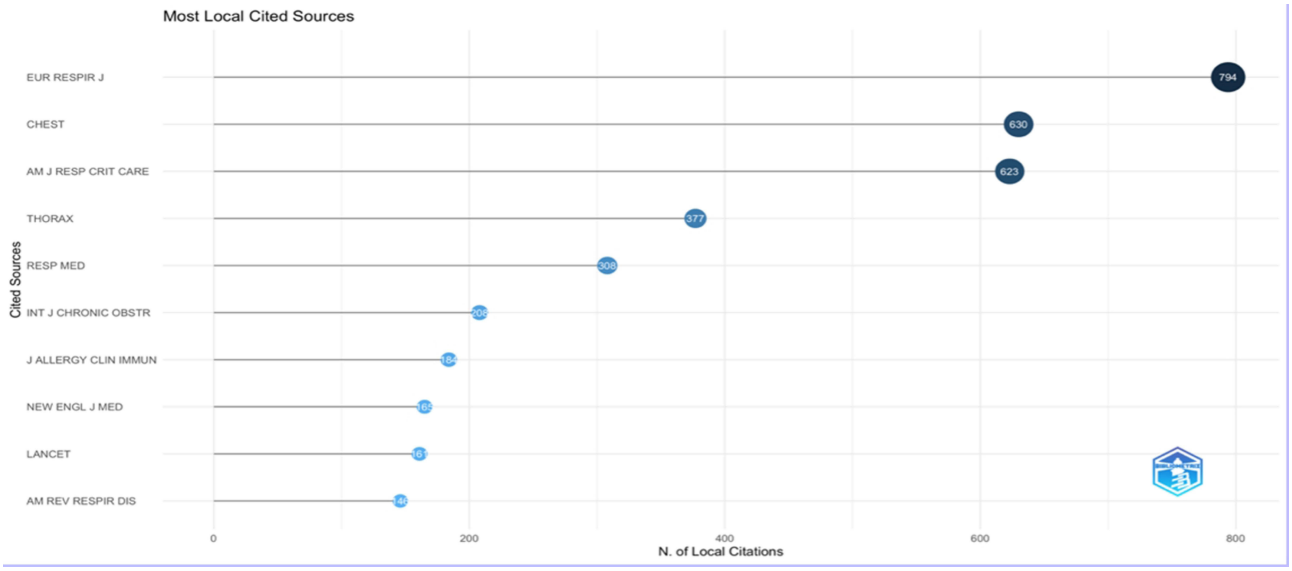

Figure 9 Top 10 co-cited journals in the field of pulmonary function testing for differentiating asthma from COPD.

Obstructive Pulmonary Disease garnered 308 and 208 citations, respectively. Figure 9 presents the top ten co-cited journals in the field of pulmonary function testing for differentiating asthma from COPD.

The analysis of publication trends over time, depicted in Figure 10, reveals the evolution of research output across multiple journals in the field of pulmonary function testing for differentiating asthma from COPD. The cumulative number of publications remained low during the early years, with journals such as Respiratory Medicine and BMC Pulmonary Medicine contributing minimal research until around 2015. From 2016 onwards, there was a noticeable increase in research activity, with journals like Chest and NPJ Primary Care Respiratory Medicine showing more significant contributions. The most prominent growth occurred in International Journal of Chronic Obstructive Pulmonary Disease, which saw a substantial rise in publications from 2020 onwards, establishing itself as the leading journal in the field. The overall trend exhibited a sharp increase in publications over the past decade, with a marked

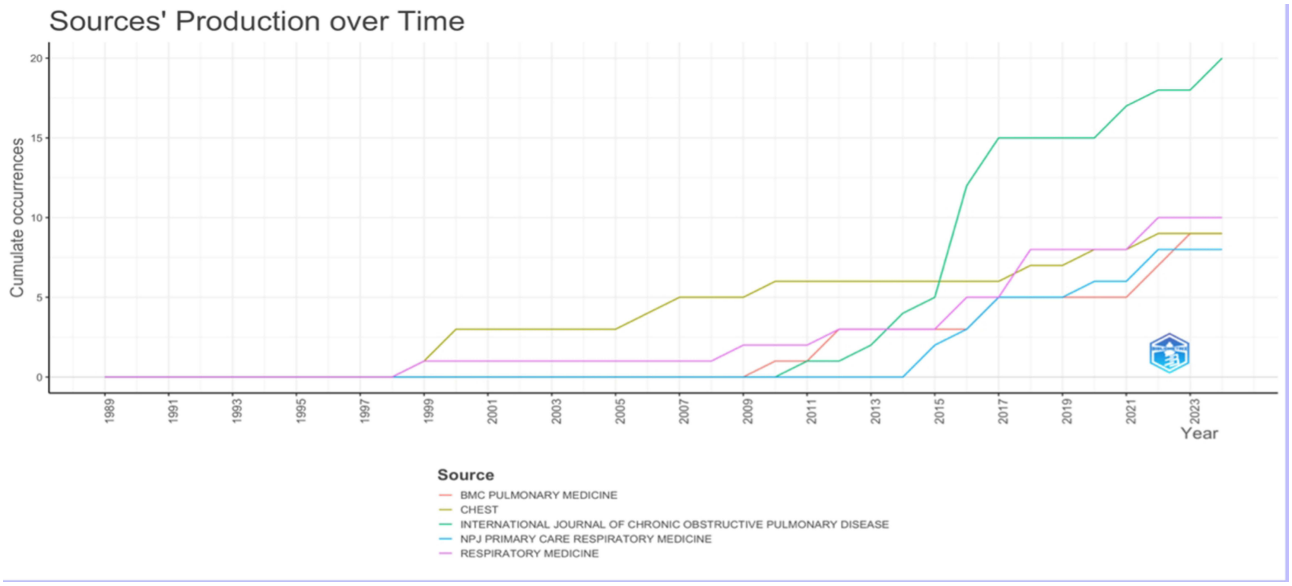

Figure 10 Journals' productions over time in the field of pulmonary function testing for differentiating asthma from COPD.

acceleration starting around 2020. This surge reflected the growing interest and advancements in pulmonary function testing during this period.

Authors and Co-Cited Authors

The analysis of contributions in the field of pulmonary function testing for differentiating asthma from COPD revealed key authors who have significantly influenced the research landscape. Hasse Melbye emerged as the leading author, contributing the highest number of publications (n=9). Following him, David Price (n=7) and Samir Gupta (n=6) made substantial contributions. Christer Janson and Shawn D. Aaron also ranked highly, each with (n=6) and (n=5) publications, respectively (Table 3).

In terms of citations, David Price was the most cited author, with (n=304) citations. Christer Janson followed with (n=165) citations, while Helen K. Reddel had a notable (n=153) citations. J. Mark Fitzgerald and Hasse Melbye rounded out the top five, each with (n=121) and (n=112) citations, respectively (Table 3).

The co-citation analysis revealed Mr. Miller as the most frequently co-cited author, with (n=77) citations. M. Miravitlles (n=57) and Ph. Quanjer (n=57) also featured prominently in the co-citation network. R. Pellegrino and Br. Celli were notable as well, with (n=48) and (n=37) co-citations, respectively (Table 3).

This analysis underscores the significant contributions of these authors in advancing the understanding of pulmonary function testing in distinguishing asthma from COPD.

Top Cited Papers

Table 4 lists the top 10 most cited papers in the field of pulmonary function testing for differentiating asthma from COPD, highlighting their significant impact on the field. The most cited paper was titled "Standardization of Spirometry

Table 3 Top 10 Authors by Publications, Citations, and Co-Citations

Number	Author with High Number of Publications	Number of Publications	Author with High Number of Citations	Number of Citations	The most Co-cited Authors	Number of co-citations
1	Melbye, Hasse	9	Price, David	304	Miller, Mr	77
2	Price, David	7	Janson, Christer	165	Miravitlles, M	57
3	Gupta, Samir	6	Reddel, Helen K.	153	Quanjer, Ph	57
4	Janson, Christer	6	Fitzgerald, J. Mark	121	Pellegrino, R	48
5	Aaron, Shawn D.	5	Gupta, Samir	112	Celli, Br	37
6	Fitzgerald, J. Mark	5	Melbye, Hasse	112	Gibson, Pg	33
7	Ainslie, Martha	4	Beasley, Richard	92	Mannino, Dm	33
8	Azher, Tanweer	4	Agusti, Alvar	84	Aaron, Sd	33
9	Boulet, Louis-Philippe	4	Make, Barry	83	Vestbo, J	32
10	Field, Stephen K.	4	Aaron, Shawn D.	58	Barnes, Pj	31

Table 4 Top ten Cited Papers in the Field of Pulmonary Function Testing for Differentiating Asthma From COPD

Number	Title of Most Cited Paper	Published Year	Number of Citations
1	Standardization of Spirometry 2019 Update. An Official American Thoracic Society and European Respiratory Society Technical Statement[24]	2019	16
2	Global Initiative on Asthma (GINA), 2020, GLOBAL STRATEGY FOR ASTHMA MANAGEMENT AND PREVENTION[25]	2020	16
3	Increased risk of exacerbation and hospitalization in subjects with an overlap phenotype: COPD-asthma[26]	2014	10

(*Continued*)

Table 4 (Continued).

Number	Title of Most Cited Paper	Published Year	Number of Citations
4	Underdiagnosis and Overdiagnosis of Chronic Obstructive Pulmonary Disease[27]	2018	9
5	Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary[28]	2013	9
6	High hospital burden in overlap syndrome of asthma and COPD[29]	2013	8
7	What is asthma-COPD overlap syndrome? Towards a consensus definition from a round table discussion[30]	2016	8
8	Reevaluation of Diagnosis in Adults With Physician-Diagnosed Asthma[31]	2017	8
9	Underdiagnosis and Overdiagnosis of Asthma[32]	2018	8
10	Standardisation of spirometry[33]	2005	8

2019 Update. An Official American Thoracic Society and European Respiratory Society Technical Statement", published in 2019, with 16 citations. Sharing the top spot, the 2020 paper "Global Initiative on Asthma (GINA), GLOBAL STRATEGY FOR ASTHMA MANAGEMENT AND PREVENTION" also received 16 citations.

The third most cited work, "Increased risk of exacerbation and hospitalization in subjects with an overlap phenotype: COPD-asthma", published in 2014, garnered 10 citations. Ranked fourth, the 2018 article "Underdiagnosis and Overdiagnosis of Chronic Obstructive Pulmonary Disease" received 9 citations. The fifth most cited article, "Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary", published in 2013, also achieved 9 citations.

Additional notable papers include the 2013 publication "High hospital burden in overlap syndrome of asthma and COPD", with 8 citations, and the 2016 paper "What is asthma-COPD overlap syndrome? Towards a consensus definition from a round table discussion", which also received 8 citations. Similarly, the articles "Reevaluation of Diagnosis in Adults With Physician-Diagnosed Asthma" (2017), "Underdiagnosis and Overdiagnosis of Asthma" (2018), and "Standardisation of spirometry" (2005) each garnered 8 citations. Figure 11 illustrates the citation burst of published papers in this field. A total of 25 papers experienced a citation burst.

Keyword Trends, Hotspots, Cluster Analysis

The analysis of keywords identified several that frequently appeared in research on pulmonary function testing for differentiating asthma from COPD. The ten most prominent keywords included "asthma" (n=132), "COPD" (n=131), "spirometry" (n=77), "obstructive pulmonary disease" (n=72), "diagnosis" (n=61), "prevalence" (n=55), "chronic obstructive pulmonary disease" (n=47), "management" (n=34), "lung function" (n=35), and "primary care" (n=18) (Figure 12).

The analysis of central keywords in the context of Pulmonary Function Testing for Differentiating Asthma from COPD revealed the following top ten influential terms: "chronic obstructive pulmonary disease" (0.22), "asthma" (0.22), "prevalence" (0.21), "diagnosis" (0.21), "obstructive pulmonary disease" (0.19), "COPD" (0.17), "pulmonary disease" (0.13), "air flow obstruction" (0.13), "airway obstruction" (0.07), and "lung function" (0.07) (Figure 13).

Our analysis identified the ten most prominent keywords in the field of pulmonary function testing for differentiating asthma from COPD, reflecting current research trends and focal areas. These keywords include "COPD", "asthma", "spirometry", "diagnosis", "management", "chronic obstructive pulmonary disease", "lung function", "inflammation",

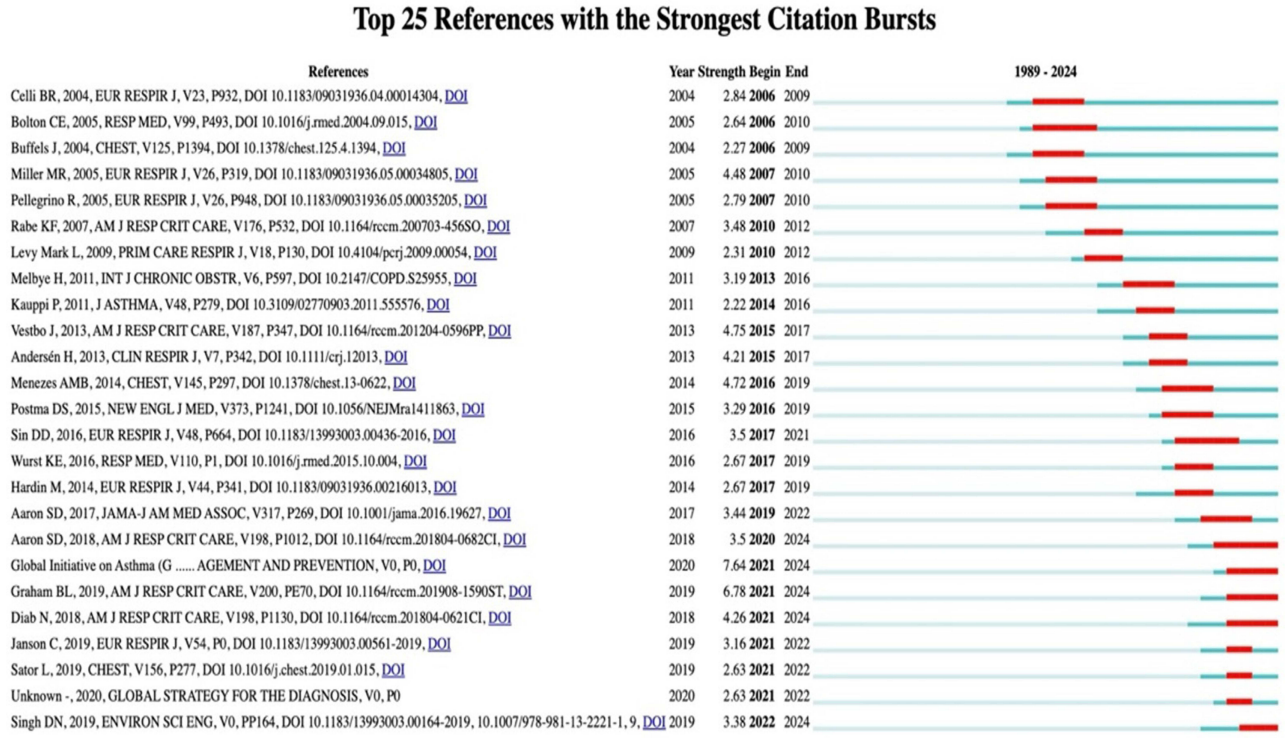

Figure 11 Citation burst of the papers in the field of pulmonary function testing for differentiating asthma from COPD.

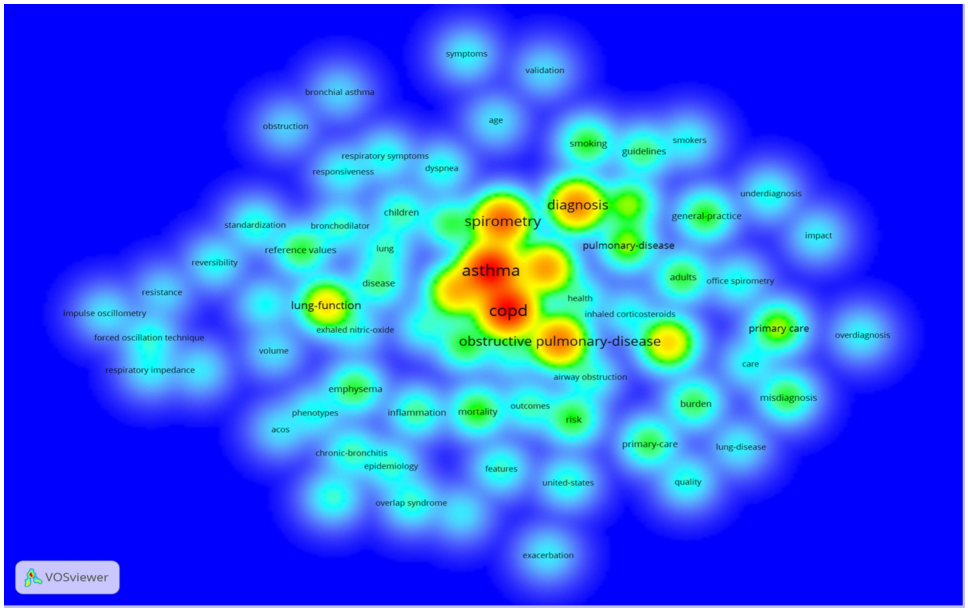

Figure 12 Density visualization map of the keywords in the field of pulmonary function testing for differentiating asthma from COPD.

"risk", and "exacerbations". These terms underscore the primary topics and emerging interests within the research community, highlighting potential areas for future exploration (Figure 14A).

The cluster analysis identified 11 main clusters, representing significant areas of research focus related to pulmonary function testing for differentiating asthma from COPD. These clusters included Chronic Respiratory Disease (#0), Drug

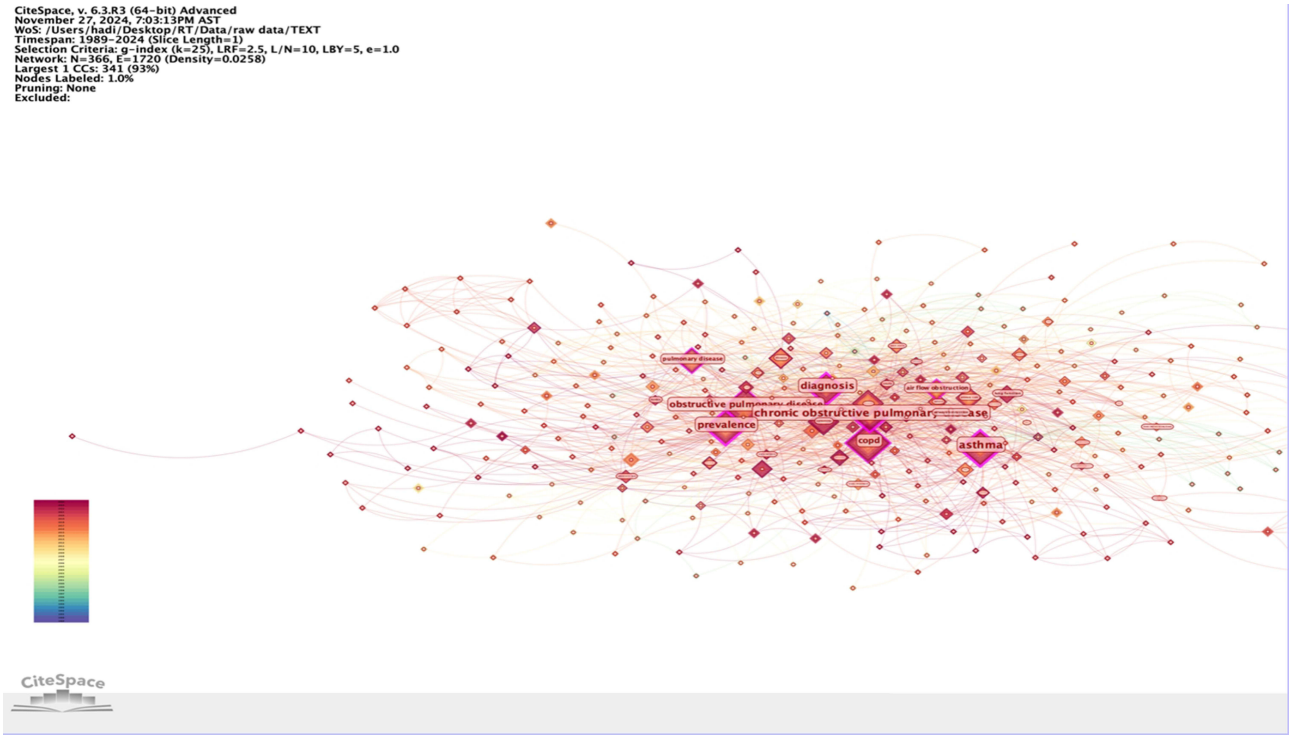

Figure 13 Keywords with the high centrality in the field of pulmonary function testing for differentiating asthma from COPD.

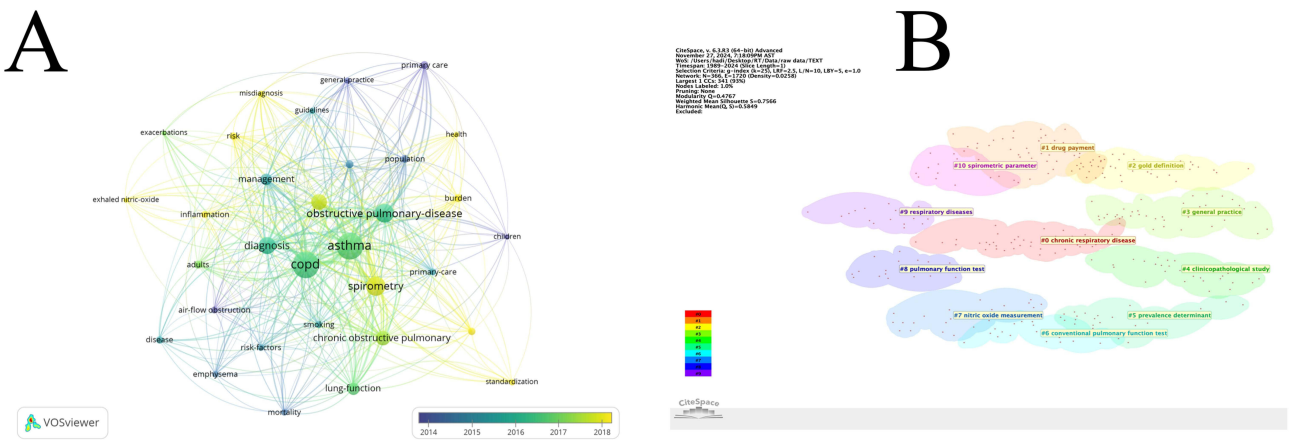

Figure 14 (**A**) Overlay visualization of keywords in the field of pulmonary function testing for differentiating asthma from COPD and (**B**) Cluster analysis of the topics in the field of pulmonary function testing for differentiating asthma from COPD.

Payment (#1), GOLD Definition (#2), General Practice (#3), Clinicopathological Study (#4), Prevalence Determinant (#5), Conventional Pulmonary Function Test (#6), Nitric Oxide Measurement (#7), Pulmonary Function Test (#8), Respiratory Diseases (#9), and Spirometric Parameter (#10) (Figure 14B).

The time trend analysis highlights a progression of research clusters related to this topic, with certain clusters gaining prominence over time. Recently, clusters such as "asthma-COPD overlap" (#0), "clinical characteristics" (#4), and "benralizumab" (#6) have attracted considerable attention, reflecting evolving trends in the field (Figure 15).

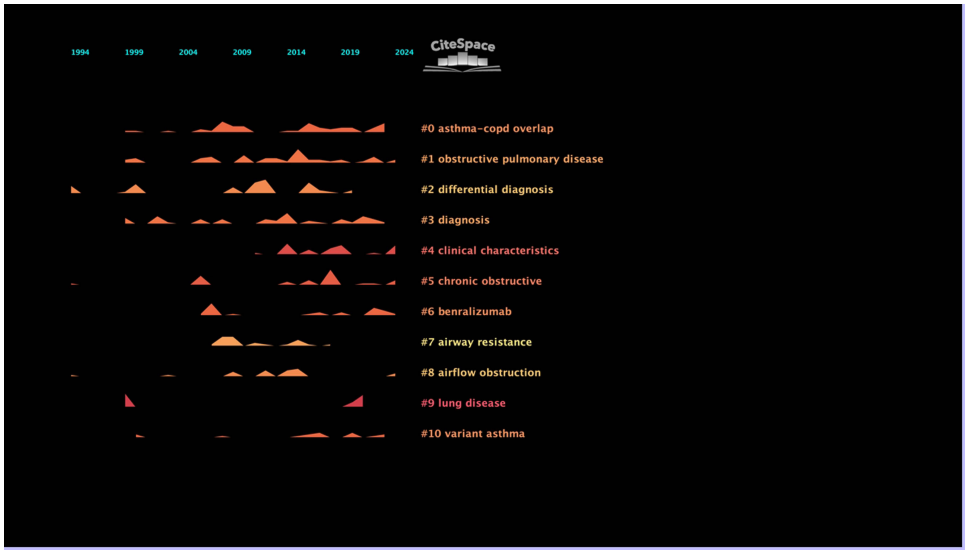

Figure 15 Time trend analysis of topics in the field of pulmonary function testing for differentiating asthma from COPD.

Discussion

The differentiation between asthma and chronic obstructive pulmonary disease (COPD) remains a critical challenge in respiratory medicine due to overlapping symptoms and pulmonary function test (PFT) results.[34] Accurate diagnosis is crucial as it impacts treatment strategies and long-term patient outcomes.[35] Our bibliometric analysis of research trends in this field highlights the growing interest in refining diagnostic approaches, with research output expanding significantly after 2006 and peaking in 2022, reaching 240 publications by 2024. This trend aligns with previous studies emphasizing the need for improved diagnostic criteria beyond traditional spirometry.[36] Recent advancements in machine learning have shown promise in enhancing diagnostic accuracy, as demonstrated by studies incorporating AI-based models for respiratory function assessment.[37,38]

Global collaboration plays a key role in advancing research on PFT differentiation.[39] The United States (n=61) and England (n=33) emerged as the most prolific contributors, followed by China (n=18) and Canada (n=18). England and the US also had the highest centrality scores, highlighting their influence in international research networks. These findings parallel prior bibliometric studies in respiratory medicine, which highlight the dominance of Western institutions in shaping global guidelines.[40,41] However, the increasing contributions from China and India reflect a broader shift toward global research equity, aligning with trends observed in precision medicine and lung disease diagnostics.[41]

The involvement of both academia and industry has been instrumental in shaping this field. AstraZeneca led institutional contributions with 11 publications, while leading universities such as the University of Toronto, UiT The Arctic University of Tromsø, and Imperial College London contributed 9 publications each. This is consistent with prior reports showing that pharmaceutical industry participation in respiratory research often accelerates the translation of novel biomarkers into clinical practice.[42–44] A study also emphasized on the need for collaboration between academic institutions and industry to refine diagnostic algorithms, particularly in differentiating asthma-COPD overlap syndrome.[45]

Despite the reliance on spirometry as the gold standard, the research landscape suggests a need for more refined diagnostic tools.[46] Recent studies indicate an increasing focus on asthma-COPD overlap, clinical characteristics, and targeted therapies like benralizumab.[47,48] The role of eosinophilic inflammation in guiding treatment strategies has gained traction, particularly in biologic therapy selection for obstructive lung diseases.[49,50] Moving forward, interdisciplinary collaborations integrating clinical expertise, artificial intelligence, and molecular diagnostics may pave the way for improved differentiation techniques, reducing misdiagnosis and enhancing patient care.[51]

Our bibliometric findings underscore a rapidly evolving field with increasing international collaboration, industry engagement, and a shift toward novel diagnostic methodologies. The surge in research output, the dominance of key

journals such as the European Respiratory Journal (n=794 citations), and the involvement of high-impact authors suggest a strong foundation for future advancements. Expanding research into underrepresented regions and focusing on non-invasive diagnostic biomarkers will be essential in addressing existing limitations. As research progresses, integrating multi-omics data, AI-driven diagnostics, and patient-centered care models will be crucial in refining asthma and COPD differentiation, ultimately improving long-term clinical outcomes.[52,53]

Limitations

First, the study's reliance solely on the Web of Science Core Collection may have excluded relevant articles from PubMed, Scopus, or non-indexed journals, limiting the comprehensiveness of the dataset. This may have led to biases, particularly underrepresenting research from specific regions or alternative methodologies in pulmonary function testing (PFT) for differentiating asthma from COPD. Second, the study included only English-language publications, potentially overlooking valuable research in non-English journals, especially from Asia, Latin America, and Europe. Future analyses incorporating multilingual studies would provide a more global perspective on PFT research. Third, the bibliometric tools used (VOSviewer, CiteSpace, and Biblioshiny) rely on citation counts, which are not always accurate indicators of research quality. Factors such as journal reputation, author collaboration networks, and topic popularity may skew citation metrics, potentially underrepresenting impactful studies published in less prominent journals. Additionally, our analysis only includes publications up to November 2024, meaning recent advancements may not be fully captured. Bibliometric analyses are also subject to publication bias, often favoring studies with positive or novel findings, which could affect the generalizability of our results. Finally, the field of pulmonary diagnostics is rapidly evolving. As our study represents a snapshot of 2024, ongoing updates will be essential to capture new developments in PFT research.

Summary of Key Updates

In summary, this bibliometric analysis highlights the sharp growth of research on pulmonary function testing (PFT) for differentiating asthma from COPD since 2006, with the United States, England, and leading academic institutions playing central roles, alongside contributions from industry such as AstraZeneca. While spirometry remains the gold standard, recent trends emphasize asthma–COPD overlap, precision medicine, and biologic therapies. Emerging diagnostic tools, including fractional exhaled nitric oxide (FeNO), impulse oscillometry, and artificial intelligence–based models, are gaining traction, pointing toward more refined and accurate diagnostic strategies. Strong international collaborations have further shaped the field, with expanding contributions from Asia. Collectively, these findings underscore a transition from traditional reliance on spirometry toward innovative, interdisciplinary approaches that integrate clinical, technological, and biomarker-based strategies to improve diagnostic precision and patient outcomes.

Future Perspectives

Looking ahead, future research should expand beyond traditional spirometry to incorporate novel diagnostic modalities that may refine the differentiation between asthma and COPD. Fractional exhaled nitric oxide (FeNO) has emerged as a valuable biomarker for airway inflammation and may offer additional sensitivity in distinguishing asthma from COPD phenotypes.[54,55] Similarly, impulse oscillometry provides complementary information on small airway dysfunction and has shown promise in differentiating obstructive patterns where spirometry alone may be insufficient.[56] Emerging work has also highlighted the role of alternative physiological measurements in capturing subtle differences between these diseases.[57] Integration of these tools with artificial intelligence and machine learning algorithms could further improve diagnostic accuracy and support precision medicine approaches. By embracing these innovations, future studies may pave the way toward more nuanced, patient-centered diagnostic strategies in obstructive airway diseases.

Conclusion

This comprehensive bibliometric analysis provides novel insights into the evolving landscape of pulmonary function testing (PFT) for differentiating asthma from COPD. By systematically mapping publication trends, citation dynamics, and global collaborations, the study not only identifies influential research and leading contributors but also highlights

gaps that warrant further investigation. The findings underline the originality of this work as one of the first bibliometric evaluations dedicated specifically to asthma–COPD differentiation. Clinically, the results emphasize the ongoing reliance on spirometry while drawing attention to the growing importance of emerging diagnostic approaches, such as FeNO, impulse oscillometry, and machine learning–based tools. These innovations carry the potential to enhance diagnostic accuracy, reduce misclassification, and improve patient outcomes by guiding more tailored therapeutic strategies. Future efforts should prioritize interdisciplinary collaboration, biomarker discovery, and the integration of artificial intelligence to ensure that diagnostic precision continues to advance in step with patient-centered care.

Data Sharing Statement

The data supporting the findings of this study were sourced from the Web of Science Core Collection database. These data are available upon reasonable request to the corresponding author.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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