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Blibiometric analysis of detection lung cancer

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Abstract

Purpose: This study aims to analyze global research trends in lung cancer detection using a bibliometric approach. It focuses on identifying publication growth, dominant research themes, citation patterns, and collaboration networks to better understand the direction and innovation of lung cancer detection research.

Methods: A bibliometric analysis was conducted using publication records retrieved from the Scopus database covering the period from 2019 to 2024. Key indicators such as publication output, citation counts, keyword co-occurrence, and author collaboration networks were analyzed.

Results: The results indicate a steady increase in publications related to lung cancer detection over the analyzed period. Major research themes include circulating tumor DNA, early detection strategies, next-generation sequencing, and liquid biopsy technologies. The analysis also reveals strong international collaboration networks, highlighting the global nature of lung cancer research and the collective effort to improve detection technologies.

Conclusion: The study concludes that research on lung cancer detection is rapidly expanding, driven by technological advancements and growing interest in non-invasive diagnostic approaches. Emerging technologies are expected to play a critical role in enhancing early diagnosis and reducing lung cancer mortality rates.

Limitation: This study is limited by its reliance on a single database (Scopus) and a relatively short time frame, which may not capture all relevant publications or long-term research trends.

Contribution: This research provides a comprehensive baseline reference for scholars and practitioners, offering valuable insights into current research directions and supporting future advancements in early lung cancer detection methods.

Keywords: *Bibliometric Analysis, Circulating Tumor DNA, Early Detection, Lung Cancer, Research Trends*

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1. Introduction

Lung cancer is one of the leading causes of death worldwide, with incidence rates increasing every year (Torre, Siegel, & Jemal, 2016). The World Health Organization (WHO) notes that lung cancer is among the three most common and deadliest cancers worldwide. The incidence and mortality rates of lung cancer are mainly influenced by risk factors such as smoking, exposure to air pollution, exposure to hazardous chemicals, and genetic factors (Akhtar & Bansal, 2017). In Asia, the increasing prevalence of lung cancer is directly proportional to the high number of smokers and exposure to pollution in urban areas, making this disease an urgent public health issue (Pakzad, Mohammadian-Hafshejani, Ghoncheh, Pakzad, & Salehiniya, 2015).

Research on lung cancer has progressed significantly over the past few decades in various aspects, including prevention, diagnosis, and therapy. This development can be observed from the increasing number of scientific publications on lung cancer, both at the national and international levels. Research focusing on early detection methods and the development of new therapies has also progressed rapidly, especially with the support of modern medical and biotechnological technologies. These studies are expected to make a real contribute to efforts to reduce the incidence and mortality of lung cancer.

Bibliometric analysis is an effective method for understanding research patterns in a field, including lung cancer (B. Wang et al., 2022). This method evaluates various scientific indicators, such as publication volume, collaboration patterns between researchers, and identification of influential authors and journals in the field (Okubo, 1997). Through a bibliometric approach, researchers can understand the development of research topics over time, find the most discussed topics, and identify the most frequently used methods (Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021). This analysis provides a comprehensive mapping of research developments in the field of lung cancer that can serve as a reference for other researchers who want to continue or deepen their research in this area (Jing et al., 2024).

This study aimed to analyze the development of scientific publications on lung cancer using bibliometric methods, focusing on trends and patterns of collaboration between countries and institutions and the role of individuals or journals in the development of related studies. By utilizing data from an international publication database, this study provides an overview of the contribution of various parties to the development of lung cancer science. This study also aims to highlight areas that are still rarely explored, so that they can become future research opportunities.

2. Literature review

2.1. Lung Cancer Detection Research Trends

Lung cancer remains one of the most fatal malignancies worldwide, driving continuous scientific interest in improving early detection and diagnostic accuracy. Over the last decade, research attention has increasingly shifted from conventional imaging-based diagnostics toward molecular and biomarker-based detection methods, particularly those utilizing circulating tumor DNA (ctDNA), liquid biopsy, and genomic profiling techniques (Molla & Bitew, 2025). These innovations aim to enable earlier diagnosis, reduce invasive procedures, and support personalized treatment strategies.

Recent studies demonstrate a notable increase in publications focusing on early detection technologies, including next-generation sequencing (NGS), DNA methylation analysis, and fragmentomic profiling (Dimitrios Mathios et al., 2021). The rapid growth of these studies reflects broader technological advancements in molecular biology and bioinformatics, which have substantially expanded the analytical capacity for cancer detection research. Consequently, lung cancer detection has become a highly dynamic research domain characterized by interdisciplinary collaboration and methodological diversification.

2.2. Bibliometric Analysis in Medical and Cancer Research

Bibliometric analysis has been widely applied as a systematic approach to map scientific knowledge structures, identify research trends, and evaluate scholarly impact within specific fields (Gan, Li, Robinson, & Liu, 2022). In medical research, bibliometric methods are particularly valuable for assessing the evolution of research themes, identifying influential publications, and examining collaboration networks among authors and institutions.

Several bibliometric studies in oncology have demonstrated that publication growth and citation patterns can effectively reflect scientific priorities and technological breakthroughs (X. Wang et al., 2019). Visualization tools such as VOSviewer enable researchers to detect keyword co-occurrence patterns, thematic clusters, and emerging research fronts, thereby offering a comprehensive overview of knowledge development in complex research areas such as lung cancer detection (Guo, Huang, & Lai, 2024).

Despite the growing volume of lung cancer research, systematic bibliometric mapping focusing specifically on detection-related studies remains limited. This gap highlights the need for an integrative analysis that captures publication trends, dominant research themes, and collaborative structures within the lung cancer detection literature.

2.3. Research Themes and Keyword Evolution in Lung Cancer Detection

Keyword-based analyses in cancer research reveal that scientific focus often evolves alongside technological innovation. In lung cancer detection studies, frequently occurring keywords such as circulating tumor DNA, liquid biopsy, non-small cell lung cancer, and next-generation sequencing indicate a strong emphasis on molecular diagnostics and minimally invasive detection strategies (Smolle, Taucher, Lindenmann, Pichler, & Smolle-Juettner, 2021).

The emergence of machine learning and advanced bioinformatics techniques further reflects the integration of computational approaches into cancer diagnostics. These trends suggest that lung cancer detection research is progressively moving toward data-driven, precision-based diagnostic models. Understanding how these themes cluster and evolve is essential for identifying future research opportunities and underexplored areas within the field.

2.4. Collaboration Networks in Lung Cancer Detection Research

Scientific collaboration plays a crucial role in accelerating innovation, particularly in complex biomedical fields. Previous bibliometric studies indicate that highly collaborative research networks tend to produce more impactful and highly cited publications (Guan, Yan, & Zhang, 2017). In lung cancer research, international and inter-institutional collaborations have increased significantly, driven by the need for large datasets, multidisciplinary expertise, and shared technological resources. Co-authorship network analysis enables the identification of key researchers and collaboration hubs that shape knowledge dissemination. Authors with central positions in collaboration networks often act as knowledge brokers, facilitating methodological diffusion and advancing research agendas within the field.

3. Methodology

This study adopted a systematic bibliometric approach to identify and analyze the literature (Garza-Reyes, 2015; Hudha et al., 2020). The research method involved five stages Tranfield, Denyer, and Smart (2003); Setyaningsih, Indarti, and Jie (2018), as presented in Figure 1.

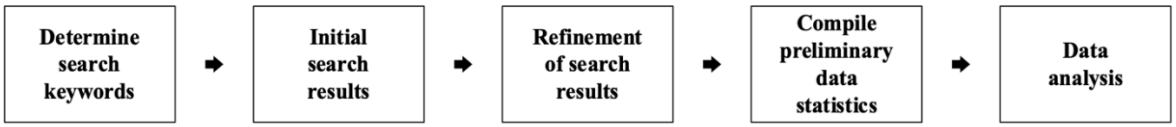

Figure 1. Five-step Method Bibliometric Analysis

3.1. Determine Search Keywords

At this stage, a literature search was conducted in November 2024 using the keyword “lung cancer detection” in the Scopus database. The Publish or Perish tool was used to conduct specific searches on article titles published between specific years, ensuring that the results focused on lung cancer detection in a scientific context.

3.2. Initial Search Results

The initial search returned 101 articles relevant to the research topic. The initial data were extracted in the RIS format to include the main information of each article, such as title, author, affiliation, abstract, and keywords.

3.3. Refinement of Search Result

Articles obtained from the initial search were screened to ensure that only journal articles were included. This procedure excluded other types of publications, such as proceedings, book reviews, and book

chapters. The filtered data were then imported into the reference management software Zotero to ensure proper management and storage.

3.4. Compile Preliminary Data Statistics

After the data were filtered, the information of each article was verified and compiled in RIS format and then analyzed to obtain the distribution of articles by year, publication source, and number of citations per year. These preliminary statistics provide an overview of publication trends and research developments in lung cancer detection.

3.5. Data Analysis

VOSviewer software was used for the bibliometric data analysis and visualization. VOSviewer was chosen because of its ability to process large datasets and generate network visualizations, such as keyword relationship maps, major topic clusters, and inter-author collaboration (Mu et al., 2022). These visual maps provide insights into frequently occurring keywords, connectivity among researchers, and research trends in lung cancer detection.

4. Result and Discussion

4.1. Publication and Citation Structure

Table 1 shows a comparison between the initial and filtered search results related to research on "lung cancer detection" for the period 2019-2024. Based on the initial search results, 101 articles on the topic were found with a total of 1,498 citations. This resulted in an average citation per year of 299.6 and an average citation per article of 14.83. Once the search was further filtered, the number of articles found was reduced to 84, with a total of 1,267 citations. Despite the decrease in the number of articles and citations, the average number of citations per article increased to 15.08, indicating that the articles in the more focused search results were of higher relevance or quality in the eyes of the academic community.

Table 1. Comparison metrics

Metrics data	*Initial search*	*Refine search*
Source	'lung cancer detection'	'lung cancer detection'
Publication year	2019-2024	2019-2024
Papers	101	84
Citations	1498	1267
Cites/year	299.6	253.4
cites/paper	14.83	15.08

The researcher attempted to present the most relevant contributions to this study. The step taken was to take 84 articles with the keyword "lung cancer detection" which has the highest citation value (10 cited articles). The results are presented in Table 2.

Table 2. Top 10 cited articles

No	Author	Title	Cites	Year	Publisher
1	Mathios, Johansen, Cristiano, and Medina (2021)	Detection and characterization of lung cancer using cell-free DNA fragmentomes	224	2021	Nature Communications
2	Davies et al. (2019)	DNA-Based versus RNA-Based Detection of MET Exon 14 Skipping Events in Lung Cancer	116	2019	Journal of Thoracic Oncology

3	Zhang et al. (2019)	Ultrasensitive Detection of Circulating Tumor DNA of Lung Cancer via an Enzymatically Amplified SERS-Based Frequency Shift Assay	75	2019	ACS Applied Materials and Interfaces
4	Liu et al. (2020)	Detection of Promoter DNA Methylation in Urine and Plasma Aids the Detection of Non–Small Cell Lung Cancer	62	2020	Clinical Cancer Research
5	Ma et al. (2020)	Detection of circulating tumor DNA from non-small cell lung cancer brain metastasis in cerebrospinal fluid samples	61	2020	Thoracic Cancer
6	Pruis, Geurts-Giele, and Meijssen (2020)	Highly accurate DNA-based detection and treatment results of MET exon 14 skipping mutations in lung cancer	43	2020	Lung Cancer
7	Yang, Qi, Sun, and Zhou (2019)	DNA methylation analysis of selected genes for the detection of early-stage lung cancer using circulating cell-free DNA	36	2019	Advances in Clinical and Experimental Medicine
8	Peng et al. (2019)	CNV detection from circulating tumor DNA in late stage non-small cell lung cancer patients	35	2019	Genes
9	Wei et al. (2021)	A panel of DNA methylation biomarkers for detection and improving diagnostic efficiency of lung cancer	30	2021	Scientific Reports
10	S. Wang et al. (2023)	Multidimensional Cell-Free DNA Fragmentomic Assay for Detection of Early-Stage Lung Cancer	25	2023	American journal of respiratory and critical care medicine

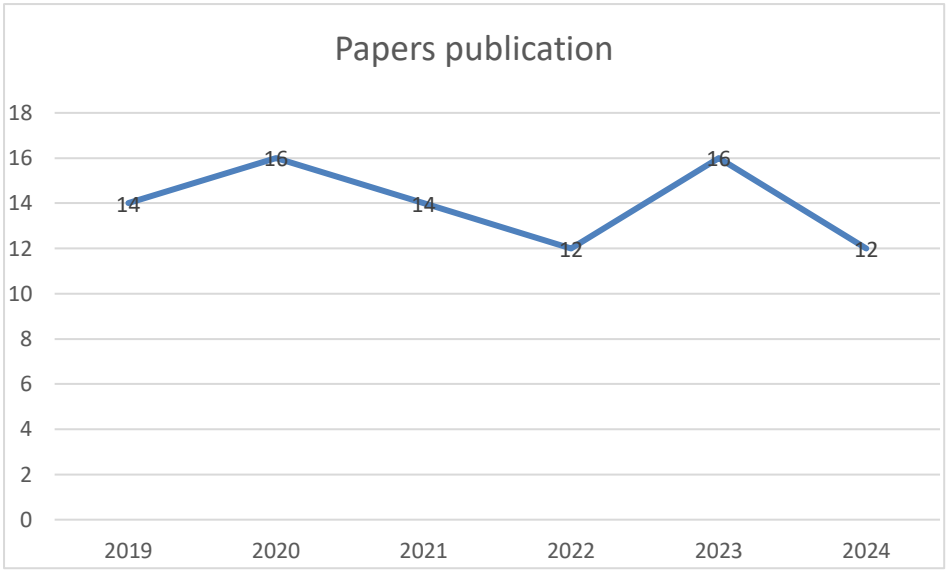

Figure 2. Papers Publication/Year

This bibliometric analysis identifies publication trends and citation patterns in "lung cancer detection" research based on Scopus data. Of the 84 selected articles, the distribution of articles showed an increase in research in recent years. The most cited article was that by (D. Mathios et al., 2021) in Nature Communications, with 224 citations, indicating high academic interest in tumor characterization-based detection methods.

4.2. Keyword Network Visualization

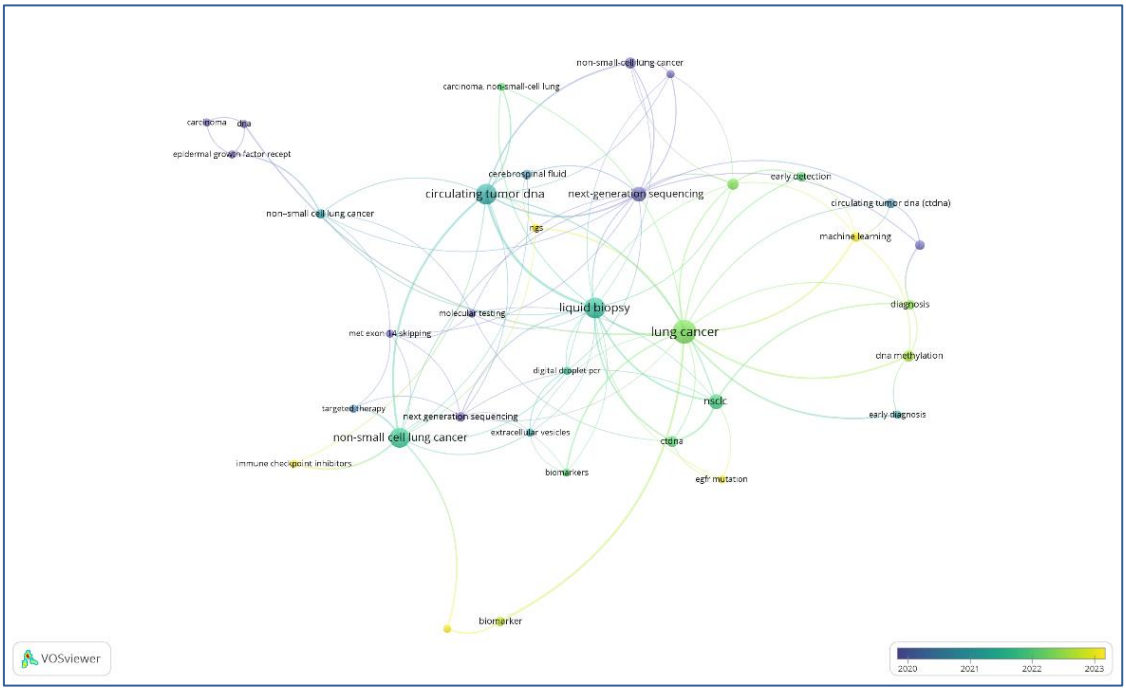

Figure 3. Network Visualization on Scopus Database

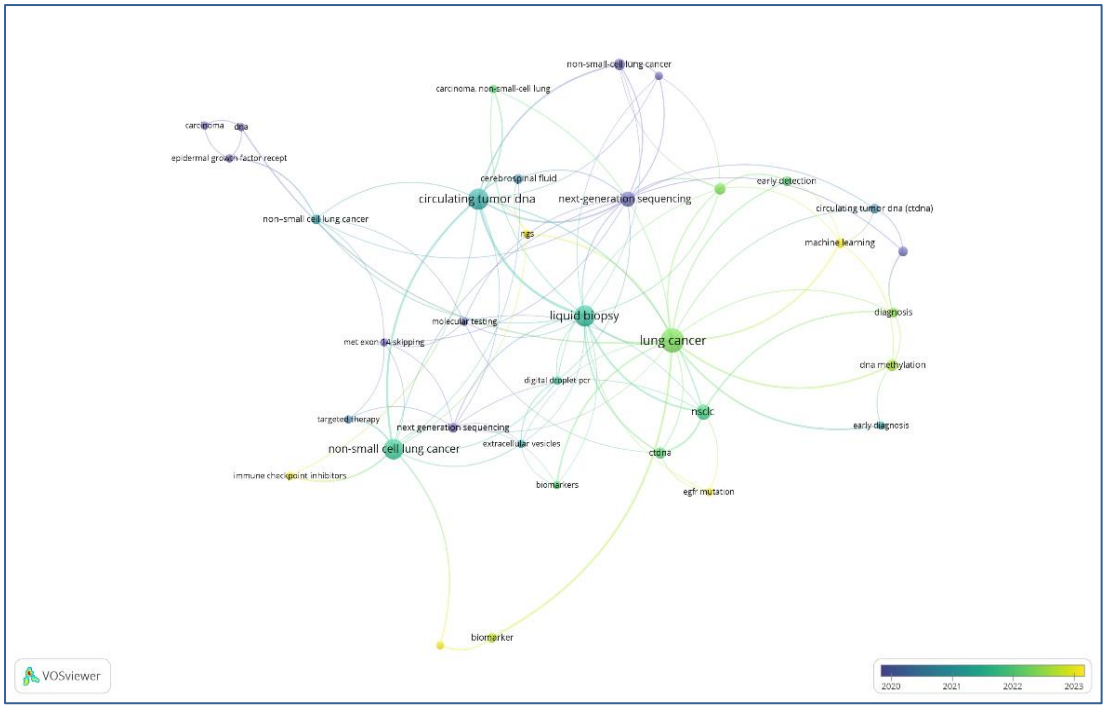

Figure 4. Overlay Visualization

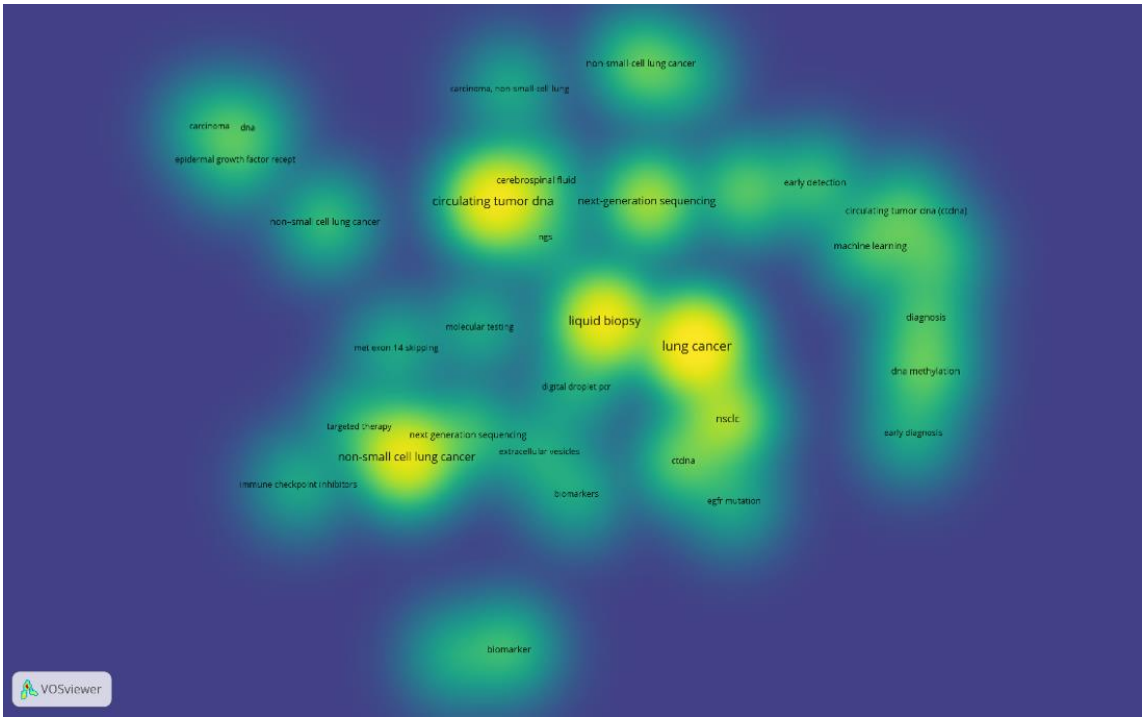

Figure 5. Density Visualization

Keyword network visualization with VOSviewer identified major clusters in lung cancer detection research. Seven main clusters of keywords appear in this network

Table 3. The cluster keyword represents

No	Cluster	Element
1	Cluster 1 (red) - 9 item	Cell-free dna(8), circulating tumor dna(ctdna)(4), diagnosis(4), dna methylation(4), early detection(3), early diagnosis(2), lung cancer(16), machine learning(5), non-small cell lung cancer (nsclc)(3).

2	Cluster 2 (green) - 8 item	Biomarkers(4), digital droplet pcr(5), extracellular vesicles(6), immune checkpoint inhibitors(2), met exon 14 skipping(6), next generation sequencing(9), non-small cell lung cancer(11), targeted therapy(3).
3	Cluster 3 (blue) - 5 item	ctdna(5), egfr mutation(3), liquid biopsy(16), molecular testing(6), nsclc(7)
4	Cluster 4 (yellow) - 4 item	Carcinoma, non-small-cell lung(3), cerebrospinal fluid(4), circulating tumor dna(12), ngs(4).
5	Cluster 5 (purple) - 4 item	Carcinoma(2), dna (3), epidermal growth factor receptor(3), non-small cell lung cancer(6).
6	Cluster 6 (light blue) - 3 item	Gene mutation(5), next-generation sequencing(13), non-small-cell lung cancer(5).
7	Cluster 7 (orange) - 2 item	Biomarker(2), cancer detection(2).

4.3. Author Relationships and Collaborations

Figure 6 shows a visualization of the co-authorship network between lead authors in research related to lung cancer detection. In this network, each node represents an author, and the connecting lines between nodes indicate co-authorship collaborations. Authors with a high number of collaborations, such as Kong Jinming and Zhang Jingen, appear to have a central role in the network, as indicated by their position at the center and the extensive number of connections. Colored nodes indicate collaboration groups or subgroups of authors who often work together on a specific topic.

For example, the group led by Zhang Jawen is colored red, whereas the group involving Wang Dazhong is represented by blue. This reflects the connectedness between authors working in certain specializations and similar research areas. This network provides an overview of the structure of academic collaboration in lung cancer detection research, identifying key authors who are often key contributors and facilitating knowledge flow in this field.

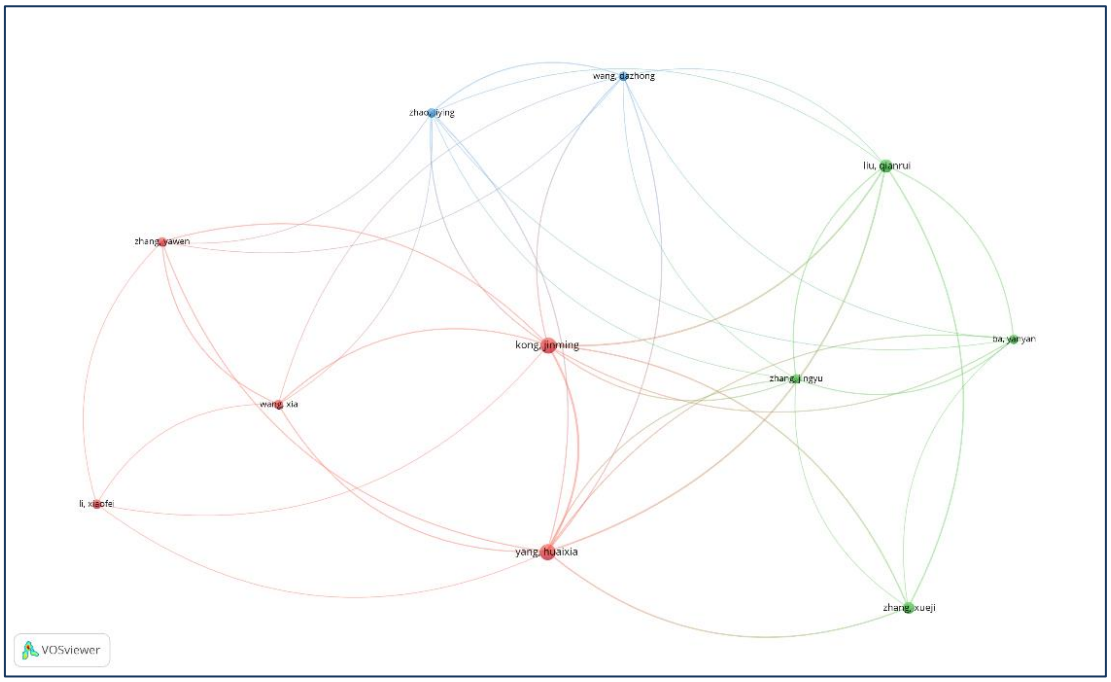

Figure 6. Author relationship and collaboration

4.4. Discussions

This study identifies research trends and collaboration networks in the field of lung cancer detection using data from articles published between the period 2019-2024. Based on the results of the bibliometric analysis, there is increasing interest and publications in lung cancer detection research as

technologies such as next-generation sequencing and liquid biopsy develop. These technologies play an important role in the early detection of cancer biomarkers, which is key to improving patients' life expectancy. From the keyword visualization, it can be seen that the main topics frequently researched in lung cancer detection include circulating tumor DNA, non-small cell lung cancer, and molecular testing.

The strong relationship between these keywords indicates a focus on developing more accurate and less invasive lung cancer detection methods. This finding indicates that the scientific community is increasingly recognizing the importance of early detection in lung cancer treatment and is actively developing new and more efficient approaches. The co-authorship network analysis shows that some authors have significant influence in this field, such as Kong Jinming and Zhang Jingen, who have collaborated with other researchers. These close collaborations accelerate knowledge dissemination and drive innovation in lung cancer detection methods.

Overall, this study provides insights into the latest developments and collaborative structures in lung cancer detection research. We hope that the results of this study can serve as a basis for future research to improve diagnostic techniques and reduce lung cancer mortality. In the future, further research on the application of machine learning and genomic profiling is expected to open new opportunities for more personalized and precise lung cancer detection.

5. Conclusions

5.1. Conclusion

This bibliometric study provides a comprehensive overview of global research trends in lung cancer detection during the period 2019–2024. The findings reveal a consistent increase in scientific publications, indicating growing academic and clinical interest in early and accurate lung cancer detection. Dominant research themes include circulating tumor DNA, liquid biopsy, next-generation sequencing, and molecular biomarkers, highlighting a strong shift toward non-invasive and precision-based diagnostic approaches. The citation and keyword analyses confirm that technological innovation plays a central role in advancing detection methods. In addition, the co-authorship network demonstrates strong international collaboration, suggesting that lung cancer detection research is driven by collective global efforts. Overall, this study confirms that lung cancer detection research is rapidly evolving and increasingly focused on early diagnosis to reduce mortality rates.

5.2. Implications

The results of this study have important theoretical and practical implications. From a theoretical perspective, the findings enrich the understanding of the evolution of lung cancer detection research, particularly in relation to emerging technologies and interdisciplinary collaboration. The identification of dominant keywords and research clusters provides a conceptual framework that can guide future studies and help researchers position their work within the existing scientific discourse. From a practical perspective, the strong emphasis on non-invasive detection technologies indicates significant potential for improving clinical screening and early diagnosis practices. Policymakers, healthcare institutions, and medical researchers can use these insights to prioritize research funding, strengthen international collaboration, and accelerate the translation of advanced detection technologies into clinical applications.

5.3. Suggestions

Based on the findings and limitations of this study, several recommendations are proposed for future research. First, future bibliometric analyses should incorporate multiple databases, such as Web of Science and PubMed, to provide broader coverage and reduce database bias. Second, extending the analysis period would enable the identification of long-term research trends and emerging shifts in lung cancer detection strategies. Third, future studies should combine bibliometric analysis with qualitative content analysis to better capture the depth and clinical impact of key innovations. Finally, further research is encouraged to explore the integration of machine learning, artificial intelligence, and genomic profiling in lung cancer detection, as these approaches hold strong potential for advancing personalized and precision medicine.

References

Akhtar, N., & Bansal, J. G. (2017). Risk factors of Lung Cancer in nonsmoker. *Current problems in cancer, 41*(5), 328-339. doi:https://doi.org/10.1016/j.currproblcancer.2017.07.002

Davies, K. D., Lomboy, A., Lawrence, C. A., Yourshaw, M., Bocsi, G. T., Camidge, D. R., & Aisner, D. L. (2019). DNA-based Versus RNA-based Detection of MET Exon 14 Skipping Events in Lung Cancer. *Journal of Thoracic Oncology, 14*(4), 737-741. doi:https://doi.org/10.1016/j.jtho.2018.12.020

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of business research, 133*, 285-296. doi:https://doi.org/10.1016/j.jbusres.2021.04.070

Gan, Y.-n., Li, D.-d., Robinson, N., & Liu, J.-p. (2022). Practical guidance on bibliometric analysis and mapping knowledge domains methodology–A summary. *European Journal of Integrative Medicine, 56*, 102203. doi:https://doi.org/10.1016/j.eujim.2022.102203

Garza-Reyes, J. A. (2015). Lean and green–a systematic review of the state of the art literature. *Journal of cleaner production, 102*, 18-29. doi:https://doi.org/10.1016/j.jclepro.2015.04.064

Guan, J., Yan, Y., & Zhang, J. J. (2017). The impact of collaboration and knowledge networks on citations. *Journal of Informetrics, 11*(2), 407-422. doi:https://doi.org/10.1016/j.joi.2017.02.007

Guo, Z., Huang, L., & Lai, S. (2024). Global knowledge mapping and emerging research trends in the microbiome and asthma: A bibliometric and visualized analysis using VOSviewer and CiteSpace. *Heliyon, 10*(2). doi:https://doi.org/10.1016/j.heliyon.2024.e24528

Hudha, M. N., Hamidah, I., Permanasari, A., Abdullah, A. G., Rachman, I., & Matsumoto, T. (2020). Low Carbon Education: A Review and Bibliometric Analysis. *European Journal of Educational Research, 9*(1), 319-329.

Jing, Y., Wang, C., Chen, Y., Wang, H., Yu, T., & Shadiev, R. (2024). Bibliometric mapping techniques in educational technology research: A systematic literature review. *Education and Information Technologies, 29*(8), 9283-9311. doi:https://doi.org/10.1007/s10639-023-12178-6

Liu, B., Filho, J. R., Mallisetty, A., Villani, C., Kottorou, A., Rodgers, K., . . . Hulbert, A. (2020). Detection of Promoter DNA Methylation in Urine and Plasma Aids the Detection of Non–Small Cell Lung Cancer (pp. 4339-4348). doi:https://doi.org/10.1158/1078-0432.CCR-19-2896

Ma, C., Yang, X., Xing, W., Yu, H., Si, T., & Guo, Z. (2020). Detection of circulating tumor DNA from non-small cell lung cancer brain metastasis in cerebrospinal fluid samples. *Thoracic Cancer, 11*(3), 588-593. doi:https://doi.org/10.1111/1759-7714.13300

Mathios, D., Johansen, J. S., Cristiano, S., & Medina, J. E. (2021). Detection and characterization of lung cancer using cell-free DNA fragmentomes. *Nature communications, 12*. doi:https://doi.org/10.1038/s41467-021-24994-w

Mathios, D., Johansen, J. S., Cristiano, S., Medina, J. E., Phallen, J., Larsen, K. R., . . . Velculescu, V. E. (2021). Detection and characterization of lung cancer using cell-free DNA fragmentomes. *Nature Communications, 12*(1). doi: https://doi.org/10.1038/s41467-021-24994-w

Molla, G., & Bitew, M. (2025). The future of cancer diagnosis and treatment: Unlocking the power of biomarkers and personalized molecular-targeted therapies. *Journal of Molecular Pathology, 6*(3), 20. doi:https://doi.org/10.3390/jmp6030020

Mu, F., Tang, M., Guan, Y., Lin, R., Zhao, M., Zhao, J., . . . Tang, H. (2022). Knowledge mapping of the links between the gut microbiota and heart failure: a scientometric investigation (2006–2021). *Frontiers in Cardiovascular Medicine, 9*, 882660. doi:https://doi.org/10.3389/fcvm.2022.882660

Okubo, Y. (1997). Bibliometric indicators and analysis of research systems: methods and examples.

Pakzad, R., Mohammadian-Hafshejani, A., Ghoncheh, M., Pakzad, I., & Salehiniya, H. (2015). The incidence and mortality of lung cancer and their relationship to development in Asia. *Translational Lung Cancer Research, 4*(6), 763. doi:https://doi.org/10.3978/j.issn.2218-6751.2015.12.01

Peng, H., Lu, L., Zhou, Z., Liu, J., Zhang, D., Nan, K., & Zhao, X. (2019). CNV detection from circulating tumor DNA in late stage non-small cell lung cancer patients. *Genes*. doi:https://doi.org/10.3390/genes10110926

Pruis, M. A., Geurts-Giele, W. R. R., & Meijssen, I. C. (2020). Highly accurate DNA-based detection and treatment results of MET exon 14 skipping mutations in lung cancer. *Lung Cancer*. doi:https://doi.org/10.1016/j.lungcan.2019.11.010

Setyaningsih, I., Indarti, N., & Jie, F. (2018). Bibliometric analysis of the term'green manufacturing'. *International Journal of Management Concepts and Philosophy, 11*(3), 315-339. doi:https://doi.org/10.1504/IJMCP.2018.093500

Smolle, E., Taucher, V., Lindenmann, J., Pichler, M., & Smolle-Juettner, F.-M. (2021). Liquid biopsy in non-small cell lung cancer—current status and future outlook—a narrative review. *Translational Lung Cancer Research, 10*(5), 2237. doi:https://doi.org/10.21037/tlcr-21-3

Torre, L. A., Siegel, R. L., & Jemal, A. (2016). Lung cancer statistics. *Lung cancer and personalized medicine: current knowledge and therapies*, 1-19. doi:https://doi.org/10.1007/978-3-319-24223-1_1

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British journal of management, 14*(3), 207-222. doi:https://doi.org/10.1111/1467-8551.00375

Wang, B., Pei, J., Wang, S., Cheng, K., Yu, J., & Liu, J. (2022). Prognostic potential of circulating tumor DNA detection at different time periods in resectable non-small cell lung cancer: Evidence from a meta-analysis. *Critical Reviews in Oncology/Hematology, 177*. doi:https://doi.org/10.1016/j.critrevonc.2022.103771

Wang, S., Meng, F., Li, M., Bao, H., Chen, X., Zhu, M., . . . Yin, R. (2023). Multidimensional Cell-Free DNA Fragmentomic Assay for Detection of Early-Stage Lung Cancer (pp. 1203-1213). doi:https://doi.org/10.1164/rccm.202109-2019OC

Wang, X., Guo, J., Gu, D., Yang, Y., Yang, X., & Zhu, K. (2019). Tracking knowledge evolution, hotspots and future directions of emerging technologies in cancers research: a bibliometrics review. *Journal of Cancer, 10*(12), 2643. doi:https://doi.org/10.7150/jca.32739

Wei, B., Wu, F., Xing, W., Sun, H., Yan, C., Zhao, C., . . . Ma, J. (2021). A panel of DNA methylation biomarkers for detection and improving diagnostic efficiency of lung cancer. doi:https://doi.org/10.1038/s41598-021-96242-6

Yang, Z., Qi, W., Sun, L., & Zhou, H. (2019). DNA methylation analysis of selected genes for the detection of early-stage lung cancer using circulating cell-free DNA. *Advances in Clinical and Experimental Medicine.* doi:https://doi.org/10.17219/acem/84935

Zhang, J., Dong, Y., Zhu, W., Xie, D., Zhao, Y., Yang, D., & Li, M. (2019). Ultrasensitive Detection of Circulating Tumor DNA of Lung Cancer via an Enzymatically Amplified SERS-Based Frequency Shift Assay. *ACS Applied Materials and Interfaces, 11*(20), 18145-18152. doi:https://doi.org/10.1021/acsami.9b02953