

A Bibliometric Analysis of Global Trends in Pharmaceutical Research

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Abstract

The study aims to provide a comprehensive analysis on global pharmaceutical research trends using 436 publications listed in the Scopus database, published between 1998 and 2023. The study uses advanced bibliometric techniques and VOSviewer to analyze global pharmaceutical research trends. The study found that there is a multimodal progress in the volume of research output in this domain with time, specifying the growth in terms of multidisciplinary collaboration and the addition of studies using biotechnology-based research with medicine-based research. The study found that China has published 72 studies with 1731 citations, while India has to its credit 44 studies with 1259 citations, emerging as the topmost contributors with publications and citation count, reflecting the rising power of Asia on global research. Keyword analysis also identified new research themes like drug discovery, indicating a new dimension towards future studies.

Keywords: Bibliometric Analysis, Knowledge Mapping, Medicine Pharmaceutical Research, Research Trends, VOSviewer

Introduction

Pharmaceutical based research studies are at the forefront of scientific innovation and is rapidly evolving as per the complicated healthcare challenges. Researchers, decision-makers, and business professionals must all grasp the fundamental patterns and trends that underline the rapid changes that the pharmaceutical sciences are experiencing on a worldwide scale (Nayak et al., n.d.-a). The term "bibliometrics" refers to the quantitative analysis of bibliographic data to reveal patterns, trends, and relationships within scholarly publications (Li et al., 2023). The research focuses on a thorough bibliometric analysis, exploring the vast domain of literature search

and study in the field of pharmaceutical research during the quarter century i.e. from 1998 to 2023 (Koenig, 1983). A comprehensive analysis is performed for better understanding of the research hotspots and trends in discovery of medical active agents during 1998 to 2023 (Lian et al., 2023). We assume that this bibliometric study will reveal opaque relationships and clarify the complex network of information that underpins pharmaceutical research. It has recently been observed that bioactive chemicals have positive effects on human health. The study concludes research in the domain of Herbal medicine uses and effectiveness (Alvarez-Leite, 2025). By utilizing bibliometric approaches to analyze the large reservoir of research this research aims to reveal the progress of the pharmaceutical research field. The ultimate aim is to highlight significant research contributions, eminent authors and growing areas of interest. Such sets of results not only help in generating better set of knowledge towards pharmaceutical based research, they also offer insightful predictions towards offering new dimensions in the field (B. Lin et al., 2024; Sun et al., 2023a). The study collected pharmaceutical care literature from the Scopus indexed databases and analyzed it using visualizations generated by VOSviewer 1.6.20. The objective of this research is to study the potential to make a substantial contribution to the development of policies, the strategic planning of upcoming research projects, and the resource optimization of the pharmaceutical research environment. The paper will create a better understanding of the dynamics that shape pharmaceutical research, as well as promote more exploration in new territory by presenting a complete outline of this ever-changing field. There is no uncertainty that the pharmaceutical industry has been a catalyst in moving healthcare

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forward, with research being the spark that ignites new ideas. The purpose of this report is to recognize the most prominent research themes, methodologies, and geographic centers by conducting an in-depth analysis of publications, citations, and collaborations. The analysis will also seek to recognize shifts in focus, the creation of multidisciplinary partnerships, as well as the impact that technological advancements will have on pharmaceutical research.

Objectives of the Study

- Analyse global trends in pharmaceutical research (1998–2023) using bibliometric methodology.
- Identify leading countries, authors, journals, and key research themes in the field.
- Map keyword patterns and emerging hotspots shaping pharmaceutical sciences.
- Provide insights for future research planning and collaboration strategies.

Research Question

- How has pharmaceutical research output changed over the past 25 years?
- Which countries, authors, and journals are most influential in this field?
- What are the major research themes and frequently used keywords?
- How do international collaborations influence research growth?
- What emerging trends and technologies are shaping the future of pharmaceutical research?

Review of Literature

(Nayak et al., n.d.-b) analyzed 20 years of pharmacological care research review. The study stated that current bibliometric analysis monitored frontiers and identified developmental trends in the field of pharmaceutical care over the previous 20 years. Based on the analysis, the United States was the leader in this field in terms of publications, citations, funding sources, and international collaboration. Individuals are dedicated

to creating cutting-edge pharmaceutical care, gradually taking on a central role in modern healthcare systems and fostering favorable economic and health consequences. Regarding the contents of basic pharmaceutical care, there are two categories: enhanced pharmaceutical care and traditional pharmaceutical care. (Gu et al., 2022) in the “Bibliometric Analysis Reveals a 20-Year Research Trend for Chemotherapy-Induced Peripheral Neuropathy” evaluated publications connected to Chemotherapy-induced peripheral neuropathy (CIPN) to pinpoint the main field of study. Chemotherapy-induced peripheral neuropathy (CIPN) has increased in prevalence because of longer lifetimes and an increase in cancer survivors. Even though there is a substantial amount of literature on CIPN, it has not been compiled or examined. As a result, the study carried out a thorough bibliometric analysis of CIPN-related publications from 2001 to 2021 in the current showed significant progress. Bibliometric can give a thorough overview of literature and is a valuable method for quantifying the number of publications in a discipline. This is the first bibliometric analysis that focuses on research and maps visualization related to COVID-19 and PPE. The coronavirus disease, which struck at the end of December 2019, has grown to be a hazard to public health worldwide and has an impact on all facets of human existence. The use of vaccinations and medicinal medications was the primary focus of earlier COVID-19 research. To stop the epidemic from spreading further, it is especially crucial to limit the virus’s path of transmission because it is continually evolving (Zhang et al., 2022). On the other hand, (Lu et al., 2019) evaluated the network pharmacology (NP) field’s current state by performing a bibliometric analysis of the top 100 cited works. Key study data—such as publication year, citation count, authorship, countries/regions, institutions, and journals—were thoroughly analyzed. The analysis revealed that network pharmacology (NP) is an emerging and innovative approach to drug discovery, utilizing network analysis to investigate potential mechanisms of drug action by integrating bioinformatics, systems biology, omics technologies, and computational biology. The study found that the USA and China are leading countries in terms of contribution to network pharmacology studies. The studies conducted by these countries are more focused on developing new NP methods, verifying experimental results, and exploring

the molecular mechanisms of traditional Chinese medicine in the treatment of serious diseases such as cancer and cardiovascular diseases.

(Litvinova et al., 2023) noted an increase in the number of publications concerning digital pills, demonstrating the increased importance of this emerging technology. The authors emphasized the need for studies on pharmacoeconomic evaluations, as well as randomized controlled trials and meta-analyses, which are crucial for establishing high-level (Level I) evidence on the therapeutic potential of digital pills. On another note, the extensive literature on transdermal drug delivery published between 2003 and 2022, covering 2,555 articles, showed a general upward trend in publications, demonstrating increased research interest and development in this technology. The articles that were referenced the most were those concerning optimization of drug delivery and transdermal drug delivery via nanotechnology. The countries with the highest research programs in transdermal drug delivery were China, the US, and India.

(Wang et al., 2023) discussed 3D printing, also known as additive manufacturing, which uses computer-aided design (CAD) technology in the production of objects in a layer-by-layer fashion. This technology has great potential in the assessment of the advantages and disadvantages of various drug delivery techniques, especially in the application of 3D printing in the development of dosage formulations.

(Safiqur et al., 2021) An analysis using quality research published in the Web of Science database showed that there has been an increase in published abstracts on medicinal plant research showing interest in this area. However, despite the growing interest, there remains a noticeable lack of comprehensive bibliometric analyses specifically focused on the field of medicinal plant research. The 'web of science' is being used to analyses and thoroughly study medicinal plant studies published in India between 1977 and 2020. According to this bibliometric analysis, research on medicinal plants has become increasingly prominent, with Saudi Arabia and the United States working closely with India in this regard.

(Sun et al., 2023b) conducted a bibliometric study on HIV-1 capsid inhibitors, offering a comprehensive

analysis of research trends and key hotspots in this area of pharmaceutical research. It is anticipated that this finding will give the scientific community fresh perspectives to advance HIV-1 capsid inhibitor development. According to the data, there has been a consistent upward trend in the number of articles published annually between 2000 and 2022, which has helped to identify areas of research interest and development patterns in this sector.

The development of capsid inhibitors faces certain limitations and uncertainties, primarily because research in this area began relatively late. Previous studies were more focused on the microscopic structure and molecular aspects of the capsid protein, with less emphasis on practical aspects in terms of therapeutic exploration. With advancements in molecular biology and computational technologies, future approaches leveraging co-crystal structures and computer-aided drug design are expected to significantly enhance the discovery of novel and effective capsid inhibitors.

In a related study, (C. Lin et al., 2024) employed bibliometric and knowledge mapping analysis to examine the current research landscape and emerging trends surrounding IL-33. This study gives in depth insights and the direction of IL-33-related research for scholars. *Frontiers in Immunology* is the most widely published journal, and the *Journal of Immunity* is the most frequently mentioned. Jochen Schmitz received the greatest number of co-citations, while Andrew N. J. McKenzie published the greatest number of publications. Saad et al. (2021) studied The Eastern Mediterranean Region (EMR) hosts some of the world's worst humanitarian and health crises. The study concluded that over the past ten years, there has been a steady growth in research production, with Iran leading the way in publishing pertinent research. Two recurring topics in recent monitoring were SARS-CoV-2 and COVID-19.

(AlBloushi, 2022) analyzed every COVID-19 publication connected to Saudi Arabia, recorded until December 2019, using the Web of Science, and carried out bibliometric in October 2021. In terms of COVID-19 research production, Saudi Arabia is in the top fifteen countries worldwide and as the leading Arabian country. It is necessary for Saudi Arabian researchers to continue working toward producing more high caliber articles on a worldwide scale.

(Singh & Chunglok, 2022) explained Bio-based polymers are synthetic materials derived from sustainable sources. In recent times, the need for biodegradable polymers has attracted the attention of academics and manufacturers globally, owing to the scarcity of polymers derived from fossil fuels. Natural biodegradable excipients have drawn a lot of interest lately because of their designed uses and sustainability. Biopolymers Towards Green and Sustainable Development provides an overview of biopolymers, their impact on the environment and health, emerging sources, structural and morphological characterization techniques, thermomechanical properties, and applications in pharmaceutical, biomedical, and textile industries.

(Zhang et al., 2024) utilized a bibliometric approach to explore the current state of research in pharmaceutical care, identifying key areas of interest, emerging trends, and potential future directions based on an analysis of publication data. Over the past decade, there has been a substantial rise in the number of publications related to pharmaceutical care. Notably, research focusing on the COVID-19 pandemic, chronic obstructive pulmonary disease (COPD), and pharmacy practice has emerged as particularly prominent. Within the field, pharmaceutical services and clinical pharmacy have been identified as the primary research hotspots, attracting significant scholarly attention.

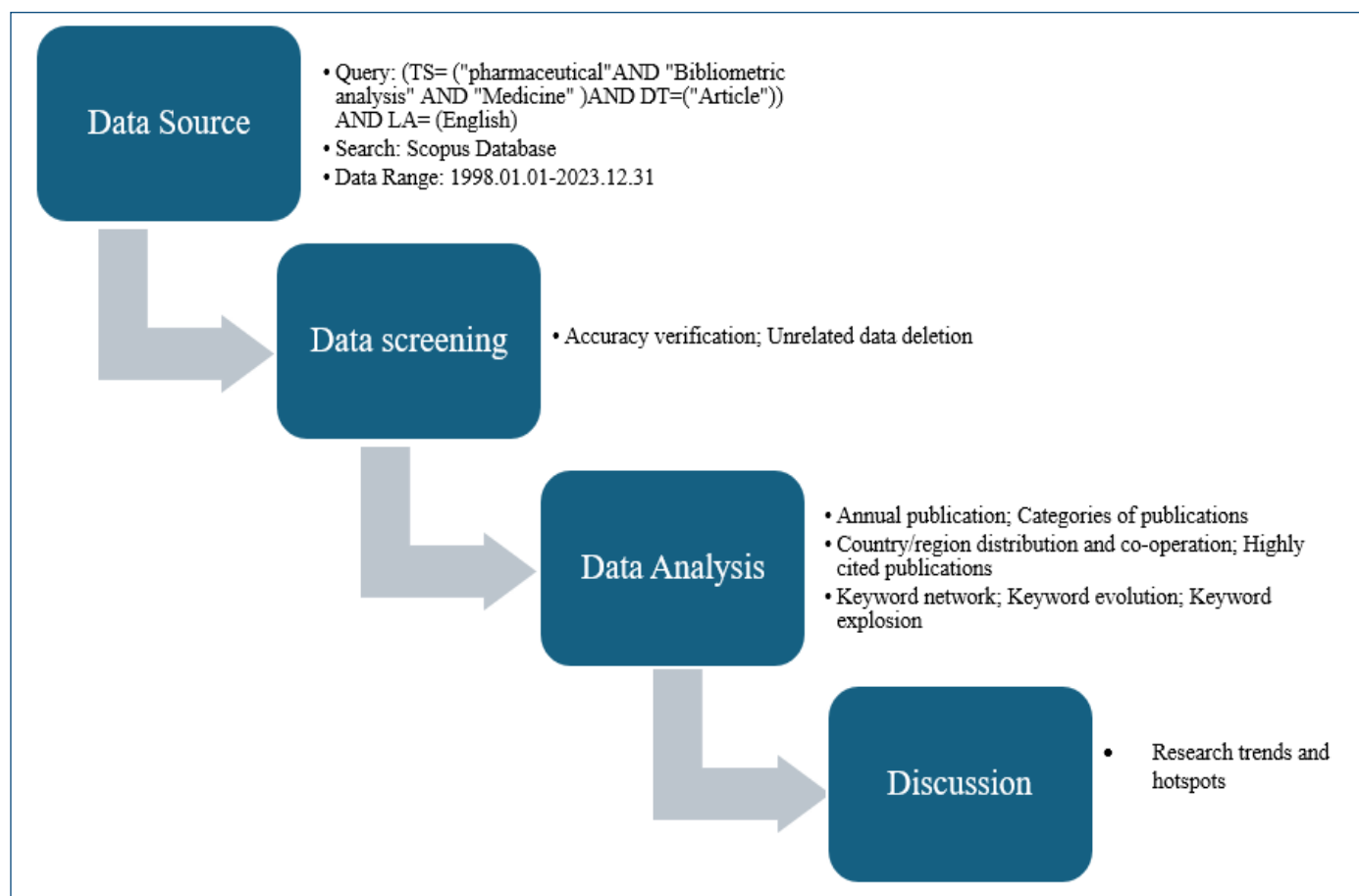
Research Gap

The present research found a large number of growing applications of bibliometric analysis to examine and evaluate specific domains like pharmaceutical care, chemotherapy-induced peripheral neuropathy, network pharmacology, digital pills, transdermal drug delivery, and emerging technologies like 3D printing in medicine. These set of studies have offered across valuable insights across publication trend, influential set of authors and

growing research in the specific domain. However, most of the research is specifically towards trends and therapeutic domain thereby presenting a clear guideline toward only a tip of the huge pharmaceutical research domain. There is an ample scope towards comprehensive assessment which presents a systematic assessment of the overall global trends, collaboration flow and the thematic evaluation across the entire domain of pharmaceutical based research. Further, presence of limited number of studies towards integrating advanced level of mapping to identify the emerging set of research at macro level. Towards addressing the gap, present research is an attempt to undertake a comprehensive bibliometric analysis of research publications indexed across Scopus database from the year 1998 to 2023, using visualization and mapping techniques through VOSviewer to provide a thorough understanding of the structure, research in the domain and new set of directions in global pharmaceutical research.

Research Methodology

The research is literature recollection and advanced retrieval of data from Scopus Database Collection conducted on October 2024 by the formula {(Topic Search (TS) = (“Pharmaceutical” AND “Bibliometric analysis” AND “Medicine”))} and Document Type (DT) = article, Language (LA) = (English). Then, after evaluation, 355 search results met the selection criteria. The search findings are exported in the “Full Record and Cited References” basic text file structure, which contains the researcher’s name, title, abstract, source publication, keywords, affiliated institutions, citation times, and so on (Abdelwahab & Mohamed, 2022; Singh & Chunglok, 2022). The present study provides a bibliometric examination of the pharmaceutical research industry using VOSviewer (version 1.6.20) and the Scopus collection database. The assessment and analysis method are demonstrated in Fig. 1.



Source: Authors compilation.

Fig. 1: Research Flow Chart

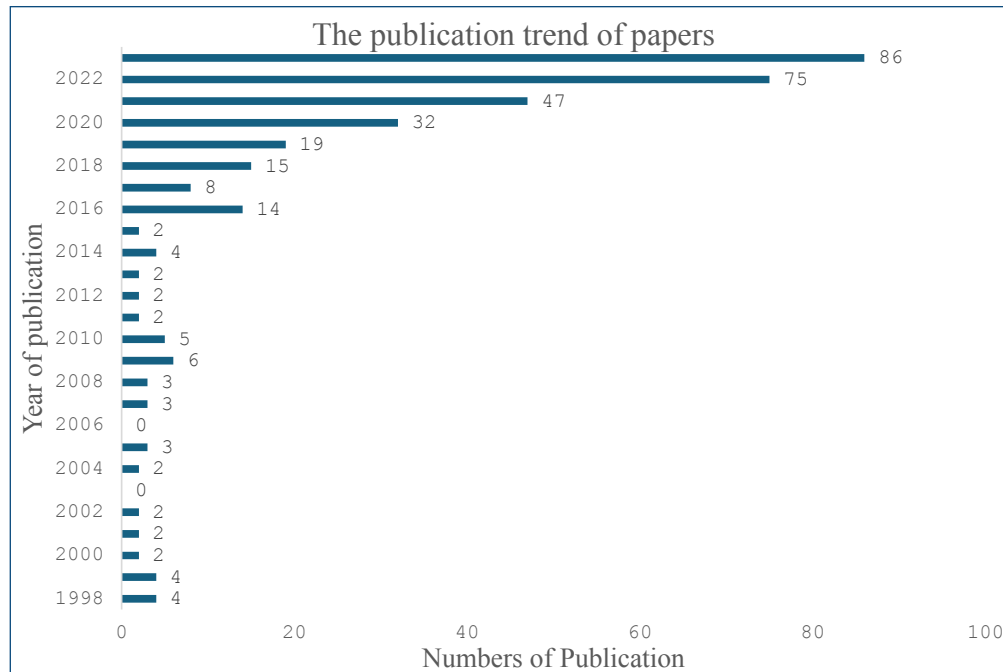
Results and Discussion

Data Source

The data was sourced from Scopus core database using the following search criteria: title keywords “Pharmaceutical” “Bibliometric analysis” and “Medicine”. The search time spanned from 1998 to 2023. The study was restricted to the search of language (English) and only considered type as articles. The search formula is as follows: TS = (“pharmaceutical” AND “bibliometric analysis” AND “medicine”) DT=(“Article”) LA = (“English”)

Data Interpretation

It can be observed from the Fig. 2 of year-by-year publications shows a consistent increase in the volume of research in pharmaceutical sciences from 1998 to 2023. Peaks may coincide with major industrial events, advances in biotechnology, or increasing pharmaceutical funding. This upward trend indicates increased interest and investment in pharmaceutical research, which is being driven by rising healthcare demands and technological advancement.



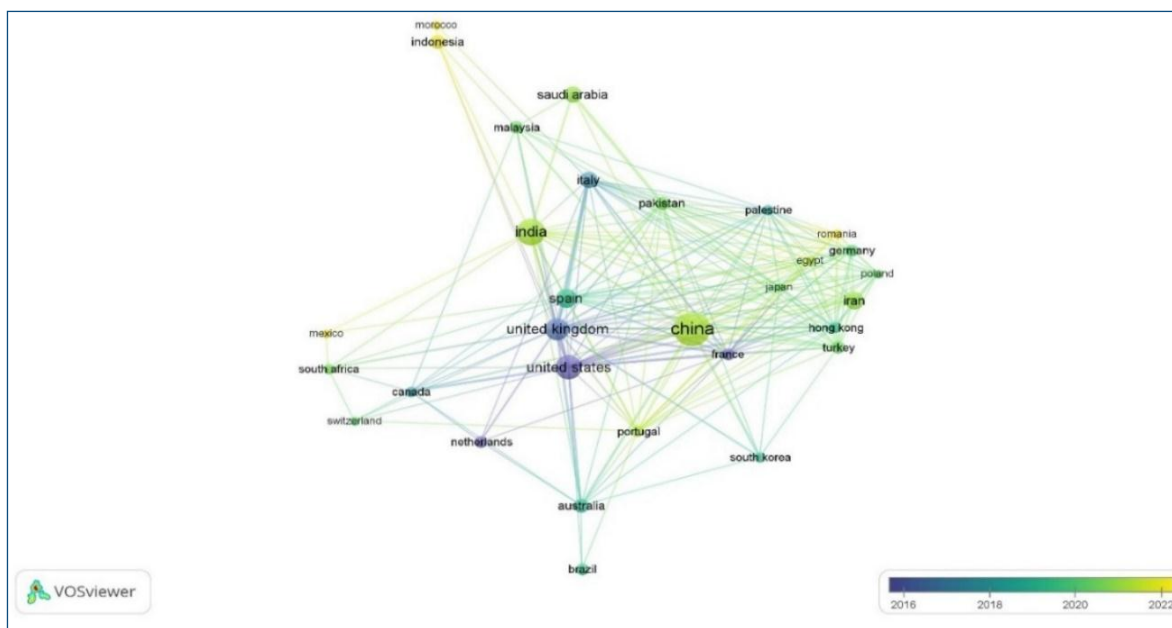
Source: Authors compilation.

Fig. 2: The Publication Trend of Paper is Based on Number of Publications

Country-Wise Publication

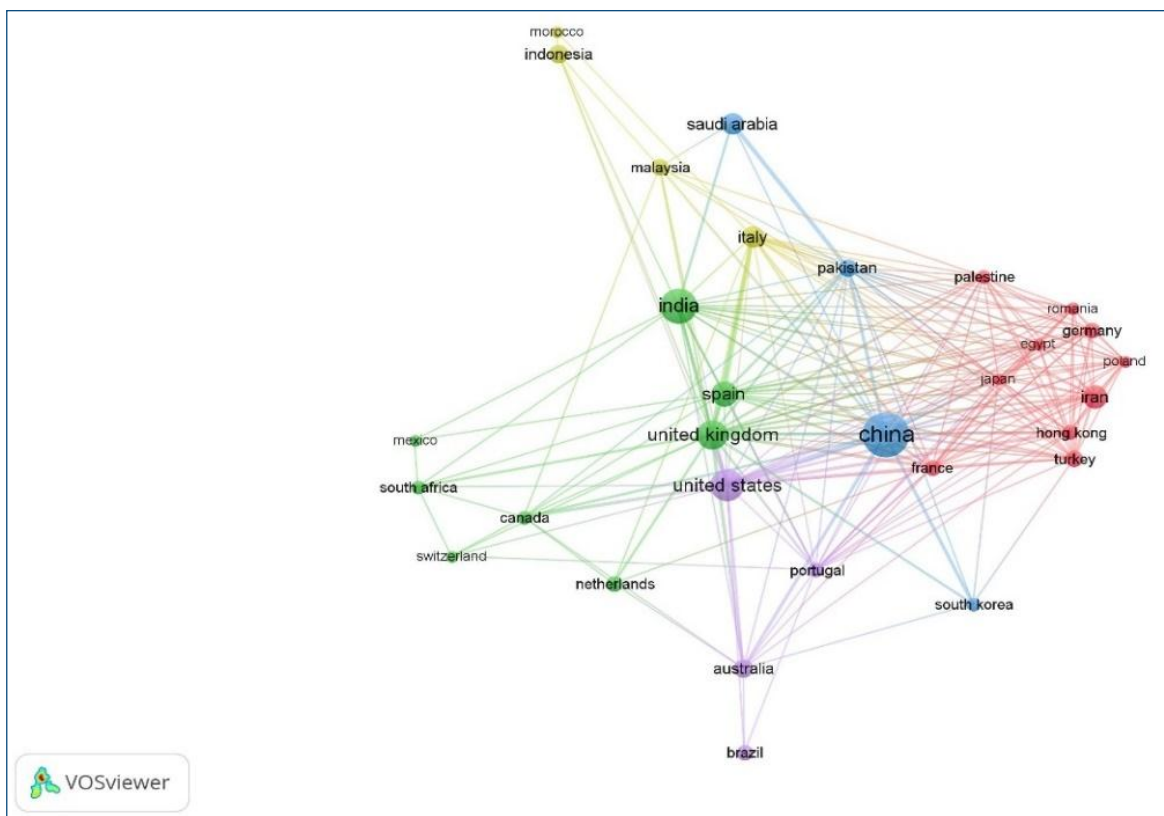
While using the full count method, these co-authorships within the countries are shown as five clusters (Fig. 3A, 3B). The figure shows the threshold was five documents

per country. Out of 91 countries, 30 meet the criteria. The analysis shows China leading the research with 72 documents (1731 citations) within the set parameters, followed by India 44 documents (1259 citations).



Source: Authors compilation.

Fig. 3 (A): Co-Authorship Overlay Visualization of Countries



Source: Authors compilation.

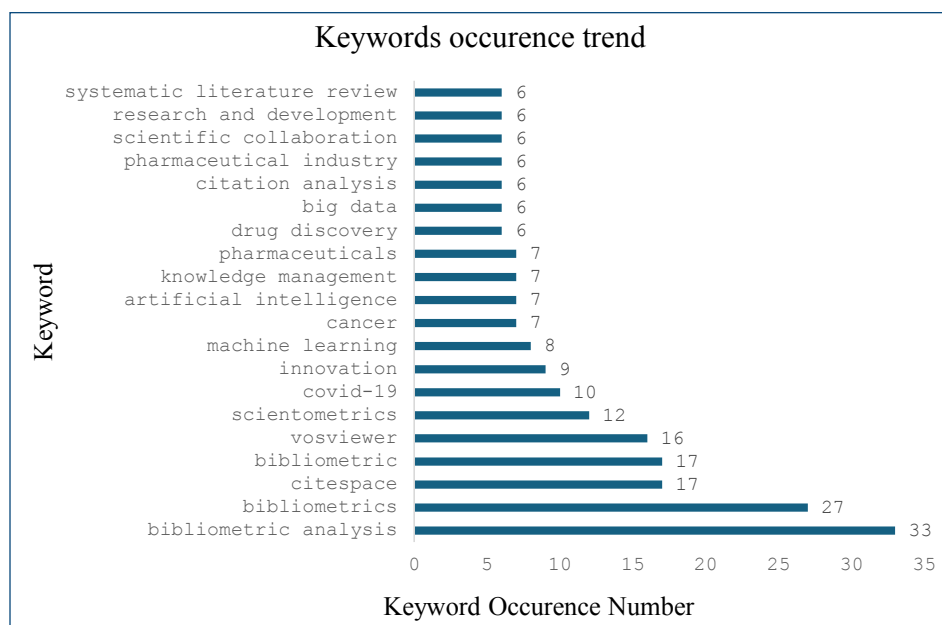
Fig. 3(B): Co-Authorship Network of Countries

It can be interpreted from Fig. 3, a bibliometric network visualization graph created using VOSviewer, showing relationships between countries based on collaborative research efforts, co-authorships, or related scholarly activities. A nation is represented by each node. Greater research output or more collaborations are indicated by larger nodes, which indicate stronger involvement in the network. The connections or cooperation between nations are shown by the lines connecting the nodes. The number of common research results or the degree of collaboration is shown by the lines' thickness and intensity. The colour scale, ranging from blue to yellow in Fig. 3(A), represents the temporal trends in the research contributions or collaborations over the period 2016-2022, (selection of the year is based on the highest number of publications

from Fig. 2). Yellow represents recent contributions, while blue represents past contributions.

Keyword Occurrence

Fig. 4 represents the major themes in the study, as it includes the total count of 1,226 keywords, out of which 55 frequently appearing keywords are grouped in clusters. Frequently appearing keywords such as "Bibliometric Analysis," "CiteSpace," "COVID-19," and "VOSviewer" represent the major focus areas in the field of study. The prominence of the particular keywords represents the emerging trends in the field of study, while the clustering approach helps in the identification of the subfields in the pharmaceutical research domain.



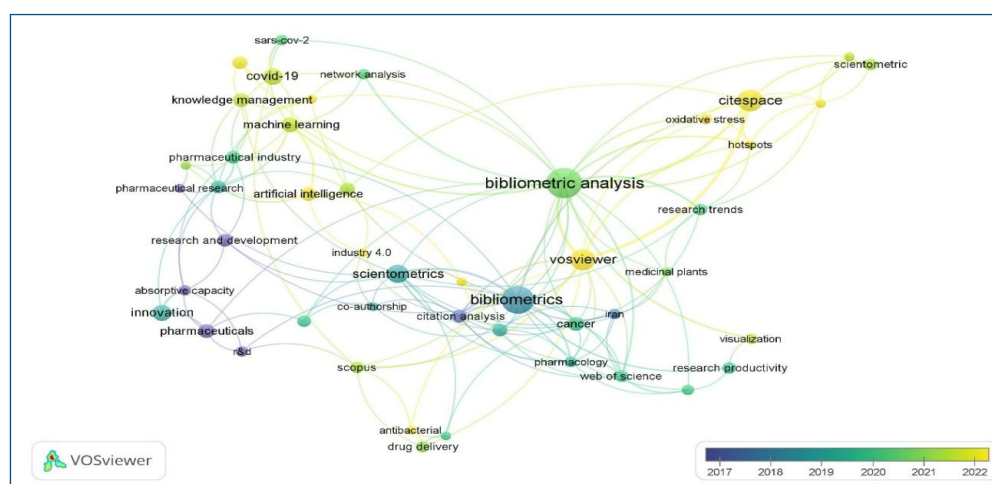
Source: Authors compilation.

Fig. 4: Keyword Based on Occurrence

Visualization Analysis of Co-Occurrence and Keyword Analysis

To determine the major areas of interest in the field of study, the entire domain was analyzed using the keyword analysis approach. A total of 1,226 keywords were extracted from the abstract, title, and author keywords of the documents in the domain, as they provide the groundwork for the identification of the research themes and trends in the field of study. A minimum occurrence of three instances per keyword was set, and standardized keywords were created using consistent wordlist files.

The most prominent keywords were identified on the basis of their frequency of occurrence. Using the full count method, VOSviewer software grouped the authors' keywords into seven distinct clusters, with each cluster representing a major thematic area of the research landscape. Out of the 1,226 keywords, 55 keywords met the criterion of the minimum frequency of occurrence, i.e., three or more times, which were then processed using clustering tools, leading to the creation of word clusters, as shown in Fig. 5.



Source: Authors compilation.

Fig. 5(A) : Keywords Overlay Visualization



The VOSviewer visualization displays a complex network of research topics. The central node is 'bibliometrics', which is highly connected to other nodes like 'bibliometric analysis', 'scientometrics', and 'social network analysis'. Other prominent nodes include 'machine learning', 'drug discovery', 'open innovation', 'knowledge management', 'systematic literature review', 'covid-19', 'scopus', 'wound healing', 'drug delivery', 'innovation', 'pharmaceuticals', 'network analysis', 'artificial intelligence', 'co-authorship', 'citation analysis', 'pharmacology', 'iran', 'web of science', 'medicinal plants', 'sci-expanded', 'research trends', 'cancer', 'visualization', 'voviewer', 'oxidative stress', 'citespace', 'vos viewer', 'scientific collaboration', 'industry 4.0', 'cloud computing', and 'artificial intelligence'.

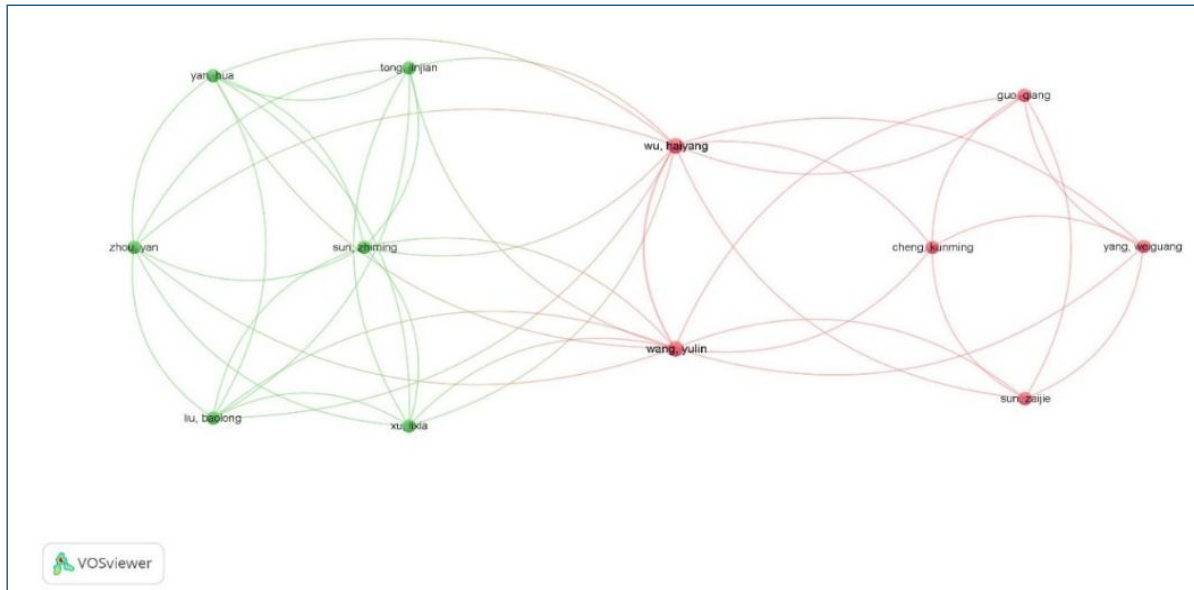
Fig. 5(C): The Keyword Heat Map

In order to find the top researchers and scholars in the pharmaceutical industry, we analyzed the publications of the works that have been retrieved. The results of the

statistical analysis revealed that a total of 55 papers were written by 1,492 researchers, reflecting a high level of teamwork in the field. The collaboration network (Fig. 6A) represents all the individual authors as nodes, with

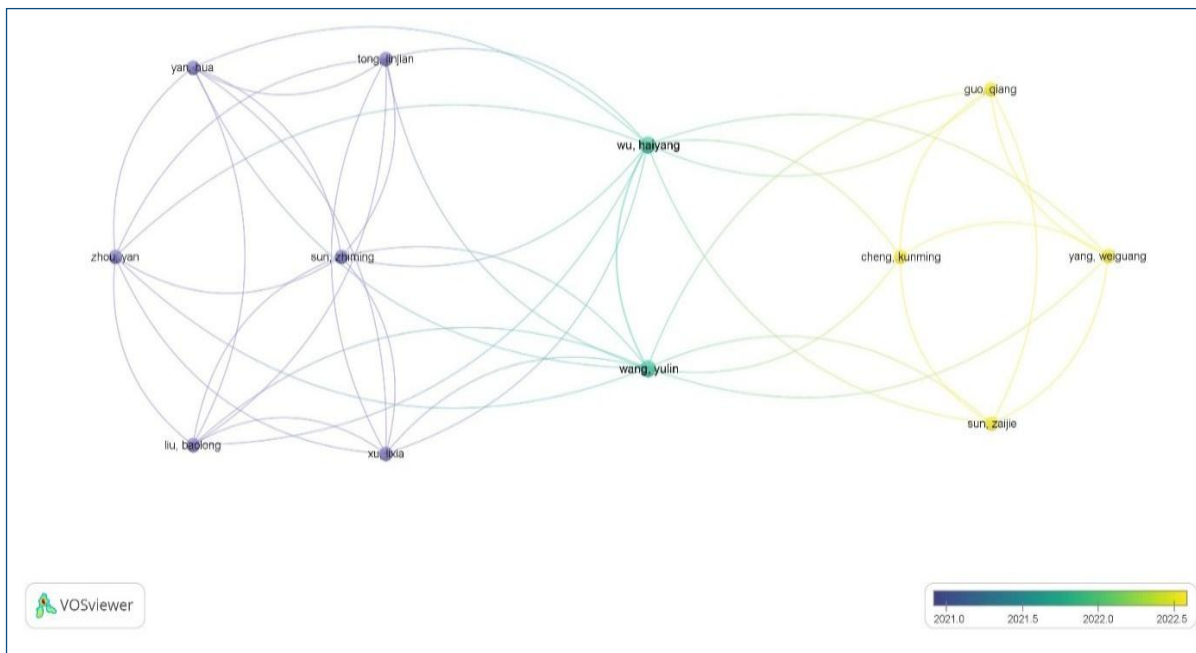
the algorithm used in the analysis establishing a minimum threshold of two co-authored papers and at least six citations per author. Upon analyzing the top contributors in terms of the published papers and the outcomes of

the citation count, the top authors were found to be the key contributors in the field. Of these, Wang Yuling and Wu Haiyang were found to be active participants in the collaborative research activities.



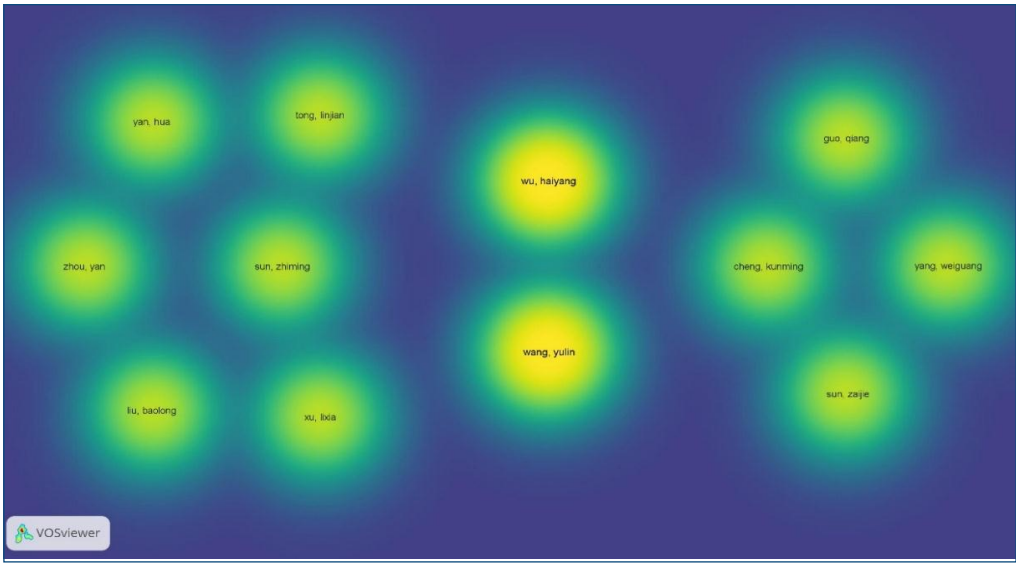
Source: Authors compilation.

Fig. 6(A): Co-Authorship Network



Source: Authors compilation.

Fig. 6(B): Authors Overlay Visualization



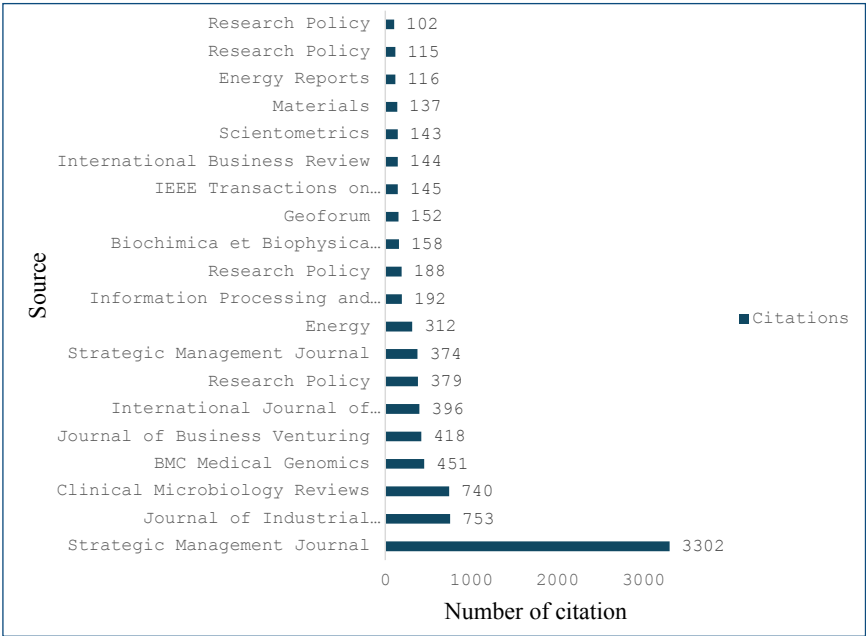
Source: Authors compilation.

Fig. 6(C): Authors Heat Map

Journal and Citation Analysis

Publishing journals were identified through an examination of the journals and the citation status of the literature. A citation standard of over 100 citations was set to recognize the most influential and commonly cited journals in the field. Fig. 7 represents the top twenty journals that have the highest number of publications, focusing on those that have made the most significant contribution to the field. It is thought-provoking to note that journals such as the Strategic Management Journal

(3,302 citations), Journal of Industrial Economics (753 citations), Clinical Microbiology Reviews (740 citations), BMC Medical Genomics (451 citations), and Journal of Business Venturing (418 citations) have gained significant attention from researchers, indicating that they are the most influential in this field of study. These citation findings provide valuable insights into an active area of publications, representing that those with the most citations are the most active and key sources of information and innovation.



Source: Authors compilation.

Fig. 7. Top 20 Sources with the Most Cited Papers

Findings

The results of the bibliometric analysis indicated that the hotspots of research with the theme of “pharmaceutical research” in recent years were primarily focused on bibliometric analysis and drug discovery. Pharmaceutical research has gradually grown over the last 25 years, with key publications between 1998 and 2023. This shows that the number of papers on pharmaceutical research has grown due to the rise in the demand for healthcare services and technological advances. The results indicated that China had the highest number of publications on pharmaceutical research, followed by research and development in India, and the US. The findings of the research specified that VOSviewer identified 1,226 keywords, with 55 frequently occurring terms forming clusters. The key research issues identified were related to drug development, biotechnology, and the use of bibliometric analysis in pharmaceutical research. The findings of the research indicated that 1,492 researchers had published 55 papers, with key scholars cooperating with each other. This indicates an emerging trend of trans-disciplinary research and international relations. The key journals were identified based on citation benchmarks of over 100, with key publications to promote pharmaceutical research.

Discussion

The findings of the study, therefore, show the evolving and predominant role of global pharmaceutical research over the past two decades. The consistent rise in the number of publications in the domain shows the increased global focus on healthcare innovation, drug discovery, and technology development in the field of pharmaceutical science. The focus of the study on the top contributing countries, i.e., China and India, also shows the increased shift in the global focus of pharmaceutical research, indicating the rising importance of the emerging economies of these two Asian countries in the global pharmaceutical research domain. The thematic clusters that the study found through keyword analysis also show that the focus of the pharmaceutical research in the present global set-up is predominantly on the domain of drug development, biotechnologies, and the application of these tools to evaluate the in-depth scientific advancements in the field of pharmaceutical science. The findings also show the existence of collaborative networks, indicating

the increased focus on the trend of interdisciplinarity in the field of pharmaceutical research, as it is the only way to overcome the challenges in the field of healthcare.

Conclusion

Bibliometric analysis indicates the global development in pharmaceutical research over the last two decades, i.e., from 1998 to 2023, with an increase in the volume of publications, the development of research hotspots, and the advancement of international collaborations. To begin with, initial evaluation of pharmaceutical research publications over time can be done by analyzing the annual publication volume and publication categories. Secondly, by analyzing the region of publication and supportive relationships, it can be demonstrated that global collaborations are improving with each passing year. After that, co-occurrence analysis can be used to analyze the author’s keywords. This increase aligns with the development of diverse research techniques and technology improvements, emphasizing the importance of global collaborations in addressing complex health challenges. The study provides data to inform future research directions, funding allocations, and strategic planning in the pharmaceutical sector. However, this study only makes bibliometric analysis on Scopus core database, which may lead to incomplete analysis and some limitations. Hence it is recommended that future research expands its data sources for a more comprehensive viewpoint.

Managerial Implication

From a managerial perspective, the findings of the current study can be used for setting valuable visions for academic institutions and research managers in the pharmaceutical field. For instance, knowledge of the global trends in research, prominent authors, and their affiliated institutions can be used to identify possible collaboration opportunities and direct resources to research fields that are likely to have a major impact in the future. Moreover, bibliometric findings can be used for strategic planning in research organizations to ensure that their research priorities are aligned to emerging trends in science and medicine. In addition, knowledge of collaboration patterns and hubs of knowledge can be used to advise policymakers and managers on how to build research strengths and facilitate interdisciplinary

collaborations. Therefore, the use of bibliometric findings to enlighten the research management strategies can be used to improve productivity and sustainability in pharmaceutical research and development.

Scope for Future Research

Future studies can build on this bibliometric analysis by investigating the emerging thematic areas that shape the current pharmaceutical science, such as precision medicine, nanotechnology-based drug delivery systems, drug repurposing, pharmacogenomics, and artificial intelligence-assisted drug discovery. Future bibliometric studies can also consider the extension of the database beyond the single source used in the study and explore other sources such as Clarivate Analytics' Web of Science database, and the National Center for Biotechnology Information's PubMed database for a more representative picture of the global pharmaceutical research output. Future bibliometric studies using visualization tools such as BiblioTool, CiteSpace, CitNet Explorer, and TechneCoWord (CopalRed) can also consider the temporal trend analysis of the bibliographic data and the upsurges in the citation and thematic analysis for the emerging pharmaceutical domains in the global pharmaceutical research output. This can help in the discovery of emerging therapeutic areas and pharmacological approaches that shape global pharmaceutical care and global pharmaceutical research and development.

Limitations of the Study

The present study under consideration comes up with its own set of limitations to start with the findings cannot be generalized because the data were obtained exclusively from the use of Scopus as a database rather than from publications across other databases like Web of Science, Dimensions, PubMed etc. Second, to get a deep comprehension of the topic under consideration it is necessary to conduct a complete qualitative literature study this is because the inquiry in this field involves a bibliometric analysis, and the identification of future directions relies majorly on quantitative analysis.

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Conflict of Interest

The author/s hereby declare there is no conflict of interest towards publication of this paper.

AI Disclosure

The authors confirm that no AI-based tools were utilized in conducting this research or writing the manuscript. All content is original and reflects the authors' own work.

References

- Abdelwahab, S. I., & Mohamed, M. M. E. T. (2022). A comprehensive bibliometric analysis of *Catha edulis* (Vahl) Endl. (khat) research (1961–2021). *Bulletin of the National Research Centre*, 46(1). doi:https://doi.org/10.1186/s42269-022-00967-x
- AlBloushi, A. F. (2022). Contribution of Saudi Arabia to regional and global publications on COVID-19-related research: A bibliometric and visualization analysis. *Journal of Infection and Public Health*, 15(7), 709–719. doi:https://doi.org/10.1016/j.jiph.2022.05.013
- Alvarez-Leite, J. I. (2025). The role of bioactive compounds in human health and disease. *Nutrients*, 17(7). doi:https://doi.org/10.3390/nu17071170
- Gu, J., Hu, M., Gu, Z., Yu, J., Ji, Y., Li, L., Hu, C., Wei, G., & Huo, J. (2022). Bibliometric analysis reveals a 20-year research trend for chemotherapy-induced peripheral neuropathy. *Frontiers in Neurology*, 12. doi:https://doi.org/10.3389/fneur.2021.793663

- Koenig, M. E. D. (1983). A bibliometric analysis of pharmaceutical research. *Research Policy*, 12(1), 15–36. doi:https://doi.org/10.1016/0048-7333(83)90024-0
- Li, S., Li, F., Fan, X., Sun, J., Yu, Z., Shang, H., Dongye, S., Yan, S., Xiao, J., & Xin, T. (2023). Identifying global research trends on inflammation associated with traumatic brain injury by bibliometric and visualized analysis. *Heliyon*, 9(12). doi:https://doi.org/10.1016/j.heliyon.2023.e22807
- Lian, K., Li, X., Wang, X., Wang, F., Yang, M., Ye, J., Li, L., & Hu, Z. (2023). A bibliometric and visual analysis of research trends and hotspots of myocardial apoptosis: A review. *Medicine*, 102(38), e35236. doi:https://doi.org/10.1097/MD.00000000000035236
- Lin, B., Jin, Y., Qiu, Y., Chen, J., Ping, Z., & Zhang, L. (2024). Global trends and hotspots in standardized patients research in the last 30 years: A bibliometric analysis. *Heliyon*, 10(17). doi:https://doi.org/10.1016/j.heliyon.2024.e36701
- Lin, C., Chen, Y., Ge, Y., Niu, H., Zhang, X., Jiang, F., & Wu, C. (2024). A bibliometric and knowledge-map analysis of macrophage polarization in insulin resistance from 1999 to 2023. *Immunity, Inflammation and Disease*, 12(10). doi:https://doi.org/10.1002/iid3.70048
- Litvinova, O., Klager, E., Yeung, A. W. K., Tzvetkov, N. T., Kimberger, O., Kletecka-Pulker, M., Willschke, H., & Atanasov, A. G. (2023). Bibliometric analysis and evidence of clinical efficacy and safety of digital pills. *Frontiers in Pharmacology*, 14. doi:https://doi.org/10.3389/fphar.2023.1023250
- Lu, C., Bing, Z., Bi, Z., Liu, M., Lu, T., Xun, Y., Wei, Z., & Yang, K. (2019). Top-100 most cited publications concerning network pharmacology: A bibliometric analysis. *Evidence-Based Complementary and Alternative Medicine*, 2019. doi:https://doi.org/10.1155/2019/1704816
- Nayak, Y., Yu, D., Lin, Z., & Zhang, B. (n.d.). A bibliometric analysis of global trends in the research field of pharmaceutical care over the past 20 years.
- Safiqur, M., Khadeeja, R., Ansari, M. N., Tewari, L., & Shah, K. (2021). A bibliometric study of Indian medicinal plant research: An analysis of quality research papers based on the Web of Science. *Qualitative and Quantitative Methods in Libraries*, 10, 505–530.
- Singh, S., & Chunglok, W. (2022). *Biopolymers towards green and sustainable development*. Bentham Science Publishers. doi:https://doi.org/10.2174/97898150793021220101
- Sun, L., Zhang, T., Xu, S., Zhang, X., Zhan, P., & Liu, X. (2023). Bibliometric analysis and visualization of research trends on HIV-1 capsid inhibitors (2000–2022). *Frontiers in Pharmacology*, 14. doi:https://doi.org/10.3389/fphar.2023.1282090
- Wang, S., Chen, X., Han, X., Hong, X., Li, X., Zhang, H., Li, M., Wang, Z., & Zheng, A. (2023). A review of 3D printing technology in pharmaceutics: Technology and applications, now and future. *Pharmaceutics*, 15(2). doi:https://doi.org/10.3390/pharmaceutics15020416
- Zhang, Y., Hu, M., Wang, J., Wang, P., Shi, P., Zhao, W., Liu, X., Peng, Q., Meng, B., Feng, X., & Zhang, L. (2022). A bibliometric analysis of personal protective equipment and COVID-19 research. *Frontiers in Public Health*, 10. doi:https://doi.org/10.3389/fpubh.2022.855633
- Zhang, Y., Yao, J., Li, W., & Wang, H. (2024). Global research trends and hotspots in pharmaceutical care: A bibliometric analysis and visualisation using CiteSpace and VOSviewer. *European Journal of Hospital Pharmacy*, 31(6), 511–519. doi:https://doi.org/10.1136/ejhpharm-2022-003617