

ORIGINAL ARTICLE

INSIGHTS INTO THE STATE OF PAIN MANAGEMENT RESEARCH: A BIBLIOMETRIC ANALYSIS

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ABSTRACT

Pain management is a medical speciality focused on diagnosis, prevention, and treatment. It is implied indirectly that healthcare personnel are essential for pain management to enhance patients' quality of life. This study aims to conduct a bibliometric analysis of pain management research using the Scopus and Web of Science (WoS) databases by assessing the trend in pain management research output and identifying pain management research topics and trends. The Scopus and WoS databases were utilised to locate pain management-related publications. Using ScientoPy and VOSviewer, the gathered datasets were then analysed. From 2012 to 2022, Scopus and WoS databases demonstrated an upward trend in pain management research production. WoS grew consistently from 436 in 2012 to 900 in 2022, whilst Scopus grew similarly but more modestly from 205 in 2012 to 302 in 2022. With 3,332 papers, the United States has regularly led the world in pain management research production. "Pain", with 1717 papers, is the most researched theme in pain management research, followed by "pain management", with 1584 publications, "analgesia" and "opioid", with 867 and 649 papers, respectively. The co-occurrence analysis of authors' keywords found that "analgesia", "pain", "pain management", "chronic pain", "opioid", and "acute pain" were the most tightly interconnected and had the most substantial relationship. This study's findings provide valuable insights into the current state of pain management research and highlight the need for ongoing research to develop more effective pain management strategies and enhance patients' quality of life.

Keywords: Bibliometrics, pain management, chronic pain, analgesia, life quality

INTRODUCTION

Pain management is the medical speciality concerned with diagnosis, prevention, and treatment¹. Pain management is vital to improve the quality of life for people with acute and chronic diseases²⁻³, making it essential in healthcare settings⁴. Pain occurs due to various circumstances, such as an accident, illness, or surgery, and can majorly impact a patient's physical, mental, and social well-being⁵. Consequently, pain management has become essential, and research in this field has proliferated. In this regard, comprehensive, interdisciplinary, and systemic strategies must be applied to pain management to establish substantive pain management⁶.

Pain is a multifaceted and frequently disabling medical condition that can devastate a person's standard of living. A likely explanation is that managing chronic pain remains challenging and complex, frequently including a combination of pharmacological and non-pharmacological techniques⁷. The significance of pain management

in the daily lives of persons and the consequent improvement in their quality of life for those who benefit from this intervention is sufficiently emphasised⁸. Medication, physical therapy, psychological interventions, and alternative therapies, such as acupuncture and massage, can all be utilised to manage pain⁹⁻¹⁰. Researchers can learn more about the causes of pain, locate effective medications, and create novel strategies by studying pain management.

From natural therapies to modern pharmaceutical and technology interventions, the history of pain management research has been distinguished by progressive growth¹¹. Pain management continues to be an important and quickly expanding subject of study, with continual efforts to find novel and more effective pain therapies. In 1973, the International Association for the Study of Pain (IASP) was founded, marking a significant event in the development of pain management research¹². The IASP is today the preeminent international organisation devoted to the study and treatment

of pain, and it has been instrumental in promoting pain management research and teaching¹³.

Given the volume of literature on pain management, methods like bibliometric analysis are necessary for gaining a firm grasp on the field's current level of knowledge, pinpointing research needs, and monitoring the field's development through time. Journal articles, books, and conference papers are all part of the published literature that can be analysed through bibliometrics, a quantitative research tool used to assess the breadth and depth of a topic's contribution to knowledge¹⁴. The bibliometric analysis is a systematic and objective method for evaluating research in a specific area, analysing influential researchers and publications, and revealing recurring themes and collaboration patterns¹⁵. Citation counts and the h-index are examples of how bibliometrics can shed light on a study's influence in the scientific community¹⁶.

Over the past few years, bibliometric analysis has been increasingly popular for assessing state of the art in pain research. Numerous studies have concentrated on bibliometric evaluations of pain research, some of which have zeroed in on specific subfields such as the connection between cancer and pain¹⁷, exercise and neuropathic pain¹⁸, or pain and depression¹⁹. Therefore, a thorough bibliometric examination of pain management research is required to shed light on the state of the industry as a whole and reveal new ways researchers work together.

This study aims to undertake a bibliometric analysis of pain management research utilising the Scopus and Web of Science (WoS) databases by examining the trend in pain management research output over time and identifying pain management research themes and trends. In order to achieve the aims of the study, the following research questions will be addressed:

1. What is the progression of pain management research output?
2. How has the focus of pain management research shifted over time?
3. What are the most investigated pain management themes?
4. How do the themes and patterns found through bibliometric analysis relate to current clinical practice in pain management?

METHODS

This study followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for conducting and reporting bibliometric analysis²⁰. By adopting the PRISMA criteria, the current bibliometric analysis can be

conducted and published thoroughly and reproducibly. Bibliometric analysis, systematic literature review, and scoping review are all methods for analysing research literature, but their objectives, methodologies, and outcomes are distinct.

The bibliometric analysis is preoccupied with the quantitative evaluation of research output²¹. In contrast, systematic literature and scoping reviews concentrate on the qualitative analysis of research articles to answer specific research questions or map the existing literature on a specific topic²². Since the primary objective of this study is to provide a comprehensive overview of the research output and trends in pain management, bibliometric analysis was the most suitable methodology.

Identification datasets

In this study, Scopus and WoS databases were used to identify publications on pain management. Scopus and WoS are comprehensive databases of scientific, technical, medical, and social sciences literature. Also, these databases have strict selection criteria for including publications, ensuring that only high-quality, peer-reviewed research is included. This makes them a reliable source of information for pain management research.

To retrieve the publications, the search terms used were as follows: ("pain management" OR "pain control" OR "pain relief"). The search was conducted within the title field on 18th February 2023. The filter was applied to limit the search to 2012 to 2022, a ten-year period that allows for an in-depth analysis of the research output and impact on pain management.

During this stage, merging databases and selecting document types was accomplished using ScientoPy software. ScientoPy is a Python-based software that provides bibliometric analysis capabilities, including data cleansing, visualisation, and statistical analysis²³. The software can import data from the Scopus and WoS databases, which can then be pre-filtered following the PRISMA recommendations.

Screening datasets

The search results were screened to exclude irrelevant studies and select those that meet the inclusion criteria. In addition, this stage entails cleansing, standardising, and preparing bibliographic data for analysis. This includes eliminating duplicates, addressing errors, and ensuring the data is in an analysis-ready manner.

Inclusion criteria

The inclusion criteria are essential in bibliometric analysis to ensure that the returned publications

are pertinent to the research issue and of appropriate quality. This study included the article, review, proceedings, book chapter, and conference paper as document types, and the selection publication period was from 2012 to 2022.

Analyse and report the results

This step involves a bibliometric evaluation of the gathered datasets. This analysis was conducted in response to the research questions in the study’s

RESULTS

Preliminary data analysis

Using the ScientoPy module, preliminary data analysis on pain management research in Scopus and WoS databases could be performed more effectively by combining datasets and removing duplicates. The downloaded datasets resulted in 21697 publications in both databases. The

introduction. This study examines bibliometric datasets using the well-known tools VOSviewer and ScientoPy. VOSviewer is a tool for visualising bibliographic data in network maps, which can facilitate the identification of patterns, trends, and publication clusters^{16,24}. ScientoPy can generate statistical summaries, produce charts and tables, compare bibliometric indicators across different groups, and assist with clustering analysis to identify groups of publications with similar bibliographic data²⁵.

inclusion criteria based on document types such as articles, reviews, proceedings, book chapters, and conference papers yielded 16545 to be analysed, with publications in Scopus 8979 and WoS 7566. After removing duplicates, there were 9712 datasets counted, with 2256 Scopus and 7566 WoS datasets. A total of 6833 duplicate papers have been eliminated from this analysis. Figure 1 depicts the structure of database and registry searches.

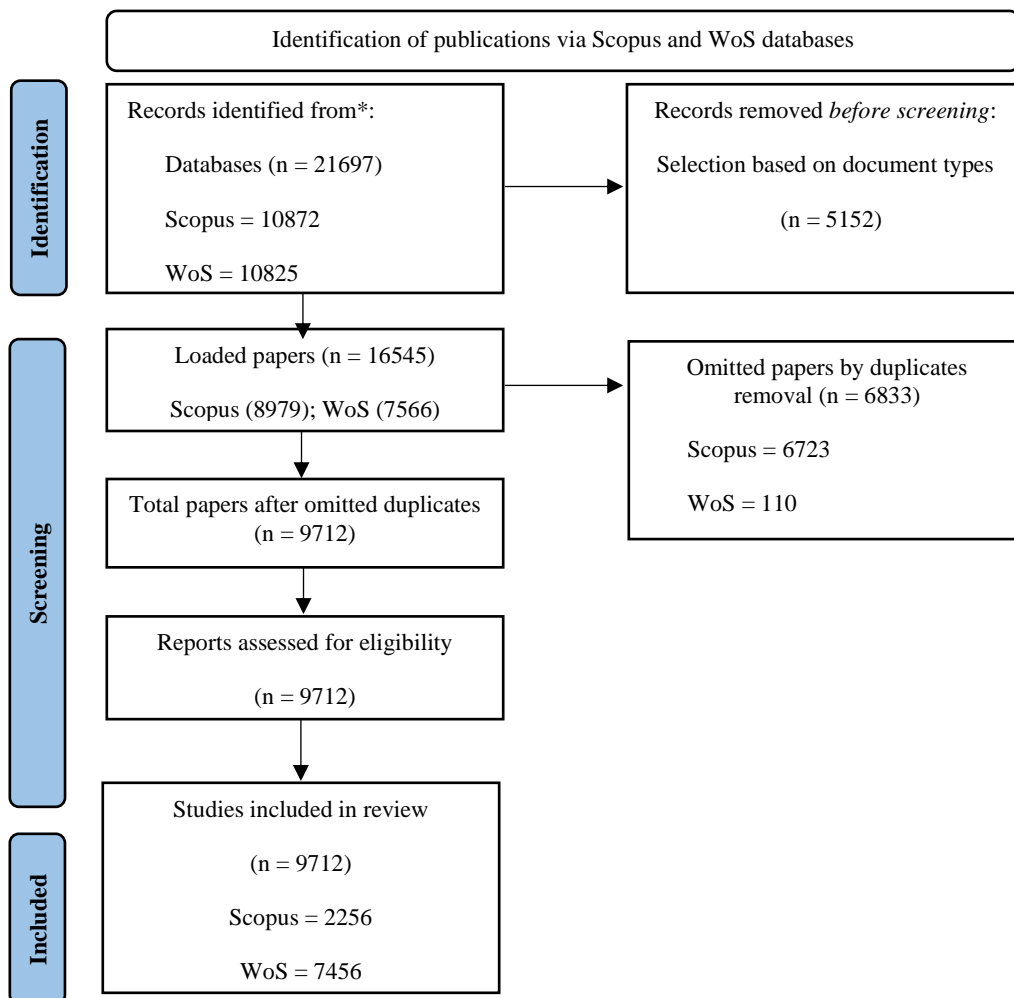


Figure 1: Flow diagram of searches of databases and registers

The progression of pain management research output

The bibliometric analysis of pain management research output utilising the Scopus and WoS

databases has provided valuable insights into the trends and patterns in the field. Figure 2 displays a timeline graph representing the advancement of pain management research publications.

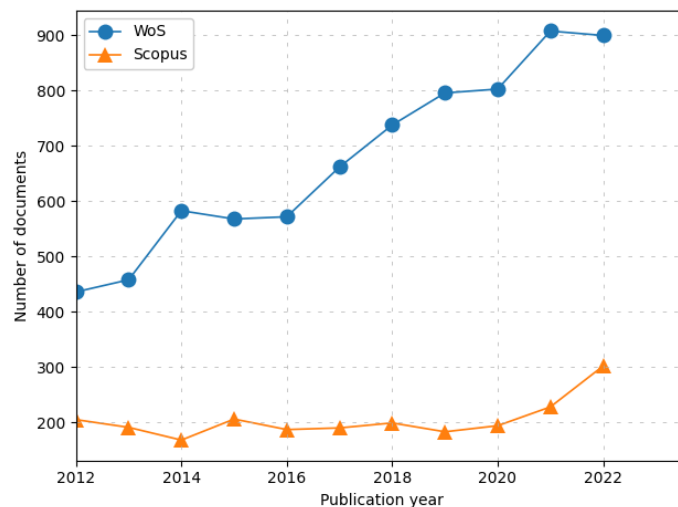


Figure 2: Timeline graph of pain management research growth

Based on Figure 2, it can be observed that both Scopus and WoS databases showed an increasing trend in pain management research output from 2012 to 2022. WoS showed steady growth from 436 in 2012 to 900 in 2022, while Scopus showed a similar but smaller growth from 205 in 2012 to 302 in 2022. It is also interesting to note that there were fluctuations in the yearly output for both databases. WoS had a dip in 2015, with a total output of 568, but it quickly recovered and steadily increased in the following years. Conversely, Scopus had a dip in 2014, with only 168 outputs, but it also recovered and showed a steady increase in output in the succeeding years. The results suggest a growing interest in pain management research, as evidenced by the increasing trend in output. However, it should

also be noted that the data only represents two databases, and other sources of pain management research output may not be included.

Figure 3 depicts the country's evolution graph. The distribution of pain management research output across countries suggests a shift in research focus over time. The United States, with 3,332 publications, has consistently been the leading country in pain management research output. However, with 702 publications, China has experienced a substantial increase in pain management research output and now holds the second position. The United Kingdom (639), Canada (539), India (422), and Iran (408) also show a significant level of activity in pain management research

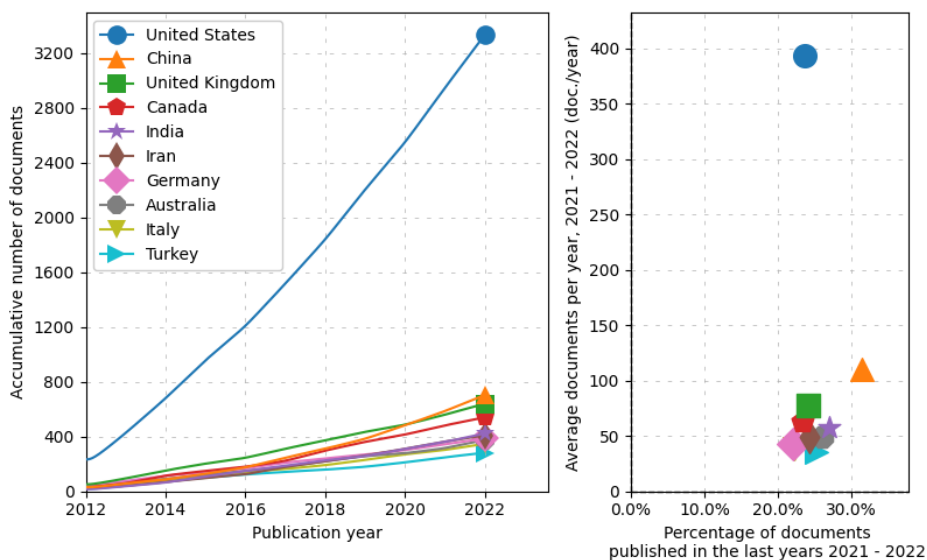


Figure 3: The country's evolution graph

When examining the percentage of documents published in the last two years (2021 to 2022), China stands out, with 32% of their total publications falling in this period, followed by India (27%) and Australia (26%). This suggests that these countries are currently focusing on pain management research and may produce more recent and relevant findings. However, with 24% of their total publications falling in this period, the United States still maintains a significant presence in recent pain management research.

The most investigated pain management themes

Based on Figure 4, the top three subjects with the highest total number of publications in pain

management research were Neurosciences & Neurology (1090), General & Internal Medicine (1083), and Anesthesiology (1038). Surgery (732), Nursing (706), and Pharmacology & Pharmacy (501) also had a substantial number of publications in pain management research. The remaining subjects had relatively fewer publications, with Integrative & Complementary Medicine (119), Dentistry, Oral Surgery & Medicine (118), and Radiology, Nuclear Medicine & Medical Imaging (105) having the least number of publications in pain management research. These results suggest that pain management research is a multidisciplinary field with diverse subjects contributing to the literature.

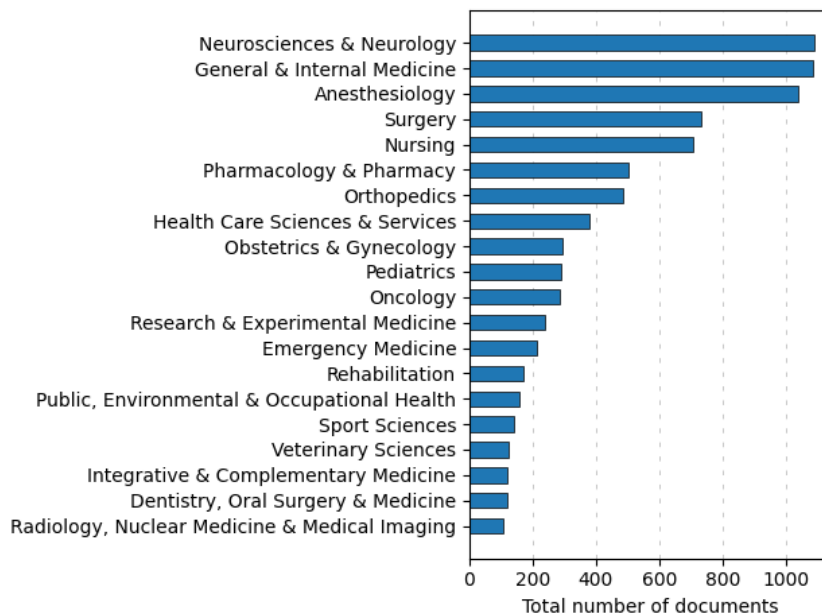


Figure 4: Subject bar-graph

The most investigated theme or topic in pain management research based on Figure 5 is “Pain”, with 1717 publications, followed by “Pain management”, with 1584 publications. “Analgesia” and “Opioid” are among the top investigated themes, with 867 and 649

publications, respectively. The analysis of the percentage of a document published in the last two years (PDLY) indicates that “Opioid” and “Chronic pain” are the most current research themes, with 29% of their publications being published in 2021 and 2022, respectively.

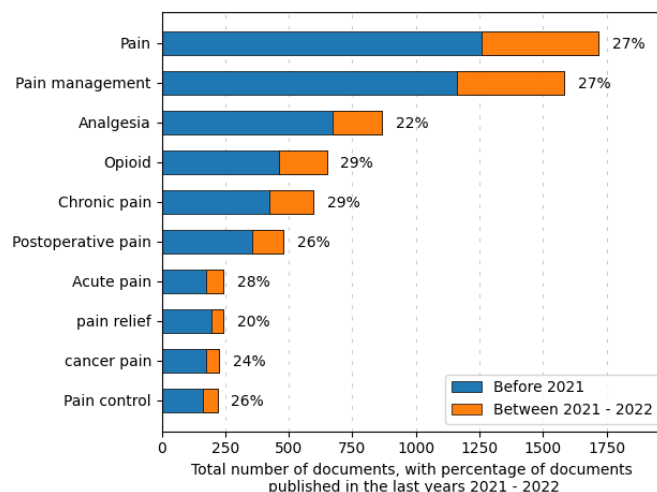


Figure 5: The top ten most investigated themes

The overlay visualisation of authors' keywords in Figure 6 can provide insights into how the themes and patterns found through bibliometric analysis relate to current clinical practice in pain management by highlighting the most used and

corresponding keywords in the field. By exploring this aspect, researchers can identify areas where further research is needed to bridge the gap between research and clinical practice.

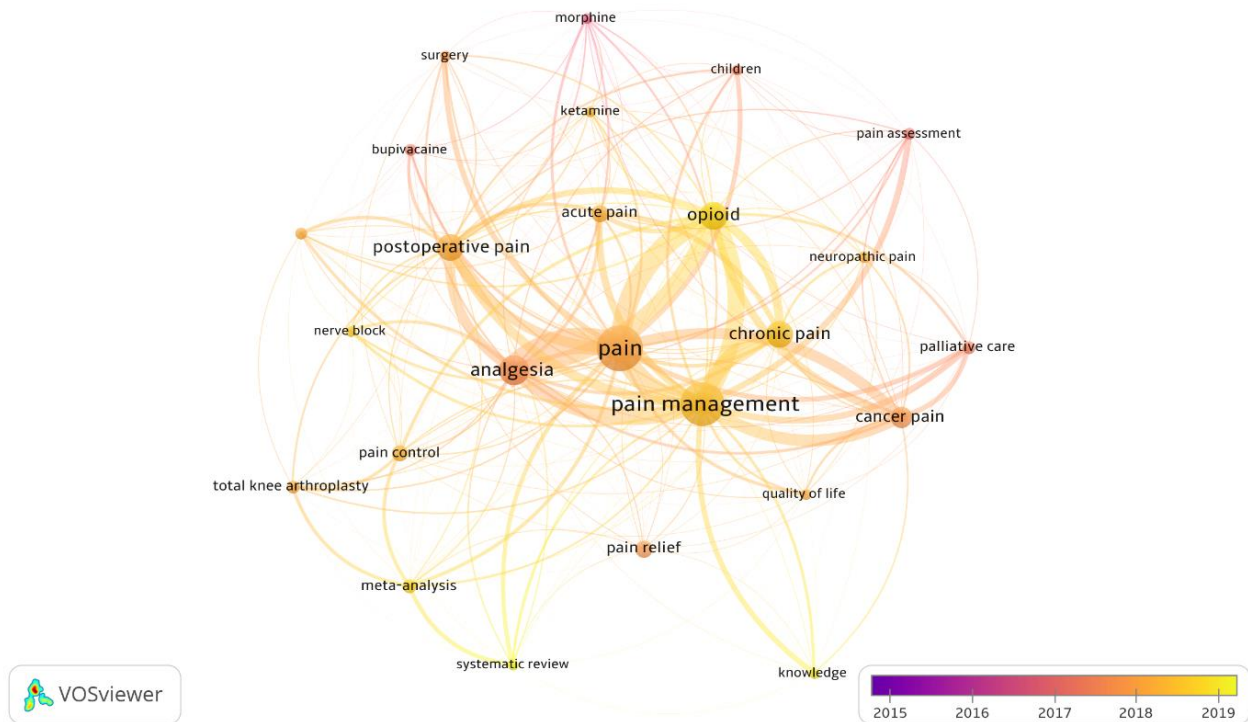


Figure 6: The overlay visualisation of authors' keywords on pain management research

The co-occurrence analysis of authors' keywords revealed that the most used and corresponding keywords in pain management research since 2018 were "analgesia", "pain", "pain management", "cancer pain", "neuropathic pain", "palliative care", "opioid", "acute pain", "postoperative pain", "pain control", "pain relief", "quality of life", "total knee arthroplasty", "meta-analysis", "systematic review", and "knowledge". These keywords reflect the current clinical practice in pain management and the focus of recent research. The most tightly interconnected keywords, representing the most substantial relationship, were "analgesia", "pain", "pain management", "chronic pain", "opioid", and "acute pain". This suggests that recent research has focused on understanding and managing chronic and acute pain, including using opioids and another analgesia. Additionally, there is a growing interest in understanding the impact of pain on quality of life and exploring new treatments, such as palliative care. The emphasis on evidence-based research is reflected in the frequent appearance of terms such as "meta-analysis", and "systematic review", indicating a rigorous approach to evaluating existing research. These findings suggest that recent research is

closely aligned with current clinical practice in pain management, with a strong emphasis on understanding and improving patient outcomes.

DISCUSSION

The distinctiveness of the present investigation lies in its inclusive bibliometric evaluation of pain management research output spanning from 2012 to 2022, employing the Scopus and Web of Science databases. The research furnishes noteworthy perceptions into the present state of pain management research by scrutinising the escalation in research output, the allocation of research across countries, the most thoroughly explored patterns and topics, and the existing clinical practice in pain management.

The increase in pain management research output over time is one of the most important findings of this study. The examination of the timeline graph revealed an upward trend in pain management research output in Scopus and WoS databases from 2012 to 2022. The results indicate a growing interest in pain management research, as indicated by the output's upward trend. Lee et al. (2020)²⁶ discovered that the number of

publications on pain therapy had increased steadily over the past two decades (2000-2019). In addition, the study by Zajacova et al. (2021)²⁷ emphasises the significance of monitoring trends in chronic pain prevalence and social distribution to comprehend the burden of this health issue and enhance public health. This consistency in findings across several studies over a more extended period bolsters the significance of the current findings. It implies that the interest and emphasis on pain management research are growing. Consequently, it is vital to continue research to develop more effective pain management methods to enhance patients' quality of life.

The distribution of pain management research output among countries was another significant finding of this study. China, the United Kingdom, Canada, India, and Iran have trailed the United States regarding pain management research output, whereas the United States has consistently been the leader. Consistent with earlier research, such as the bibliometric study conducted by Wang and Zhao (2018)²⁸, which determined that the United States is the most prolific country in back pain research, the results demonstrated that the United States plays a leadership role in pain management research. The fact that the United States is the leader in pain management research means that American academics are at the forefront of inventing new and novel pain treatment techniques. This information can help policymakers and healthcare practitioners determine where to focus resources and funds for pain management research and treatment.

China, India, and Australia stand out when considering the percentage of documents published in the previous two years (2021 to 2022), indicating that these countries focus on pain management research and may provide more recent and relevant discoveries. According to Qin et al. (2021)²⁹, since the proposal of the three-step analgesic ladder in 1986 and the launch of the "Good Pain Management Ward" campaign by the Chinese Ministry of Health in 2011, the management of cancer pain has received increased attention in China. In India, more research must be conducted at the institutional and individual levels about pain predictors and access to proper pain management³⁰. Hence, improvements in pain management for cancer patients in India are urgently required. Barriers to pain management research in Australia were identified as staff perceptions of patients' pain

levels and attitudes towards pain assessment and pain management³¹. These studies indicate that China, India, and Australia strongly emphasise pain management research and offer fresh and pertinent discoveries.

The themes "Pain", "Pain management", "Analgesia", and "Opioid" were the most researched topics in the field of pain management. The examination of the percentage of documents published within the last two years revealed that "Opioid" and "Chronic pain" are the two most recent research topics. The results indicate that pain management research is a multidisciplinary field with contributions from numerous disciplines³². The overlay visualisation of the authors' keywords gave additional insight into the relationship between the themes and patterns discovered through bibliometric research and current clinical practice in pain management by highlighting the most frequently used and relevant keywords. The co-occurrence analysis of authors' keywords revealed that "analgesia," "pain," "pain management," "cancer pain," "neuropathic pain," "palliative care," "opioid," "acute pain," "postoperative pain," "pain control," "pain relief," "quality of life," "total knee arthroplasty," "meta-analysis," "systematic review," and "knowledge" were the most frequently used and corresponding keywords in pain management. These keywords reflect the current clinical practice in pain treatment and the emphasis of current research.

The ramifications of this study's findings for future pain treatment research are substantial. The findings indicate an increasing interest in pain management research, emphasising chronic and acute pain management, including using opioids and other analgesics. In addition, there is a growing need to comprehend the impact of pain on quality of life and to investigate innovative treatments, such as palliative care. The prevalence of "meta-analysis" and "systematic review" reflects the emphasis on evidence-based research, showing a thorough approach to analysing previous research. Our findings imply that future research on pain management should continue to focus on understanding the complicated mechanisms behind pain, generating more effective and safe medications, and investigating the impact of pain on patients' quality of life.

CONCLUSION

In conclusion, the current study performed a bibliometric analysis of pain management

research output utilising Scopus and Web of Science databases between 2012 and 2022. The results demonstrated a consistent rise in pain management research papers and a growing interest in the field. China, India, and Australia stand out for their recent and significant pain management discoveries, but the United States has emerged as the leader in pain management research. “Pain”, “Pain Management”, “Analgesia”, and “Opioids” were the most investigated themes in pain management, emphasising chronic and acute pain management, evidence-based research, and understanding the impact of pain on patients’ quality of life. The findings of this study provide valuable insights into the current state of pain management research and underscore the need for continuous research to develop more effective pain management approaches and improve patients’ quality of life.

Contributions to the body of knowledge and professional practices

Bibliometric analysis of pain management research has significantly contributed to the body of knowledge and clinical practices. Firstly, the investigation has provided an overview of the existing research in pain management, identifying the key countries that have contributed the most to the field. This information can inform research collaborations, funding decisions, and academic appointments, ultimately improving the quality and impact of pain management research. For example, the examination has divulged that China, India, and Australia have evinced a noteworthy augmentation in their research output concerning pain management in recent years. This discovery can expedite research collaborations among these nations and others, as scholars can recognise prospective partners with a relentless emphasis on pain management. Such partnerships can engender shared proficiency, resources, and innovative methodologies to confront the predicaments in pain management.

Secondly, the analysis has identified key research themes and areas of focus within pain management. This information can identify areas where more research is needed and guide the development of new treatments and interventions. For example, an increasing interest in “Opioid” and “Chronic pain” can aid in prioritising research endeavours to address the challenges related to opioid use and chronic pain management. By prioritising these areas, clinicians and researchers can enhance pain management strategies and create personalised and efficient treatments for patients with chronic pain conditions.

Limitations

Although bibliometric analysis provides valuable insights into research in a particular field, it has some limitations. One limitation is that it only includes studies published in peer-reviewed journals (Scopus and WoS). It may miss essential studies not published in these outlets, such as unpublished theses, dissertations, or reports. This limitation could introduce a bias in the findings, as the analysis may not reflect the entirety of pain management research. Additionally, the bibliometric analysis relies on the accuracy and completeness of the metadata associated with each publication, which may not always be reliable. For instance, incorrect or incomplete information about authors, affiliations, or keywords may lead to misclassification or misinterpretation of the data. Finally, bibliometric analysis cannot provide insight into the quality or impact of the studies analysed. Therefore, it should be used with other evaluation methods, such as systematic reviews or expert opinions.

Future research directions

The pain management bibliometric study suggests various prospective research directions. Directions include:

1. Other non-pharmacological pain management: Mindfulness, cognitive behavioural therapy, and physical therapy are gaining popularity as alternatives to medication pain management. These methods may be tested alone or with drugs in future studies.

2. Population-specific pain treatment research: The bibliometric analysis showed that pain management research in children, the elderly, and the chronically ill are scarce. These people have specific pain management demands and challenges. Future research could discover beneficial therapies.

3. Technology in pain management: Recent investigations have shown an increasing interest in telemedicine and mobile health apps. Thus, these techniques may improve pain management and treatment access in future studies.

4. Assessment of the influence of pain management on quality of life: Pain management is frequently focused on reducing pain intensity but also affects the quality of life. Pain treatment strategies may affect mental health, social functioning, and functional status.

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Conflict of interest

There is no potential conflict of interest declared by the authors

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