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CURRENT TOPIC

Tracking Advances in Precision Medicine for Osteoarthritis

Lalu Muhammad Irham,[1] Petrina Theda Philothra[2]

1. Faculty of Pharmacy, Universitas Ahmad Dahlan, Yogyakarta, Indonesia.
2. Department of Rehabilitation Medicine, General Hospital Yogyakarta City, Yogyakarta, Indonesia.

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Corresponding author:
LALU MUHAMMAD IRHAM
E: lalu.irham@pharm.uad.ac.id

Abstract

Osteoarthritis (OA) is a prevalent degenerative joint disease that significantly affects the quality of life for millions of individuals globally. As research in this area continues to grow, conducting a bibliometric study becomes essential to analyse publication trends, identify key focus areas and assess the overall impact of research on OA. This study aimed to undertake a comprehensive bibliometric analysis of the existing literature on OA, emphasising the urgency of understanding current trends and advancements in this field. Utilising databases such as *Scopus*, the number of publications, citation metrics and collaborative networks among researchers were evaluated. Findings indicated that "osteoarthritis" was the most frequently used keyword among the 1,911 unique keywords identified in analysis. Notably, a peak in studies related to precision medicine for OA in 2023 was observed, with a total of 127 publications projected for 2024. The *International Journal of Molecular Sciences* emerged as the most productive journal in this domain, publishing 17 documents specifically focused on precision medicine for OA. Furthermore, the United States was identified as the most cited country in this research area, accumulating a total of 3,953 citations. Among individual articles, The *Lancet* was recognised as the most cited source, with its article titled “Osteoarthritis” receiving 2,648 citations, underscoring its substantial influence on both clinical practice and further research in OA. The data also highlights that the United States leads in both single country publications (SCP) and multiple country collaborations (MCP), reflecting its extensive resources and commitment to advancing precision medicine initiatives. Given the increasing prevalence of OA and its associated healthcare burden, this bibliometric study is crucial for guiding researchers, clinicians and policymakers in developing effective interventions and improving patient outcomes. Through this analysis, we seek to promote collaboration and innovation in OA research, ultimately enhancing management strategies for this chronic condition. These collaborative efforts across various disciplines are crucial for developing effective interventions and improving outcomes for those affected by OA.

Key words: Osteoarthritis; Precision medicine; Personalised medicine; Bibliometrics.

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Introduction

Osteoarthritis (OA) is a prevalent and significant health concern worldwide, characterised by the degeneration of joint cartilage and underlying bone, leading to pain and reduced mobility.[1] As of 2020, approximately 595 million people were living with OA, representing about 7.6 % of the

global population. This reflects a significant increase of 132.2 % since 1990, indicating that OA is becoming increasingly common as populations age and lifestyles change.[2] The prevalence of OA varies by region and sex. For instance, in high-income Asia Pacific regions, the age-standardised prevalence was reported as high as 8,632.7 per 100,000, while Southeast Asia had a lower prevalence at around 5,677.4 per 100,000.[2] The prevalence increases significantly with age. For individuals aged 40 and older, the prevalence rate rises to 22.9 %. It is also noted that among adults aged 70 years and older, OA is a leading cause of disability.[3] The annual incidence of OA has been estimated at approximately 46.6 million new cases globally in 2021. This indicates a rising trend in the number of individuals developing OA each year.[1, 2] The incidence rates are expected to continue rising due to factors such as aging populations and increasing obesity rates, which are significant risk factors for developing OA.[3] By 2050, it is projected that nearly 1 billion people will be affected by OA due to ongoing demographic changes. By 2050, it is projected that nearly 1 billion people will be affected by OA due to ongoing demographic changes.

The OA significantly impacts health, well-being and economic stability, which aligns with several goals of the United Nations Sustainable Development Goals (SDGs). The relationship between OA and the SDGs underscores the importance of addressing this prevalent condition through comprehensive strategies that encompass healthcare access, economic support, mental health considerations, urban planning and collaborative efforts. By focusing on these areas, stakeholders can work towards mitigating the impact of OA on individuals and society while contributing to the broader goals of sustainable development.[4] The gap between the SDGs and the urgency for implementing precision medicine in OA is significant and multifaceted. The urgency for implementing precision medicine in OA is critical not only for improving patient outcomes but also for achieving broader health-related SDGs. By addressing the unique challenges posed by OA through personalised approaches, stakeholders can work towards reducing health inequalities, enhancing economic stability and ultimately improving overall well-being in affected populations.

The urgency for implementing precision medicine in OA stems from the need for more effective, individualised treatment approaches that consider the complexity of this condition. By focusing on patient-specific characteristics and utilising advanced data analytics, healthcare providers can significantly improve outcomes for individuals suffering from OA while also addressing broader public health challenges associated with this prevalent disease.[5, 6] The urgency for monitoring precision medicine in OA is underscored by the complexity of the disease, the potential benefits of personalised treatment strategies and the need for continuous assessment of research productivity in this area. By leveraging technological advancements and focusing on individualised care, stakeholders can improve outcomes for patients with OA while addressing existing gaps in knowledge and practice. Assessing research productivity through bibliometric studies helps identify trends, gaps and emerging areas of focus within the field of OA research. This type of analysis can inform stakeholders about the current state of knowledge, guide funding decisions and prioritise areas needing further investigation. Bibliometric studies are essential tools for analysing research productivity, trends and impact within specific fields like OA.

Methods

The methodology employed in this study was characterised by a systematic approach to bibliometric analysis using the *Scopus* database. By utilising a well-defined search strategy and analysing a diverse range of publication types, the study aimed to provide comprehensive insights into publication trends, citation metrics and collaborative efforts in precision medicine related to OA. This methodology lays a strong foundation for understanding the current state of research and identifying key areas for future investigation in this important field.

Database selection

The study utilised the *Scopus* database, which is recognised for its extensive coverage of approximately 23,000 journals across various fields. *Scopus* is preferred in bibliometric studies due to its larger number of indexed journals compared to other databases like *Web of Science*, making it suitable for comprehensive research analysis.[7] This information highlights *Scopus*'s significance as a valuable resource for researchers seeking to analyse publication trends and citation metrics

across various fields.[8] The data collection was conducted on 20 November 2024, ensuring that all analyses, including citation metrics and publication counts, were performed on the same day. This approach helps maintain consistency and accuracy in the dataset. A specific search strategy was employed using keywords: "Osteoarthritis" AND "Precision medicine" OR "Personalised medicine." This search strategy aimed to capture relevant publications that focus on both OA and precision medicine.

Types of documents analysed

The study included various types of documents to provide a comprehensive overview of the research landscape in precision medicine for OA. This diversity allows for a richer understanding of how different formats contribute to the field. Although not explicitly detailed in the provided text, bibliometric studies typically involve quantitative analysis techniques such as citation analysis, co-authorship networks and keyword frequency analysis. Tools like *CiteSpace*, *VOSviewer*[9] and mapping using the *Biblioshiny* interface in the R software.[10] This software is commonly used for visualising data and identifying trends within the literature. The timeframe for the study spanned from 1996 to 2025, allowing researchers to analyse historical trends and project future developments in the field of precision medicine for OA.

Bibliometric indicators

This study employed bibliometric indicators to provide a comprehensive overview of the research landscape concerning OA and precision medicine. Key indicators included the annual number of publications, which reveals trends in research activity over time and the identification of active countries contributing to OA research, highlighting geographical distribution and leading nations by publication volume. The analysis also examined active journals that frequently publish relevant articles, guiding researchers on suitable submission venues. Additionally, active institutions producing significant OA research were listed to facilitate future collaborations. Citation information was analysed to assess the impact of published works, with high citation counts indicating influential studies and emerging research areas. The study categorised various document types (eg, articles, reviews, books, book chapters etc) to illustrate the diversity of research outputs. It identified the most frequently used keywords to highlight trending topics and noted peak publication years that signify increased interest in OA and precision medicine. Furthermore, the identification of the most productive journal and the most cited country provided insights into influential platforms and contributors in this field. Finally, recognising the most cited article offers a glimpse into studies that have significantly impacted subsequent research and clinical practice in OA. The detail information related to the flow of trend study of bibliometric based approach was depicted on the Figure 1.

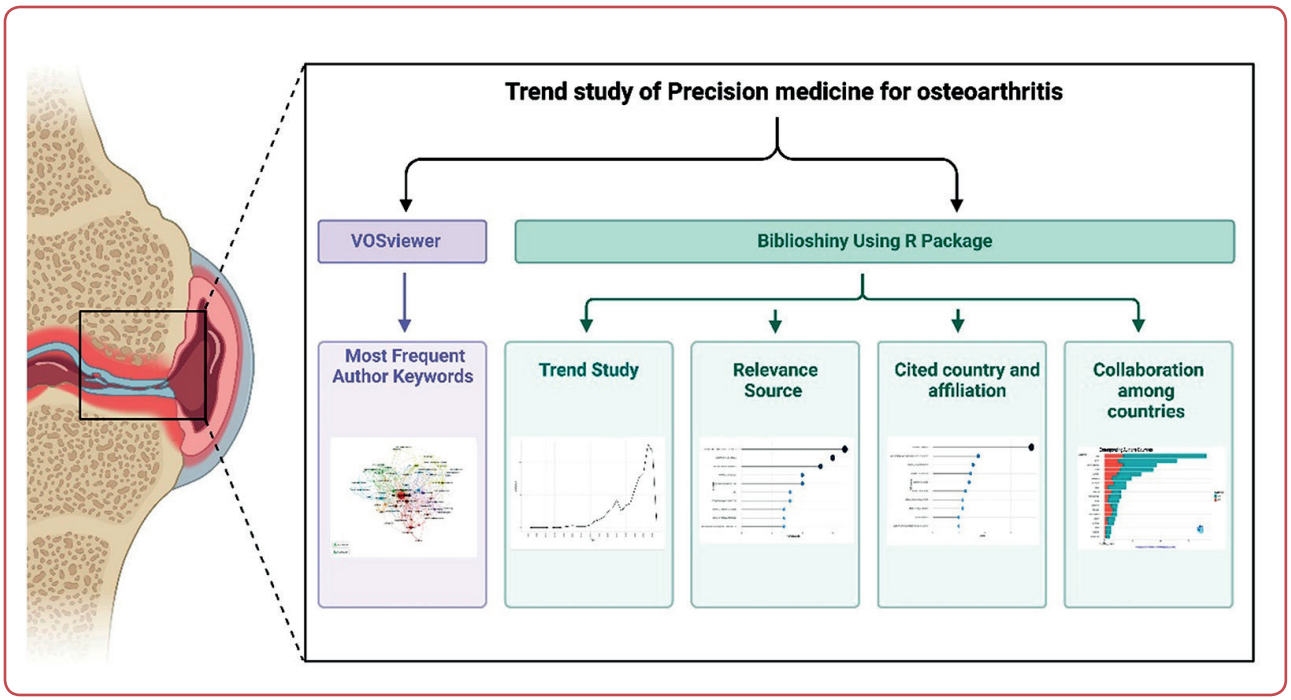

Figure 1: Flow of bibliometric study on precision medicine for osteoarthritis

This figure was created on Biorender.com under agreement number: LK27M3WX0H.

Results

Visualisation of most frequent keywords

The search yielded a total of 714 documents from 423 journals, covering a timespan from 1996 to 2025. The analysis identified a total of 3,927 authors, with different types of publications including: articles: 362, books: 1, book chapters: 17, conference papers: 10, conference reviews: 2 editorials: 49, errata: 1, letters: 6, notes: 18, reviews: 239, short surveys: 9. This indicates that the study included a graphical representation (visualisation) of the keywords that authors frequently use in their publications related to precision medicine for OA. Visualisation techniques, such as *VOSviewer*, help researchers understand trends, relationships and the prominence of specific keywords in the literature. Current study set minimum occurrences of five times. The criteria set for inclusion in this visualisation was that a keyword must appear at least five times across the analysed publications. This threshold ensured that only significant and relevant keywords were highlighted, filtering out fewer common terms that may not contribute meaningfully to understanding the research landscape. Out of a total of 1,911 unique keywords identified in the literature on precision medicine for OA, only 68 keywords met the minimum occurrence requirement. This suggests that while there was a wide range of topics covered in the literature, only a subset was frequently discussed among researchers, indicating key areas of focus within the field (Figure 2).

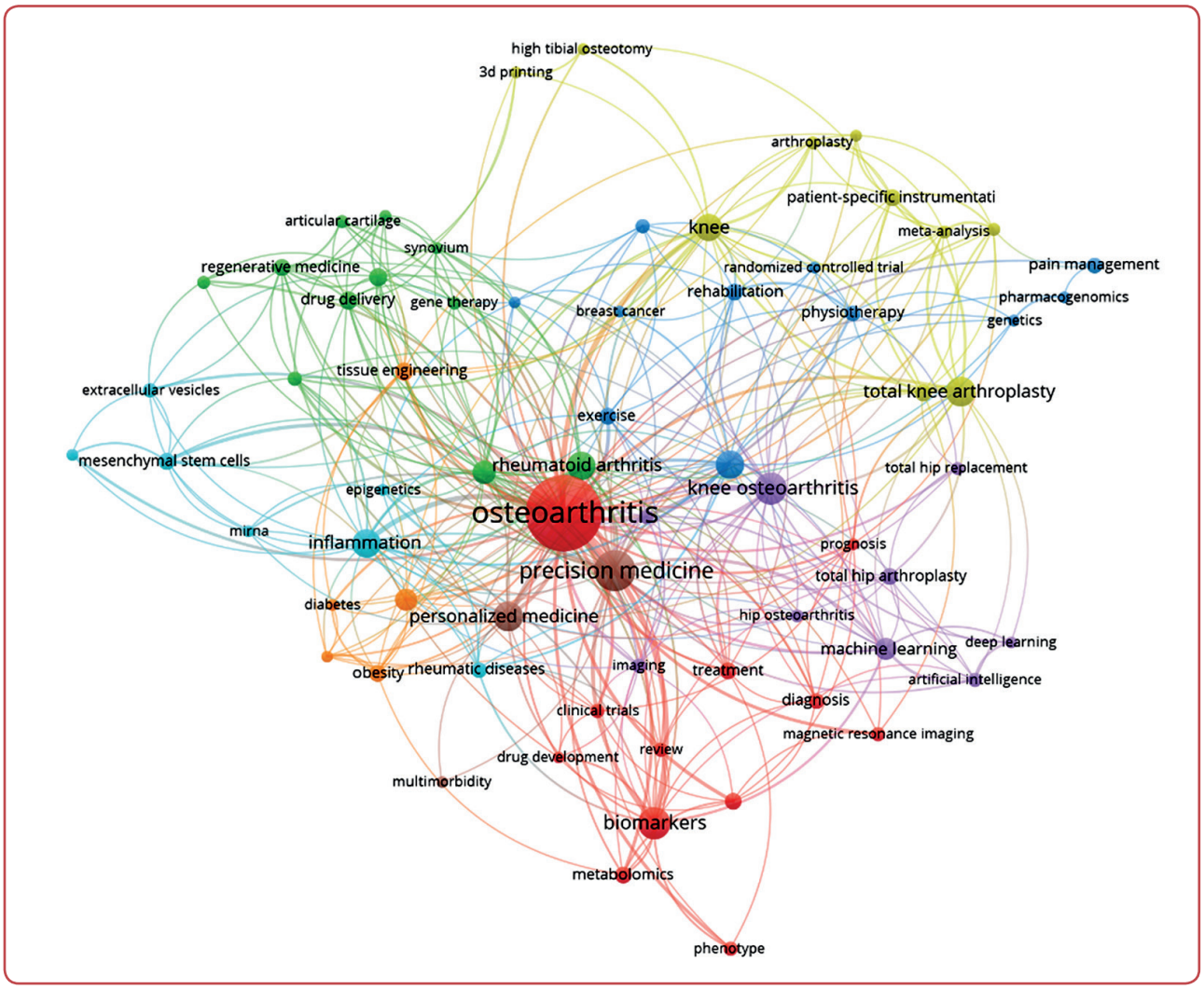

Figure 2: Visualisation of most frequent author keywords (minimum occurrences of 5 times) related to the precision medicine for osteoarthritis

Out of 1,911 keywords 68 meet the threshold.

Urgency for trend study related to precision medicine for osteoarthritis

The data indicated a significant upward trend in the number of documents related to precision medicine for OA, culminating in a peak in 2023 with a total of 127 publications. This was followed by a projected 112 documents in 2024. The historical data showed that the number of relevant publications has steadily increased over the years, with 84 documents in 2022, 77 in 2021, 58 in 2020, 37 in 2019 and 34 in 2018. This trend suggests a growing interest and research activity in the application of precision medicine approaches to OA, reflecting advancements in understanding the disease and developing targeted therapies (Figure 3). The peak in 2023 may be attributed to recent breakthroughs or increased funding and collaboration within the field.

Most relevance source related the precision medicine for osteoarthritis

The study presents an overview of the top sources contributing to research on precision medicine for OA, as illustrated in a referenced Figure 3. The analysis of the top 10 sources related to precision medicine for OA is crucial for understanding

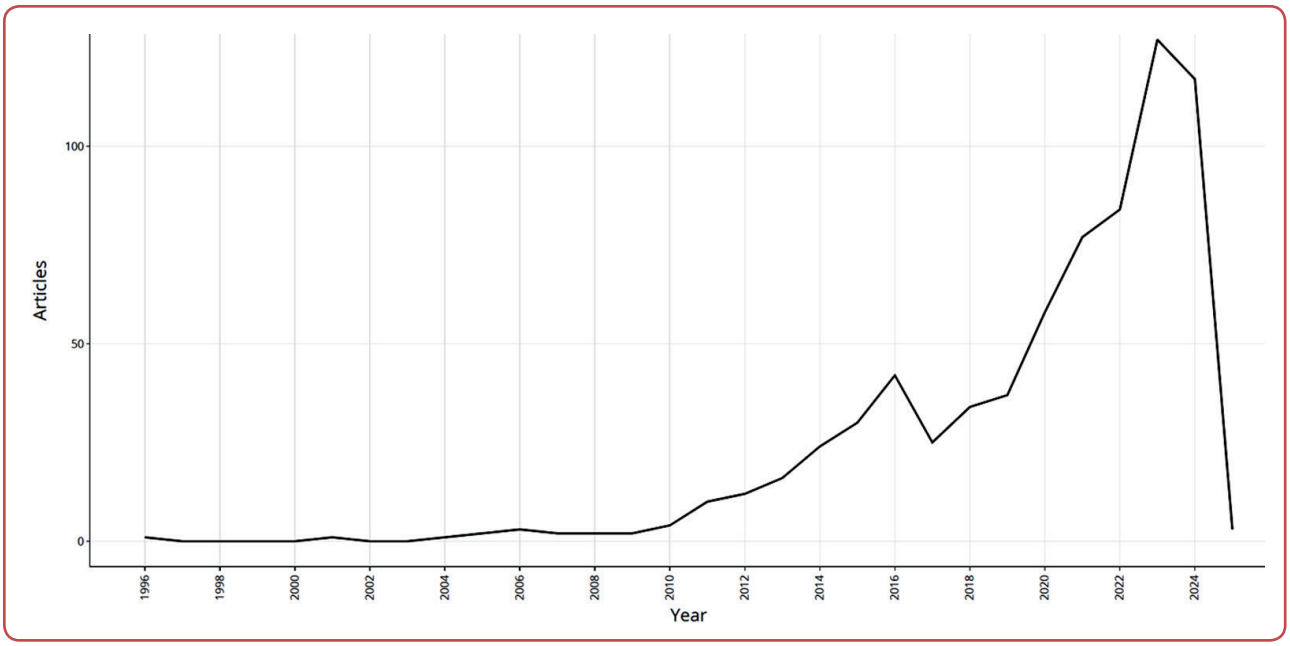

Figure 3: Publication trend related to the precision medicine for osteoarthritis

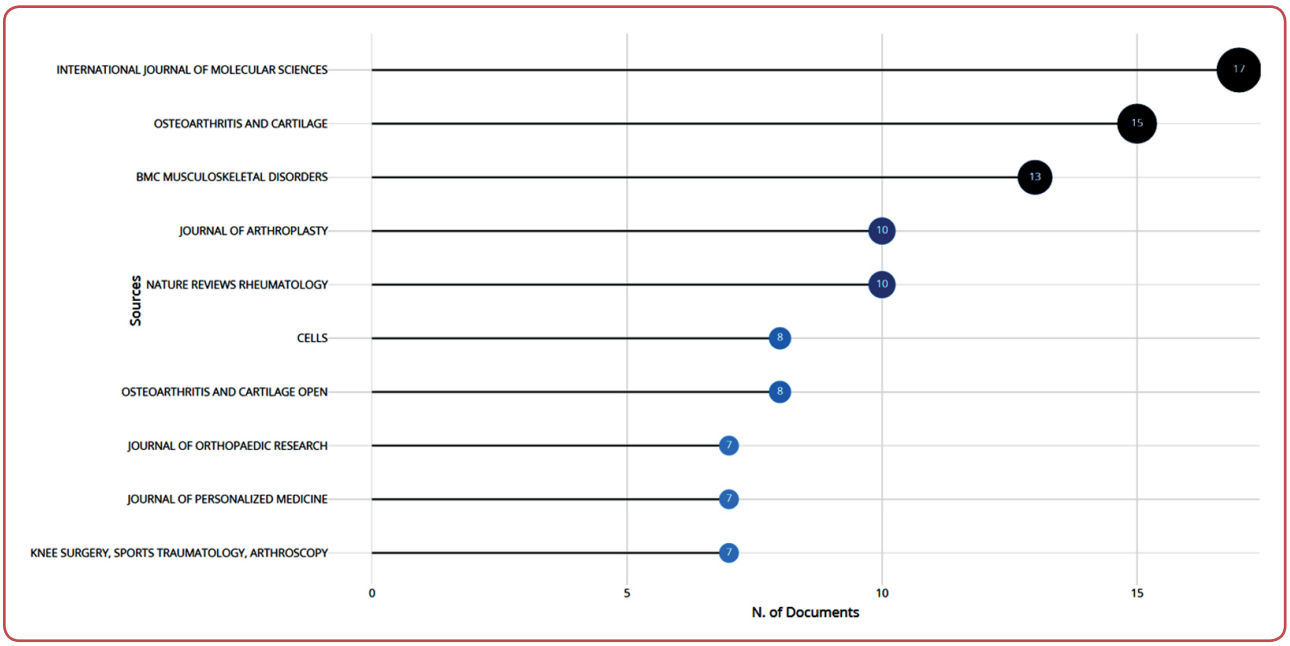

Figure 4: Top 10 journals with publications related to the precision medicine for osteoarthritis

where significant research contributions are being made. The findings indicate that specific journals were leading the way in publishing relevant studies, which helps illuminate the current landscape of OA research. The *International Journal of Molecular Sciences* stood out as the most productive journal in this field, having published 17 documents related to precision medicine for OA. This journal is known for its focus on molecular biology and its applications in various health-related fields, making it a vital platform for disseminating research findings pertinent to OA. Following closely was *Osteoarthritis and Cartilage*, which published a total of 15 documents. This journal specifically addresses the mechanisms, diagnosis and treatment of OA, making it a key resource for researchers and clinicians alike (Figure 4).

The journal *BMC Musculoskeletal Disorders* contributed 13 documents, further emphasising the importance of musculoskeletal health in OA research. Both the *Journal of Arthroplasty* and *Nature Reviews Rheumatology* each published 10 documents. The *Journal of Arthroplasty* focuses on surgical interventions for joint disorders, while *Nature Reviews Rheumatology* provided comprehensive reviews on various rheumatological conditions, including OA. Identifying these journals highlights where active research is being conducted and published, providing insights into which platforms are most influential in shaping the discourse around precision medicine for OA. The presence of multiple journals contributing to this field suggests potential collaboration opportunities among researchers. By sharing findings across these platforms, researchers can foster innovation and enhance the collective understanding of OA. The data presented about the top sources related to precision medicine for OA underscores the significance of these journals in advancing research and clinical practice. By focusing on high-quality publications from leading journals, stakeholders can better navigate the evolving landscape of OA research, identify key trends and contribute to developing effective precision medicine strategies that improve patient outcomes in OA management.

Overview of citation data related to the precision medicine for osteoarthritis

According to the data illustrated in the referenced figure, the United States emerged as the most cited country in research related to precision medicine for OA, with a total of 3,953 citations. This substantial figure underscores the significant influence and contribution of United States researchers in this field, reflecting a long-standing tradition of leadership in scientific research and innovation. Following the United States, Australia ranked second with 2,922 citations. This indicates that Australia is also a prominent player in OA research, contributing valuable insights and findings that are recognised by the global scientific community. The presence of a robust research infrastructure and collaboration among Australian institutions likely supports this high citation count (Figure 5).

China comes next with 1,213 citations, highlighting its growing impact on OA research. Over recent years, China has significantly increased its research output and citation rates across various scientific disciplines, including health sciences. This trend reflects China's commitment to advancing its scientific capabilities and contributing to international research efforts. The United Kingdom (UK) followed closely with 1,092 citations, demonstrating its continued relevance in the field of OA research. The UK has a rich history of contributions to rheumatology and musculoskeletal disorders, which is reflected in its citation metrics. Finally, Germany rounded out the list with 937 citations. As one of Europe's leading countries in scientific research, Germany's contributions to precision medicine for OA further emphasise the collaborative nature of global scientific inquiry.

The citation data presented highlights not only the leadership role of the United States in precision medicine for OA but also the significant contributions from other countries like Australia, China, the UK and Germany. Understanding these trends is essential for researchers, policymakers and healthcare providers as they navigate the evolving landscape of OA treatment and strive to implement effective precision medicine strategies that enhance patient outcomes worldwide.

Table 1 provides insights into the Top 10 cited articles related to precision medicine for OA. This analysis highlights the most influential publications that have shaped the understanding and development of precision medicine approaches in managing OA. The *Lancet* journal was identified as the most cited source, with a total of 2,648 citations for its article titled "Osteoarthritis." This high citation count indicates that the research published in The *Lancet* has had a substantial impact on the field, influencing both clinical prac-

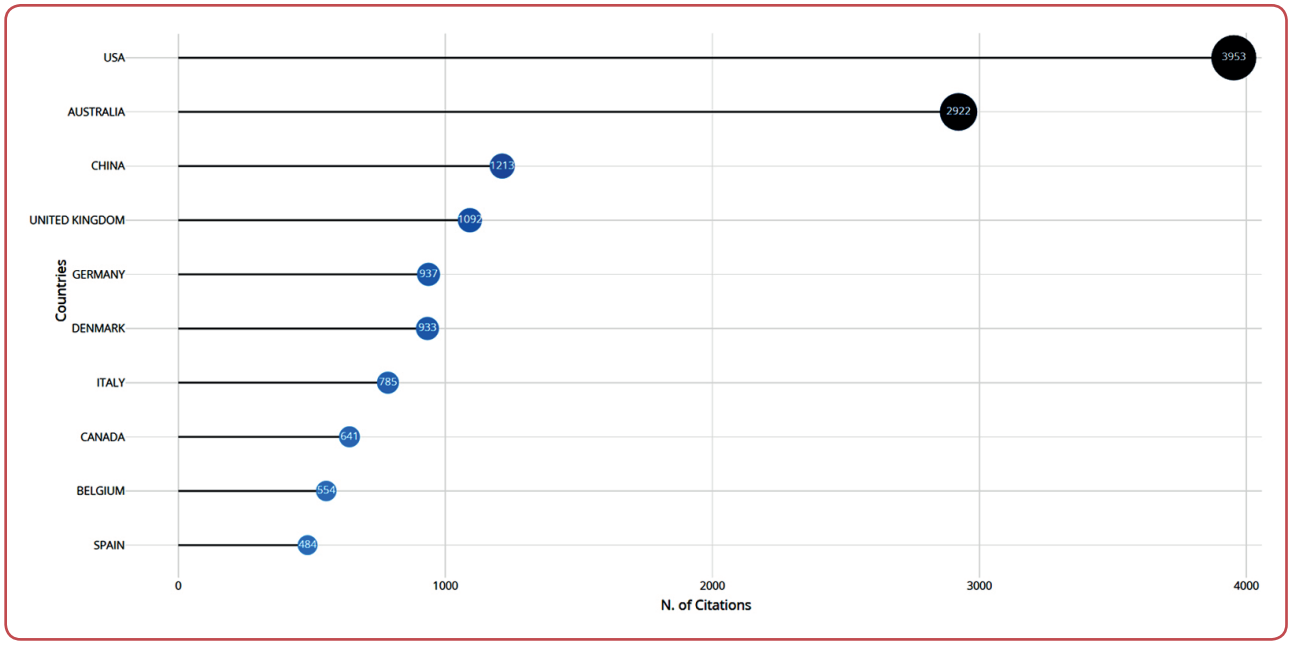

Figure 5: Top 10 cited countries related to the precision medicine for osteoarthritis

Overview of cited articles related to the precision medicine for osteoarthritis

Table 1: Top 10 cited articles related to the precision medicine for osteoarthritis

Authors	Year	Journal	PMID	TC	TC per year	Normalised TC
Hunter et al	2019	*Lancet*	31034380	2648	441.33	25.73
Booth et al	2012	*Comprehensive Physiology*	23798298	1749	134.54	11.01
Roos et al	2016	*Nature Review Rheumatology*	26439406	358	39.78	7.13
Mobasheri et al	2016	*Annals of Physical and Rehabilitation Medicine*	27546496	280	31.11	5.58
Wei et al	2021	*Bioactive Materials*	33102942	261	65.25	10.67
Nijs et al	2021	*Lancet Rheumatology*	38279393	225	56.25	9.20
Hewett et al	2016	*Journal of Orthopaedic Research*	27612195	197	21.89	3.92
Howell et al	2018	*Journal of Arthroplasty*	30122435	184	26.29	4.62
Rannou et al	2016	*Seminars in Arthritis and Rheumatism*	26806189	180	20.00	3.58
Hodgkinson T et al	2022	*Nature Reviews Rheumatology*	34934171	175	58.33	13.51

PMID: *PubMed* unique identifier; TC: Total citations;

tice and further research in OA. Following the *Lancet*, the journal *Comprehensive Physiology* has garnered 1749 citations for its article titled "Lack of Exercise is a Major Cause of Chronic Diseases." This article emphasised the critical role of physical activity in preventing various chronic conditions, including OA, thereby contributing to the discourse on lifestyle factors affecting OA.[11]

The article "Strategies for the Prevention of Knee Osteoarthritis" published in *Nature Reviews Rheumatology* has received 358 citations.[12] This publication focused on preventive strategies for knee OA, highlighting the importance of early intervention and lifestyle modifications to reduce the risk of developing this debilitating condition. Another significant contribution came from the journal *Annals of Physical and Rehabilitation Medicine*, which has been cited 280 times for its article titled "An Update on the Pathophysiology of Osteoarthritis." This article provided a comprehensive overview of the underlying biological mechanisms involved in OA, enhancing the understanding of how precision medicine can be applied to tailor treatments based on individual pathophysiological profiles.[13]

The table detailing the top cited articles related to precision medicine for OA underscores the importance of understanding both the biological

underpinnings and preventive measures associated with this condition.[14-20] By analysing these influential publications, researchers and practitioners can gain valuable insights into effective strategies for managing OA through personalised approaches that consider individual patient characteristics and risk factors. This knowledge is vital for improving patient outcomes and advancing the field of precision medicine in OA management.

Overview of research affiliations in precision medicine for osteoarthritis

The analysis of research affiliations related to precision medicine for OA reveals key institutions that were at the forefront of this important area of study. According to the data, the University of Warwick emerged as the leading institution, having published a total of 76 documents on this topic. This substantial output underscores the University's commitment to advancing knowledge and innovation in OA research, particularly in the context of precision medicine, which aims to tailor treatments based on individual patient characteristics.

Following closely was Northwestern University Feinberg School of Medicine, which had contributed 35 documents to the field. This institution is known for its strong emphasis on interdisciplinary research and collaboration, which likely enhances its capacity to produce impactful studies related to OA and precision medicine. The Medical University of Vienna ranked third with 31 documents. This university has a long-standing reputation for excellence in medical research and education, particularly in rheumatology and musculoskeletal disorders. Its contributions are crucial for understanding the complexities of OA and developing personalised treatment strategies (Figure 6).

Next was the University of California, which had published 29 documents related to precision medicine for OA. The University of California system encompasses several campuses renowned for their research capabilities, particularly in health sciences and biomedical research. This extensive network allows for collaborative efforts that can lead to significant advancements in understanding and treating OA. Finally, the University of Oxford rounded out the list with 28 documents. As one of the leading research institutions globally, Oxford's contributions to OA research are significant. The university is known for its innovative approaches in various medical fields, including rheumatology and its focus on translating research findings into clinical practice.

The data regarding the top affiliations related to precision medicine for OA reveals a landscape rich with research activity and innovation. Institutions like the University of Warwick, Northwestern University Feinberg School of Medicine, Medical University of Vienna, University of California and University of Oxford were leading con-

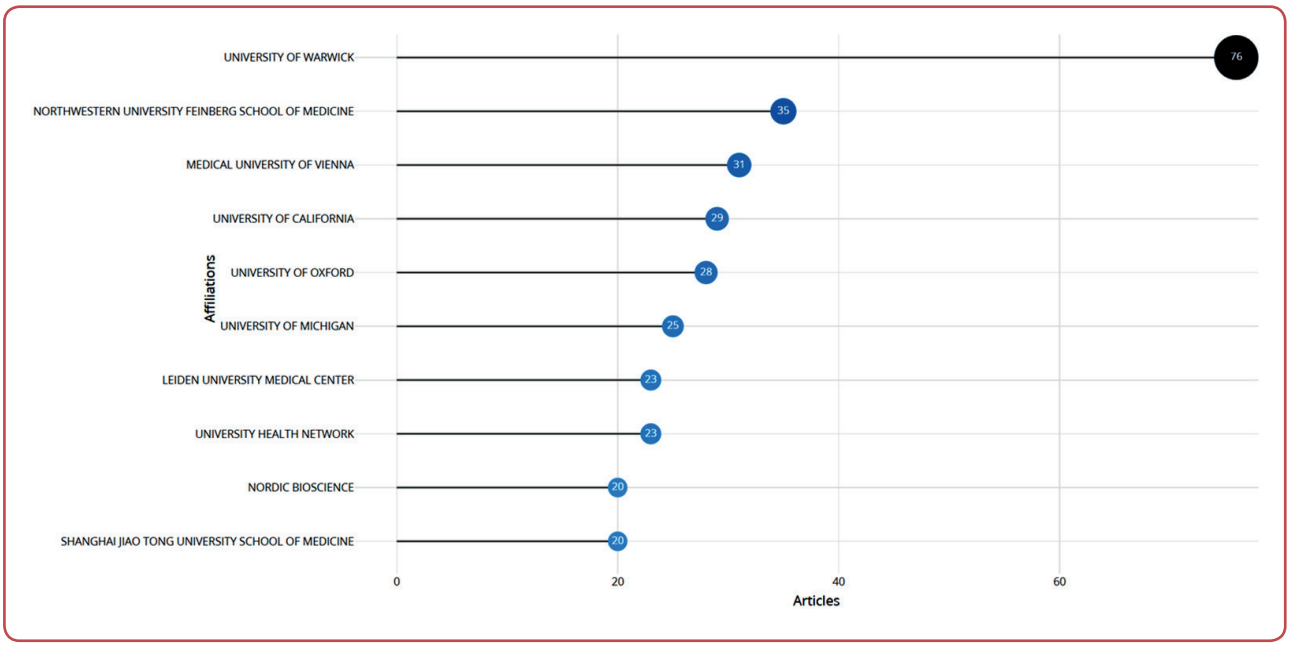

Figure 6: Top 10 affiliations related to the precision medicine for osteoarthritis

tributors to this field. Their collective efforts not only advance scientific understanding but also pave the way for personalised approaches that can significantly improve outcomes for individuals living with OA.

Overview of country contributions to precision medicine for osteoarthritis

The analysis of publications related to precision medicine for OA reveals important insights into the collaborative efforts among different countries. The data indicated that the United States is the leading country in this field, demonstrating a robust presence in both single country publications (SCP) and multiple country collaborations (MCP). The USA's total output not only highlights its dominance in OA research but also reflects its extensive resources, research infrastructure and commitment to advancing precision medicine initiatives.

In the context of SCP, which are indicated by green colour in the data visualisation, the USA stands out as a significant contributor. This suggests that a substantial amount of research on precision medicine for OA is being conducted independently within the country, showcasing the depth of expertise and innovation present in American institutions. Conversely, MCP, represented by red colour, indicate collaborative research efforts that span across national borders. The USA also leads in this category, emphasising its role as a central hub for international collaboration in OA research. Such collaborations are crucial for pooling resources, sharing knowledge and fostering innovation, ultimately enhancing the quality and impact of research findings (Figure 7).

Following the USA, China ranked as the second highest contributor to precision medicine for OA with a notable number of publications. This reflects China's growing investment in healthcare research and its increasing prominence on the global stage. The Chinese research community is actively engaging in OA studies, contributing valuable insights that align with international efforts to improve patient outcomes through personalised treatment approaches. The United Kingdom and Italy also emerged as significant players in this field. The UK's strong academic institutions and focus on health research have positioned it well within the landscape of OA studies. Similarly, Italy's contributions highlight its commitment to advancing medical research and developing innovative solutions for managing OA. The analysis highlights the significant contributions of various countries to precision medicine for OA, with the United States leading both single country publications and collaborative efforts. The involvement of China, the UK and Italy further emphasises the global nature of this research field. By fostering collaboration among these nations, stakeholders can enhance their collective understanding of OA and drive advancements in personalised treatment strategies that ultimately benefit patients worldwide.

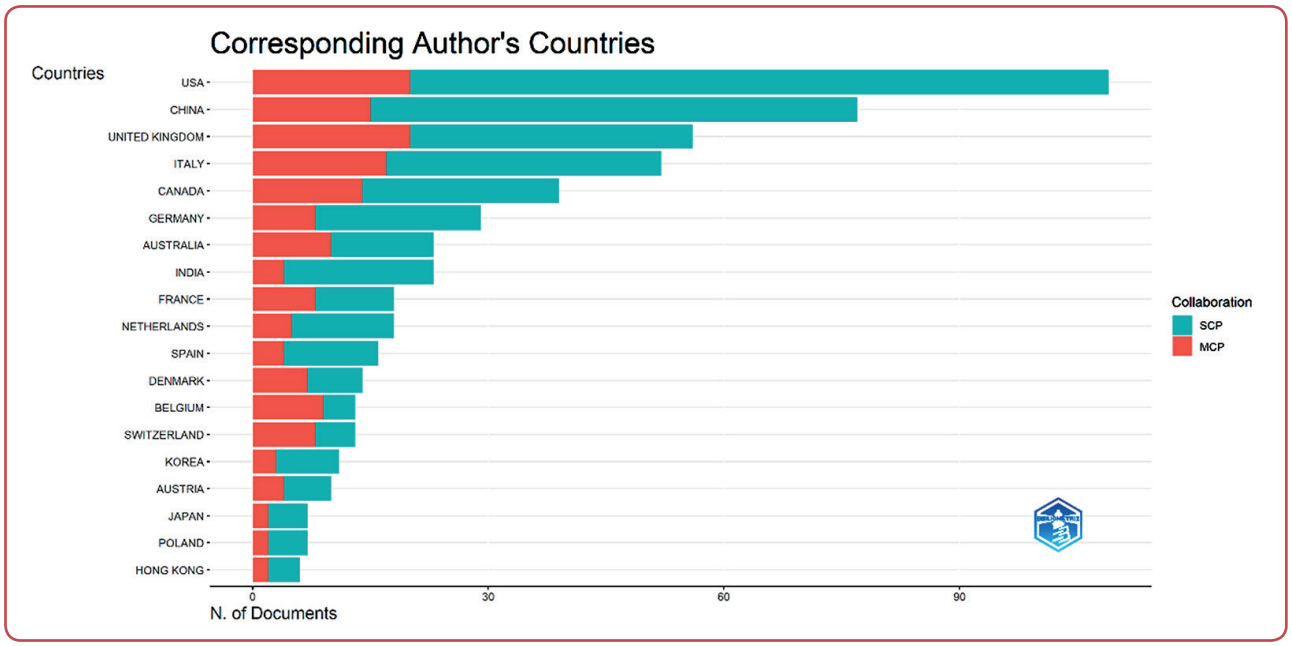

Figure 7: Research collaboration among countries in precision medicine for osteoarthritis. Single country publications (SCP) and multiple country publications (MCP): the precision medicine for osteoarthritis.

Discussion

This bibliometric study on precision medicine for OA provides valuable insights into the evolving landscape of research in precision medicine, highlighting key trends, influential publications and collaborative efforts among researchers. The findings underscore the urgency of addressing the growing prevalence of OA, a degenerative joint disease that significantly impacts the quality of life for millions worldwide. Even though previous study has been performed the trend study.[21, 22] However, the previous study focused solely on publications from the *Web of Science Core Collection* (WoSCC). This exclusion of other databases, such as *PubMed* or *Scopus*, may lead to an incomplete representation of the research landscape. Important studies published in these other platforms could be overlooked, potentially skewing the understanding of trends and hotspots in macrophage research related to OA. Furthermore, there is no specific study focused on the precision medicine for OA. Therefore, presented study aimed to undertake a comprehensive bibliometric analysis of the existing literature on OA, emphasising the urgency of understanding current trends and advancements of precision medicine for OA. Precision medicine refers to tailored treatment approaches that consider individual differences in patients' genes, environments and lifestyles. In the context of OA, this means developing personalised strategies for prevention and treatment that go beyond traditional methods.[6]

One of the most notable observations from this study is the peak in publications related to precision medicine for OA in 2023, with a projected total of 127 documents for 2024. This surge indicates a heightened interest in personalised treatment approaches that consider individual patient characteristics, which is essential for improving outcomes in OA management. The increasing focus on precision medicine aligns with broader trends in healthcare that prioritise tailored interventions over traditional one-size-fits-all strategies. The observed peak in publications related to precision medicine for OA in 2023 can be attributed to a combination of increased research interest, emerging treatment paradigms, heightened awareness of OA's impact, collaborative efforts, technological advancements and positive projections for future research output. These factors collectively underscore the dynamic nature of OA research and the critical role that precision medicine plays in developing effective management strategies for this prevalent condition.

The *International Journal of Molecular Sciences* being identified as the most productive journal with 17 publications further emphasises the importance of interdisciplinary research in this field. This journal's focus on molecular mechanisms and therapeutic interventions provides a platform for disseminating cutting-edge research that can inform clinical practice and guide future investigations. the identification of the *International Journal of Molecular Sciences* as a leading publication in the field underscores its role in promoting interdisciplinary research on OA and precision medicine. By facilitating the exchange of ideas across various scientific domains, this journal contributes significantly to advancing knowledge and developing innovative solutions for managing OA effectively. This emphasis on collaboration and integration is essential for addressing the complexities associated with OA and improving patient outcomes through personalised treatment strategies. The special issue of the *International Journal of Molecular Sciences* on OA underscores the importance of interdisciplinary research in understanding and managing this prevalent condition. By focusing on molecular mechanisms and inviting contributions from various fields, it aims to bridge existing knowledge gaps and promote innovative approaches to treatment. This initiative reflects a broader trend towards collaborative research efforts that are essential for tackling complex health issues like OA effectively. Several recent trends of OA studies published on this issue.[23-25]

The United States being identified as the most cited country with 3,953 citations indicates that research originating from the US is highly recognised and referenced by other scholars in the field of OA. This high citation count suggests that United States-based studies are influential and contribute significantly to the global understanding of OA. High citation counts often correlate with studies that have practical implications for clinical practice. Research from the United States may provide evidence-based guidelines, treatment protocols, or novel therapeutic approaches that are widely adopted by healthcare professionals managing OA.[26, 27] The high citation count of articles published in *The Lancet*, particularly

the article titled "Osteoarthritis," illustrates the significant impact that high-quality research can have on clinical guidelines and treatment protocols. This influence is critical as healthcare providers look to evidence-based practices to inform their treatment strategies. Moreover, the distinction between SCP and MCP highlights the collaborative nature of modern research. The United States not only leads in SCP but also excels in MCP, indicating a willingness to engage with international partners to tackle complex health challenges like OA. This collaborative approach is vital for fostering innovation and ensuring that diverse perspectives are integrated into research efforts. US is noted for leading both SCP and MCP, suggesting that it has a strong presence in both domestic research and international collaborations. This leadership position indicates that United States researchers are not only producing significant amounts of research independently but are also actively engaging with global partners to address health challenges like OA. Furthermore, the trend is driven by the complexity of health issues like OA, which require diverse expertise and resources that may not be available within a single country. Collaborative efforts can enhance the quality and impact of research by pooling knowledge, skills and funding from various international partners.

Despite these positive trends, there remain gaps in knowledge that warrant further investigation. For instance, while there is a growing body of literature on precision medicine for OA, additional studies are needed to explore specific biomarkers and genetic factors that influence treatment responses. Understanding these elements will be crucial for developing effective personalised therapies. Furthermore, as OA continues to be a significant public health concern, it is essential for researchers, clinicians and policymakers to work together to translate findings from bibliometric analyses into actionable strategies. This includes prioritising funding for research areas identified as underexplored and fostering collaborations that bridge gaps between basic science and clinical application. In summary, this bibliometric study on OA offers significant strengths by providing a comprehensive overview of publication trends, influential journals and global contributions to OA research from 1996-2025. However, it also has limitations related to database selection, potential biases in citation metrics and a lack of qualitative insights that should be considered when interpreting its findings. Addressing these limitations will enhance future bibliometric analyses and contribute to more effective strategies for managing OA through targeted research initiatives.

Conclusion

This bibliometric analysis not only sheds light on current trends in OA research but also emphasises the importance of precision medicine in improving patient outcomes. By continuing to foster collaboration and innovation within this field, stakeholders can develop more effective management strategies for OA, ultimately enhancing the quality of life for those affected by this chronic condition. As we move forward, ongoing monitoring of publication trends and citation metrics will be essential for guiding future research directions and ensuring that advancements in precision medicine are effectively integrated into clinical practice.

Ethics

This study was a secondary analysis based on the currently existing data and did not directly involve with human participants or experimental animals. Therefore, the ethics approval was not required in this paper.

Acknowledgement

This paper is dedicated to our marriage, marking the beginning of a fruitful collaboration between clinician and academician-not only as partners in life but also for to benefiting others and humankind. We hope that this work will be beneficial to others especially in the field of precision medicine. We also want to express our heartfelt gratitude to our big family, especially Mamik Ali, Mama Airmah, Dr. Nersiwad, and Mama Eny, for their unwavering support and encouragement in our journey to become dedicated scientists and clinicians committed for serving others. Their love, patience, and faith in our abilities have been a constant source of inspiration. This accomplishment would not have been possible without their

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Conflicts of interest

The authors declare that there is no conflict of interest.

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Data access

The data that support the findings of this study are available from the corresponding author upon reasonable individual request.

Author ORCID numbers

Lalu Muhammad Irham (LMI):
0000-0002-0091-4887
Petrina Theda Philothra (PTP):
0009-0007-7023-6851

Author contributions

Conceptualisation: LMI, PTP
Methodology: LMI, PTP
Formal analysis: LMI, PTP
Data curation: LMI, PTP
Writing - original draft: LMI, PTP
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References

1. Qiao L, Li M, Deng F, Wen X, Wang J, Deng H, et al. Epidemiological trends of osteoarthritis at the global regional and national levels from 1990 to 2021 with a projection from 2021 to 2050. medRxiv 2024;10.1101/2024.06.30.24309697. doi:10.1101/2024.06.30.24309697.
2. GBD 2021 Osteoarthritis Collaborators. Global, regional, and national burden of osteoarthritis, 1990-2020 and projections to 2050: a systematic analysis for the Global Burden of Disease Study 2021. Lancet Rheumatol. 2023 Aug 21;5(9):e508-e522. doi: 10.1016/S2665-9913(23)00163-7.
3. Cui A, Li H, Wang D, Zhong J, Chen Y, Lu H. Global, regional prevalence, incidence and risk factors of knee osteoarthritis in population-based studies. EClinicalMedicine. 2020 Nov 26;29-30:100587. doi: 10.1016/j.eclinm.2020.100587.
4. Höld E, Chmelar S, Aubram T, Leitner G, Nehrer S, Neubauer O, et al. Nutrition and movement to improve quality of life in patients with knee osteoarthritis: the NUMOQUA study protocol for a randomised controlled trial. Trials. 2024 Apr 9;25(1):245. doi: 10.1186/s13063-024-08048-2.
5. Sawitzke AD. Personalized medicine for osteoarthritis: where are we now? Ther Adv Musculoskelet Dis. 2013 Apr;5(2):67-75. doi: 10.1177/1759720X12470752.
6. Moretti L, Bizzoca D, Geronimo A, Moretti FL, Monaco E, Solarino G, et al. Towards precision medicine for osteoarthritis: focus on the synovial fluid proteome. Int J Mol Sci. 2022 Aug 27;23(17):9731. doi: 10.3390/ijms23179731.
7. Pranckutė R. Web of Science (WoS) and Scopus: The Titans of Bibliographic Information in Today's Academic World. Publications. 2021;9:12. doi: 10.3390/publications9010012.
8. Baas J, Schotten M, Plume A, Côté G, Karimi R. Scopus as a curated high-quality bibliometric data source for academic research in quantitative science studies. Quanti Sci Stud. 2020;1(1):377-86. doi:10.1162/qss_a_00019.
9. van Eck NJ, Waltman L. Software survey: VOSviewer, a computer program for bibliometric mapping. Scientometrics. 2010 Aug;84(2):523-38. doi: 10.1007/s11192-009-0146-3.
10. Aria M, Cuccurullo C. bibliometrix: An R-tool for comprehensive science mapping analysis. J Informetrics. 2017;11(4):959-75. doi: 10.1016/j.joi.2017.08.007.
11. Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. Compr Physiol. 2012 Apr;2(2):1143-211. doi: 10.1002/cphy.c110025.
12. Roos EM, Arden NK. Strategies for the prevention of knee osteoarthritis. Nat Rev Rheumatol. 2016 Feb;12(2):92-101. doi: 10.1038/nrrheum.2015.135.
13. Mobasheri A, Batt M. An update on the pathophysiology of osteoarthritis. Ann Phys Rehabil Med. 2016 Dec;59(5-6):333-9. doi: 10.1016/j.rehab.2016.07.004.
14. Hunter DJ, Bierma-Zeinstra S. Osteoarthritis. Lancet. 2019 Apr 27;393(10182):1745-59. doi: 10.1016/S0140-6736(19)30417-9.
15. Wei W, Ma Y, Yao X, Zhou W, Wang X, Li C, et al. Advanced hydrogels for the repair of cartilage defects and regeneration. Bioact Mater. 2020 Oct 10;6(4):998-1011. doi: 10.1016/j.bioactmat.2020.09.030.
16. Nijs J, George SZ, Clauw DJ, Fernández-de-Las-Peñas C, Kosek E, Ickmans K, et al. Central sensitisation in chronic pain conditions: latest discoveries and their potential for precision medicine. Lancet Rheumatol. 2021 May;3(5):e383-e392. doi: 10.1016/S2665-9913(21)00032-1.

17. Hewett TE, Myer GD, Ford KR, Paterno MV, Quatman CE. Mechanisms, prediction, and prevention of ACL injuries: Cut risk with three sharpened and validated tools. J Orthop Res. 2016 Nov;34(11):1843-55. doi: 10.1002/jor.23414.
18. Howell SM, Shelton TJ, Hull ML. Implant survival and function ten years after kinematically aligned total knee arthroplasty. J Arthroplasty. 2018 Dec;33(12):3678-84. doi: 10.1016/j.arth.2018.07.020.
19. Rannou F, Pelletier JP, Martel-Pelletier J. Efficacy and safety of topical NSAIDs in the management of osteoarthritis: Evidence from real-life setting trials and surveys. Semin Arthritis Rheum. 2016 Feb;45(4 Suppl):S18-21. doi: 10.1016/j.semarthrit.2015.11.007.
20. Hodgkinson T, Kelly DC, Curtin CM, O'Brien FJ. Mechanosignalling in cartilage: an emerging target for the treatment of osteoarthritis. Nat Rev Rheumatol. 2022 Feb;18(2):67-84. doi: 10.1038/s41584-021-00724-w.
21. Yang Z, Lin J, Li H, He Z, Wang K, Lei L, et al. Bibliometric and visualization analysis of macrophages associated with osteoarthritis from 1991 to 2021. Front Immunol. 2022 Oct 4;13:1013498. doi: 10.3389/fimmu.2022.1013498.
22. Luo ZQ, Zhou B, Xiong H. A bibliometric analysis of exosomes therapy in the treatment of osteoarthritis from 2012 to 2022. J Pain Res. 2023 Jun 26;16:2171-88. doi: 10.2147/JPR.S407050.
23. Shorter E, Avelar R, Zachariou M, Spyrou GM, Raina P, Smagul A, et al. Identifying novel osteoarthritis-associated genes in human cartilage using a systematic meta-analysis and a multi-source integrated network. Int J Mol Sci. 2022 Apr 15;23(8):4395. doi: 10.3390/ijms23084395.
24. Thottakkattumana Parameswaran V, Hild C, Eichner G, Ishaque B, Rickert M, Steinmeyer J. Interleukin-1 induces the release of lubricating phospholipids from human osteoarthritic fibroblast-like synoviocytes. Int J Mol Sci. 2022 Feb 22;23(5):2409. doi: 10.3390/ijms23052409.
25. Shang X, Böker KO, Taheri S, Lehmann W, Schilling AF. Extracellular vesicles allow epigenetic mechanotransduction between chondrocytes and osteoblasts. Int J Mol Sci. 2021 Dec 10;22(24):13282. doi: 10.3390/ijms222413282.
26. Vaishya R, Gupta BM, Mamdapur GMN, Kappi MM, Vaish A. Global research on osteoarthritis during 1994-2023: a scientometric assessment of publications and citations. Indian J Orthop. 2024 Feb 29;58(6):650-60. doi: 10.1007/s43465-024-01111-9.
27. Yin F, Yang Q, He Y, Peng L, Zhao Z, He C, et al. Top 100 cited articles on osteoarthritis from 1990 to 2020. Rheumatol Immunol Res. 2021 Dec 31;2(4):241-8. doi: 10.2478/rir-2021-0033.