REVIEW ARTICLE

Four Decades of Glaucoma in Primary Care: A Comprehensive Bibliometric Review (1978-2024)

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Abstract

Background: This bibliometric study analyses the global output of glaucoma in primary healthcare from 1978 to 2024.
Methods: The study surveyed trends in publications, leading research institutions, and principal contributors, utilizing data from the Web of Science (WoS) and Scopus databases. The analysis revealed an increase in scholarly articles focused on glaucoma within primary healthcare, reflecting an enhanced emphasis on early detection and management at the initial level of care. Relevant documents were identified using a reliable search strategy from the WoS and Scopus databases and were reviewed and evaluated using Microsoft Excel and the bibliometrix R-package.
Results: The United States, Portugal, and Brazil were identified as leading countries in glaucoma research, demonstrating a broad commitment to addressing this eye condition. Research has focused on enhancing awareness among patients and healthcare providers, developing effective screening protocols, and improving the quality of life for those affected by glaucoma. The findings highlight the importance of an integrated approach that includes educating primary care providers, adopting advanced diagnostic technologies, and actively involving patients in their care and monitoring. Challenges such as limited access to proficient healthcare services and the incorporation of specialized ophthalmological services within primary care frameworks were also noted.
Conclusion: This bibliometric analysis underscores the need for enhanced cross-disciplinary collaboration and worldwide knowledge exchange regarding early glaucoma detection and management in primary care settings. The insights gained could guide the development of strategies to improve access to glaucoma diagnosis and treatment while heightening public awareness of the condition.

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Introduction

Glaucoma represents a significant public health issue, serving as a primary cause of irreversible visual impairment worldwide. The demographic shift toward an aging global population underscores the urgent need for early detection and effective, efficient management of glaucoma within primary healthcare settings.[1] Primary healthcare plays a crucial role in ensuring access to and maintaining the quality of glaucoma care, highlighting

the importance of ongoing research in this area.[2]

Although extensive studies have examined various aspects of glaucoma care within primary healthcare systems—such as diagnostic tools, screening techniques, and treatment options[1,2]—a comprehensive bibliometric review remains necessary. Such a review would identify emerging trends, recognize leading contributors, and highlight the most active research institutions in glaucoma care.

Recent studies underscore the vital importance of early glaucoma detection in preventing disease progression and preserving vision. However, challenges persist in primary care settings due to the lack of specialized diagnostic tools and insufficient training for healthcare providers. International research highlights the critical role of early glaucoma detection in preventing blindness and reveals deficiencies in primary healthcare systems regarding the prioritization of glaucoma screenings and follow-up care.[3-] Glaucoma often remains undiagnosed until significant vision loss occurs, particularly pronounced in regions with limited access to specialized eye care services.

Therefore, it is imperative to implement robust screening initiatives and enhance the capabilities of primary healthcare professionals in detecting and managing glaucoma at an early stage. Such measures could significantly mitigate the impact of glaucoma, improve patient outcomes, and enhance the quality of life for affected individuals.

This bibliometric review analyzes global scholarly contributions to glaucoma research in primary healthcare. Its objectives are to identify principal research themes, evaluate global and institutional contributions, and envisage future research trajectories. By examining the landscape of glaucoma research in primary healthcare settings, this analysis highlights areas for improving patient care and proposes directions for future investigative efforts.

Methods

Eligibility Criteria and Data Source

This bibliometric analysis aimed to examine the global scientific literature on glaucoma within the context of primary healthcare. The study included peer-reviewed scientific articles published in English. Data were retrieved from the Scopus and Web of Science databases, with all relevant metadata extracted in BibTeX and plain text formats, respectively. The compiled data were processed using RStudio and subsequently exported into Excel for further analysis.

Search Strategy

A comprehensive search was conducted using advanced search techniques within the Scopus and Web of Science databases. Employing a combination of Boolean and wildcard search operators, we identified relevant keywords for the study (Table 1). The search was performed in January 2024, with the methodology depicted in Figure 1. Articles deemed irrelevant were systematically excluded based on their titles, abstracts, and, where necessary, full-text reviews. After applying the eligibility criteria, 208 articles were selected for inclusion in the bibliometric analysis.

Bibliometric Analyses

Data management and bibliometric analyses were conducted using the Bibliometrix R-package (version 3.1.4) and the Biblioshiny web application within RStudio (Version 2023.09.0+463, PBC, Boston, Massachusetts). The authors created all illustrations presented in this study solely using the Biblioshiny software.

The analysis encompassed 46 years (1978–2024) and focused on scientific articles published in English. It examined publication trends, citation patterns, and high-output institutions based on the volume of glaucoma-related research. Collaboration networks were constructed among 118 leading research institutions using clustering algorithms and data normalization techniques applied to 208 scientific articles.

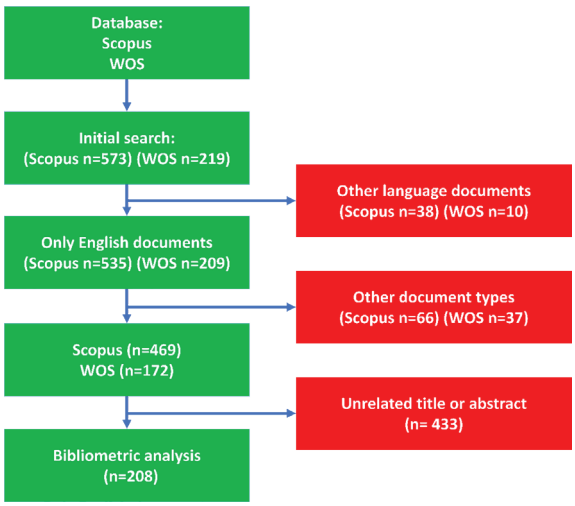

Figure 1: Flowchart for selecting articles in the bibliometric analysis of glaucoma in primary care

Table 1: Search strategy queries employed for a comprehensive bibliometric review of glaucoma in primary care, utilizing Web of Science and Scopus databases

No	Queries
#1	"Glaucoma" OR "Glaucomas"
#2	"Primary Health Care" OR "Care, Primary Health" OR "Health Care, Primary" OR "Primary Healthcare" OR "Healthcare, Primary" OR "Primary Care" OR "Care, Primary"
#3	#1 AND #2 (Author keywords OR Title OR Abstract)

The frequency of their publications identified significant contributors (authors). The analysis also highlighted the 10 most frequently cited papers and the prominent journals in the field.

The interconnections among 10 prominent journals, research domains, and countries contributing to glaucoma research in primary care over the past 46 years were analyzed. A world map was constructed to visualize global scientific collaboration. Additionally, a TreeMap was used to display the 10 most commonly used keywords in articles published on this topic. Finally, a Thematic Map was developed to categorize themes into four areas: core subjects, niche subjects, emerging or declining subjects, and overarching foundational subjects.

Results

Search Results

Seven hundred ninety-two articles were retrieved from searches conducted in the Scopus and Web of Science databases. Following the inclusion and exclusion criteria application, 584 studies were excluded for not meeting the selection criteria, leaving 208 articles eligible for this bibliometric analysis. Among these, 177 research articles and 31 review articles were included. Due to the limited sample size, all articles were consolidated for the bibliometric analysis (Figure 1).

Key Characteristics of the Analyzed Articles

All articles analyzed, including research and review papers, were original contributions, accounting for 100% of the selected documents. These articles had an average citation rate of 25.49 per document per year. Research articles authored by researchers from the United States received the highest citation count, accumulating 2,122 citations.

The 208 scientific studies included in the analysis represented contributions from 916 authors across 118 countries. Table 2 summarizes the top 10 most-cited articles in the dataset.

Publication and Citation Trends

There has been a notable increase in research

Table 2: The top 10 most cited documents of the provision of medical care for patients with glaucoma in primary care settings

Rank	Author, Year [references]	Title of the document	Journal name	Total citations	DOI*
1	Weinreb RN, 2014	The pathophysiology and treatment of glaucoma: a review	JAMA	2122	10.1001/jama.2014.3192
2	Stein JD, 2021	Glaucoma in adults-screening, diagnosis, and management: a review	JAMA	171	10.1001/jama.2020.21899
3	Garway-Heath DF, 1998	Quantitative evaluation of the optic nerve head in early glaucoma	Brit J Ophthalmol	97	10.1136/bjo.82.4.352
4	Zimmerman TJ, 1983	Facilitating patient compliance in glaucoma therapy	Surv Ophthalmol	94	10.1016/0039-6257(83)90142-X
5	Saunders LJ, 2014[10]	Examining visual field loss in patients in glaucoma clinics during their predicted remaining lifetime	Invest Ophth Vis Sci	81	10.1167/iovs.13-13006
6	Distelhorst JS, 2003[11]	Open-angle glaucoma	Am Fam Physician	80	ND
7	Gupta D, 2016[12]	Glaucoma	Am Fam Physician	79	ND
8	Moyer VA, 2013[13]	Screening for glaucoma: U.S. Preventive Services Task Force recommendation statement	Ann Intern Med	78	10.7326/0003-4819-159-6-201309170-00686
9	Rowe S, 2004[14]	Preventing visual loss from chronic eye disease in primary care - Scientific review	JAMA	74	10.1001/jama.291.12.1487
10	Leske MC, 1996[15]	Open-angle glaucoma and ocular hypertension: The Long Island glaucoma case-control study	Ophthalmic Epidemiol	68	10.3109/09286589609080113

*DOI: Digital object identifier; ND: No data

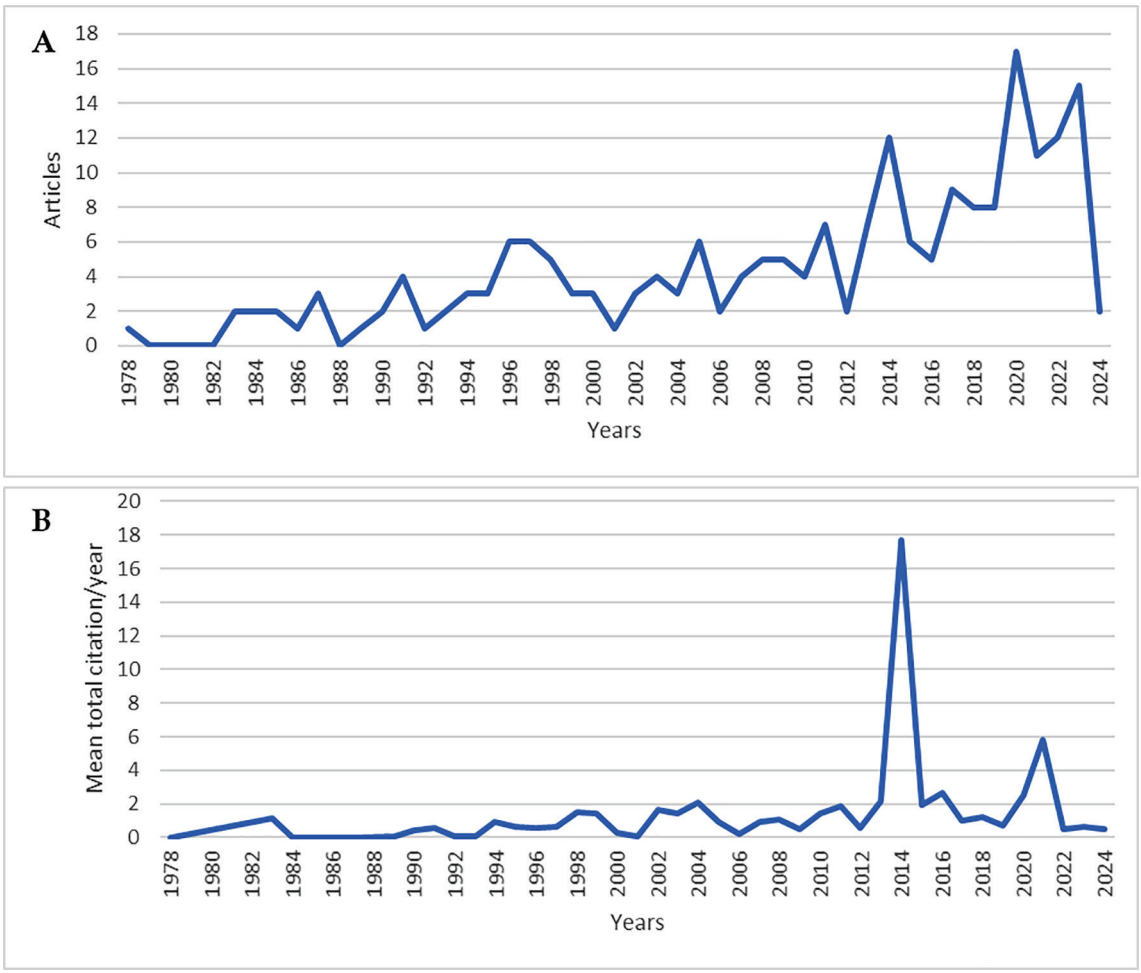

Figure 2: Global annual trends in (A) publications and (B) mean total citations per year on glaucoma in primary care

publications addressing primary care for patients with glaucoma over the 46 years from 1978 to 2024. The period from 1978 to 1982 marked the least productive phase, with only one study published in English during this time. In contrast, the highest number of publications, totaling 55, was observed between 2020 and 2023 (Figure 2A).

The average annual number of citations increased gradually and steadily until 2013. The peak in average citations per year occurred in 2014, reaching a value of 17.66 (Figure 2B).

Trend of Publication and Citation

Using Bradford's Law, which describes the distribution of scientific articles across journals, we identified ten core journals considered the primary outlets for researchers in the field (Figure 3). According to this law, these core journals collectively accounted for a substantial proportion of the articles published on glaucoma in primary healthcare.

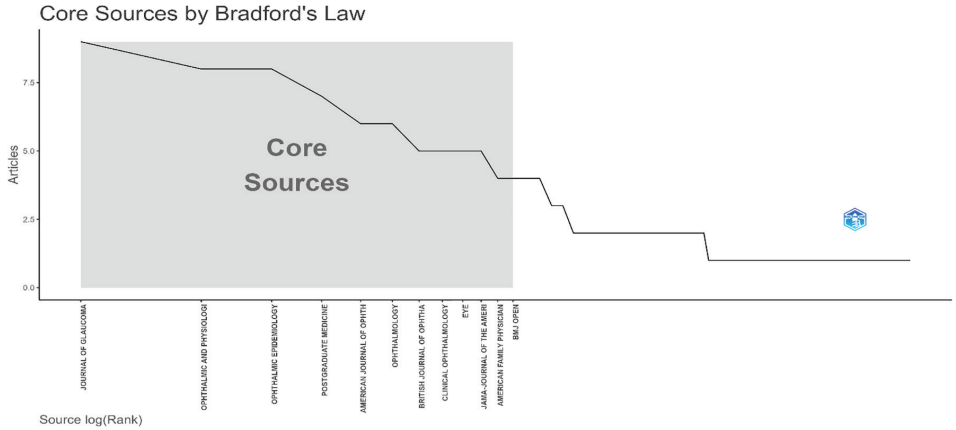

Figure 3: The plot of Broadford's Law identifying ten core journals on glaucoma in primary care

Table 3: The top 10 most cited journals on glaucoma in primary care

Sources	Articles
Ophthalmology	433
Arch Ophthalmol	258
Brit J Ophthalmol	233
Am J Ophthalmol	230
Invest Ophth Vis Sci	192
Eye	123
J Glaucoma	121
Ophthal Physiol Opt	74
Jama-J Am Med Assoc	67
Jama Ophthalmol	50

Analyzing the publication data from these core journals, we found that the Journal of Glaucoma was the most prolific, contributing seven articles, representing approximately 4.3% of the total articles over the study period. Additionally, we examined the local citations received by these core journals within our dataset. Notably, *Ophthalmology* emerged as the journal with the most local citations, accumulating a remarkable total of 433 citations (Table 3).

The Most Relevant Affiliations

Jefferson Medical University emerged as the leading institution in analyzing medical care provision for glaucoma patients at the primary healthcare level, contributing a significant body of work with 22 published articles (Figure 4). Closely following in second place was University College London, which also made substantial contributions, publishing 17 articles on this topic.

The Most Active Authors and Their Network of Cooperation

In our study on primary care for glaucoma patients, we analyzed the authorship of documents using fractional measurement. Among the researchers who contributed significantly to the scientific articles, the leading authors, as shown in Figure 5, include those with the highest fractional values (n=7, fractional value=0.47). The following are Heller J, Hendrix J, and Baby B, with n=6 and fractional values ranging from 0.37 to 0.40.

Figure 6 provides a graphic representation of the ten leading authors over time, showcasing the most prolific contributors to the field. These authors are identified based on their h-index, meaning each author has received at least «h-index» citations for their published works. In Figure 6, the size of the circles represents the number of articles published by the author, with larger circles signifying a higher volume of publications. Additionally, the color of the circles indicates the total number of citations per year, with darker shades representing a higher number of citations.

The Most Productive Journals

Among the articles included in this study, the *Journal of Glaucoma* published the highest number of research articles, nine. This was followed by two journals, *Ophthalmic and Physiological Optics* and *Ophthalmic Epidemiology*, each contributing eight articles, as shown in Figure 7.

Global Scientific Production and Cooperation

Figure 8 provides a visual representation of the most significant scientific contributions in the field of glaucoma, with the United States emerging as a leading participant among the top ten countries. The figure also highlights the collaboration between 13 countries in this area of research. Joint initiatives between the United States and Israel have occurred five times.

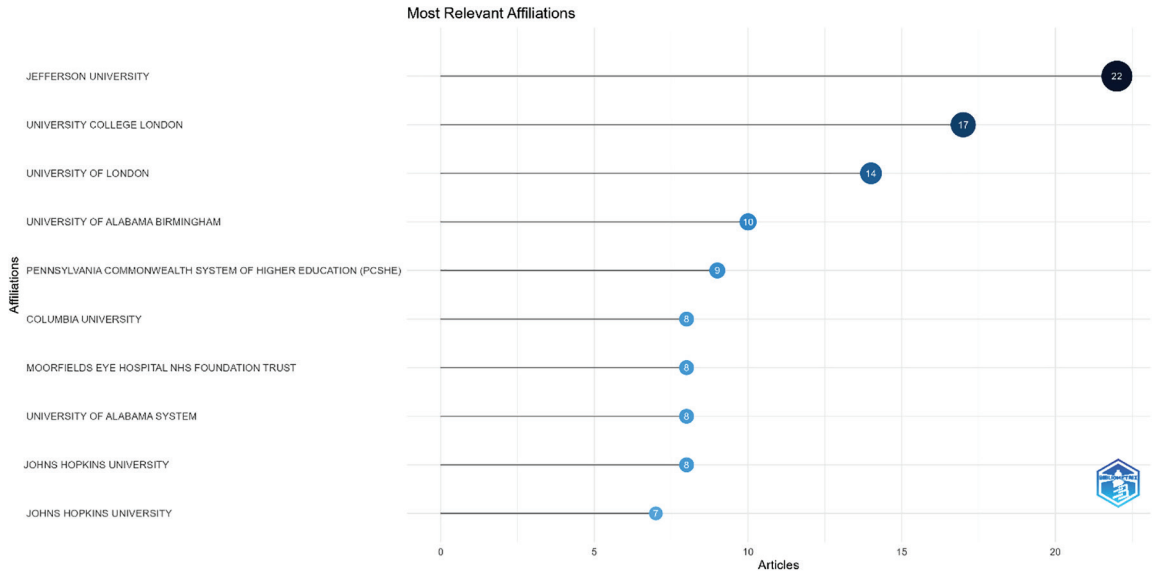

Figure 4: The top 10 affiliations that published articles that published on glaucoma in primary care

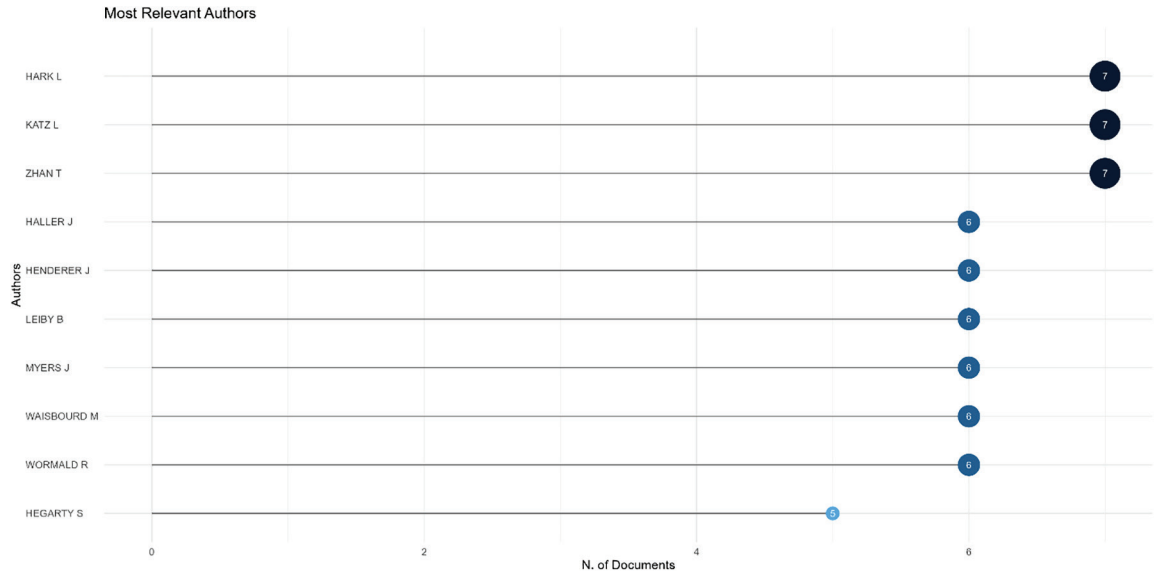

Figure 5: The top 10 most prolific authors of articles on glaucoma in primary care

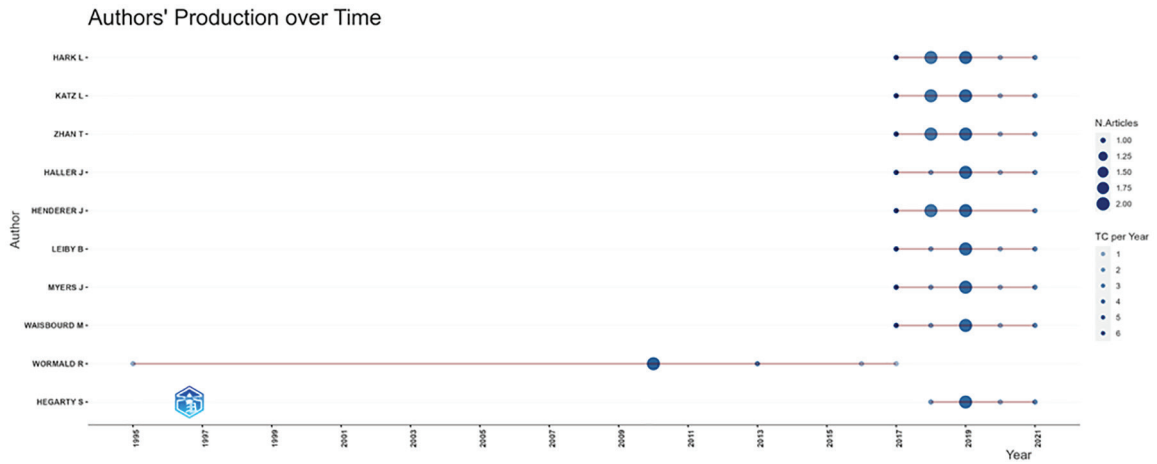

Figure 6: The top 10 most prolific authors and their articles on medical care for patients with glaucoma in primary care settings

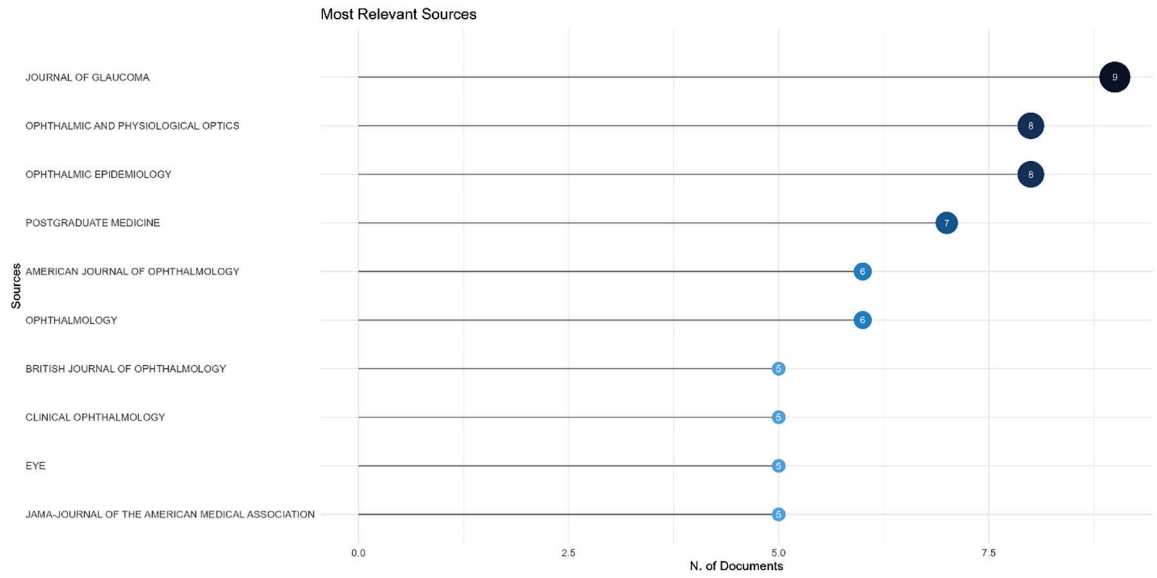

Figure 7: The top 10 journals publishing papers on glaucoma in primary care

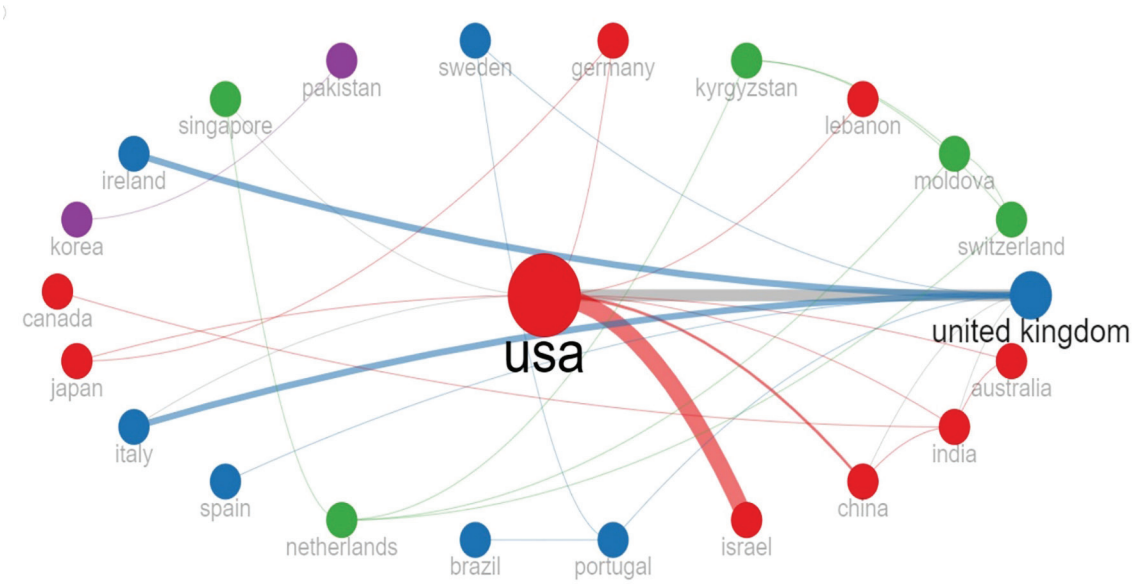

Figure 8: A visual representation of global collaborative networks in glaucoma research within primary care. This map illustrates the international cooperation between countries, emphasizing the global nature of research in this field.

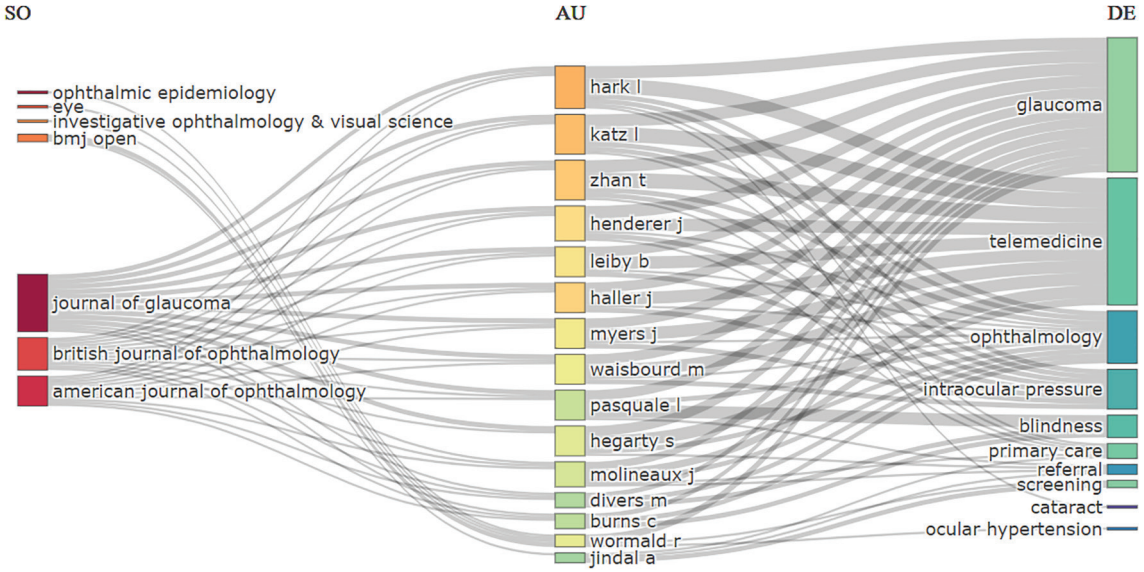

Figure 9: A three-field plot illustrating the interconnections between the top ten journals, authors, and keywords that have significantly contributed to articles on medical care for glaucoma patients in primary care settings. This plot visualizes the incoming and outgoing influence flows among these key elements in the research field.

A graphical representation highlighted the significant contributions from the top ten journals, authors, and keywords in glaucoma research within primary care. This visualization illustrates the interactions and relationships among these domains within the articles (Figure 9).

TreeMap and Thematic Map

The TreeMap visualization, shown in Figure 10, highlights the 20 most frequently used keywords in research articles related to glaucoma. Notably, three keywords—»glaucoma» (32% usage), «screening» (11% usage), and «primary healthcare» (7% usage)—stand out as the most prominent in this research area.

Figure 11 presents a thematic map constructed using authors' keywords to capture recurring terms in research articles. This thematic map is based on a two-dimensional matrix measuring centrality (X-axis representing topics' significance) and density (Y-axis indicating topic development). The analysis results show that Quartile 1 (Q1) includes well-established issues, emphasizing their importance and comprehensive development. In contrast, Q2 pertains to specialized topics, signifying more focused yet significant research areas. Q3 represents emerging or declining topics, while Q4 encompasses comprehensive and foundational issues. Notably, the size of each circle on the thematic map corresponds to the frequency of the respective term.

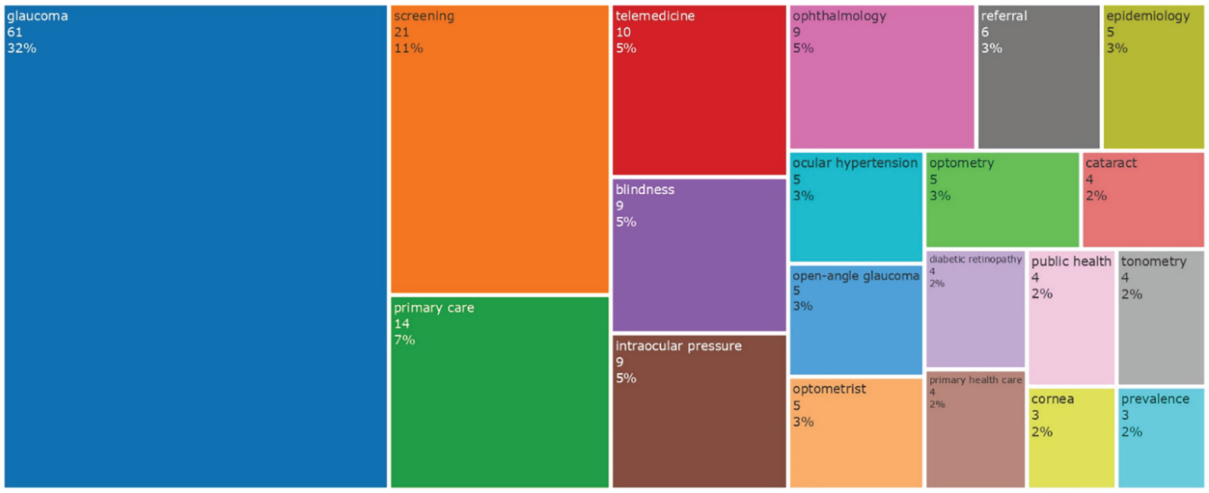

Figure 10: TreeMap visualization highlights the top 20 author keywords in articles related to glaucoma in primary care.

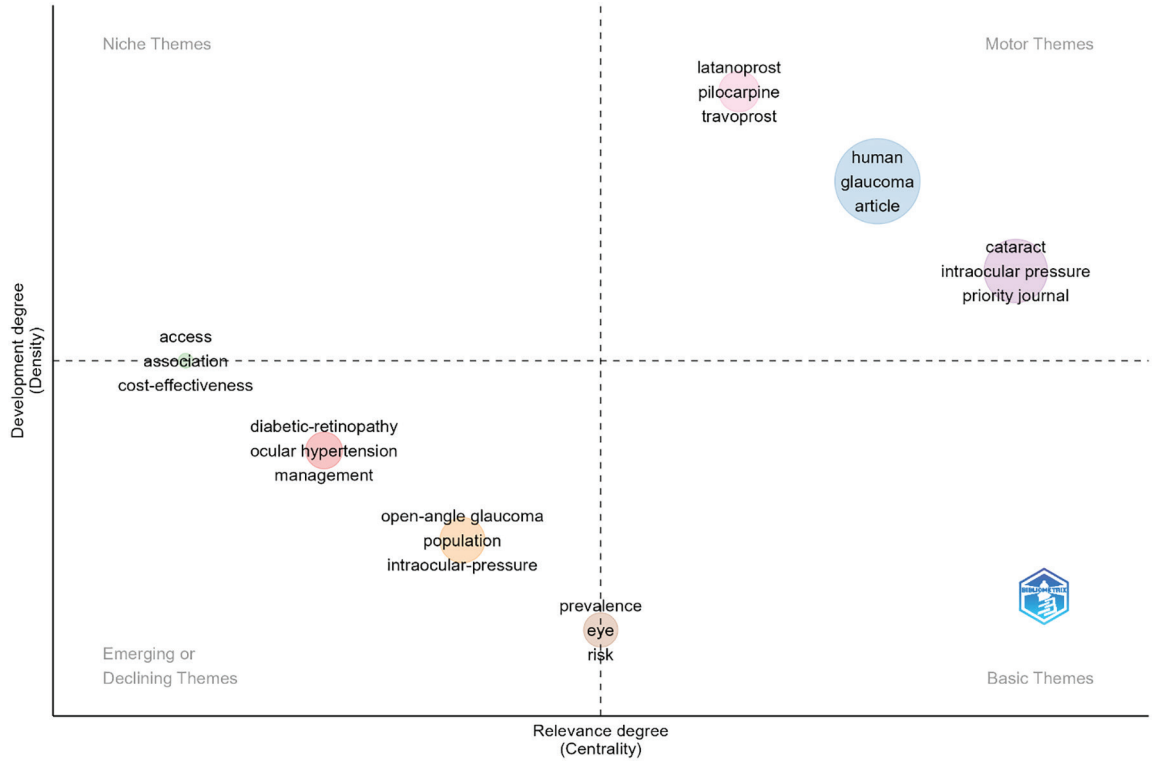

Figure 11: The Thematic Map utilizes keywords commonly found in research articles, providing insights into recurring terms and their thematic relevance in glaucoma in primary care.

Furthermore, the hierarchical ranking of centrality and density for research articles can be summarized as follows: Q4>Q2>Q1=Q3 by density and Q2>Q4>Q1=Q3 by centrality, with ranks varying from high to low. As for review articles, the hierarchical ranking of density and centrality can be explained as follows: Q4>Q2>Q1=Q3 by density, indicating a decreasing order from high to low. Meanwhile, by centrality, the order is Q2>Q4>Q1=Q3, reflecting a decreasing order of ranks from high to low.

Figure 12 visually depicts the main author keywords in the production of articles over time, highlighting the most influential keywords in the field: «glaucoma,» «screening,» and «primary care.» These keywords reflect significant contributions to the field. In the figure, the size of the circles is proportional to the frequency of term mentions, with larger circles indicating higher keyword frequency.

Discussion

This bibliometric review delineates the evolving landscape of glaucoma research within primary healthcare. As one of the most severe ocular diseases, glaucoma leads to irreversible vision loss, emphasizing the critical importance of early diagnosis and intervention for public

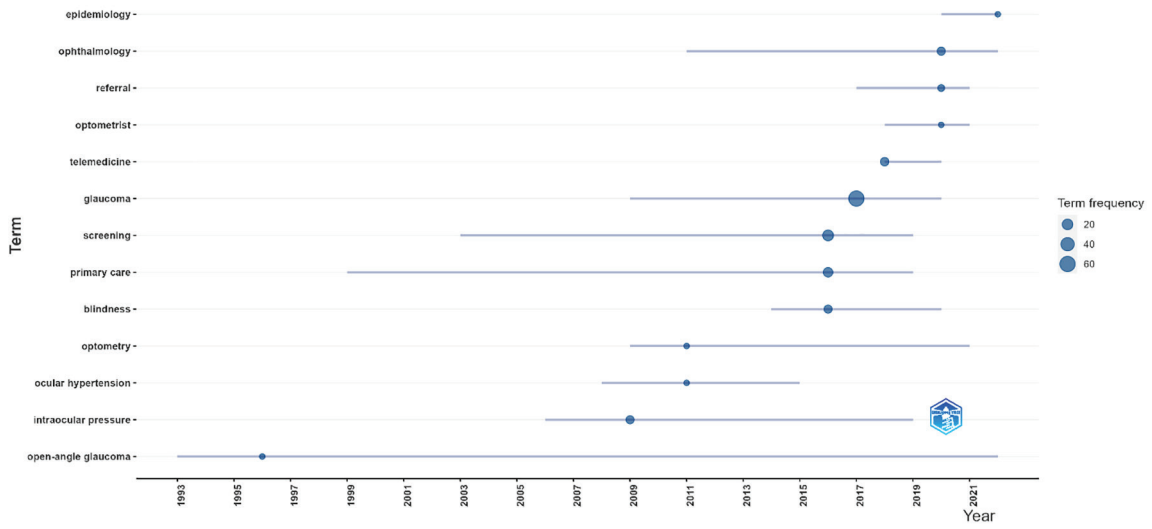

Figure 12: The most crucial author keywords in articles published over time (1993–2021) on glaucoma in primary care.

health. Our analysis of scientific publications from 1978 to 2024 reveals a consistent increase in focus on this issue, particularly in recent years. This trend reflects an expanding research community dedicated to addressing glaucoma within the primary healthcare framework.

Our analysis identified 208 publications focused on glaucoma, with 27.4% of these studies published in the last five years. This notable increase underscores the growing global recognition of the importance of early glaucoma diagnosis and the urgent need to develop effective intervention strategies.

A key direction highlighted by our study is the emphasis on training and raising awareness among primary healthcare professionals regarding optimal screening and management strategies for glaucoma cases. Publications have increasingly underscored the importance of interdisciplinary approaches and collaboration between ophthalmologists and general practitioners, emphasizing integrated care models as essential for improving patient outcomes.

Furthermore, our bibliometric analysis reveals a rising trend in using digital technologies and artificial intelligence to enhance the accuracy of glaucoma screening and early-stage diagnosis. These innovations promise to make diagnostic procedures more accessible and efficient, particularly in regions with limited access to specialized ophthalmic care.

This bibliometric analysis of significant research on glaucoma in primary healthcare has identified several key trends and directions in the field. For example, one study[16] highlights an increasing number of prescriptions issued in primary healthcare settings in England, reflecting a growing emphasis on the early-stage management of glaucoma.

This is supported by research evaluating the performance of HRT (retina and optic nerve tomography) and GDx (nerve fiber scans) in glaucoma screening,[17] which underscores the importance of advanced technologies in enhancing diagnostic capabilities. Another study[18] provides an updated review of congenital glaucoma, emphasizing the critical role of early detection and intervention in preventing childhood blindness. This is particularly vital in primary healthcare, where early diagnosis can significantly improve treatment outcomes. Furthermore, the successful application of mixed methods to evaluate community-based glaucoma screening programs has been illustrated,[19] highlighting the potential of local initiatives in improving access to diagnosis and treatment.

These studies emphasize the need for integrating advanced diagnostic technologies, educational programs for healthcare professionals and communities, and interdisciplinary approaches to address glaucoma within primary healthcare. They also reaffirm the pivotal role of early detection and intervention in preventing irreversible blindness, calling for further research and innovation in this essential area.

The bibliometric analysis confirms that while progress has been made, additional efforts are required to develop and implement comprehensive glaucoma management strategies in primary healthcare. This is especially critical given the global aging population and the rising prevalence of this condition.

Institutions

Jefferson University, University College London, and the University of London have emerged as leading contributors to glaucoma research. These institutions produce a substantial volume of study and foster prominent interdepartmental collaborations that transcend geographical boundaries. Their work

emphasizes the global nature of efforts to combat glaucoma, with significant contributions from research centers within and beyond Europe.

According to global ranking systems such as ARWU, QS, and THE, these universities hold prestigious positions on the international academic stage, underscoring their impactful contributions to glaucoma research. Additionally, these institutions are recognized for robustly supporting their researchers, facilitating high-quality output in this critical field.

Looking ahead, developing and enhancing collaborative networks among research institutions and groups will be pivotal in advancing fundamental and applied glaucoma research. International and interinstitutional collaboration will continue to play a key role in enriching the scientific foundation and fostering innovative approaches to glaucoma diagnosis and treatment.

Authors

The authors contributing to glaucoma research represent an exceptional group of scientists unified by their commitment to advancing knowledge and disseminating impactful findings. Figure 5 highlights the most productive and highly regarded authors in this field, showcasing the total number of research papers they have contributed to.

Figure 6 introduces the H-index, a key metric used to evaluate an author's productivity and the influence of their work. The H-index reflects the number of publications (n) an author has produced, where each publication has been cited at least n times. This metric provides a dual perspective on an author's academic output and the extent to which their research is recognized and cited within the scholarly community.

Prominent contributors such as Hark L, Katz L, and Zhan T exemplify significant productivity and impact in the academic community. Their work highlights not only the quantity of research papers and reviews they have authored but also the considerable influence these publications have had in shaping the field of glaucoma research.

By examining these contributions, the H-index offers an insightful measure of both productivity and recognition. It demonstrates that each of these authors has consistently produced high-quality research that has been cited in proportion to their academic achievements. This underscores their active and valuable role in advancing knowledge and improving outcomes related to glaucoma management.

Thus, the H-index reflects not only the quantity of research conducted by an author but also the significance and recognition of their work within the scientific community. Our results highlight L. Hark, L. Katz, and T. Zhan as leaders in the field of glaucoma research, with other prominent contributors such as J. Haller also making significant strides. The contributions of these authors are profoundly impactful, deepening our understanding of glaucoma and driving progress in scientific research related to this disease.

Researchers and practicing physicians specializing in glaucoma must recognize the likelihood of frequently encountering articles authored by these leading researchers. Studying their publications is highly recommended, as integrating the insights gained from their work can enrich one's research endeavors and enhance practical activities in glaucoma diagnosis, management, and treatment.

Countries

An analysis of the international collaboration network reveals key insights into the contributions of various countries to glaucoma research within primary care. Notably, the United States, Portugal, Brazil, and Sweden have emerged as pivotal players in advancing this critical area of medical research.

The United States has the highest PageRank score, reflecting its central role in the global research network. This underscores its leadership in both the quantity and quality of scientific publications on glaucoma, positioning it as a cornerstone of international collaboration in this field.

While having a smaller overall research footprint than the United States, Portugal occupies a significant position due to its high betweenness centrality score. This metric highlights Portugal's role as a crucial connector within the collaboration network, fostering knowledge exchange and bridging diverse research clusters.

Although Brazil and Sweden exhibit lower network metrics than the United States and Portugal, they also contribute meaningfully to the collaboration network. Their involvement enriches the diversity of glaucoma research by introducing varied geographical and cultural perspectives, which are critical to understanding and managing the disease in different global contexts.

Together, these nations represent the core of the international collaboration network, underscoring their significance as leaders in glaucoma research. Furthermore, a clear trend toward the global expansion of research efforts is evident, with a growing emphasis on fostering international partnerships and collaborations. This global perspective is vital to improving primary care strategies for glaucoma patients and addressing the increasing burden of this disease worldwide.

In conclusion, the country's collaboration network analysis highlights the leading contributors and

the importance of international cooperation. By strengthening these global partnerships, the medical community can further enhance knowledge and practices for managing glaucoma, ensuring better patient outcomes worldwide.

Journals

Figure 7 highlights the analysis of high-impact journals, underscoring their critical role in publishing research related to glaucoma in primary healthcare. These journals, recognized for their influence and citation metrics within the medical and optical communities, serve as key platforms for disseminating cutting-edge knowledge and advancements in the field.

At the forefront is the "Journal of Glaucoma," which leads with nine published articles on the topic, cementing its role as a central resource for the latest research and developments in glaucoma. Close behind are "Ophthalmic and Physiological Optics" and "Ophthalmic Epidemiology," each contributing eight articles. These journals significantly advance scientific understanding and provide practical recommendations for diagnosis, treatment, and epidemiology of glaucoma. "Postgraduate Medicine," with seven articles, also stands out as a prominent publication, reflecting its role in educating and equipping healthcare professionals with updated knowledge and strategies in glaucoma care.

An examination of these journals reveals their high scientific value. According to Journal Citation Reports (JCR), the majority are classified within the first (Q1) or second (Q2) quartiles. This classification underscores the quality and impact of published research and highlights the sustained scientific and practical interest in glaucoma research.

Therefore, the analysis of journals with high-impact factors identifies leading platforms for disseminating knowledge about glaucoma and highlights the critical need for continued research in this field. With the rapid advancements in medical technologies and treatment methods, such analyses play a vital role in shaping the direction of future research. This approach ensures a focus on improving the diagnosis, treatment, and prevention of glaucoma, ultimately enhancing patient care and addressing the growing global burden of this condition.

Keywords

The selection of keywords in research on glaucoma within the context of primary healthcare not only concisely represents the core topics discussed but also reveals the key directions of scientific inquiry in this area. A bibliometric analysis of keywords, conducted using software for visualizing scientific data, enables the identification of the most frequently used terms in this field. Moreover, this approach allows researchers to trace shifts in interest over time, offering insights into the evolving structure of knowledge and emerging trends in glaucoma research.

Keywords such as «glaucoma,» «primary healthcare,» «glaucoma diagnosis,» and «glaucoma treatment» are the most frequently cited, underscoring the field's focus on the critical importance of early diagnosis and the accessibility of effective treatment. This pattern highlights a growing recognition of the need to develop robust primary healthcare strategies to manage glaucoma. It also emphasizes the importance of improving the overall quality of healthcare services and enhancing patient awareness to ensure better outcomes for those affected by this condition.

Our findings underscore the critical need for research on optimizing the approaches to diagnosing and treating glaucoma within primary healthcare settings. Additionally, they highlight the importance of fostering international collaboration and knowledge exchange to develop universally applicable recommendations. These efforts are essential for enhancing the effectiveness of disease prevention and early detection on a global scale.

The bibliometric analysis of keywords offers fresh insights into the current state of glaucoma research within primary healthcare. It lays a valuable foundation for future scientific endeavors to improve glaucoma diagnosis and treatment strategies. Furthermore, this analysis fosters an interdisciplinary perspective on the issue, uniting the efforts of ophthalmologists, general practitioners, and public health experts.

Strengths and Limitations

Our study boasts several notable strengths that enhance understanding of trends and advancements in glaucoma research within primary healthcare. One key strength lies in our inclusive approach, where we chose not to differentiate between research and review articles in our analysis. This decision was driven by the relatively small number of review articles compared to research articles. Differentiating between the two could have risked misinterpretation of the data and distorted the overall picture of glaucoma research in primary care. Treating all article types equally ensured consistency and accuracy in our findings. However, we acknowledge that this approach may have limited our ability to specifically analyze trends and assess review articles' unique contributions to the field's development.

Firstly, the depth of our longitudinal analysis, spanning the period from 1978 to January 2024, is a significant strength of our study. This extensive timeframe allows us to identify evolving trends and patterns in glaucoma research, offering valuable insights into the shifting dynamics of research

interests and contributions within the scientific community. Secondly, our comprehensive bibliometric methodology, which encompasses the analysis of articles, authors, keywords, and international collaborations, represents another key strength. This holistic approach provides a thorough overview of the research landscape in glaucoma, shedding light on critical aspects and emphasizing the global impact of this field on medical science and practice.

However, our study has several limitations that warrant acknowledgment. Firstly, while we utilized extensive databases such as Web of Science and Scopus, it is possible that some relevant publications were not captured, which may affect the completeness and accuracy of our findings. This limitation highlights the need for broader coverage of sources to present a more comprehensive representation of the research landscape. Consequently, the trends we identified may not fully reflect the entire scope of glaucoma research, potentially introducing a bias to our conclusions. To address this limitation, future research should incorporate additional databases and sources to enhance the depth and comprehensiveness of bibliometric analyses in this field.

Secondly, our exclusive focus on English-language publications may have introduced a language bias, potentially excluding important research published in other languages. This limitation underscores the need to integrate multilingual sources for a more global and comprehensive analysis. The impact of this language bias could be significant, as it may result in an incomplete representation of international research trends. To provide a more balanced and inclusive view, future studies should aim to incorporate non-English sources, ensuring that valuable insights from diverse linguistic and cultural contexts are considered.

Thirdly, relying on citation metrics to assess the impact and significance of research may not always accurately reflect the quality or contribution of a study to the scientific community. Various factors that may not directly correspond to the work's scientific value often influence citation counts. This limitation suggests that our evaluation of research impact might be partial, potentially affecting the conclusions drawn about the significance of specific studies. To address this, future research could incorporate additional qualitative assessments,

Despite analyzing international collaborations, we did not account for the qualitative aspects of these partnerships, which could offer a deeper understanding of the dynamics and effectiveness of international scientific exchange in glaucoma research. The absence of a qualitative analysis may limit our understanding of the true nature of these collaborations and their specific contributions to research advancements. Future studies should consider exploring qualitative dimensions to provide richer insights into the effectiveness and impact of these partnerships on the field.

Conclusion

Our study underscores the growing significance of addressing glaucoma within the primary healthcare framework, emphasizing the control of intraocular pressure as a key preventive measure to preserve vision. The findings highlight the need to enhance early detection methods and implement effective treatment strategies—additionally, advancements in artificial intelligence present promising opportunities for improving glaucoma diagnosis and management. However, a persistent challenge remains in patients seeking medical assistance at advanced stages of the disease, underscoring the need for earlier intervention.

We emphasize the importance of making tools for measuring intraocular pressure and conducting glaucoma screenings readily available in primary healthcare settings. Furthermore, the inclusion of glaucoma on the list of socially significant diseases is vital to raising public awareness and enhancing accessibility to treatment. Future research should focus on strengthening collaborative efforts, bridging existing gaps in healthcare access, and evaluating the effectiveness of emerging diagnostic and treatment technologies. These efforts will enable the medical community to develop more equitable and comprehensive strategies to address the global burden of glaucoma.

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Authors' Contribution

Conceptualization, LY; Data curation, ZZ; Formal analysis, MT; Methodology, MT; Project administration, LY, FB, VB; Software, MT; Supervision, FB; Writing – original draft, MT; Writing – review & editing, MT, LY, FB, ZZ, VB

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