Review Article

Bibliometric Analysis of Bibliometric Analyses on Oral Health Literature (1999-2024): A Meta-Bibliometric Approach

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ABSTRACT

This meta-bibliometric analysis investigates the evolution and trends of bibliometric analyses on oral health research over the past two and a half decades, based on publications in PubMed from 1999 to 2024. The study reveals a notable increase in the volume of bibliometric analyses, with China emerging as the leading contributor, followed by Brazil, India, and Saudi Arabia. The analysis highlights a trend towards international collaboration, enhancing the breadth of research perspectives. Major research themes include endodontics, dental caries, and pediatric dentistry. Despite these advancements, the study identifies gaps, including the need for more inclusive and multilingual databases and bibliometric analysis software that simplifies data integration from multiple databases for more comprehensive analyses. Overall, this analysis presents the current landscape of bibliometric analyses on oral health research and offers the research community meaningful insights that can guide future bibliometric analyses and improve the quality and relevance of oral health research assessments. The increasing volume and diversity of research output reflect a maturing field with a global focus. In contrast, the need for methodological advancements and broader inclusivity in research outputs points to areas for future development.

Keywords

Bibliometrics, Oral Health, Oral and maxillofacial research, Meta-bibliometric, VOSviewer, Biblioshiny, Network Analysis, Thematic Analysis, Visualization

INTRODUCTION

The field of oral health research has witnessed a significant proliferation of scientific output in recent years, paralleled by an increasing interest in quantitative methods to analyze this burgeoning literature [1]. Bibliometric analysis, a statistical approach to evaluating published research, has emerged as a valuable tool, offering insights into research trends, impact, and collaborative patterns within the dental sciences [2]. As the volume of oral health literature expands, bibliometric studies have become instrumental in navigating this complex landscape, helping researchers and policymakers identify influential

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works, emerging topics, and gaps in current knowledge [3-5]. Interestingly, applying bibliometric methods to oral health research has become a subject of study, creating a meta-analytical layer that warrants exploration [6]. This "bibliometric analysis of bibliometric analyses" in oral health research represents a novel approach to understanding how our field evaluates and interprets its scientific output. By examining the methodologies, focus areas, and trends within bibliometric studies of oral health, we can gain valuable insights into the evolving nature of assessment of research in oral health and potentially identify biases or limitations in our current analytical approaches [7,8].

The use of bibliometric analyses in dental research has grown substantially over the past decade, covering areas such as periodontology, implantology, orthodontics, and public health dentistry [9,10]. These studies have contributed to identifying seminal papers, tracking the evolution of research themes, and even forecasting future directions in various dental specialties [11]. However, as with any analytical tool, the efficacy of bibliometric analysis is contingent upon its appropriate application and interpretation. This meta-bibliometric study aims to provide a comprehensive overview of how bibliometric methods have been applied to oral health research. By analyzing the body of bibliometric studies in dentistry, we seek to uncover patterns in research evaluation practices, highlight potential areas of over- or under-representation, and identify methodological trends and possible innovations in the field. Our investigation delves into the co-authorship patterns and thematic foci of bibliometric studies in oral health. This approach illuminates the current state of bibliometric research in dentistry and critically reflects our methods of evaluating scientific impact and productivity in the field. Through this meta-analysis, we hope to contribute to refining bibliometric methodologies in oral health research and foster a more nuanced understanding of how we measure and interpret scientific progress in dentistry. As we embark on this meta-bibliometric journey, we aim to provide the dental research community with valuable insights that can improve future bibliometric analyses.

MATERIAL AND METHODS

Data Identification

We conducted an online search of the PubMed database on August 10, 2024, to identify bibliometric studies focusing on oral health research. The search strategy employed a combination of keywords related to bibliometrics and oral health. The search string used was: ("Bibliometric" OR "Scientometric" OR "Informetric") AND ("Oral health" OR "Maxillofacial" OR "Oral" OR "Dentist*" OR "Dental*"). No date restrictions were applied to capture all relevant studies up to the search date. All the identified studies were exported to a text file.

Study Selection

Two independent reviewers screened the retrieved articles based on predefined inclusion and exclusion criteria. Studies were included if they (1) were bibliometric analyses, (2) focused on any aspect of oral health or dentistry, and (3) were published in English. We excluded reviews, letters to the editor, and conference abstracts. Any disagreements between reviewers were resolved through discussion with a third reviewer. The study selection followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [12]. A flow diagram illustrating the selection process was generated using the PRISMA flow diagram template (Figure 1).

Data Extraction

For each included study, the following data was extracted using the Biblioshiny App: author(s), publication year, journal, country, affiliation, keywords, and abstract.

Bibliometric Analysis

We used two software tools for our bibliometric analysis:

VOSviewer (version 1.6.20, Centre for Science and Technology Studies, Leiden University, The Netherlands) [13]: This tool was employed to create and visualize bibliometric networks. To map research themes, we generated co-authorship networks to identify collaborative patterns and co-occurrence networks of keywords.

Biblioshiny (version 4.3.1, an R-tool of Bibliometrix) [14]: This web interface for bibliometrix R-package was used for comprehensive science mapping analysis. We utilized it to perform descriptive analysis of bibliometric data, including annual scientific production, top authors, countries, and journals.

Data Analysis

Thematic analysis of research focus areas was performed using the keyword co-occurrence network generated by VOSviewer. Collaboration patterns were

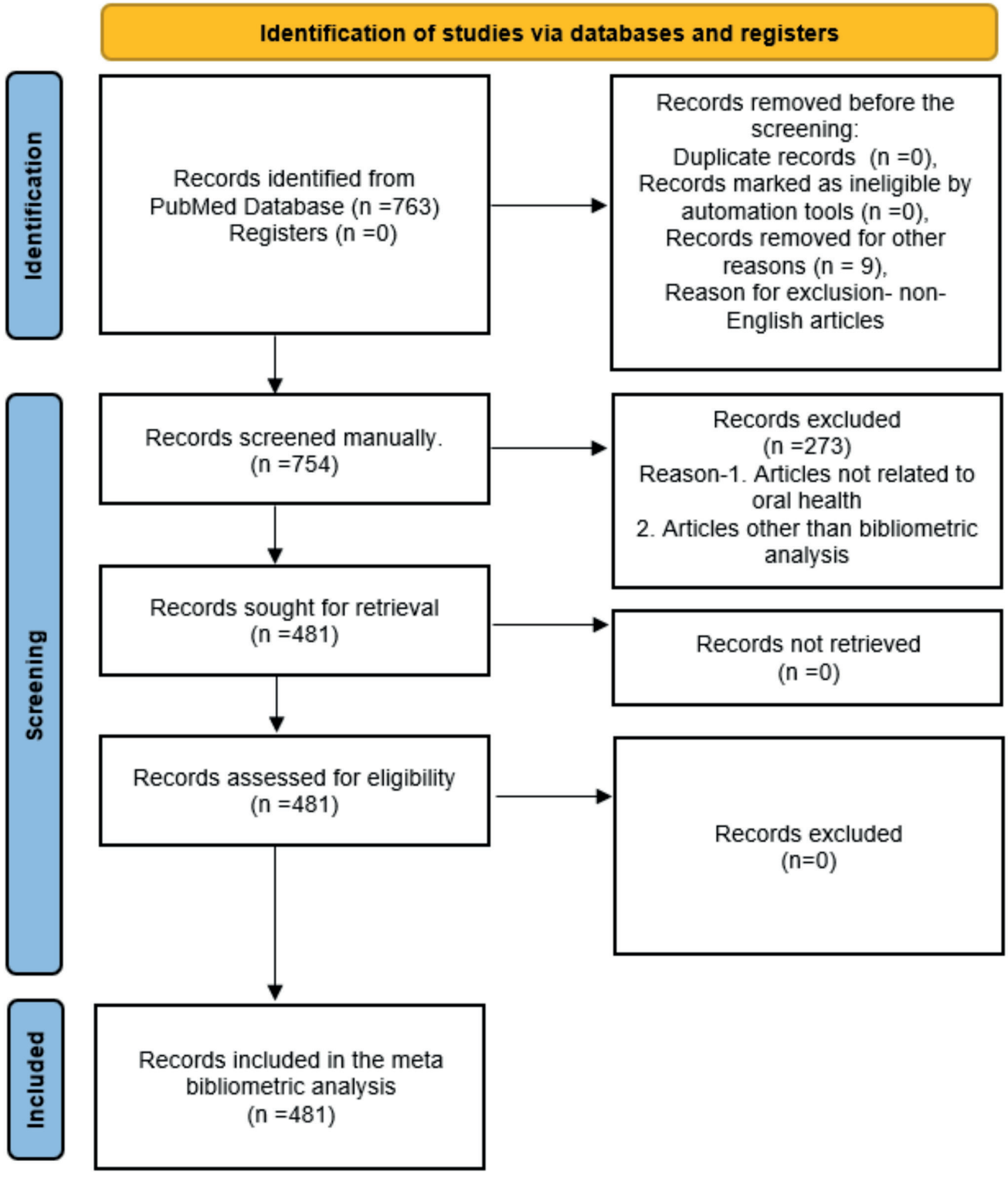

Figure 1: Flow chart depicting the study selection process for the meta-bibliometric analysis.

Image Credit: Namrata Dagli.

examined through co-authorship networks, particularly international collaborations. In addition, MS Excel and the BioRender app were used to create figures to display the findings [15]. We also manually extracted the data about methodological approaches used in the bibliometric studies, including the databases used for data collection and bibliometric software used for data analysis.

RESULTS

We obtained 763 results when the search string was used in the published database. Out of these 763, 754 articles published in English were selected. All the articles were manually inspected for their relevancy for this study. After excluding 2 editorials, 2 commentaries, and 269 irrelevant articles, 481 articles were selected (Figure 1).

Main Information

A meta-bibliometric analysis of oral health research by Biblioshiny App, using data from the PubMed database, reveals several key findings spanning 1999 to 2024. The study included 189 sources, including journals, books, and other academic publications, showing an annual growth rate of 17.64%. The average age of the documents is 2.94 years. Regarding document content, there are 552 unique "Author's Keywords" (DE). The analysis identified 1,699 authors, of which 12 contributed to single-authored documents. There are 22 single-authored papers, while the average collaboration is 5.12 co-authors per document. Additionally, 23.08% of the publications involve international co-authorships, indicating a significant level of global collaboration in oral health research. Data from abstracts suggest that out of 481 articles, 216 used Web of Science, 160 used Scopus, and 51 used PubMed database for analysis. One hundred twenty-five bibliometric analyses used VOSviewer, 62 used Citespace, 11 used Biblioshiny, 3 used Histcite, and 3 used Pajek bibliometric software.

Annual Scientific Production

The bibliometric analysis of oral health research articles identified from the PubMed database reveals a significant increase in publication activity over time, particularly since the early 2000s. Between 1999 and 2011, the

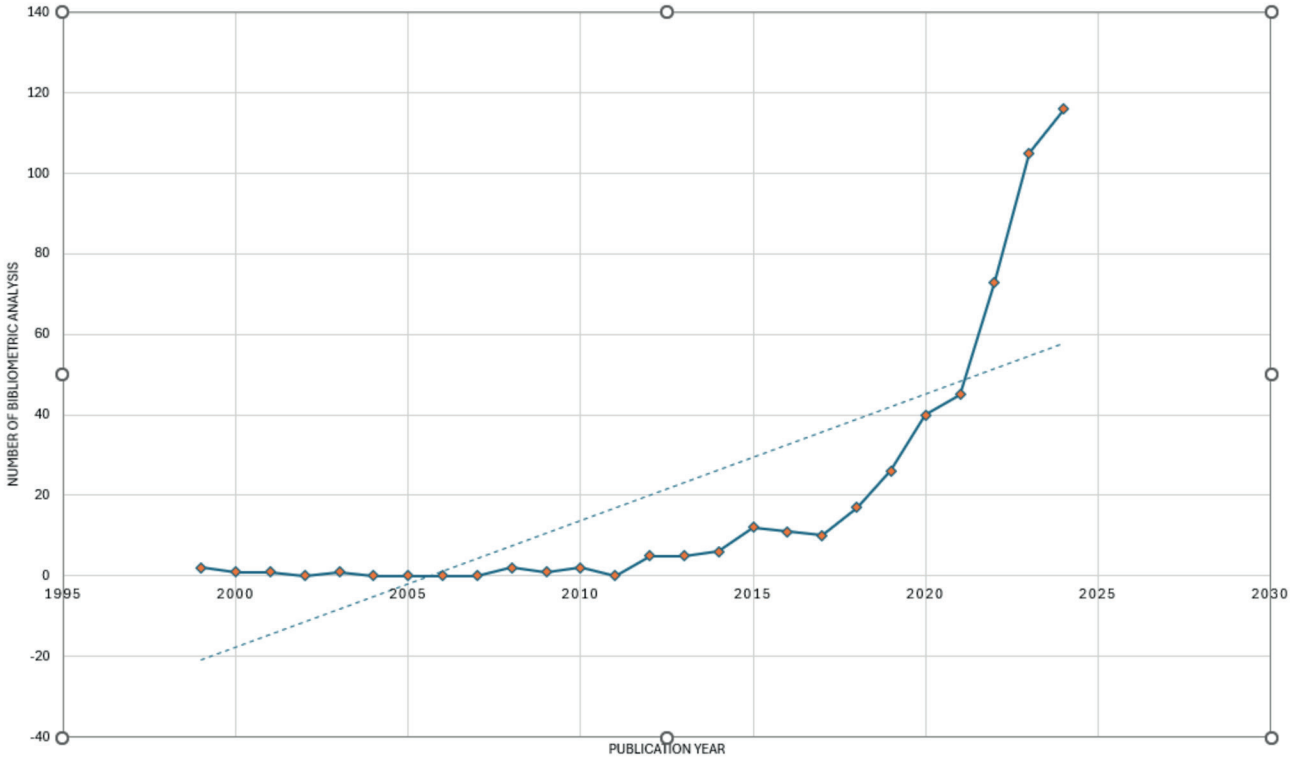

Figure 2: Annual Scientific Production of Bibliometric Analysis on Oral Health in PubMed

Image Credit: Namrata Dagli.

number of articles published annually remained low, ranging from 0 to 2 per year. From 2012 onward, there is a consistent upward trend, starting with 5 articles and peaking dramatically in recent years. The number of articles grew from 12 in 2015 to 73 in 2022 and further surged to 116 in 2024. This exponential growth, especially after 2015, reflects a growing research interest and focus on oral health. The steep rise post-2021 suggests a major turning point in research activity, possibly influenced by technological advancements, increased global awareness, or other external factors promoting research in this area (Figure 2).

Most Relevant Authors and Their Scientific Production Over Time

The most relevant authors based on the number of bibliometric analyses on oral health published in PubMed are presented in Figure 3. The analysis using Biblioshiny (RStudio 4.3.1) reveals distinct publication trends over time. Cardoso M shows a steady increase in publication frequency, starting with 1 paper in 2021 and rising to 5 papers in 2024. Li Y also exhibits a growing trend, with a significant rise in output from 1 paper in 2020 to 6 papers in 2023, maintaining high productivity into 2024. Liu W has shown consistent contributions, beginning in 2019, with 5 papers in 2024 marking their peak. Tovalino FRM had the highest publication output in 2022, with 6 papers, maintaining strong contributions through 2024. Yeung AWK, an earlier contributor, began publishing in 2018, showing stable productivity across the years, with a slight peak in 2021. Overall, the analysis highlights increasing contributions from these authors, with most showing steady growth in their research output on oral health over time (Figure 4).

Most Relevant Affiliations

A meta-bibliometric analysis on oral health research, based on PubMed data, processed using Biblioshiny (RStudio 4.3.1), reveals significant contributions from several global academic institutions (Table 1), with a noticeable increase in output over the years. Sichuan University leads the way, beginning with no publications until 2012, when it contributed 5 articles annually. The output remained steady until 2020, after which there was a sharp increase: 13 articles in 2021, 37 in 2022, 88 in 2023, and 151 by 2024. This positions Sichuan University as the most dominant contributor in the field. The University of Hong Kong showed a similar trend of rapid growth. It had no publications until 2015 when it contributed 2 articles per year. After 2019, the output escalated, reaching 6 articles in 2019, 8 in 2020, 23 in 2021, 33 in 2022, and 59 in 2024. Chinese institutions - the School of Medicine, Shanghai Jiao Tong University also showed a notable increase with 4 publications

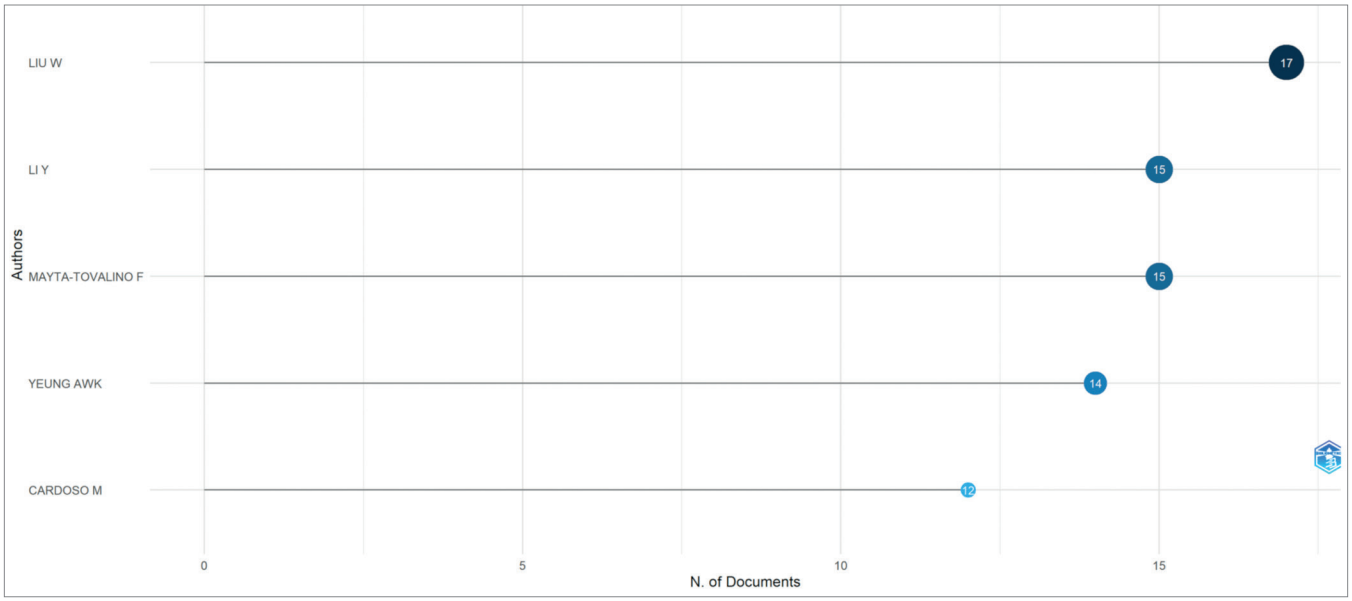

Figure 3: Most relevant authors based on the number of bibliometric analyses on oral health published in PubMed.
Image Credit: Namrata Dagli

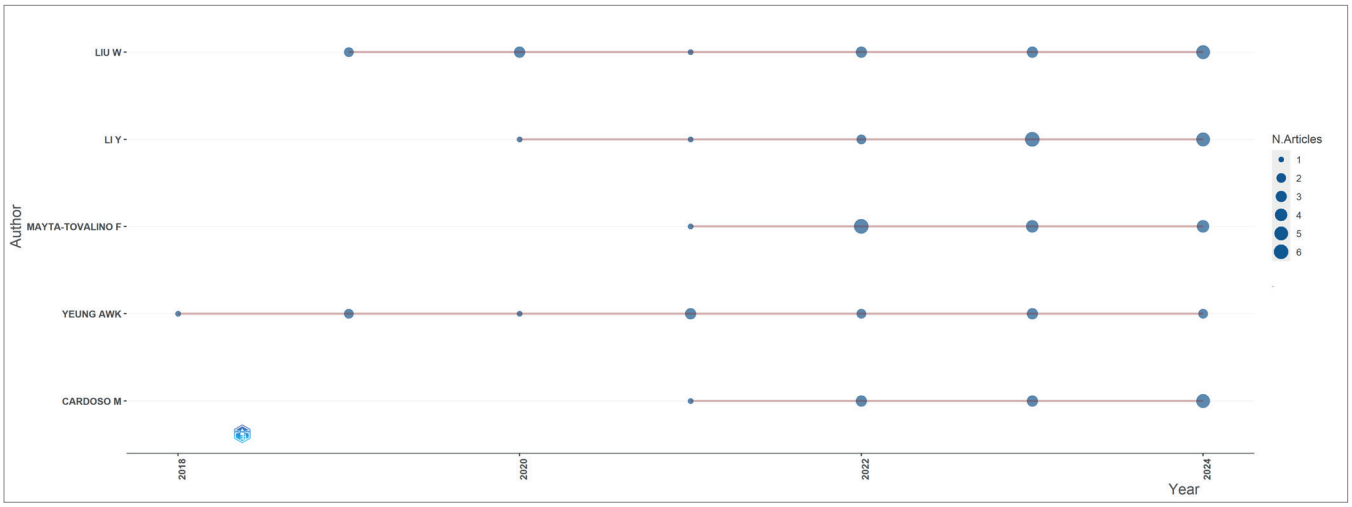

Figure 4: Scientific production of the most relevant authors of bibliometric analysis on oral health over time in PubMed.
Image Credit: Namrata Dagli

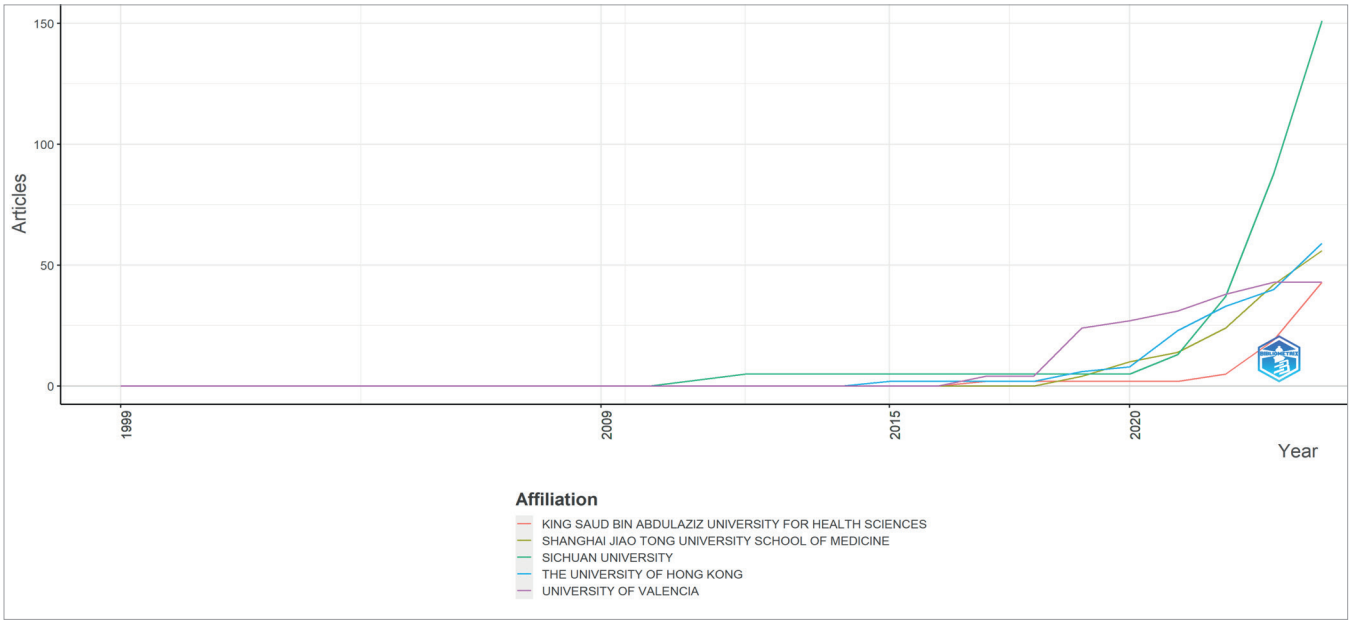

Figure 5: Scientific production of bibliometric analyses on oral health literature by institutions over time
Image Credit: Namrata Dagli

in 2019, rising steadily to 56 by 2024. King Saud bin Abdulaziz University for Health Sciences, which had no contributions until 2017, experienced a more gradual rise. Starting with only 2 articles per year between 2017 and 2021, the institution saw a marked increase in 2022 (5 articles) and surged to 19 articles in 2023, reaching 43 by 2024. Similarly, the University of Valencia showed no activity until 2017 but rapidly increased its research output, with 4 articles in 2017 and 2018, rising to 24 in 2019 and peaking at 43 by 2024 (Figure 5). Overall, this analysis highlights a global surge in bibliometric analyses on oral health research, with universities from China,

Saudi Arabia, and Spain increasing their contributions notably after 2020, showcasing the growing academic interest in the field.

Table 1: Most relevant authors based on the number of bibliometric analyses on oral health published in PubMed.

Affiliation	Number of bibliometric analyses published
Sichuan University, China	151
The University Of Hong Kong, China	59
School Of Medicine, Shanghai Jiao Tong University, China	56
King Saud Bin Abdulaziz University For Health Sciences, Saudi Arabia	43
University Of Valencia, Spain	43

Coauthorship Analysis of Authors

Coauthorship analysis of authors of bibliometric analyses on oral health by VOSviewer identified 1185 authors, out of which 113 published a minimum of 3 articles. The total strength of coauthorship links was calculated for all of them. The largest group of connected items included 10 authors, which were included in generating network visualization (Figure 6). These 10 authors were spread across 4 clusters with 13 links and a Total Link Strength of 21. Tovalino FRM has been identified with the highest link strength, 51 (15 publications), followed by Cardoso M with 33 (12 publications) and Munive-Degregori A with 32 (8 publications).

Analysis of Scientific Production of Corresponding Author's Country

The meta-bibliometric analysis on oral health, based on PubMed data using Biblioshiny (RStudio 4.3.1), presents a detailed comparative view of research output across various corresponding authors' countries. China leads the pack with 109 bibliometric analyses, of which 100 are single-country publications (SCP), and 9 are multi-country publications (MCP), showing a strong focus on domestic research (MCP Ratio of 0.083). Following closely is Brazil, with 67 Bibliometric analyses and a higher proportion of international collaboration, evidenced by 19 MCPs and an MCP

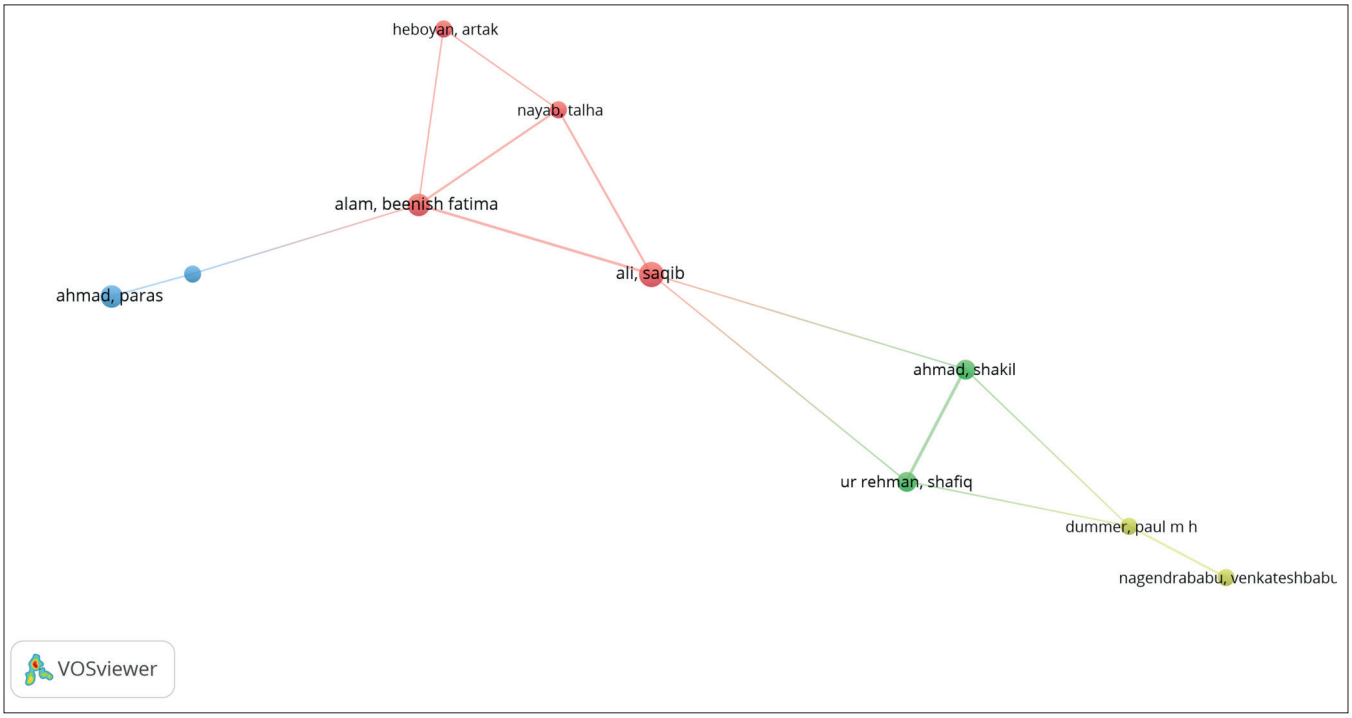

Figure 6: Coauthorship Analysis of authors of bibliometric analysis on oral health published in PubMed
Image Credit: Namrata Dagli.

Table 2: Analysis of Scientific Production of Bibliometric Analysis on Oral Health by Corresponding authors' countries.

Country	Articles	SCP	MCP	Frequency	MCP_Ratio
China	109	100	9	0.227	0.083
Brazil	67	48	19	0.139	0.284
India	26	21	5	0.054	0.192
Saudi Arabia	21	9	12	0.044	0.571
Spain	17	14	3	0.035	0.176
Turkey	15	12	3	0.031	0.200
Pakistan	14	9	5	0.029	0.357
USA	14	10	4	0.029	0.286
Iran	13	11	2	0.027	0.154
Peru	12	12	0	0.025	0.000
Italy	10	9	1	0.021	0.100
France	6	4	2	0.012	0.333
Switzerland	6	4	2	0.012	0.333
Yemen	6	0	6	0.012	1.000
Australia	5	1	4	0.010	0.800
Greece	5	4	1	0.010	0.200
Malaysia	5	2	3	0.010	0.600
Indonesia	4	3	1	0.008	0.250
Hong kong	3	3	0	0.006	0.000
Canada	2	1	1	0.004	0.500
Egypt	2	0	2	0.004	1.000
Germany	2	2	0	0.004	0.000
Ireland	2	2	0	0.004	0.000
Japan	2	2	0	0.004	0.000
Jordan	2	2	0	0.004	0.000
Netherlands	2	0	2	0.004	1.000
Romania	2	1	1	0.004	0.500
Austria	1	0	1	0.002	1.000
Cambodia	1	0	1	0.002	1.000
Latvia	1	0	1	0.002	1.000
Lithuania	1	0	1	0.002	1.000
Morocco	1	0	1	0.002	1.000
Portugal	1	0	1	0.002	1.000
Serbia	1	0	1	0.002	1.000
Slovenia	1	1	0	0.002	0.000
Syria	1	1	0	0.002	0.000

Notes: SCP = Single Country Publication, MCP = Multiple Country Publication.

Ratio of 0.284. India, Saudi Arabia, and Spain also make notable contributions. Saudi Arabia stands out with a high MCP Ratio of 0.571, indicating more than half of its oral health research is conducted with international collaborators. Similarly, countries like Pakistan (0.357) and the USA (0.286) also demonstrate significant global collaborations. Countries like Peru, Hong Kong, Jordan, Slovenia, Germany, Ireland, Japan, and Syria have no international co-authorships, indicated by an MCP Ratio of 0.000.

On the other hand, smaller countries, including Yemen, Australia, and Malaysia, exhibit high MCP Ratios (Yemen 1.000, Australia 0.800, Malaysia 0.600), showing that almost all their research involves international cooperation. Additionally, countries like Egypt, the Netherlands, and several smaller nations such as Latvia and Morocco have an MCP Ratio of 1.000, indicating complete reliance on international partnerships for their research output. In summary, China and Brazil dominate in quantity, but smaller and emerging countries exhibit more vital international collaboration, as reflected by their higher MCP Ratios. (Table 2).

Total Scientific Production of Countries

The meta-bibliometric analysis of oral health research from the PubMed database, conducted using Biblioshiny in RStudio 4.3.1, reveals significant variations in publication output across different countries and regions (Figure 7). The temporal analysis of the publications is depicted in Figure 8. China leads the field with an impressive 845 articles, showing a remarkable surge in research output from the early 2010s to 2024. Brazil follows with 421 articles, indicating a substantial increase in research activity in recent years. Saudi Arabia has also demonstrated notable growth, with its publications rising to 153 articles, reflecting a growing investment in oral health research. With 126 articles, India steadily increased its research output, highlighting a growing focus on the field. Spain and Italy contribute significantly, with 115 and 93 articles, respectively. Peru, with 82 articles, and Pakistan, with 64 articles, show emerging research interests. Turkey, with 53 articles, also displays moderate research activity.

It should be noted that a higher-than-actual publication count for individual countries is likely due to the inclusion of multi-author, multi-country papers being counted multiple times. This analysis underscores China's dominant position in oral health research,

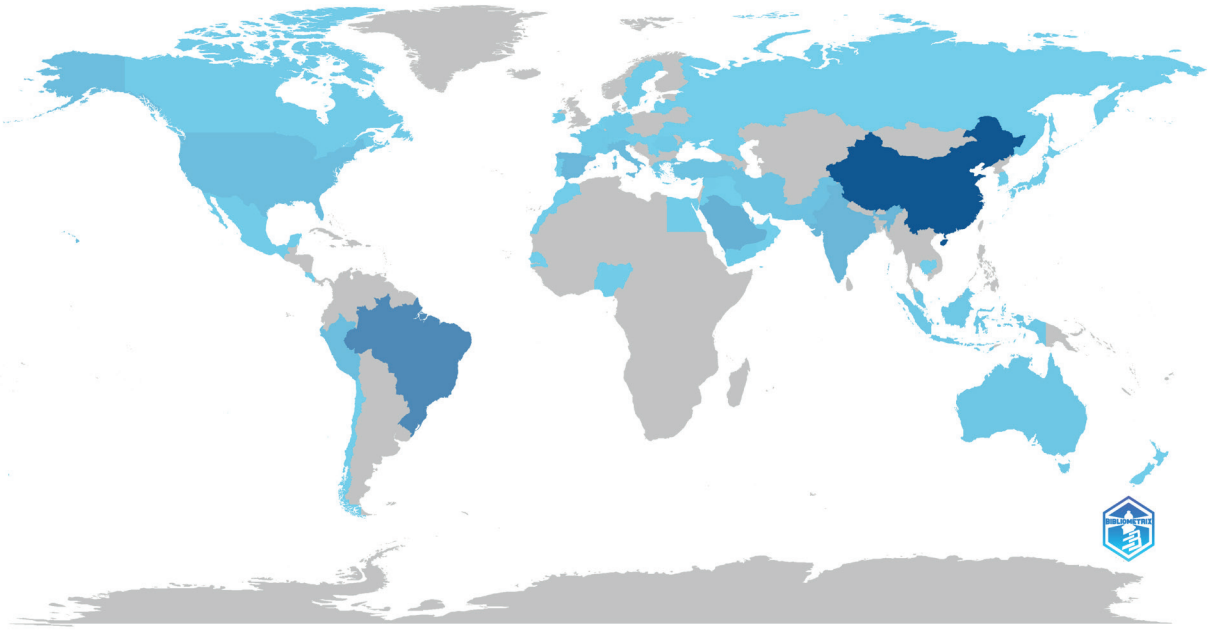

Figure 7: Scientific Production of the Countries.
Image Credit: Namrata Dagli.

followed by Brazil and Saudi Arabia. The steady rise in research output from countries like India, Spain, and Italy, along with emerging interest from Peru, Pakistan, and Turkey, reflects a growing global emphasis on oral health research.

Most Relevant Sources

A meta-bibliometric analysis of oral health publications, using data from PubMed and analyzed through Biblioshiny in RStudio 4.3.1, highlights significant contributions from various journals (Table 3). The temporal analysis of publications is depicted in Figure 9. The journal Cureus has led in recent years, with 21 articles published by 2024, showcasing a rapid growth from 2 in 2022. Journal of Dental Sciences follows a similar trajectory, rising from 1 article in 2020 to 17 in 2024. Other prominent journals, such as The Journal of Prosthetic Dentistry and Journal of Stomatology, Oral and Maxillofacial Surgery, have also steadily increased their contributions, reaching 11 and 10 articles by 2024. This growth reflects a surge in research output across journals, particularly after 2020. For instance, Dental Traumatology, International Endodontic Journal, and International Journal of Environmental Research and Public Health each published 9 articles by 2024. The Saudi Dental Journal and Clinical Oral Investigations also saw similar trends, with each contributing 9 and 8 articles, respectively, by 2024.

Although most journals did not contribute significantly until the mid-2010s, the rapid increase in oral health publications in recent years points to heightened global research interest. Journals like Heliyon and International Dental Journal also joined this trend, contributing consistently to the last few years. Journal of Oral Pathology & Medicine has steadily increased articles, reaching 7 in 2023. This analysis reflects a well-rounded representation of research in oral health, with increasing contributions from various journals emphasizing the growing importance of oral health research globally (Figure 9).

Keyword Cooccurrence Analysis

VOSviewer identified 441 MeSH keywords, out of which 60 keywords were repeated a minimum of 5 times. The total strength of the cooccurrence link was calculated for all these keywords, which were included in creating network visualization. These 60 keywords

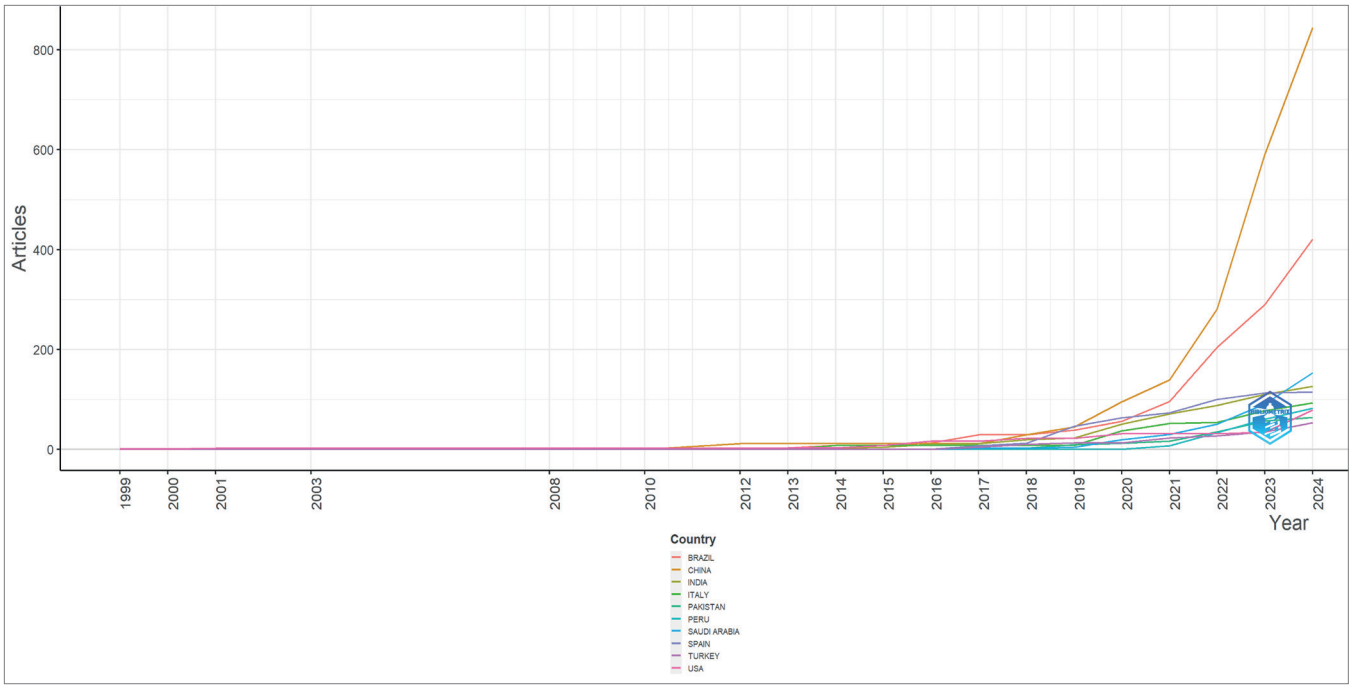

Figure 8: Scientific output of the countries over time
Image Credit: Namrata Dagli.

Table 3: Most relevant sources based on the number of bibliometric analyses published in PubMed.

Sources	Articles
Cureus	21
Journal Of Dental Sciences	17
The Journal Of Prosthetic Dentistry	11
Journal Of Stomatology, Oral And Maxillofacial Surgery	10
The Journal Of Contemporary Dental Practice	10
Dental Traumatology: Official Publication Of International Association For Dental Traumatology	9
International Endodontic Journal	9
International Journal Of Environmental Research And Public Health	9
The Saudi Dental Journal	9
Clinical Oral Investigations	8

were spread across 8 clusters with 694 links and 2744 Total link strength. The keywords with the highest TLS are bibliometrics and humans with TLS values 950 and 868, respectively. The subject-related keywords with the highest TLS are Endodontics, Oral Surgery, Orthodontics, Dental caries, and Pediatric dentistry, with TLS values of 106, 99, 80, 79, and 67, respectively.

In the context of bibliometric analysis on oral health, the clusters of keywords presented in Table 3 indicate various research themes. Cluster 1 indicates bibliometric analyses on oral health issues involving diverse populations (adolescents, adults, children), particularly dental caries, implants, periodontal diseases, and COVID-19. Cluster 2 highlights bibliometric analysis on specific medical concerns like squamous cell carcinoma and oral leukoplakia. Cluster 3 indicates bibliometric analyses on dentistry, particularly dental materials and oral medicine, primarily investigating authorship and publishing efficiency. Cluster 4 suggests the focus of bibliometric analyses on geographic distribution and international collaboration in oral health research. Cluster 5 points to bibliometric analyses

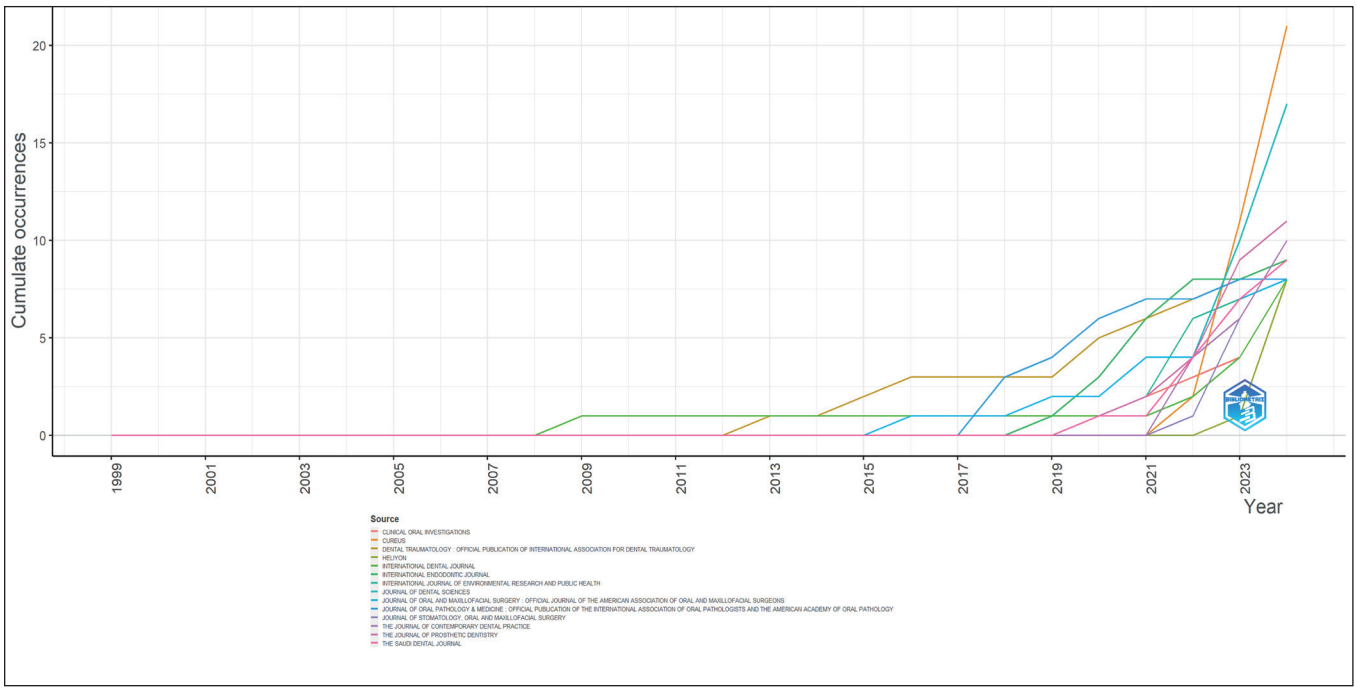

Figure 9: Most relevant journals based on the number of bibliometric analyses on oral health published over time in PubMed.
Image Credit: Namrata Dagli.

Table 4: Keywords in clusters identified in cooccurrence analysis by VOSviewer.

Clusters	Keywords
Cluster 1 (12 items)	adolescent, adult, animals, child, COVID-19, dental caries, dental implantation, dental implants, pediatric dentistry, periodontal diseases, periodontics, randomized controlled trial
Cluster 2 (12 items)	academies and institutes, bibliometrics, biomedical research, carcinoma squamous cell, female, humans, Italy, journal impact factor, leukoplakia oral, male, mouth neoplasms, time factors
Cluster 3 (10 items)	authorship, dental materials, dental research, dentistry, efficiency, MEDLINE, oral medicine, periodicals as topic, prosthodontics, publishing
Cluster 4 (8 items)	Brazil, cross-sectional studies, Europe, India, Japan, Turkey, United Kingdom, United States
Cluster 5 (5 items)	Australia, cone-beam computed tomography, databases factual, endodontics, publications.
Cluster 6 (5 items)	language, orthodontics, orthognathic surgery, retrospective studies, temporomandibular joint
Cluster 7 (4 items)	China, dental care, oral health, quality of life
Cluster 8 (4 items)	oral surgical procedures, research design, oral surgery, traumatology

in endodontics, cone-beam computed tomography, and factual databases. Cluster 6 indicates bibliometric analyses related to orthodontics, orthognathic surgery, and temporomandibular joint studies. Cluster 7 is centered around bibliometric analyses of dental care, oral health, and quality of life, particularly in China. Cluster 8 indicates bibliometric analyses on oral surgery, particularly oral surgical procedures, research design, and traumatology.

DISCUSSION

The meta-bibliometric analysis of oral health research in PubMed offers a window into the evolving landscape of this field over the past two decades. The data reveals a steady increase in research output, reflecting a growing awareness of assessing the oral health research landscape. The increasing number of recent publications correlates with heightened academic interest, technical advancement, and funding opportunities that have enabled more comprehensive investigations into oral health. The geographical distribution highlights the dominance of certain regions, particularly China and

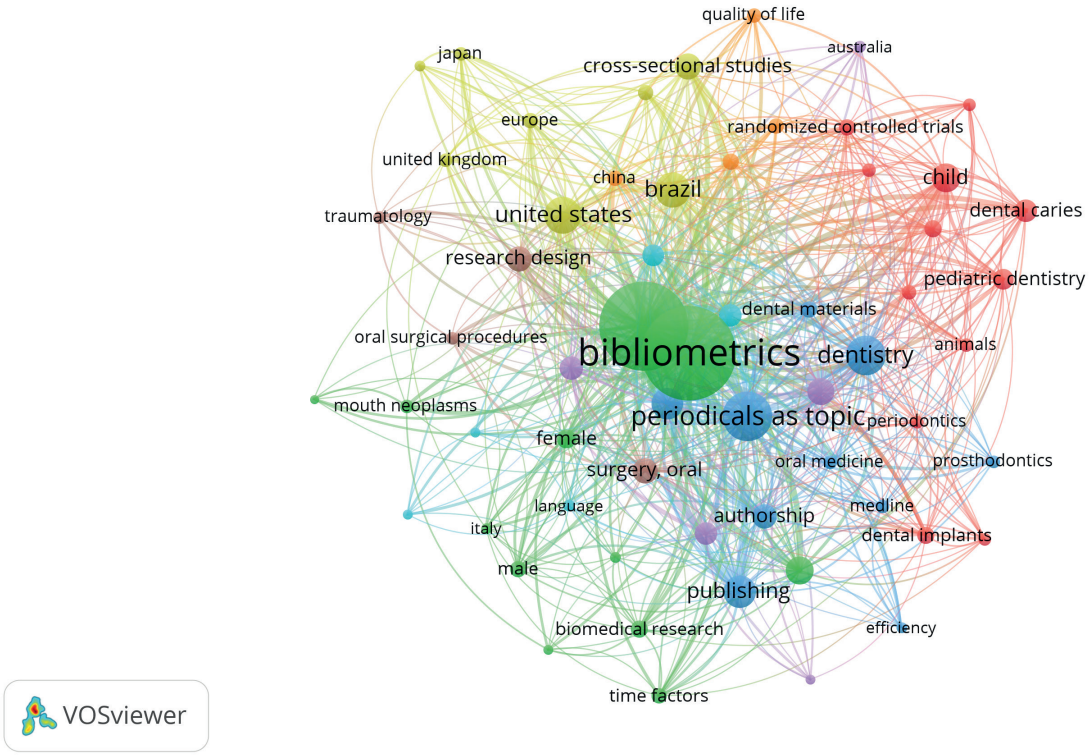

Figure 10: Cooccurrence analysis of MeSH keywords of bibliometric analysis on oral health published in PubMed

Image Credit: Namrata Dagli.

Brazil [16]. The rapid rise in contributions from these countries suggests strengthening research infrastructure and more excellent prioritization of oral health evaluation within their public health agendas. The collaboration patterns observed, particularly the high rates of international co-authorship from countries like Saudi Arabia and Australia, indicate a growing interconnectedness in the research community. These partnerships may enhance the diversity of perspectives and the applicability of research findings across different populations. Institutional contributions also reflect broader trends in research funding and policy. Leading institutions such as Sichuan University have emerged as considerable contributors, suggesting a concentration of expertise and resources in these centers. This concentration also raises questions about the technical advancement and awareness of the need to evaluate the research on oral health across less dominant regions.

Keyword co-occurrence analysis provides insights into the thematic focus of the field. The clustering of keywords around specific topics such as endodontics, dental caries, and pediatric dentistry indicates areas of interest. Meanwhile, the emergence of COVID-19 as a significant topic reflects the adaptive nature of research in responding to global health crises. The prominence of terms like "quality of life" in association with oral health research highlights an increasing emphasis on patient-centered outcomes, suggesting a shift towards more holistic approaches in dental research. The data also indicates a maturation of the field, as evidenced by the increasing number of publications and the diversity of research topics. The involvement of a wide array of journals in disseminating this research points to a broadening of the field, with oral health issues being addressed in various sub-disciplines. This diversification is crucial for the field's growth, as it allows for exploring new research frontiers and integrating oral health with

other health disciplines.

In terms of research methodologies, analysis of abstracts of all articles revealed the preference for Web of Science followed by Scopus and PubMed among researchers for bibliometric analysis in the field. Furthermore, VOSviewer emerged as the dominant bibliometric software utilized in 125 analyses, indicating its popularity due to its robust visualization capabilities. Citespace was the second most used tool, with 62 occurrences, suggesting its strength in identifying trends and patterns in citation networks. Biblioshiny, Histcite, and Pajek were used far less frequently, with 11, 3, and 3 occurrences demonstrating their more specialized or less widespread application in the domain. This manual inspection of abstracts highlights the diverse approaches and tools employed in bibliometric analyses, reflecting researchers' varying needs and preferences in this area.

To our knowledge, this is the first meta-bibliometric analysis of oral health research. However, other disciplines [17-19] have used a similar approach. Overall, this meta-bibliometric analysis reflects the dynamic nature of oral health research. A key strength of this study is the integration of thematic and quantitative analysis, which provides a more in-depth understanding of the research landscape. Additionally, automatic and manual inspections were conducted to ensure the sample studies' appropriateness, enhancing the findings' reliability and comprehensiveness. However, the analysis is not free from limitations. The study is restricted to PubMed, which may not capture all relevant publications, particularly those in non-indexed journals or other databases, leading to potential gaps in coverage. The exclusion of non-English articles introduces language bias, potentially overlooking significant research from non-English-speaking regions.

Moreover, the analysis suffers from keyword overlap and inconsistencies. Some key topics may be underrepresented if not adequately captured by the chosen keywords. Additionally, regional disparities in research output may lead to an incomplete global understanding. Including multi-author, multi-country papers can result in inflated publication counts for individual countries or institutions. Importantly, PubMed does not allow citation analysis, limiting the ability to assess the impact of research based on citations. The focus on publication numbers and co-authorship links may obscure a deeper analysis of the content and implications of the research.

Furthermore, the results are based only on the title and abstract analysis. A detailed review of the included bibliometric analysis is not done. These limitations suggest that while this analysis offers valuable insights into trends in oral health research, it should be interpreted cautiously. Future studies could address these limitations by incorporating data from multiple databases, considering non-English publications, and focusing on quantitative and qualitative research output. Regular updates to this analysis would be beneficial in tracking evolving trends and emerging areas of interest within the field. While there is significant progress in expanding the research output and enhancing global collaboration, the findings also underscore the need for continued investment in both research infrastructure and the diversification of research agendas to address the unmet needs in oral health across different populations and regions. Future research should build upon these trends as the field evolves, ensuring that research outputs translate into tangible health outcomes for diverse populations. We have summarized the findings in Figure 11.

Recommendations for Bibliometric Analysis Improvement

To improve the accuracy and effectiveness of future bibliometric analyses, several methodological enhancements can be suggested based on this meta-bibliometric study: Data Integration and Inclusion of Multiple Databases: Future bibliometric analyses should integrate data from multiple databases like Scopus, Web of Science, and Google Scholar, alongside PubMed, to ensure a more comprehensive and representative dataset that captures a broader spectrum of research outputs across various regions and disciplines. Additionally, the development of further tools is required to simplify the integration of data from these diverse sources.

Language Diversity: Expanding the analysis to include non-English publications can mitigate language bias and provide a more accurate global perspective. Automated translation tools or collaboration with multilingual researchers could be employed to analyze non-English texts.

Advanced Keyword Standardization: Keyword standardization can reduce inconsistencies and overlap,

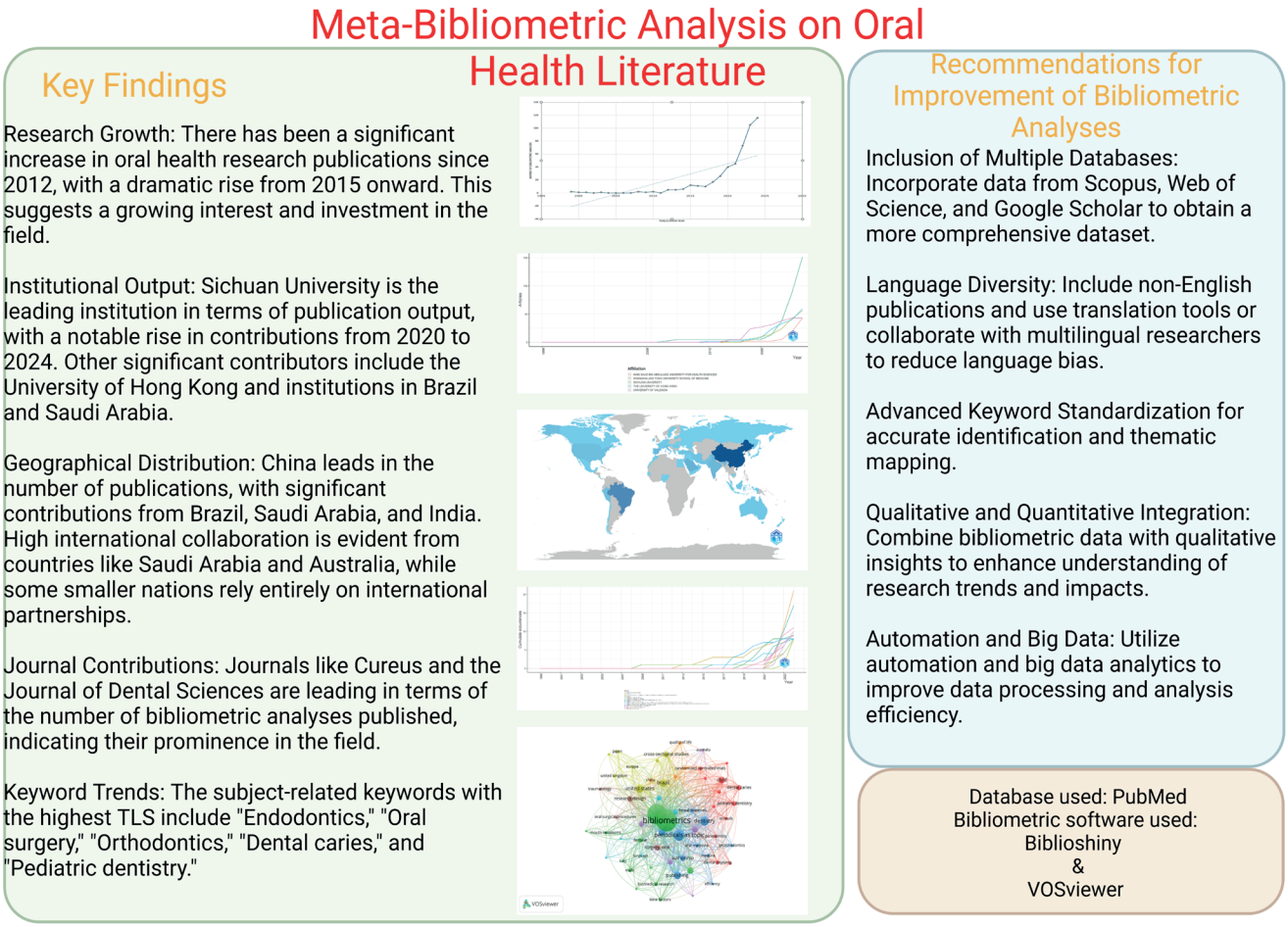

Figure 11: Key findings of Meta-bibliometric Analysis on Oral Health literature.

Note: This figure was drawn using the premium version of BioRender (https://biorender.com/) [16], with the agreement license number SJ277QXGMN.

Image Credit: Namrata Dagli.

increasing bibliometric analyses' accuracy. Utilizing natural language processing (NLP) techniques and machine learning models can improve the accuracy of keyword identification and clustering, leading to more precise thematic mapping.

Integration of Qualitative and Quantitative Data: Combining quantitative bibliometric data with qualitative insights (e.g., content analysis and expert opinions) can offer a more nuanced understanding of research trends and impact. This hybrid approach can enhance the depth and context of bibliometric findings.

Automation and Big Data Analytics: Employing advanced big data analytics and machine learning techniques can improve the processing and analysis of large datasets. Automation in data cleaning, categorization, and pattern recognition would enhance the accuracy and efficiency of bibliometric studies, allowing for the handling of increasingly complex and voluminous datasets. Future studies should consider expanding the range of bibliometric tools and databases to ensure comprehensive analyses. While Web of Science and Scopus are heavily relied upon, incorporating other databases like PubMed more frequently could provide a broader perspective, especially in fields like life sciences and medicine. Additionally, while VOSviewer and

Citespace are famous for their visualization and trend identification capabilities, exploring and integrating less commonly used tools like Biblioshiny, Histcite, and Pajek could offer new insights and methodological advantages.

By addressing these methodological areas, future bibliometric analyses can become more accurate, comprehensive, and insightful, better reflecting the research landscape in any field. However, standard methodological guidelines are needed to ensure these analyses' transparency, credibility, validity, reliability, and utility.

CONCLUSION

The meta-bibliometric analysis of oral health research published in PubMed from 1999 to 2024 reveals a significant increase in research activity, with China leading in publication volume and many emerging contributors like Brazil and Saudi Arabia also making substantial contributions. International collaboration is prevalent, enhancing the diversity of research perspectives. Key research areas include endodontics, dental caries, and pediatric dentistry, with a notable shift toward patient-centered approaches. Despite advancements, the study highlights the need for more comprehensive databases, diverse language inclusion, and improved bibliometric tools to capture the field's progress and address existing gaps fully. This study highlights the predominant reliance on Web of Science and Scopus databases and the widespread use of VOSviewer and Citespace in bibliometric analyses. Expanding diverse databases and bibliometric tools is recommended to enhance the comprehensiveness and depth of future research.

Consent for Publication

The author reviewed and approved the final version and has agreed to be accountable for all aspects of the work, including any accuracy or integrity issues.

Disclosure

The author declares that they do not have any financial involvement or affiliations with any organization, association, or entity directly or indirectly related to the subject matter or materials presented in this editorial. This includes honoraria, expert testimony, employment, ownership of stocks or options, patents, or grants received or pending royalties.

Data Availability

Information is taken from freely available sources for this Bibliometric analyses.

Authorship Contribution

All authors contributed significantly to the work, whether in the conception, design, utilization, collection, analysis, and interpretation of data or all these areas. They also participated in the paper's drafting, revision, or critical review, gave their final approval for the version that would be published, decided on the journal to which the article would be submitted, and made the responsible decision to be held accountable for all aspects of the work.

REFERENCES

1. Jayaratne YS, Zwahlen RA. The evolution of dental journals from 2003 to 2012: a bibliometric analysis. *PLoS One*. 2015;**10**(3): e0119503. doi: 10.1371/journal.pone.0119503.
2. Pritchard A. Statistical bibliography or bibliometrics. J Doc. 1969;**25**(4):348-349. Available at https://cir.nii.ac.jp/crid/1570009750342049664 [Accessed August 23, 2024]
3. Dagli N, Haque M, Kumar S. A Bibliometric Analysis of Literature on the Impact of Diet on Oral Health. *Cureus.* 2024;**16**(4):e59418. doi: 10.7759/cureus.59418.
4. Dagli N, Haque M, Kumar S. The Interplay Between Diabetes and Oral Health: A Comprehensive Bibliometric Analysis of Clinical Trials (1967-2024). *Cureus.* 2024;**16**(4): e58667. doi: 10.7759/cureus.58667.
5. Dagli N, Haque M, Kumar S. Bibliometric Analysis of Clinical Trials on the Effect of Sugar Alcohol Consumption on Oral Health: Trends, Insights, and Future Directions (1967-2024). *Cureus.* 2024;**16**(5): e60248. doi: 10.7759/cureus.60248.
6. Krymskaya AS. The Bibliometrics of Bibliometrics as a New Area of Research. *Sci Technol Inf Process.* 2023;**50**(4):286-91. doi: 10.3103/S0147688223040147
7. Ellegaard O, Wallin JA. The bibliometric analysis of scholarly production: How great is the impact? *Scientometrics.* 2015;**105**(3):1809-1831. doi: 10.1007/s11192-015-1645-z.
8. Hicks D, Wouters P, Waltman L, de Rijcke S, Rafols I. Bibliometrics: The Leiden Manifesto for research metrics. *Nature.* 2015;**520**(7548):429-431.
9. Pulgar R, Jiménez-Fernández I, Jiménez-Contreras E, Torres-Salinas D, Lucena-Martín C. Trends in World Dental Research: an overview of the last three decades using the Web of Science. *Clin Oral Investig.* 2013;**17**(7):1773-83. doi: 10.1007/s00784-012-0862-6.
10. Tarazona B, Vidal-Infer A, Alonso-Arroyo A. Bibliometric analysis of the scientific production in implantology (2009-2013). *Clin Oral Implants Res.* 2017;**28**(7):864-870. doi: 10.1111/clr.12891.
11. Prevezanos P, Tsolakis AI, Christou P. Highly cited orthodontic articles from 2000 to 2015. *Am J Orthod Dentofacial Orthop.* 2018; **153**(1):61-69. doi: 10.1016/j.ajodo.2017.06.015.
12. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Akl EA, Brennan SE, Chou R, Glanville J, Grimshaw JM, Hróbjartsson A, Lalu MM, Li T, Loder EW, Mayo-Wilson E, McDonald S, McGuinness LA, Stewart LA, Thomas J, Tricco AC, Welch VA, Whiting P, Moher D. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Rev Esp Cardiol (Engl Ed).* 2021; **74**(9):790-799. English, Spanish. doi: 10.1016/j.rec.2021.07.010.
13. van Eck NJ, Waltman L. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics.* 2010;**84**(2):523-538. doi: 10.1007/s11192-009-0146-3.
14. Aria M, Cuccurullo C. bibliometrix: An R-tool for comprehensive science mapping analysis. *J Informetr.* 2017;**11**(4):959-975. doi: 10.1016/j.joi.2017.08.007
15. BioRender. 2024. Available at https://www.biorender.com/ [Accessed August 23, 2024]
16. I Narayan A, Chogtu B, Janodia M, Venkata SK. A bibliometric study on the research outcome of Brazil, Russia, India, China, and South Africa. *F1000Res.* 2021; **10**:213. doi: 10.12688/f1000research.51337.1.
17. Ülker P, Ülker M, Karamustafa K. Bibliometric analysis of bibliometric studies in tourism and hospitality. *J Hospitality Tour Insights.* 2023; **6**(2):797-818. doi: 10.1108/JHTI-10-2021-0291.
18. Yilmaz I. Bibliometric Analysis of Bibliometric Studies on Tourism Published in Turkey. *Anais Brasileiros De Estudos Turísticos*. 2019; **9**(1, 2 e 3). doi:10.34019/2238-2925.2019.v9.27111
19. Khan A, Goodell JW, Hassan MK, Paltrinieri A. A bibliometric review of finance bibliometric papers. *Fin Res Lett.* 2022; **47**:102520. doi: 10.1016/j.frl.2021.102520