

Bibliometric analysis and visualization of research on nanotechnology in dentistry from 1999 to 2022

Namrata Dagli¹ , Bhavin Patel² , Rushabh Dagli³ , Nihad Adnan⁴ , Rahnuma Ahmad⁵ , Mainul Haque^{6*} ,
Santosh Kumar¹ 

¹Adjunct Research Faculty, Karnavati Scientific Research Center, Karnavati School of Dentistry, Karnavati University, Gandhinagar, India.

²Department of Periodontology, Karnavati School of Dentistry, Karnavati University, Gandhinagar, India.

³Department of Public Health Dentistry, Vyas Dental College and Hospital, Jodhpur, India.

⁴Department of Microbiology, Jahangirnagar University, Savar, Bangladesh.

⁵Department of Physiology, Medical College for Women and Hospital, Dhaka, Bangladesh.

⁶Unit of Pharmacology, Faculty of Medicine and Defence Health, Universiti Pertahanan Nasional Malaysia (National Defence University of Malaysia), Kuala Lumpur, Malaysia.

ARTICLE INFO

Received on: 15/03/2023

Accepted on: 25/06/2023

Available Online: 04/09/2023

Key words:

Bibliometric,
nanodentistry, network
analysis, nanomaterials,
nanotechnology, dentistry,
nanomaterials, nanodrugs,
nanoparticles.

ABSTRACT

The medical field is highly fascinated with nanotechnology, which offers many opportunities, including tissue engineering and nanomedicine. Nanobiotechnology has the potential to revolutionize the field of dentistry. This study investigates the research patterns, the most relevant authors, organizations, themes, journals, and their co-occurrences. An online search was conducted in the PubMed database for the literature on nanotechnology applications in dentistry using specific strings. The articles selected were reviews, including systematic reviews, meta-analyses, and clinical trials. Network analysis and visualization were done using MS Excel, VOS viewer, and Biblioshiny software. The initial search identified 5,898 documents, and finally, 913 articles published in 363 journals by 4,261 authors from 1999 to 2020 were selected. According to the analysis, the nanoparticle is the keyword specific to the field with the field with the highest co-occurrence. Tabriz University of medical sciences is recognized as a top contributor. Collaboration frequency is highest between Iran and the United States of America. The data suggest an increasing research and publishing trend in the field of nanotechnology in dentistry. Research trends have shifted from the chemical properties of nanomaterials to practical applications such as tissue engineering. This analysis provides a comprehensive understanding of nanotechnology in dentistry.

INTRODUCTION

The application of nanotechnology in dentistry was first proposed by Freitas (2000). Nanotechnology is the study and engineering of materials and devices at the nanoscale, which is typically defined as the range of 1–100 nm. At this scale, materials

and devices exhibit unique physical, chemical, and biological properties that are not present at larger scales. This allows creating materials and devices with novel properties and functionalities that can be used in various applications. Nanotechnology has the potential to revolutionize every aspect of dental care, including prevention, diagnosis, and treatment. Nanotechnology has been explored extensively in almost all dentistry branches in the past few decades (Sreenivasalu *et al.*, 2022). Many studies also suggested its application in tissue engineering, cancer treatment, and diagnostics (Jin *et al.*, 2020; Khoobchandani *et al.*, 2021; Laird *et al.*, 2021; Sil *et al.*, 2021).

However, many studies have been done in nanotechnology, and no bibliometric analysis has been done

*Corresponding Author

Mainul Haque, Unit of Pharmacology, Faculty of Medicine and Defence Health, Universiti Pertahanan Nasional Malaysia (National Defence University of Malaysia), Kuala Lumpur, Malaysia.

E-mail: runurono@gmail.com

on nanotechnology research in dentistry. Bibliometric analysis refers to the quantitative analysis of scientific and scholarly publications. It involves examining publication and citation patterns to understand the impact, visibility, and influence of research in a particular field or discipline. Bibliometric analysis can be used to identify trends in research, measure the impact of specific publications, evaluate the productivity of researchers and institutions, and identify potential collaborators or competitors. It can also be used to assess the quality and importance of research, as well as to inform decisions about funding, policy, and strategy. Bibliometric analysis is critical in the context of academic research, where the assessment of impact and productivity is often based on publication and citation metrics. It can help researchers and institutions to understand how the wider academic community is receiving their work and to identify areas for future research or collaboration. The bibliometric analysis provides a valuable tool for assessing the quality and impact of scientific and scholarly research and making informed decisions about funding, policy, and strategy in academia and beyond.

This study uses a bibliometric approach to review the research pattern on nanotechnology in dentistry. The objective is to identify significant themes, most productive authors, leading institutions and journals, leading countries, co-occurrence of authors, organizations, and keywords from 1999 to 2022 in the field of nanotechnology.

MATERIAL AND METHODS

An online electronic search was performed on 22 August 2022 in the Pubmed database, and articles published on “Nanotechnology application in dentistry” were identified. The search strategy used was—(dentistry AND nanotechnology) OR (dentistry AND nanomaterial) OR (dentistry AND nano-drug) OR (dentistry AND nanoparticles). Article types included review articles, clinical trials, and meta-analyses. Books, documents, and editorials were excluded. No filter was applied for species, language, gender, journal, age, or publication date. The flow chart of the study selection process was generated according to the PRISMA guidelines (Page *et al.*, 2021).

The information about citations, publications, authorship patterns, and keywords from the articles identified in PubMed was exported into MS Excel. The process was repeated by two authors independently, and then the results obtained were cross-checked to avoid any kind of subjective bias. Finally, network analysis and visualization were done with the help of the VOS viewer software (version 1.6.18) and Biblioshiny. Biblioshiny is a shiny app providing a web interface for bibliometrix- an R-tool for comprehensive science mapping analysis (Aria and Cuccurullo, 2017).

The following aspects were analyzed:

- (i) Publishing trends,
- (ii) the authors with the highest number of publications and their co-occurrence,
- (iii) the most commonly used keywords and their co-occurrence,
- (iv) the organizations with the highest number of publications related to nanotechnology in dentistry, and their co-occurrences

- (v) the countries with the highest number of publications related to nanotechnology in dentistry and their collaboration frequency
- (vi) most relevant journals in the field of nanotechnology in dentistry, and
- (vii) Average link strength between various authors, organizations, and keywords. The greater the link strength, the stronger the co-occurrence.

RESULTS

The initial search yielded 5,898 documents published between the years 1999 and 2022. After selecting the article type, 913 articles were left, of which 673 were reviews, 213 were clinical trials, 14 were systematic reviews, and 13 were meta-analyses (Fig. 1). The graph plotted between the number of publications and the year of publication shows the research pattern in the field of nanotechnology in dentistry (Fig. 2).

Publishing trend of articles

The first publication on the topic was published in the year 2000. Then, there was a slight increase in 2010, followed by a small reduction. Finally, a significant increase can be noticed in 2018, with 97 publications published. The maximum number of research papers ($N = 149$) was published in 2021.

Most relevant authors

This bibliometric analysis identified Tayebi L, Kim HW, Sharifi S, Maleki Dizaj S, and Mozafari M has been recognized as the most contributing authors in the field of nanotechnology in dentistry, with the number of publications ranging from 12 to 17 (Fig. 3).

A total of 4,127 authors were identified, of which 47 authors have more than five articles in the field of nanotechnology in dentistry. The average link of strength was 9.62, ranging from 0 to 70. Network analysis included 513 authors who had at least two publications. Figure 4 represents the largest connected network of 154 authors with 11 clusters and 693 links. The shorter the distance between circles representing authors, the stronger the link between them. The circle size represents the number of publications.

Analysis of organization

Articles had been written by authors belonging to 2,968 organizations/institutions or research centers. Only 11 organizations have more than five publications. The network analysis included 157 organizations with more than two publications. The most extensive set of related items comprised 68, including 8 clusters and 254 links (Fig. 5). The total link strength was found to be 342. The number of items in the collection ranges from 5 to 14. Out of 10 organizations with the highest co-occurrence, 5 are non-dental organizations (Table 1).

Analysis suggests that Tabriz University of medical sciences in Iran is the major contributor with the leading publication (16.3%), followed by Dankook University, University of Queensland, and Tehran University of Medical Sciences. The top five universities contribute 47.86% of total publications (Fig. 6).

Keywords analysis

The analysis yielded a list of 3,276 keywords, 343 (10.47%) of which co-occurred more than five times. 5 clusters

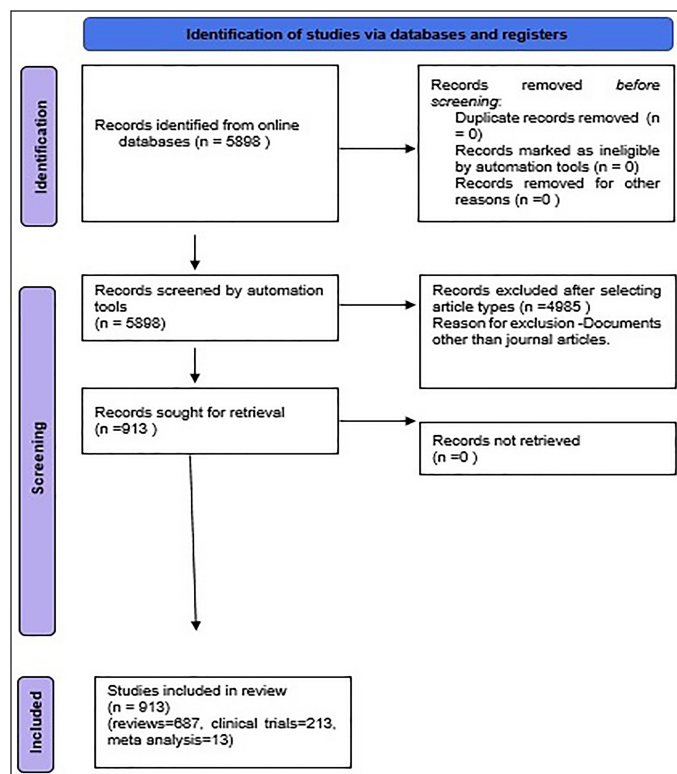


Figure 1. Flow chart – process of selection of studies.

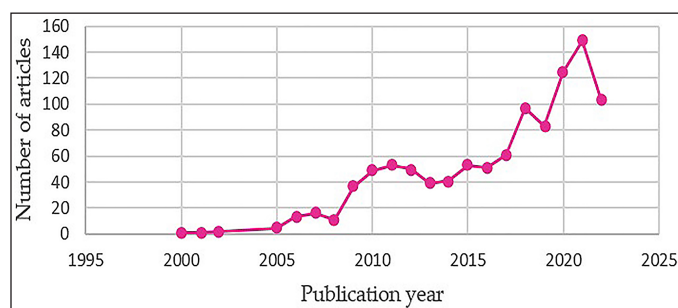


Figure 2. The research trend in the field of nanotechnology in dentistry.

were generated for 343 items (ranging from 20 to 174) with a total of 11,149 links and total link strength of 39,760. Keywords with the highest co-occurrences included non-specific terms, such as humans, animals, male, female, etc. The terms specific to the field and with the highest co-occurrence are nanoparticles, nanotechnology, surface properties, and nanostructures (Fig. 7).

Trend topic analysis and thematic evaluation

The trend topic analysis suggests an increase in the use of the term drug delivery system while a decrease in the use of the terms nanoparticles and polymers. The research trend shifted from dental materials to tissue engineering and drug delivery from 2006 to 2021. The analysis highlights that the most commonly used terms between 2009 and 2017 were chemical properties, surface properties, dental bonding agent, etc. In 2015, the term “dental caries prevention and control” was used frequently. From 2018 to 2022, the most common terms used were therapeutic uses, drug delivery system, implant, tissue engineering, and drug

carriers. Thus, research trends have shifted from the properties of nanomaterials to practical applications (Fig. 8).

The thematic evaluation graph shows how the themes have changed with progress in the past 22 years (Fig. 9).

Three field plot

The three-field plot analysis indicates that all leading countries contribute to human and animal studies, but human studies are more than animal studies. Most animal studies occur in Iran, China, and the USA. In Brazil, Italy, Saudi Arabia, Australia, India, and Canada, most studies are done on humans and very few on animals (Fig. 10).

In Brazil and Italy, the study population is mainly middle-aged. Brazil primarily contributes to the research on material testing, composite resin, and dental materials/chemistry. Research papers from China, Brazil, the USA, and Iran mainly use surface property.

Most of the articles from Iran are published in the International Journal of Nanomedicine. All the research papers from Australia are published in Nanomaterials, Materials, and the Journal of Dental Research. Most publications from the USA are in the Journal of Dental Research. Most of the research papers from Brazil are published in Clinical Oral Investigation and the Journal of Dentistry. In contrast, research papers from Italy are primarily published in nanomaterial and the International Journal of Molecular Sciences. The two journals – nanomaterials and International Journal of Nanomedicine, published research papers from India, Saudi Arabia, and Korea.

Most relevant sources

Nanomaterials have the highest number of publications (3.39%), followed by dental material: official publication of the Academy of Dental Materials (2.6%), Operative Dentistry (2.6%), International Journal of Molecular Sciences (2.4%), and Oral Clinical Investigations (2.3%). The 10 most relevant journals (Table 2) belong to the Q1 (6 journals) and Q2 (4 journals) categories and contribute 23.22% of the total publications selected for the analysis. Their H index ranges from 77 to 195 (According to Scopus).

Analysis of countries and their collaboration frequency

Iran is the most contributing country, followed by USA, Brazil, China, and India. Iran has an approximately equal percentage (50%) of single-country publications (SCP) and multiple-country publications (MCP), whereas Sweden is the country with only SCP (Fig. 11). In Saudi Arabia, there are more MCP than SCP. In most of the corresponding author's countries, SCP is more than MCP.

The country with the highest collaboration frequency is the USA; it collaborates with China, Italy, Brazil, and India. The highest frequency of collaboration is between Iran and USA. Iran also collaborates with Italy with a collaboration frequency of 18. India collaborates with Saudi Arabia and Malaysia. Another partnership with high frequency can be seen between China, Australia, and Italy (Table 3).

DISCUSSION

The publishing trend of nanotechnology applications in dentistry has grown gradually since 2010, and exponential growth

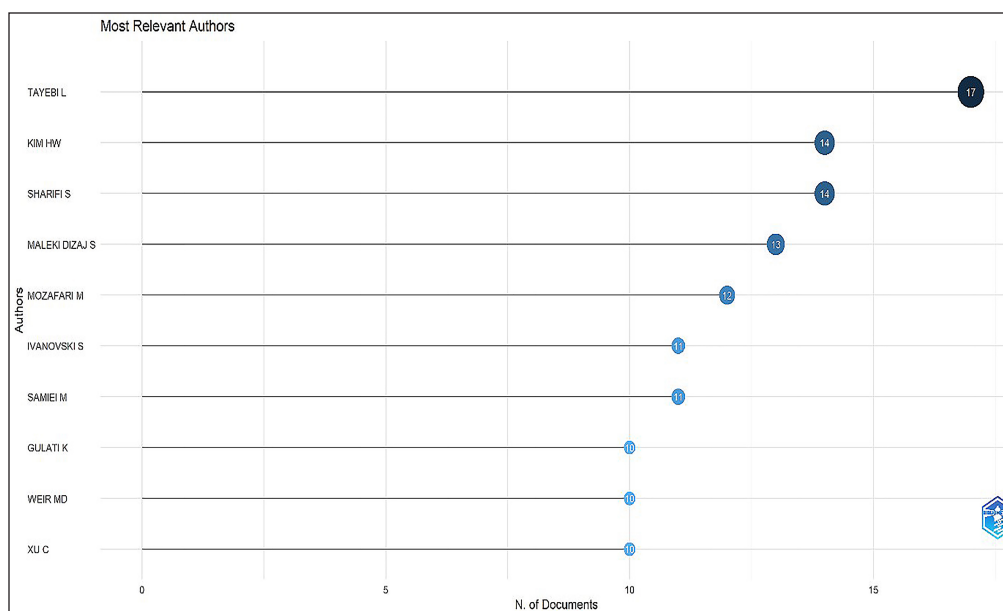


Figure 3. Most contributing authors in the field of nanotechnology in dentistry.

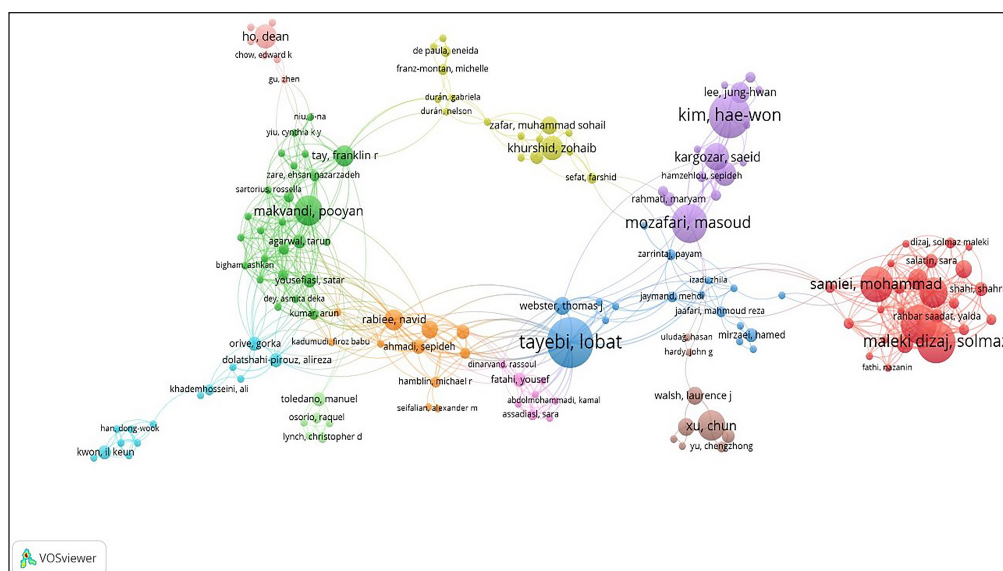


Figure 4. The total strength of co-authorship links in the field of nanodentistry. All authors from the same cluster are shown with the same color. The circle size represents the number of publications. The link color is consistent with the color of their source clusters.

occurred after 2017. The maximum number of research papers were published in the year 2021. A slight drop in publications can be observed in 2019, which may be attributed to the COVID-19 pandemic (Fig. 2).

The trend-topic analysis indicates that initially, research was focused on chemical properties, surface properties, and effects on dental materials. In contrast, research is now focused more on practical applications such as tissue engineering, drug delivery system, biocompatible implant materials, and drug carriers.

Nanotechnology is a rapidly growing field that significantly contributes to many areas of medicine, including dentistry. Nanotechnology is being used to develop new dental

materials that are stronger, more durable, and more resistant to wear and tear. Nanoparticles can be designed to deliver drugs directly to the site of oral infection (Lal *et al.*, 2021). This approach minimizes the exposure of healthy tissue to drugs and reduces the risk of side effects. Nanotechnology is being used to improve the design and function of dental implants. Nanoscale coatings can be applied to implant surfaces to enhance the integration of the implant with the surrounding bone tissue, reducing the risk of implant failure (Parnia *et al.*, 2017).

It is a rapidly growing field that deals with the design, production, and application of materials and devices on a nanoscale level. In recent years, there has been an increasing interest in

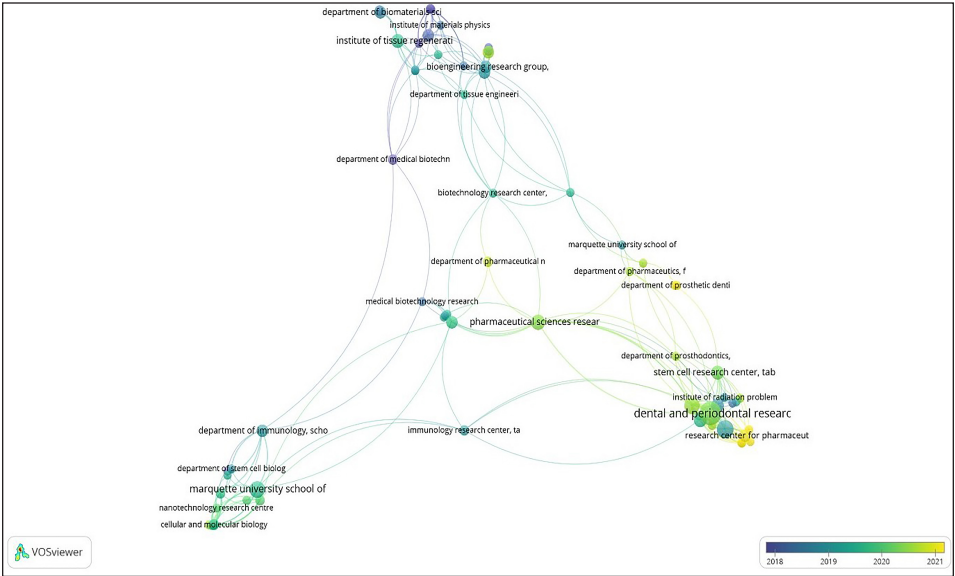


Figure 5. Overlay visualization of organizations related to the research in nanodentistry. The circle size represents the number of publications. The link color is consistent with the color of their related organization.

Table 1. Co-occurrence of organizations related to the field of nanodentistry.

S. NO.	ORGANIZATION	DOCUMENTS	TOTAL LINK STRENGTHH
1	The Dental and Periodontal Research Center, Tabriz University of Medical Sciences, Iran	14	46
2	Department of Veterinary Science and Research Branch, Islamic Azad University, Tehran, Iran	8	28
3	Faculty of Dentistry, Tabriz University of Medical Sciences, Iran	8	20
4	Research Center for the Prevention of Oral and Dental Diseases, Baqiyatallah University of Medical Sciences, Tehran, Iran	8	28
5	The Kidney Research Center, Tabriz University of Medical Sciences, Iran	7	30
6	Marquette University School of Dentistry, Milwaukee, USA	7	17
7	The Pharmaceutical Sciences Research Center, Health Institute, Kermanshah University of Medical Sciences, Iran	6	18
8	Department of Endodontics, Faculty of Dentistry, Tabriz University of Medical Sciences, Tabriz, Iran	5	16
9	Institute of Tissue Regeneration Engineering, Dankook University, Cheonan, Republic of Korea	5	14
10	Stem Cell Research Center, Tabriz University of Medical Sciences, Iran	5	16

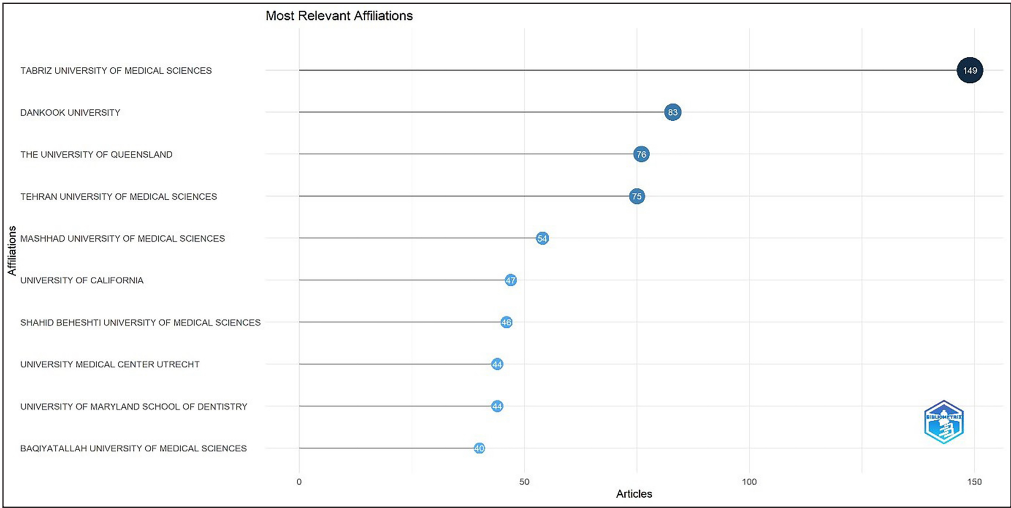


Figure 6. Most contributing universities in the field of nanodentistry.

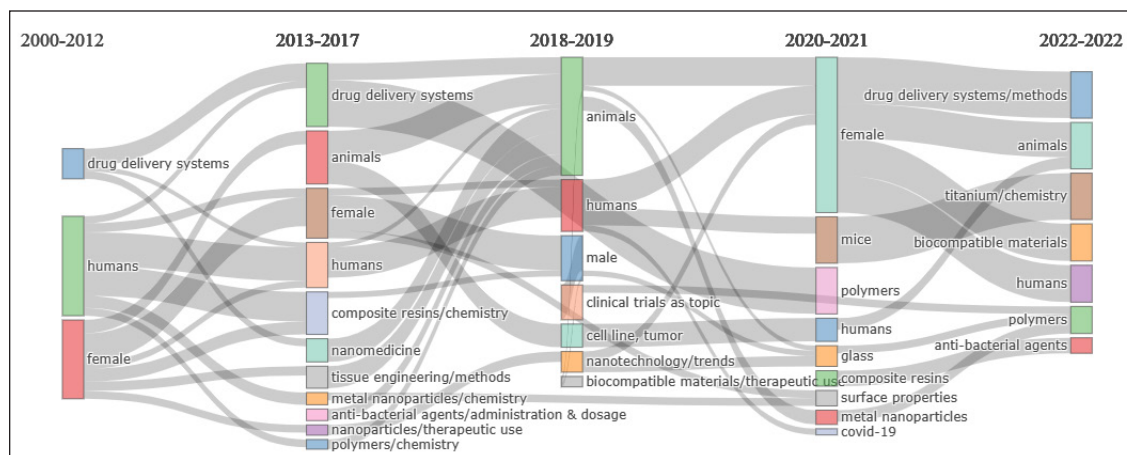


Figure 9. Thematic evolution analysis (by Biblioshiny). It identifies changes in terminology and evolution in study themes related to nanodentistry.

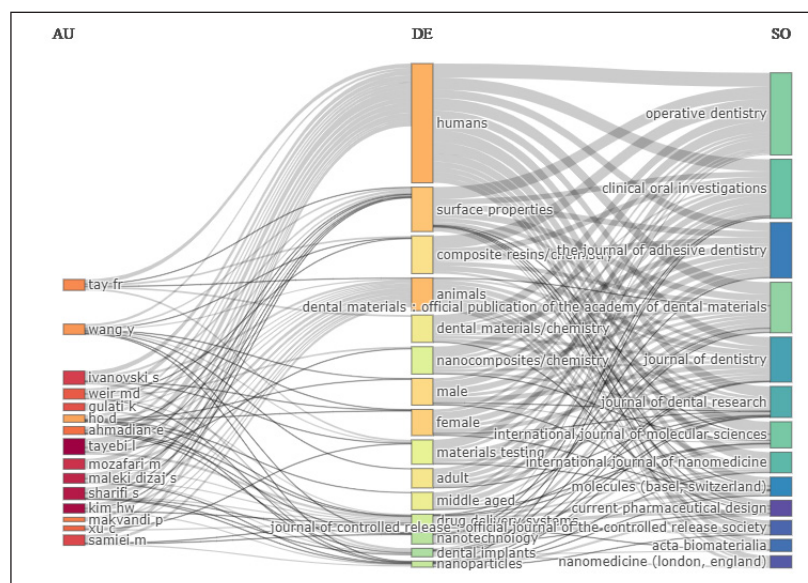


Figure 10. Three field plots, AU = Author's country, DE = keywords, SO = Source (parameters selected—AU = 15, DE = 15, and sources = 15). It represents the interrelations between various countries, sources of scientific articles and keywords.

of Silver diamine fluoride (SDF) use in dentistry are the United States of America, Hong Kong, and Japan (Qasim *et al.*, 2021).

The maximum bibliographic coupling was found among authors from various academic institutions in Hong Kong in SDF research (Qasim *et al.*, 2021). In our study, the highest collaboration frequency is identified between Iran and the United States of America.

SDF and dental caries have been the most frequently used term during the last decade (Qasim *et al.*, 2021). The latest terms indicated in the electrospun nanofibers research are bone regeneration, tissue regeneration, cell differentiation and proliferation, and drug delivery. Most studies have focused on periodontal regeneration (Jin *et al.*, 2018). According to our analysis, the most frequently used keywords are human, nanoparticles, animal, surface properties, nanotechnology, and nanostructures.

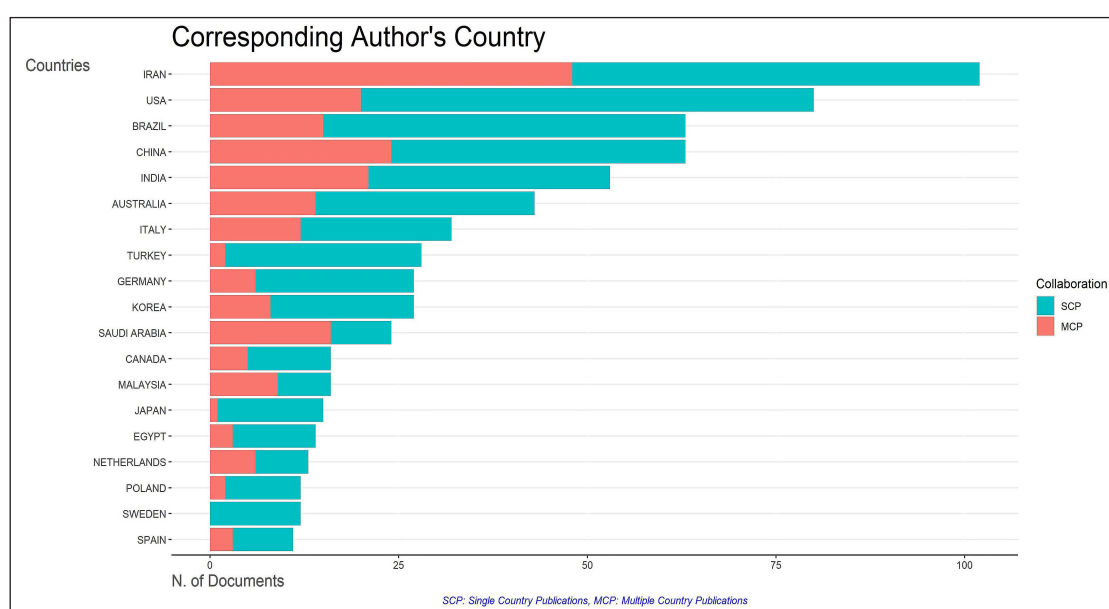
The keywords indicate the areas of research in various subbranches of nanotechnology. According to the study done

on nanomedicine, in the past 3–4 years, drug delivery system has become a primary focus area of research in nanomedicine. Another study identified nanoparticles and drug delivery as hot research topics and identified the USA, China, and India as countries with the highest co-occurrence frequency (Zhang *et al.*, 2022). A similar finding is observed in our study too. According to our network analysis, the nanoparticle is the keyword specific to the field with the highest co-occurrence.

A bibliometric analysis of nanomedicine first identified the USA as a significant contributor country and the International Journal of Nanomedicine as a major contributor journal in the field (Bragazzi, 2019). In addition, the International Journal of Nanomedicine has been identified as a significant contribution to nanomedicine applications in head and neck squamous cell carcinoma (Gao *et al.*, 2021). Our analysis identified nanomaterials as the most relevant source with 31 publications.

Table 2. Number of publications in leading journals in nanodentistry.

Name of journals	Number of publications	H-index
Nanomaterials (Basel, Switzerland)	31	77
Dental Materials: Official Publication of the Academy of Dental Materials	24	159
Operative Dentistry	24	86
International Journal of Molecular Sciences	22	195
Clinical Oral Investigations	21	88
International Journal of Nanomedicine	20	145
Journal of Dental Research	18	192
Journal of Dentistry	18	124
Materials (Basel, Switzerland)	18	128
Molecules (Basel, Switzerland)	16	177

**Figure 11.** Number of documents published in collaboration with leading countries in nanodentistry.**Table 3.** Frequency of collaboration between various countries in research in the field of nanodentistry.

From	To	Frequency of collaboration
Iran	USA	34
USA	China	27
India	Saudi Arabia	21
Iran	Italy	18
USA	Italy	18
USA	Brazil	16
USA	India	15
India	Malaysia	12
China	Australia	11
China	Italy	11

The differences in results of various published studies can be because these studies are limited to only one aspect of nanotechnology in dentistry. In contrast, our study provides a broader picture of the field.

The study's main limitation is that the conclusion is based on the data obtained from only one database. Another limitation is that the investigation is quantitative, and the quality of individual papers was not analyzed. Regardless of these limitations, this study could aid in identifying research patterns and trends. Also, it would help identify the leading researchers and organizations for budding researchers.

CONCLUSION

The analysis provides valuable information on the total number of publications on nanotechnology in dentistry from 1999 to 2022. It has shown a gradual increase in publishing trends on the topic with an upsurge after 2010. Trend analysis shows that the research in nanodentistry has focused more on drug delivery systems and tissue engineering in the past few years. Iran and USA have been identified as the most productive country, and "Nanomaterials" is the journal with the highest number of publications in nanodentistry. The analysis has also identified the leading researchers, organizations, and related research trends.

Overall, nanotechnology has the potential to significantly improve the diagnosis and treatment of dental diseases, as well

as the design and function of dental materials and implants. However, more research is needed to fully realize the potential of nanotechnology in dentistry and to address any potential safety concerns associated with these new technologies.

KEY FINDINGS

The publishing trend of nanotechnology applications in dentistry has grown gradually since 2010, and exponential growth occurred after 2017. The maximum number of research papers were published in the year 2021. A slight drop in publications can be observed in 2019, which may be attributed to the COVID-19 pandemic (Fig. 2). The analysis identified Iran as the most productive country in this field. The most frequently used keywords are human, nanoparticles, animal, surface properties, nanotechnology, nanostructures, etc. The most relevant source is nanomaterials, with 31 publications. According to the analysis, the nanoparticle is the keyword specific to the field with the highest co-occurrence. Tayebi L, Kim HW, and Sharifi S are identified as prominent contributing authors here. Tabriz University of medical sciences (Iran) is recognized as a top contributor with 149 publications. Collaboration frequency is highest between Iran and the United States of America. Research trends have shifted from the chemical properties of nanomaterials to practical applications such as tissue engineering and drug delivery system.

AUTHOR CONTRIBUTIONS

All authors made substantial contributions to the conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agreed to be accountable for all aspects of the work. All the authors are eligible to be an author as per the international committee of medical journal editors (ICMJE) requirements/guidelines.

FINANCIAL SUPPORT

There is no funding to report.

CONFLICTS OF INTEREST

The authors declared no conflict of interest.

ETHICAL APPROVALS

This study does not involve experiments on animals or human subjects.

DATA AVAILABILITY

All the data is available with the authors and shall be provided upon request.

PUBLISHER'S NOTE

This journal remains neutral with regard to jurisdictional claims in published institutional affiliation.

REFERENCES

- Aria M, Cuccurullo C. Bibliometrix: an R-tool for comprehensive science mapping analysis. *J Informetr*, 2017; 11(4):959–75.
- Bragazzi NL. Nanomedicine: insights from a bibliometrics-based analysis of emerging publishing and research trends. *Medicina*, 2019; 55(12):785; Doi:10.3390/medicina55120785

- Freitas RA. Nanodentistry. *J Am Dent Assoc*, 2000; 131(11):1559–65; doi: 10.14219/jada.archive.2000.0084
- Gao X, Wang S, Tian Z, Wu Y, Liu W. A bibliometric analysis on studies of nanomedicine applications in head and neck squamous cell carcinoma. *Transl Cancer Res*, 2021; 10(1):251–60; doi: 10.21037/tcr-20-2852
- Jin C, Wang K, Oppong-Gyebi A, Hu J. Application of nanotechnology in cancer diagnosis and therapy—a mini-review. *Int J Med Sci*, 2020; 17(18):2964–73; doi: 10.7150/ijms.49801
- Jin S, Xin B, Zheng Y, Liu S. Effect of electric field on the directly electrospun nanofiber yarns: simulation and experimental study. *Fibers Polym*, 2018; 19:116–24; doi:10.1007/s12221-018-7734-2
- Khoobchandani M, Khan A, Katti KK, Thiye VC, Al-Yasiri AY, MohanDoss DKD, Nicholl MB, Lugão AB, Hans CP, Katti KV. Green nanotechnology of MGF-AuNPs for immunomodulatory intervention in prostate cancer therapy. *Sci Rep*, 2021; 11(1):16797; doi: 10.1038/s41598-021-96224-8
- Laird NZ, Aciri TM, Chakka JL, Quarterman JC, Malkawi WI, Elangovan S, Salem AK. Applications of nanotechnology in 3D printed tissue engineering scaffolds. *Eur J Pharm Biopharm*, 2021; 161:15–28; doi: 10.1016/j.ejpb.2021.01.018
- Lal A, Alam MK, Ahmed N, Maqsood A, Al-Qaisi RK, Shrivastava D, Alkhalaf ZA, Alanazi AM, Alshubrmi HR, Sghaireen MG, Srivastava KC. Nano drug delivery platforms for dental application: infection control and TMJ management-a review. *Polymers (Basel)*, 2021; 13(23):4175; doi: 10.3390/polym13234175
- Liang Y, Liao S, Zhang X. A bibliometric analysis of reactive oxygen species based nanotechnology for cardiovascular diseases. *Front Cardiovasc Med*, 2022; 9:940769; doi: 10.3389/fcvm.2022.940769
- 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. *BMJ*, 2021; 372:n71; doi: 10.1136/bmj.n71
- Parnia F, Yazdani J, Javaherzadeh V, Maleki Dizaj S. Overview of nanoparticle coating of dental implants for enhanced osseointegration and antimicrobial purposes. *J Pharm Pharm Sci*, 2017; 20(0):148–60; doi: 10.18433/J3GP6G
- Qasim SSB, Ali D, Khan AS, Rehman SU, Iqbal A, Baskaradoss JK. Evidence-based bibliometric analysis of research on silver diamine fluoride use in dentistry. *Biomed Res Int*, 2021; 2021:9917408; doi: 10.1155/2021/9917408
- Sil BK, Jamiruddin MR, Haq MA, Khondoker MU, Jahan N, Khandker SS, Ali T, Oishee MJ, Kaitsuka T, Mie M, Tomizawa K, Kobatake E, Haque M, Adnan N. AuNP coupled rapid flow-through dot-blot immunoassay for enhanced detection of SARS-CoV-2 specific nucleocapsid and receptor binding domain IgG. *Int J Nanomed*, 2021; 16:4739–53; doi: 10.2147/IJN.S313140
- Sreenivasalu PKP, Dora CP, Swami R, Jasthi VC, Shiroorkar PN, Nagaraja S, Asdaq SMB, Anwer MK. Nanomaterials in dentistry: current applications and future scope. *Nanomaterials (Basel)*, 2022; 12(10):1676; doi: 10.3390/nano12101676
- Zhang X, Guo M, Huang Z, Huang Y, Wu C, Xin X. Mapping the intersection of nanotechnology and SARS-CoV-2/COVID-19: a bibliometric analysis. *Infect Med*, 2022; 1(2):103–12; doi:10.1016/j.imj.2022.06.005

How to cite this article:

Patel B, Dagli N, Dagli R, Adnan N, Ahmad R, Haque M, Kumar S. Bibliometric analysis and visualization of research on nanotechnology in dentistry from 1999 to 2022. *J Appl Pharm Sci*, 2023; 13(09):058–066.