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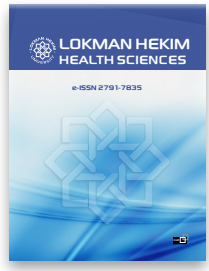

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ORIGINAL ARTICLE

Bibliometric Trends of Artificial Intelligence Applications in Pediatric Dentistry: A Scopus and Web of Science Analysis (2000–2024)

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Abstract

Introduction: Artificial intelligence (AI) has gained increasing attention in dentistry, particularly in diagnostic imaging, caries detection, and orthodontic prediction. However, pediatric applications remain underexplored, and no bibliometric synthesis has specifically mapped this research field.

Methods: A bibliometric analysis was performed using Scopus and Web of Science Core Collection (2000–2024). Search terms included "artificial intelligence," "machine learning," "deep learning," and "pediatric dentistry." Bibliographic data were analyzed using VOSviewer (v.1.6.20) and Microsoft Excel, focusing on co-authorship networks (authors and countries), keyword co-occurrence networks, citation and co-citation analyses, and bibliographic coupling of publications.

Results: A total of 92 publications were identified (Scopus: 53; WoS: 39). Annual outputs increased sharply after 2020, peaking in 2024. India, Turkey, and the United States were the most productive countries, while collaborations across regions remained limited. Keyword clustering revealed three thematic areas: (i) AI-driven diagnostics, (ii) caries risk prediction, and (iii) orthodontic growth assessment. Preventive and behavioral domains were notably underrepresented.

Discussion and Conclusion: Research on AI in pediatric dentistry is rapidly growing but remains diagnostically focused. This study provides the first pediatric dentistry-focused bibliometric overview of AI research, explicitly mapping publication trends, thematic concentrations, and underexplored preventive and behavioral domains. Future research should extend beyond diagnostics, strengthen international collaboration, and address ethical considerations to support responsible clinical integration.

Keywords: Artificial intelligence; Behavior management; Bibliometric analysis; Diagnostic imaging; Pediatric dentistry

Artificial intelligence (AI) has rapidly transformed the landscape of healthcare research and clinical practice, offering novel opportunities for diagnostics, decision support, and personalized treatment planning. In dentistry, AI-based technologies such as machine learning and deep learning have been increasingly employed for diagnostic imaging, caries detection, treatment planning, and risk prediction.[1–3] These advancements hold particular promise in pediatric dentistry, where early diagnosis and intervention are critical to long-term oral health outcomes.[4,5]

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Within pediatric dentistry, the integration of AI has gained momentum in domains such as caries risk assessment, orthodontic growth prediction, pulp therapy decision-making, and behavior management strategies.[6,7] For example, deep learning algorithms have demonstrated superior accuracy in detecting dental caries and anomalies in panoramic radiographs, often surpassing conventional diagnostic approaches.[8] Similarly, machine learning models have been applied to predict treatment outcomes in interceptive orthodontics and evaluate craniofacial growth, offering pediatric dentists evidence-based decision support tools.[9] Beyond diagnostic accuracy, these applications also hold clinical relevance for preventive strategies and behavior management in pediatric dentistry, where early risk identification and child-centered care are essential components of long-term oral health outcomes. For instance, AI-supported tools that assist in anticipating dental anxiety or tailoring communication strategies may improve patient cooperation during clinical procedures, thereby facilitating more effective and less stressful dental care for children.

Despite the rapid growth of AI-related research in dentistry, pediatric-focused applications remain relatively limited compared to other dental specialties such as orthodontics, prosthodontics, or maxillofacial radiology.[10,11]

Furthermore, the distribution of research productivity appears uneven across regions, with countries such as the United States, China, and India leading in AI innovation, while contributions from developing nations remain sparse.[12,13]

These disparities underscore the need to systematically map the global research landscape to identify key contributors, thematic foci, and emerging trends. Bibliometric analysis provides a robust methodological framework for evaluating research trends, citation impact, and collaboration patterns in a given field.[14,15] By quantifying publication output, analyzing co-authorship and country networks, and visualizing keyword co-occurrence, bibliometric studies allow researchers to understand how a topic evolves and where potential research gaps exist.[16]

Previous bibliometric studies in dentistry have mapped AI research in endodontics, implantology, and general oral health, but none have comprehensively evaluated pediatric dentistry.[7–9] The absence of a focused bibliometric synthesis makes it unclear which countries, authors, or themes are leading the field and where research gaps exist.

Therefore, this study aims to systematically map AI research in pediatric dentistry by analyzing publications indexed in Scopus and Web of Science between 2000 and 2024. Specifically, we assess (i) Publication and citation trends, (ii) leading authors and countries, (iii) thematic clusters of research through keyword analysis, and (iv) collaboration networks.

Materials and Methods

Study Design and Data Sources

This study was designed as a bibliometric analysis to systematically map research trends related to AI applications in pediatric dentistry. Two major bibliographic databases, Scopus and the Web of Science Core Collection, were selected due to their extensive coverage of high-quality, peer-reviewed literature and their widespread use in bibliometric research.

Search Strategy

A comprehensive and reproducible literature search was conducted on May 25, 2025, to identify studies related to AI applications in pediatric dentistry. The search strategy was developed using a combination of relevant keywords and Boolean operators to ensure adequate coverage of the literature.

The complete search queries used in each database were as follows:

- Scopus: (TITLE-ABS-KEY (“artificial intelligence” OR “machine learning” OR “deep learning”)) AND (TITLE-ABS-KEY(“pediatric dentistry” OR “pedodontics”)) AND PUBYEAR > 1999 AND PUBYEAR < 2025
- Web of Science Core Collection: TS=(“artificial intelligence” OR “machine learning” OR “deep learning”) AND TS=(“pediatric dentistry” OR “pedodontics”) AND PY=(2000–2024)

The search strategy incorporated Boolean operators (“AND”, “OR”) to combine AI-related and pediatric dentistry–related terms. No restrictions were applied regarding language or document type to maximize the comprehensiveness of the dataset.

Data Extraction and Preprocessing

The initial search retrieved 92 records (Scopus: 53; Web of Science: 39). Records retrieved from both databases were merged, and duplicate entries were manually identified and removed based on comparison of titles, author names, and digital object identifiers (DOIs).

Bibliographic information, including authors, affiliations, titles, abstracts, keywords, source titles, publication years, and citation counts, was exported in CSV format. Before

analysis, data cleaning and harmonization procedures were performed to standardize author names and keywords, thereby minimizing inconsistencies that could affect network visualization and interpretation.

Duplicate records retrieved from both databases were identified and removed manually based on comparison of titles, author names, and DOIs. No automated deduplication software was used. Although the exact number of duplicate records was not recorded, the process was conducted carefully to ensure data accuracy.

Bibliometric Analysis

Quantitative bibliometric analyses were conducted using VOSviewer software (version 1.6.20) and Microsoft Excel. The following bibliometric indicators and networks were examined:

- Co-authorship networks (authors and countries)
- Keyword co-occurrence networks
- Citation and co-citation networks
- Bibliographic coupling of publications.

Minimum inclusion thresholds were applied to improve the interpretability of the visualizations: authors with ≥2 publications and ≥20 citations; countries with ≥3 publications and ≥10 citations; keywords with ≥3 occurrences; and journals with ≥3 publications. For each analysis, only the largest connected components were visualized to enhance clarity and reduce network fragmentation.

All results were generated using the full counting method, whereby each author, country, or keyword occurrence was counted equally across publications. This approach was selected to facilitate transparent comparison of productivity, collaboration patterns, and thematic structures within the bibliometric networks.

Ethical Considerations

As this study relied exclusively on publicly available bibliographic metadata and did not involve human or animal participants, ethical approval was not required.

Results

This bibliometric analysis included a total of 92 publications (Scopus: 53; Web of Science: 39) focusing on the intersection of AI, machine learning, and pediatric dentistry between 2000 and 2024. The analysis covered publication output over time, country, and author productivity, collaboration patterns, keyword co-occurrence, and citation-based relationships.

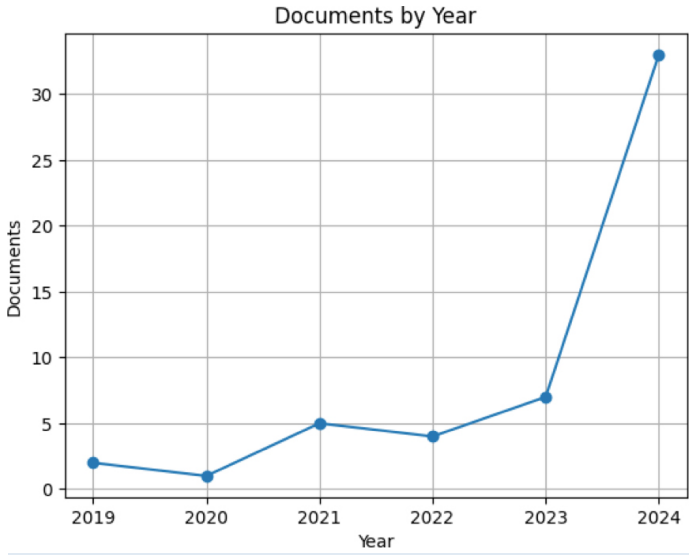

Figure 1. Annual distribution of publications on artificial intelligence in pediatric dentistry based on Scopus data (2019–2024). Data were retrieved from Scopus and the figure was generated by the author.

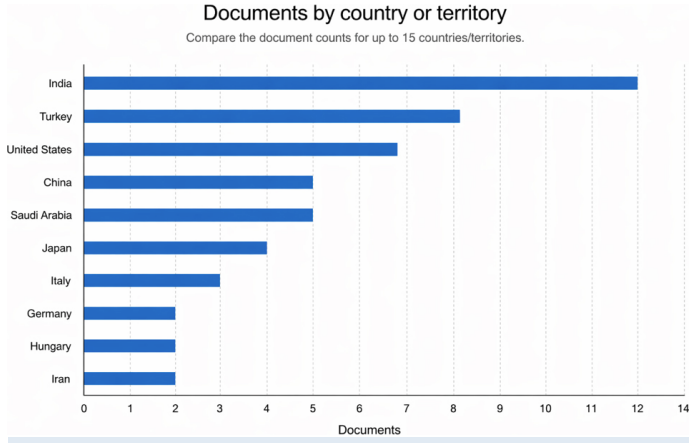

Figure 2. Distribution of publications on artificial intelligence in pediatric dentistry by country based on Scopus data. Data were retrieved from the Scopus database and the figure was generated by the author.

Publication Trends

The temporal distribution of publications showed an increase in scientific output after 2021, with a peak in 2024 (Fig. 1). Fewer than ten publications per year were identified before 2022, whereas more than thirty publications were recorded in 2024. Citation counts increased over the same period.

Geographical Distribution

Analysis of country-level contributions showed that India (n=13), Turkey (n=9), and the United States (n=7) were the most productive countries within the Scopus dataset (Fig. 2). Additional contributions were observed from China (n=5), Saudi Arabia (n=5), Japan (n=4), and several

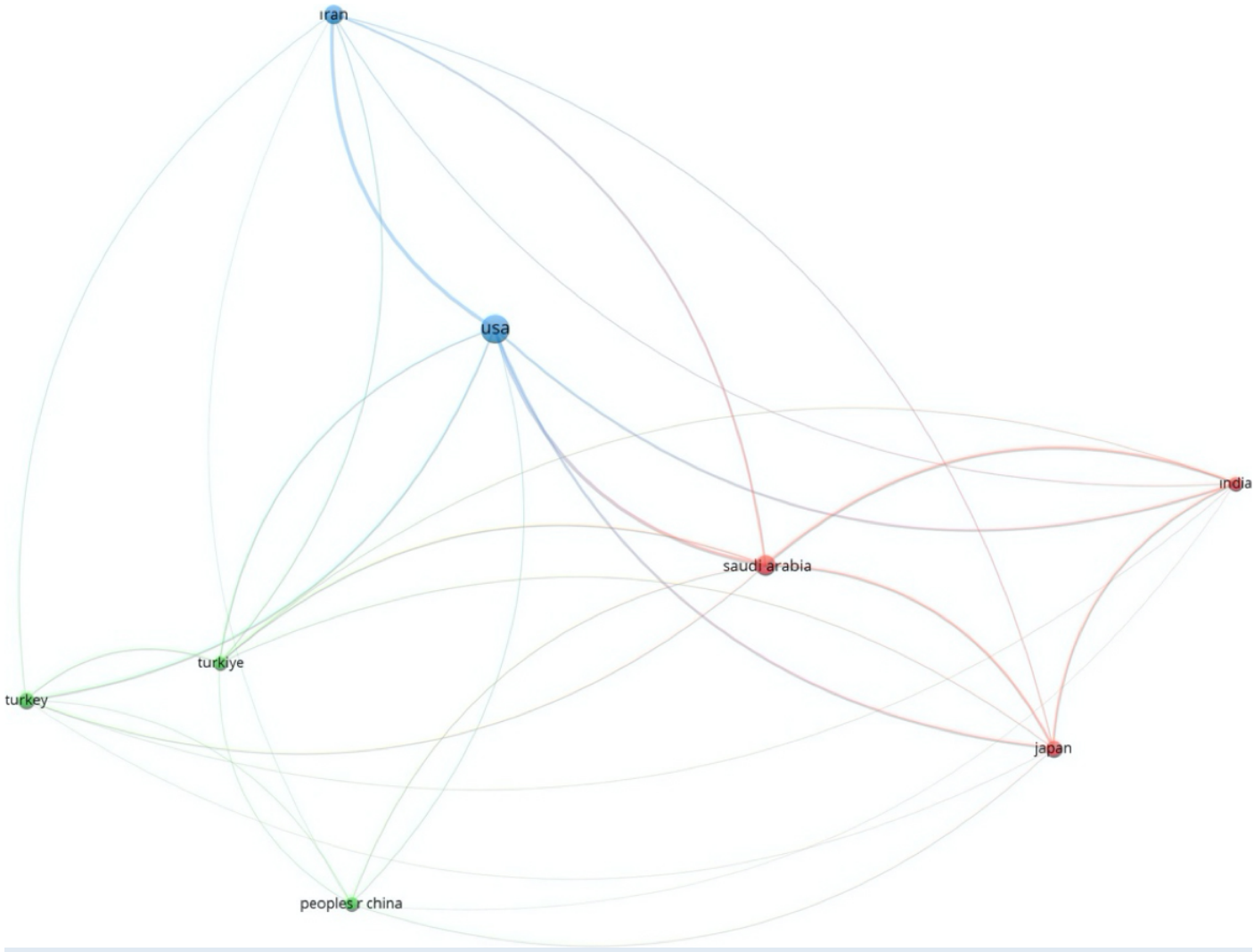

Figure 3. Network visualization of international collaboration among countries in artificial intelligence research in pediatric dentistry. The visualization was generated using VOSviewer software based on bibliometric data retrieved from the Scopus database.

European countries including Italy (n=3), Germany (n=2), and Hungary (n=2). Iran accounted for two publications during the study period. Data derived from the Web of Science database showed a similar distribution.

Bibliometric coupling of countries is presented in Figure 3. The mapping included multiple clusters. India, Turkey, and the United States were among the most connected countries. China, Saudi Arabia, and Japan were also represented within separate clusters.

Authorship and Collaboration Networks

The co-authorship analysis revealed a relatively limited and fragmented collaboration structure within the field. The network consisted of a small number of interconnected clusters, indicating that research activity was concentrated among a restricted group of contributors. Overlay visualization suggested that collaborative publications became more prominent during the 2021–2023 period. Overall, the network demonstrated moderate collaboration intensity with limited large-scale international connectivity (Fig. 4).

Keyword Co-occurrence and Thematic Clusters

Keyword analysis (Fig. 5) identified "artificial intelligence," "machine learning," "deep learning," "pediatric dentistry," and "dental caries" as the most frequently occurring terms. These keywords were grouped into three clusters: (i) Diagnostic imaging and predictive modeling, (ii) Caries detection and risk assessment, and (iii) Orthodontic growth and development.

Citation and Bibliographic Coupling Networks

Citation network analysis demonstrated the presence of

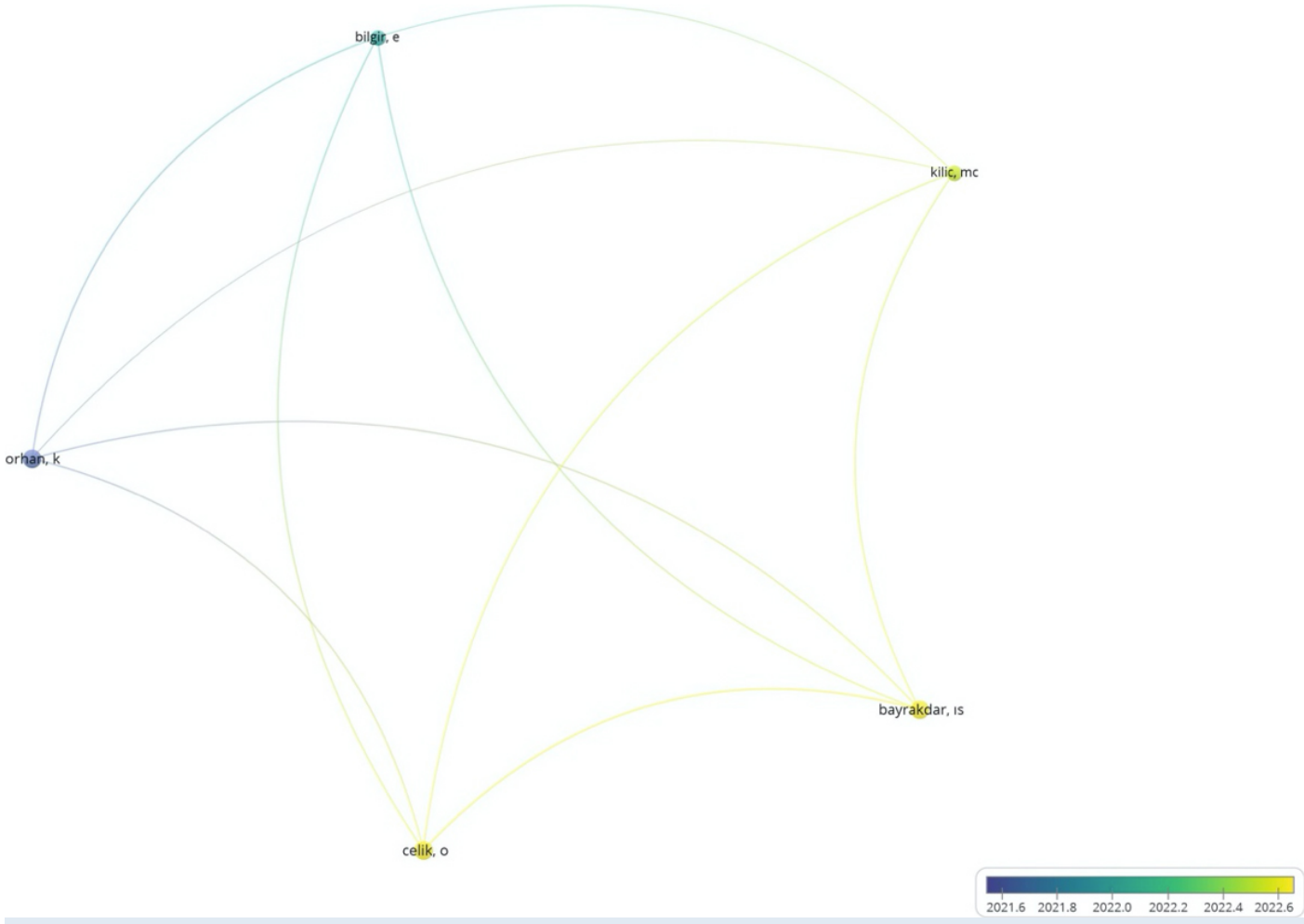

Figure 4. Overlay visualization of author collaboration in artificial intelligence research in pediatric dentistry. The visualization was generated using VOSviewer software based on bibliometric data retrieved from the Scopus database.

several interconnected clusters representing influential studies within the field. Larger nodes and stronger link strengths indicated that certain publications served as central reference points in the development of AI-related pediatric dentistry research. In addition, more recent studies appeared to contribute to the expansion and diversification of thematic research areas. Bibliographic coupling analysis further revealed shared intellectual foundations among publications and highlighted emerging research connections across diagnostic, predictive, and clinical application domains (Fig. 6).

Discussion

This bibliometric study provides a pediatric dentistry-focused synthesis of research on AI, offering a structured overview of publication trends, thematic orientations, and collaboration patterns within this emerging field. The findings demonstrate a clear increase in AI-related publications after 2020, particularly during 2023 and 2024, consistent with the broader expansion of AI research across healthcare disciplines.[12,13] Despite this quantitative growth, the existing literature remains largely concentrated on diagnostic applications, indicating that AI integration in pediatric dentistry is still in an early stage of development.

At the global level, India, Turkey, and the United States emerged as the most productive contributors, consistent with previous bibliometric analyses in dentistry and pediatric research.[16–19] Earlier studies have emphasized the predominance of observational and diagnostically oriented research designs in pediatric dental journals.[19] The present findings align with this pattern, highlighting a relatively limited number of experimental or clinically interventional studies, which may constrain the translation of AI technologies into routine pediatric dental practice.

Authorship and collaboration analyses further revealed that scientific output is concentrated among a relatively

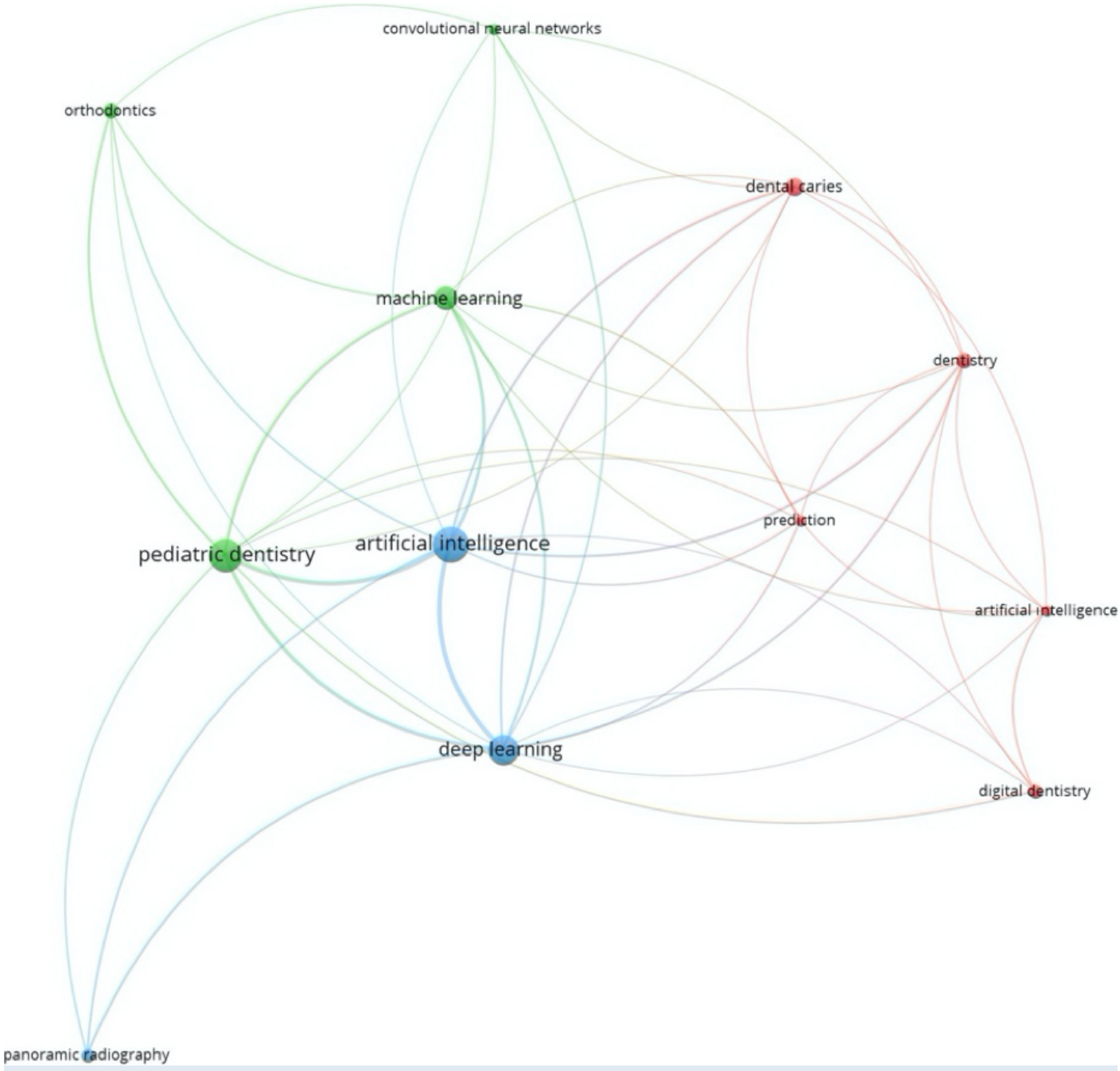

Figure 5. Network visualization of keyword co-occurrence in artificial intelligence research in pediatric dentistry. The network was generated using VOSviewer software based on bibliometric data retrieved from the Scopus database.

small number of researchers and research groups. Similar patterns have been reported in bibliometric studies of AI applications in endodontics and implantology, where early growth phases are characterized by fragmented collaboration networks and a predominance of methodological or review-based publications.[17,18] These findings suggest that AI research in pediatric dentistry is still consolidating its intellectual and collaborative structure.

Thematic analysis based on keyword co-occurrence demonstrated a strong emphasis on diagnostic imaging, caries detection, and orthodontic growth assessment. In contrast, topics related to preventive dentistry, behavior management, and patient-reported outcomes were comparatively underrepresented. This imbalance is particularly important given the central role of prevention and behavior guidance in pediatric dental care. Previous bibliometric research has highlighted increasing interest in non-pharmacological behavior management approaches,

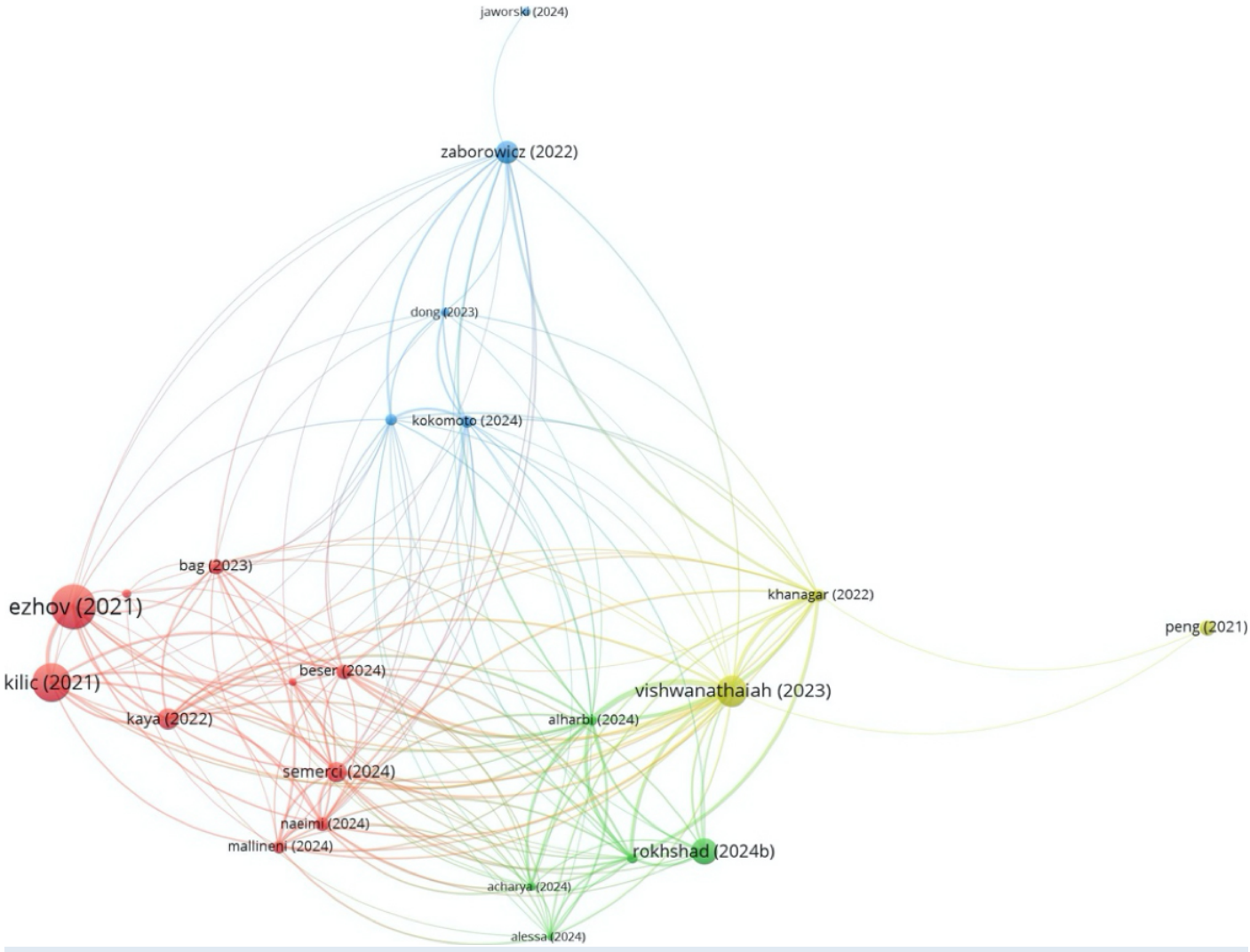

Figure 6. Network visualization of author relationships in artificial intelligence research in pediatric dentistry. The network was generated using VOSviewer software based on bibliometric data retrieved from the Scopus database.

including virtual reality and digital distraction techniques.[19] The limited representation of such themes in AI-focused pediatric dental research indicates important opportunities for future investigations.

From a clinical perspective, AI applications in pediatric dentistry have the potential to extend beyond diagnostic support toward improving behavioral management, early risk prediction, and personalized preventive strategies. AI-assisted tools may contribute to identifying dental anxiety, optimizing communication approaches, and enhancing patient cooperation during clinical procedures.[20,21] However, the implementation of such technologies in pediatric settings should remain clinician-guided and ethically grounded, with particular attention to transparency, data security, and the protection of children's rights.

From a national perspective, Türkiye has emerged as a notable contributor to AI research in pediatric dentistry, particularly in diagnostic imaging and radiographic analysis.[7,8,20–23] Nevertheless, the relatively limited extent of international collaboration observed in this study is consistent with findings from broader AI bibliometric analyses in healthcare.[13] Strengthening cross-regional and interdisciplinary collaborations may therefore be essential to improving methodological rigor, increasing data diversity, and enhancing the clinical applicability of AI-based approaches.

Citation and bibliographic coupling analyses highlighted the continued influence of early foundational studies alongside the emergence of more recent publications forming distinct research fronts.[24–27] This pattern reflects the gradual consolidation of AI research in pediatric

dentistry while also indicating a relatively narrow base of highly influential studies compared with more established AI domains in dentistry. In addition, the relatively limited number of publications identified in this study may reflect both the emerging nature of AI applications in pediatric dentistry and the specificity of the search strategy.

The strengths of this study include its systematic bibliometric design and the combined use of two major international databases. Nevertheless, several limitations should be acknowledged. Limitations related to database selection, language bias, and the dynamic nature of citation metrics may have influenced the results. In addition, the search strategy was restricted to selected AI-related terms such as "artificial intelligence," "machine learning," and "deep learning." Although these terms capture a substantial portion of the literature, additional keywords such as "neural networks", "computer vision," or "AI-assisted diagnosis" were not included, and some relevant studies may therefore have been missed.

Future bibliometric analyses may benefit from a broader and more inclusive search strategy. Furthermore, future research should prioritize preventive and behavioral applications, incorporate ethical considerations such as transparency and data privacy, and promote collaborative, clinically oriented study designs. Addressing these aspects may facilitate a more balanced, responsible, and patient-centered integration of AI technologies into pediatric dental practice.

Conclusion

This bibliometric analysis demonstrates that research on AI in pediatric dentistry has grown rapidly in recent years, led primarily by contributions from India, Turkey, and the United States. The literature remains predominantly focused on diagnostic applications, whereas preventive and behavioral domains continue to be comparatively underrepresented. Addressing these gaps through clinically validated, ethically informed, and interdisciplinary research efforts may facilitate a more balanced integration of AI into pediatric dental practice and support the development of evidence-based clinical and educational frameworks.

Ethics Committee Approval: As this study relied exclusively on publicly available bibliographic metadata and did not involve human or animal participants, ethical approval was not required.

Conflict of Interest: None declared.

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References

1. Schwendicke F, Samek W, Krois J. Artificial intelligence in dentistry: chances and challenges. J Dent Res 2020;99(7):769-74. [CrossRef]
2. Lee JH, Kim DH, Jeong SN, Choi SH. Detection and diagnosis of dental caries using a deep learning-based convolutional neural network algorithm. J Dent 2018;77:106-11. [CrossRef]
3. Ekert T, Krois J, Meinhold L, Elhennawy K, Emara R, Golla T, et al. Deep learning for the radiographic detection of apical lesions. J Endod 2019;45:917-22.e5. [CrossRef]
4. Abuabara A, do Nascimento TVPM, Trentini SM, Costa Gonçalves AM, Hueb de Menezes-Oliveira MA, et al. Evaluating the accuracy of generative artificial intelligence models in dental age estimation based on the Demirjian's method. Front Dent Med 2025;6:1634006. [CrossRef]
5. Mohajeri A, Schlaud S, Spector S, Hung M. Machine learning for child oral health: a scoping review. Appl Sci 2024;14(23):11073. [CrossRef]
6. Acharya S, Godhi BS, Saxena V, Assiry AA, Alessa NA, Dawasaz AA, et al. Role of artificial intelligence in behavior management of pediatric dental patients-a mini review. J Clin Pediatr Dent 2024;48:24-30. [CrossRef]
7. Sezer B, Aydoğdu T. Performance of advanced artificial intelligence models in pulp therapy for immature permanent teeth: a comparison of ChatGPT-4 omni, deepseek, and gemini advanced in accuracy, completeness, response time, and readability. J Endod 2025;51(11):1675-84. [CrossRef]
8. Akgül EN, Gucyetmez Topal B. Detection of Dens Invaginatus on Panoramic Radiographs Using Deep Learning Algorithms. Int J Paediatr Dent 2026;36:59-66. [CrossRef]
9. Guo X, Shao Y. AI-driven dynamic orthodontic treatment management: personalized progress tracking and adjustments-a narrative review. Front Dent Med 2025;6:1612441. [CrossRef]
10. Bansal RK, Arya A, Singh B, Singla M, Gupta S. Role of artificial intelligence and machine learning in conservative dentistry and endodontics: A Review. Cureus 2025;17(7):e88515. [CrossRef]
11. Hasan F, Tantawi ME, Haque F, Foláyan MO, Virtanen JI. Early childhood caries risk prediction using machine learning approaches in Bangladesh. BMC Oral Health 2025;25(1):49. [CrossRef]
12. Aydın N. Bibliyometric analysis of artificial intelligence research in Türkiye. BAUNSOBED 2024;26(3):512-28. [Article in Turkish]

13. Gündüz A, Eren M. The role of artificial intelligence in health sciences: a bibliometric evaluation. Sağlık Akademisyenleri Dergisi 2024;11(2):95-105. [Article in Turkish]
14. Royle P, Kandala NB, Barnard K, Waugh N. Bibliometrics of systematic reviews: analysis of citation rates and journal impact factors. Syst Rev 2013;2:74. [CrossRef]
15. Park I, Yoon B. Identifying promising research frontiers of pattern recognition through bibliometric analysis. Sustainability 2018;10(11):4055. [CrossRef]
16. Cagetti MG, Campus G. The future of pediatric dentistry is now. Children (Basel) 2023;10(1):97. [CrossRef]
17. Atalay B. Artificial intelligence in endodontics: a bibliometric analysis. Turk Klin J Dent Sci 2025;31(1):45-53. [CrossRef]
18. Erdem R, Genç YS, Yalınız G, Gülşen İT. Dental implantolojide yapay zeka kullanımının bibliyometrik analizi. Aydin Dental Journal 2024;10(2):155-67. [Article in Turkish] [CrossRef]
19. Shehani A F, Ponraj S, Ramar K, A VS, S R, J G. Non-pharmacological behavior management techniques in pediatric dentistry: a bibliometric analysis. Cureus 2023;15(7):e41329. [CrossRef]
20. Bağ İ, Bilgir E, Bayrakdar İŞ, Baydar O, Atak FM, Çelik Ö, et al. An artificial intelligence study: automatic description of anatomic landmarks on panoramic radiographs in the pediatric population. BMC Oral Health 2023;23(1):764. [CrossRef]
21. Kaya E, Gunec HG, Aydin KC, Urkmez ES, Duranay R, Ates HF. A deep learning approach to permanent tooth germ detection on pediatric panoramic radiographs. Imaging Sci Dent 2022;52(3):275-81. [CrossRef]
22. Orhan AI, Bezgin T, Orhan K. Digital dentistry applications in pediatric dentistry. In: Delantoni A, Orhan K, editors. Digital Dentistry. Cham: Springer; 2024. p. 223-36. [CrossRef]
23. Beser B, Reis T, Berber MN, Topaloglu E, Gungor E, Kılıc MC, et al. YOLO-V5 based deep learning approach for tooth detection and segmentation on pediatric panoramic radiographs in mixed dentition. BMC Med Imaging 2024;24:172. [CrossRef]
24. Kwan JC, Fritz PC, Nguyen TT. Artificial intelligence in dentistry: current applications and future perspective. In: Choi AH, editor. Handbook of tissue reconstruction and regeneration. Singapore: Springer; 2026. [CrossRef]
25. Moore MM, Slonimsky E, Long AD, Sze RW, Iyer RS. Machine learning concepts, concerns and opportunities for a pediatric radiologist. Pediatric Radiology 2019;49:509-16. [CrossRef]
26. Rakhmatulla N, Iroda N, Sherzodbek R. Artificial intelligence applications in pediatric orthodontics: a comprehensive review of current technologies and clinical outcomes. American Journal of Medicine and Medical Sciences 2025;15(10):3426-31.
27. Al-Khalifa KS, Ahmed WM, Azhari AA, Qaw M, Alsheikh R, Alqudaihi F, et al. The use of artificial intelligence in caries detection: a review. Bioengineering 2024;11(9):936. [CrossRef]