

Original Article

Research Trends of Knowledge Structure of Periodontal Disease and Systemic Health: Applying Text Network Analysis

Yun-Jeong Kim

Associate professor, Department of Dental Hygiene, Kwangju Women's University, Korea (tokyj@kwu.ac.kr)

ABSTRACT

Received 24 Nov 2025

Revised 08 Dec 2025

Accepted 23 Dec 2025

Citation: Kim YJ. AResearch Trends of knowledge structure of periodontal disease and systemic health: applying text network analysis. The Journal of Transdisciplinary Studies. 2025; 9(3): 141-148. <https://doi.org/10.22685/jts.2025.9.3.141>

Copyright: © 2025 by The Journal of Transdisciplinary Studies. This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0>)

Objectives: This study examined research trends by using text network analysis on studies concerning periodontal disease and systemic health published between 2015 and 2024. **Methods:** This study examines a corpus of 2,518 articles retrieved from the PubMed database, published between 2015 and 2024, which include the keywords [Systemic health AND periodontal disease] within their titles or abstracts. The selection criteria were not confined to any particular discipline, with data collection predicated on titles that encapsulate the primary focus of the research. The gathered data were analyzed using the Textom software (Textom 6.0, The IMC Co., Ltd., Korea) to clean and organize the information. From the top 100 words, a one-mode matrix was generated, followed by a centrality analysis. **Results:** In the last ten years, it has been established that studies on periodontal disease and overall health have been actively pursued, with new research areas steadily emerging. **Conclusions:** Research generating evidence for interventions aimed at managing periodontal disease should be further expanded, and investigations implementing these interventions within dental hygiene practice should be actively encouraged to enhance oral health outcomes.

Keywords: Periodontal disease, Research trend, Systemic health, Text network analysis

1. Introduction

Periodontitis is an infectious oral disease characterized by chronic inflammation of the alveolar bone and adjacent periodontal tissues. This progressive condition results in the formation of periodontal pockets and a gradual resorption of alveolar bone, ultimately causing tooth mobility and eventual tooth loss. In its early stages, periodontitis is frequently asymptomatic, which contributes to its underdiagnosis. By the time patients experience discomfort and seek clinical intervention, the disease is often in an advanced state. Consequently, early detection, intervention, and preventive measures are critical. Despite being preventable, relatively easy to diagnose, and amenable to effective treatment, periodontitis receives comparatively less emphasis in national health policies than other diseases [1].

Periodontal disease extends its impact beyond oral health, exhibiting significant associations with systemic conditions. It induces localized tissue destruction and sys-

temic inflammatory responses that have been linked to cardiovascular disease [2]. Furthermore, a positive correlation exists between periodontal disease and inadequate glycemic control in individuals with type 2 diabetes, characterized by a bidirectional relationship that exacerbates the risk and severity of both disorders [3]. Among pregnant women, periodontal disease is associated with an approximately 1.7-fold increased risk of preterm birth and low birth weight [4]. The principal risk factors encompass genetic predispositions, environmental influences, lifestyle behaviors, and systemic health conditions, which may operate independently or synergistically [5].

Periodontal disease is a prevalent condition globally, impacting up to 50% of individuals across both developed and developing countries [6]. The incidence of severe cases is notably higher in developing regions, underscoring the critical need to enhance the quality of oral healthcare services to address disparities in oral health [7]. Consequently, it is imperative to move beyond a narrow focus on in-

dividual oral hygiene practices for the prevention of periodontal disease and adopt a more holistic strategy that incorporates socioeconomic, cultural, and environmental determinants in its management [8].

As of 2025, approximately 9,000 studies indexed in PubMed address the relationship between periodontal disease and systemic conditions. Notably, the vast majority of these publications—approximately 8,900—have been released since the year 2000, indicating a marked increase in scholarly attention to the association between periodontal health and systemic well-being [9]. Therefore, the management of periodontal disease should extend beyond the sole objective of preventing tooth loss, encompassing a multifaceted strategy aimed at improving overall health and mitigating the risk of chronic diseases.

Preventive care in dental treatment is essential not only for alleviating pain and restoring dental function but also for enhancing and sustaining oral health through the provision of high-quality dental services [10]. Dental hygienists, as licensed practitioners specialized in the prevention of oral diseases and the promotion of oral health, play a critical role in advancing oral health outcomes [11]. These professionals are required to select the most efficacious dental hygiene interventions grounded in scientific evidence [12, 13] to ensure favorable results [14]. Consequently, there is an increasing need for research trend analyses to evaluate whether investigations into dental hygiene interventions align with these requirements and to inform future strategies for oral health promotion [15].

Text network analysis treats language-based text as an object of network analysis by extracting the fundamental concepts embedded within the text, investigating the interrelations among words, and systematically interpreting the semantic structure. This methodology is widely employed in analytical contexts and is frequently referred to by terms such as semantic network (language network), word network, keyword network, and concept network [16]. Within text network analysis, centrality analysis serves to identify principal topics containing key keywords and to evaluate the degree of connectivity between keywords and significant concepts [17]. Centrality is typically quantified using measures such as degree centrality and betweenness centrality [18]. Degree centrality reflects the number of direct connections a node possesses, indicating the keyword's capacity to exert immediate influence on other concepts within the network, thereby underscoring a core topic of discussion. Conversely, betweenness centrality assesses a node's function as an intermediary along the shortest paths, signifying its control over information flow within the network, or brokerage. Accordingly, keywords exhibiting high betweenness centrality function as vital connectors

that link disparate topic clusters [19].

The analysis of research trends serves as a valuable tool for identifying patterns within related fields and for suggesting potential avenues for future investigation [20]. Text network analysis is employed to quantify the volume of studies within specific categories and to examine the relationships among keywords [21]. Moreover, this approach is widely adopted across various academic disciplines to understand research trajectories and to derive meaningful insights, thereby enhancing the reliability and validity of the analytical outcomes [22].

An analysis of research trends enables the exploration of the trajectory of studies related to periodontal disease and systemic conditions. Nonetheless, there remains a paucity of comprehensive investigations aimed at elucidating the overarching trends within this domain, with limited studies identifying principal concepts or patterns in the literature concerning periodontal and systemic diseases. Consequently, the present study employs text network analysis to systematically review scholarly publications on periodontal disease and systemic health from 2015 to 2024, segmented into five-year intervals. The objectives are to identify core keywords and network configurations, assess overall publication trends within each period, and monitor the evolution of inter-keyword relationships. Ultimately, this methodological approach seeks to construct a foundational knowledge framework on periodontal disease and systemic health, providing critical insights to inform and guide future research endeavors in this field.

2. Research design and methodology

2.1. Research process and content

This study adopts a descriptive research approach and applies text network analysis to identify principal keywords related to periodontal disease and systemic health research, elucidate the underlying network structure, and examine temporal trends. The study conducted an analysis of 2,518 articles retrieved from the PubMed database, published between 2015 and 2024, which included the keywords [Systemic health AND periodontal disease] within their titles or abstracts, thereby indicating the primary focus of the research [23]. No limitations were imposed regarding the discipline or type of publication, and data extraction was performed based on titles that encapsulated the central research theme.

The research methodology entailed the systematic collection of data and extraction of keywords from international scholarly articles indexed in PubMed, followed by data

preprocessing and centrality analysis. Initially, data acquisition involved downloading articles published over the preceding decade in CSV format, organized by publication year, and subsequently converting these files into Excel spreadsheets. The annual distribution of extracted articles was as follows: 162 in 2015, 133 in 2016, 167 in 2017, 174 in 2018, 210 in 2019, 242 in 2020, 318 in 2021, 331 in 2022, 337 in 2023, and 444 in 2024, culminating in a total of 2,518 articles. To examine the temporal evolution of the network structure, the dataset was segmented into two distinct intervals: Period 1, encompassing 846 publications from 2015 to 2019, and Period 2, comprising 1,672 publications from 2020 to 2024. Subsequent analyses and inferences were conducted based on this temporal classification.

2.2. Data analysis method

A dataset comprising 2,518 documents was processed and refined utilizing Textom 6.0 software (The IMC Co., Ltd., Korea). To enhance the specificity of the analysis, commonly occurring keywords frequently employed in journal searches—such as ‘systemic,’ ‘disease,’ ‘periodontal,’ and ‘health’—as well as prevalent research terms including ‘study,’ ‘association,’ and ‘analysis’ [23], were systematically excluded. For the purpose of centrality analysis, a one-mode network matrix was constructed based on the top 100 keywords. The importance of each keyword within the network was evaluated through degree centrality, which quantifies the number of directly connected neighboring nodes, and betweenness centrality, which assesses the extent to which a node lies on the shortest paths between other nodes.

3. Research results

3.1. Publication of periodontal disease and systemic health-related papers by year

The status of 2,518 publications related to periodontal disease and systemic health from 2015 to 2024 is presented in Fig. 1. The annual number of papers on this topic ranged from 133 to 444 between 2015 and 2024, with the volume of research published after 2021 nearly doubling compared to that before 2021.

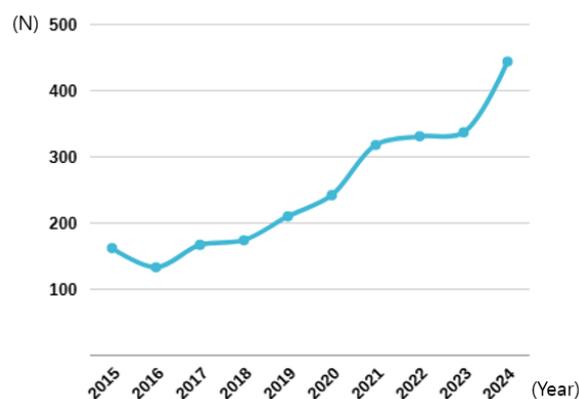


Fig. 1. Number of article by year

3.2. Change of main keywords by periods

Table 1. displays the twenty most prominent keywords for each time period, illustrating the temporal evolution of key terms. In Phase 1, the predominant terms identified were ‘patient,’ ‘review,’ ‘treatment,’ ‘diabetes,’ and ‘effect,’

Table 1. Frequency of key words by period

Rank	1 st (2015-2019)		2 nd (2020-2024)		All (2015-2024)	
	Keywords	N	Keywords	N	Keywords	N
1	patient	135	patient	268	patient	403
2	review	75	review	216	review	291
3	treatment	63	treatment	135	treatment	198
4	diabetes	63	effect	130	effect	190
5	effect	60	diabetes	102	diabetes	165
6	level	50	risk	96	therapy	140
7	therapy	50	inflammation	96	risk	136
8	status	44	factor	91	level	135
9	bone	41	therapy	89	inflammation	133
10	case	40	cross	86	factor	122
11	risk	40	level	85	status	120
12	loss	38	impact	77	bone	118
13	inflammation	37	bone	77	cross	112
14	trial	35	status	76	case	110
15	factor	31	meta	72	trial	106
16	population	30	trial	70	loss	100
17	type	29	case	70	meta	98
18	relationship	29	role	64	impact	98
19	cell	28	microbiome	63	population	88
20	woman	28	loss	62	control	88

with additional research focusing on concepts such as ‘level,’ ‘therapy,’ ‘status,’ ‘bone,’ and ‘case’. In Phase 2, the most frequently occurring terms remained ‘patient,’ ‘review,’ ‘treatment,’ ‘effect,’ and ‘diabetes,’ while studies pertaining to ‘risk,’ ‘inflammation,’ ‘factor,’ ‘therapy,’ and ‘cross’ also emerged prominently within the rankings. Over the entire duration of the study, investigations into systemic health and periodontal disease consistently emphasized keywords such as ‘patient,’ ‘review,’ ‘treatment,’ ‘effect,’ and ‘diabetes’. Notably, the keyword ‘patient’ was the most frequently occurring term, appearing 403 times, followed by ‘review’ with 291 occurrences and ‘treatment’ with 198 occurrences Fig. 1.

3.3. Change of main keywords by years

Fig. 2. presents the yearly occurrence rates of the ten most frequently used keywords: ‘patient,’ ‘review,’ ‘treatment,’ ‘effect,’ ‘diabetes,’ ‘therapy,’ ‘risk,’ ‘level,’ ‘inflammation,’ and ‘factor’. Among these, the term ‘patient’ consistently exhibited the highest frequency throughout the observed period. Notably, in 2024, the frequencies of the keywords

‘review,’ ‘effect,’ and ‘inflammation’ were approximately sixfold higher compared to their levels in 2015. Furthermore, as indicated in Table 3., the annual frequencies of these top ten keywords have nearly doubled since 2020.

3.4. Change of centrality by periods

The results of the centrality analysis by period present degree centrality and betweenness centrality for the top 1-20 keywords in each period Tables 4, 5. Both degree centrality and betweenness centrality analyses indicated that all keywords ranked within the top ten in terms of frequency consistently exhibited high centrality rankings. Furthermore, when compared to the entire study period, the terms ‘status,’ ‘bone,’ and ‘case’ demonstrated elevated prominence during the Phase 1. During the Phase 2, the terms ‘risk,’ ‘inflammation,’ and ‘factor’ were frequently observed, with the additional emergence of the term ‘meta.’ In the Phase 1, several of the most frequently occurring keywords—including ‘patient,’ ‘review,’ ‘treatment,’ ‘diabetes,’ ‘effect,’ ‘level,’ and ‘therapy’—displayed elevated values of both degree centrality and betweenness

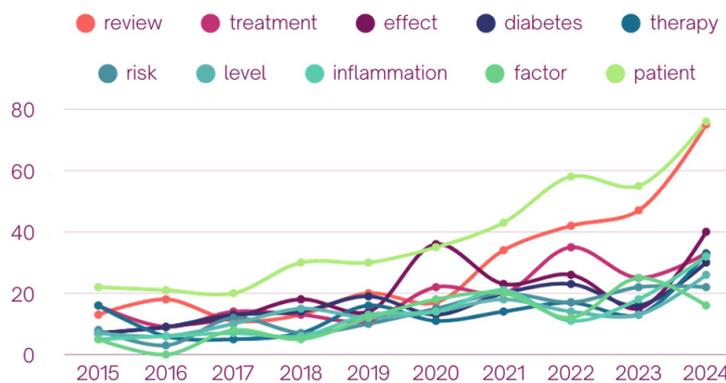


Fig. 2. Changes in 10 keywords by year

Table 2. Frequency of 10 keywords by year

Rank	Keywords	Year									
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1	patient	22	21	20	30	30	35	43	58	55	76
2	review	13	18	11	13	20	17	34	42	47	75
3	treatment	16	9	14	13	11	22	20	35	25	33
4	effect	7	9	12	18	14	36	23	26	15	40
5	diabetes	7	9	13	14	19	13	20	23	16	30
6	therapy	16	6	5	7	16	11	14	17	13	33
7	risk	8	3	12	7	10	15	20	17	22	22
8	level	7	6	10	15	12	14	18	14	13	26
9	inflammation	5	6	7	6	13	14	21	11	18	32
10	factor	5	0	8	5	12	18	20	12	25	16
	Total	106	87	112	128	157	195	233	255	249	383

Table 3. Centrality by period

Rank	1 st (2015-2019)			2 nd (2020-2024)			All (2015-2024)		
	Keywords	DC	BC	Keywords	DC	BC	Keywords	DC	BC
1	patient	3.576	0.058	patient	8.020	0.026	patient	11.707	0.026
2	review	1.616	0.040	review	5.293	0.020	review	6.970	0.020
3	treatment	1.737	0.027	treatment	3.515	0.016	treatment	5.293	0.016
4	diabetes	2.242	0.036	effect	3.848	0.020	effect	5.778	0.020
5	effect	1.899	0.025	diabetes	3.535	0.017	diabetes	5.758	0.017
6	level	1.838	0.022	risk	2.677	0.016	therapy	4.515	0.016
7	therapy	1.414	0.016	inflammation	2.162	0.015	risk	3.485	0.015
8	status	1.051	0.022	factor	2.444	0.015	level	4.889	0.015
9	bone	1.040	0.014	therapy	2.879	0.017	inflammation	2.768	0.017
10	case	1.051	0.015	cross	2.172	0.013	factor	3.333	0.013
11	risk	0.859	0.014	level	3.030	0.012	status	3.192	0.012
12	loss	1.232	0.017	bone	1.859	0.009	bone	2.909	0.009
13	inflammation	0.697	0.015	impact	1.798	0.014	cross	2.535	0.014
14	trial	0.919	0.011	status	2.253	0.012	case	3.020	0.012
15	factor	0.838	0.013	meta	2.384	0.010	trial	3.081	0.010
16	population	0.606	0.009	trial	2.071	0.005	loss	3.071	0.005
17	type	1.354	0.008	case	2.030	0.008	meta	3.202	0.008
18	relationship	0.586	0.012	role	1.253	0.007	impact	2.384	0.007
19	cell	0.616	0.006	microbiome	1.212	0.006	population	1.899	0.006
20	woman	0.657	0.010	loss	1.879	0.009	control	2.808	0.009

DC: degree centrality, BC: between centrality

centrality. During the Phase 2, all top ten keywords by frequency, with the sole exception of 'level,' exhibited similarly high levels of degree centrality and betweenness centrality.

4. Discussion

This study seeks to examine research trends through the application of text network analysis on scholarly articles addressing periodontal disease and systemic health, published between 2015 and 2024. Drawing upon the principal analytical outcomes, the study interprets the findings and evaluates overarching publication patterns and temporal trends, thereby offering insights into the developmental trajectory of research in the field of periodontal disease and systemic health.

Firstly, an examination of the publication trends from 2015 to 2024 reveals that fewer than 200 studies were published up to the year 2019. Furthermore, since 2021, the number of published studies has more than doubled in comparison to the volume recorded in 2015. The increased emphasis on health during the COVID-19 pandemic (2020–2021) also impacted oral health, leading to a surge in related research focused on its enhancement [25, 26]. A comprehensive analysis of 1,089 articles pub-

lished in the International Journal of Dental Hygiene (IJDH), the official publication of the International Federation of Dental Hygienists (IFDH), up to the year 2023, revealed the presence of four primary research clusters: 'Managing periodontitis,' 'Managing systemic disease,' 'Oral health evaluation,' and 'Oral health prevention program.' These findings underscore the considerable scholarly attention devoted to these domains [27].

Secondly, The term 'patient' was the most recurrent keyword over the entire duration, occurring 403 times. The frequent appearance of the term 'patient' in titles, abstracts, and keywords is expected, given that clinical investigations involving patients—such as cohort studies, case-control studies, and clinical trials—are fundamental for elucidating the association between periodontal disease and systemic conditions [28]. Research concerning periodontal disease and systemic health primarily addresses clinical and patient-centered inquiries, integrating concepts such as 'treatment,' 'outcome,' and 'risk factors' within the context of the patient framework [29]. This study, which focuses on the investigation of periodontal disease and its relationship with systemic health, yielded results that align with anticipated outcomes. The notably high frequency of the keyword 'review' (291 instances) likely indicates a concerted effort to minimize bias and enhance scientific rigor in studies examining the link between periodontal disease

and systemic health [30]. Keywords such as 'patient,' 'review,' 'treatment,' 'diabetes,' and 'effect' were prevalent across both Phase 1 and Phase 2. In comparison to Phase 1, Phase 2 incorporated significant terminology including 'risk,' 'inflammation,' 'factor,' and 'cross,' indicating a transition toward investigating the association between periodontal and systemic diseases. A longitudinal analysis of key terms demonstrated that 'patient' consistently maintained the highest annual frequency, while the occurrences of 'review,' 'effect,' and 'inflammation' in 2024 were approximately six times greater than in 2015. These results suggest that evidence-based research, supported by the systematic review of quantitatively accumulated studies, has become markedly more active in 2024 compared to 2015.

Finally, comparing the results of the centrality analysis, both degree centrality and betweenness centrality were high for all keywords ranked within the top 10 in frequency of occurrence. Keywords with high degree centrality have influence because they can easily spread to other keywords, and they are recognized as important since they are considered central topics of discussion in key positions within the network. Additionally, keywords with high betweenness centrality exert strong control over the flow of information within the network [31] and serve as connectors for expanding into other topics, making them essential keywords to consider when broadening related subjects [32]. Therefore, the keywords ranked within the top 10 in frequency are not only highly influential but also core keywords in research related to periodontal disease and systemic diseases. Specifically, during phase 2, the term 'meta' was observed in conjunction with the keywords 'risk,' 'inflammation,' and 'factor.' Significantly, the introduction of the keyword 'meta,' in conjunction with the previously identified keyword 'review,' signifies the advent of research employing systematic reviews and meta-analyses, methodologies recognized for delivering the highest level of evidence in clinical medicine [33]. Meta-analysis involves the statistical synthesis of multiple independent studies to achieve a more accurate estimation of the overall effect size, enhance statistical power, facilitate integrative evaluations in the presence of conflicting individual study outcomes, and investigate sources of variability through heterogeneity and subgroup analyses. This approach thereby offers valuable evidence to inform clinical practice and policy decisions [34]. Consequently, it is anticipated that the keyword 'meta,' akin to 'review,' will persist as a highly prominent term in future research and will be instrumental in generating significant findings.

This study holds significance as it systematically retrieved bibliographic data pertaining to research on periodontal

disease and systemic health from international databases spanning the last ten years, thereby enabling the analysis of trends within this domain and the documentation of temporal variations. Research employing this methodology has expanded within the field of dental hygiene and is advocated for use in dental hygienists' interventions targeting the management of periodontal disease. Nonetheless, a notable limitation of the present study is the insufficient body of research examining the associations between periodontal disease and systemic health, which restricts the ability to conduct thorough comparisons with previous investigations. Accordingly, future research endeavors should aim to overcome these limitations by offering more granular analyses of research trends, including the categorization of diverse systemic diseases.

5. Conclusions

This study examined research trends by using text network analysis on studies concerning periodontal disease and systemic health published between 2015 and 2024.

1. During the first period, the most common terms included 'patient,' 'review,' 'treatment,' 'diabetes,' and 'effect,' alongside studies focusing on 'level,' 'therapy,' 'status,' 'bone,' and 'case.' In the second period, the frequently used terms remained 'patient,' 'review,' 'treatment,' 'effect,' and 'diabetes,' with additional research topics such as 'risk,' 'inflammation,' 'factor,' 'therapy,' and 'cross' also featuring prominently.
2. The keyword with the highest frequency of occurrence, 'patient,' had the highest frequency in all years, and in 2024, the frequencies of 'review,' 'effect,' and 'inflammation' were approximately six times higher compared to 2015.
3. Both degree centrality and betweenness centrality showed that all keywords within the top 10 frequencies ranked highly, and compared to the entire period, in Phase 1, 'status,' 'bone,' and 'case' ranked higher. In Phase 2, 'risk,' 'inflammation,' and 'factor' ranked higher, and the keyword 'meta' appeared.

Over the past ten years, research exploring the relationship between periodontal disease and systemic health has significantly advanced, giving rise to novel areas of inquiry. As a result, there is an anticipated growth in studies that offer empirical evidence for the effective management of periodontal disease. Furthermore, the application of these research findings within the field of dental hygiene is expected to intensify, thereby contributing to the enhancement of oral health promotion efforts.

ORCID

<https://orcid.org/0000-0003-3908-9228>

Conflict of Interest

The authors declare no conflict of interest.

Funding

This paper was supported (in part) by Research Funds of Kwangju Women's University in 2025 (KWU25-044).

References

1. Tonetti MS, Bottenberg P, Conrads G, Eickholz P, Heasman P, Huysmans MC, et al. Dental caries and periodontal diseases in the ageing population: call to action to protect and enhance oral health and well-being as an essential component of healthy ageing - Consensus report of group 4 of the joint EFP/ORCA workshop on the boundaries between caries and periodontal diseases. *Journal of Clinical Periodontology*. 2017;44(18):S135-S144. <https://doi.org/10.1111/jcpe.12681>
2. Tonetti MS, Van Dyke TE. Periodontitis and atherosclerotic cardiovascular disease: consensus report of the Joint EFP/AAP Workshop on Periodontitis and Systemic Disease. *Journal of Periodontology*. 2013;84(4Suppl):S24-29. <https://doi.org/10.1902/jop.2013.1340019>
3. Stöhr J, Barbaresko J, Neuenschwander M, Schlesinger S. Bidirectional association between periodontal disease and diabetes mellitus: a systematic review and meta-analysis of cohort studies. *Scientific Reports*. 2021;11(1):13686. <https://doi.org/10.1038/s41598-021-93062-6>
4. Nannan M, Xiaoping L, Ying J. Periodontal disease in pregnancy and adverse pregnancy outcomes: Progress in related mechanisms and management strategies. *Frontiers in Medicine*. 2022;25(9):963956. <https://doi.org/10.3389/fmed.2022.963956>
5. Villoria GEM, Fischer RG, Tinoco EMB, Meyle J, Loos BG. Periodontal disease: A systemic condition. *Periodontology 2000*. 2024;96(1):7-19. <https://doi.org/10.1111/prd.12616>
6. Nazir MA. Prevalence of periodontal disease, its association with systemic diseases and prevention. *International Journal of Health Sciences*. 2017;11(2):72-80.
7. Chen MX, Zhong YJ, Dong QQ, Wong HM, Wen YF. Global, regional, and national burden of severe periodontitis, 1990-2019: An analysis of the Global Burden of Disease Study 2019. *Journal of Clinical Periodontology*. 2021;48(9):1165-1188. <https://doi.org/10.1111/jcpe.13506>
8. Watt RG, Venturelli R, Daly B. Understanding and tackling oral health inequalities in vulnerable adult populations: from the margins to the mainstream. *British Dental Journal*. 2019;227(1):49-54. <https://doi.org/10.1038/s41415-019-0472-7>
9. pubmed[Internet]. Systemic disease & periodontal disease [cited by 2025 Oct 21] Available from: <https://pubmed.ncbi.nlm.nih.gov/>
10. Kim SY. Factors affecting dental hygienists' response abilities to emergency treatment related to systemic diseases. *Journal of Korean Society of Dental Hygiene*. 2024;24(6):633-640. <https://doi.org/10.13065/jksdh.20240611>
11. Korean Dental Hygienist Association. Dental hygiene education curriculum [Internet]. Korean Dental Hygienist Association [cited 2025 Mar 13]. Available from: <https://www.kdha.or.kr/introduce/dentalhygienist.aspx#introduce>
12. Mun SJ, Shin SJ, Chung WG, Kim NH. Barriers to research utilization among dental hygiene researchers. *Journal of Korean Society of Dental Hygiene*. 2010;10(4):745-755.
13. Kim AY, Mun SJ. Needs, knowledge, attitudes, and performance related to evidence-based practice among dental hygienists. *Journal of Korean Society of Dental Hygiene*. 2025;25(2):263-272. <https://doi.org/10.13065/jksdh.2025.25.3.9>
14. Bischof G, Bischof A, Rumpf HJ. Motivational interviewing: an evidence-based approach for use in medical practice. *Deutsches Ärzteblatt International*. 2021;118(7):109-115. <https://doi.org/10.3238/arztebl.m2021.0014>
15. Kim YJ. Keyword network analysis of global trends in oral health research. *The Journal of Transdisciplinary Studies*. 2024;8(3):339-348. <https://doi.org/10.1001/jts.2024.8.3.339>
16. Park CS, Chung CW. Text network analysis: detecting shared meaning through socio-cognitive networks of policy stakeholders. *Institute of Governmental Studies*. 2013;19(2):73-108.
17. Jang MJ, Kim YH. Analysis of research trends of e-Learning in Korea using Text Network Analysis techniques. *Journal of Convergent Education Research*. 2023;9(1):61-86. <https://doi.org/10.69742/cer.2023.9.1.61>
18. Lee DH, Shin DH. Keyword network analysis and topic modeling in an information literacy study of

- undergraduate students. *Journal of the Korean Society for Information Management*. 2024;41(3):249-268. <https://doi.org/10.3743/KOSIM.2024.41.3.249>
19. Borgatti SP. Centrality and network flow. *Social Networks*. 2005;27(1):55-71.
 20. Kim JH, Park SM. Research trends of young children's play using the semantic network analysis. *Journal of the Korea Academia-Industrial cooperation Society*. 2020;21(2):296-303. <https://doi.org/10.5762/KAIS.2020.21.2.296>
 21. Cho JN. A study for research area of library and information science by network text analysis. *Journal of the Korean Society for Information Management*. 2011;28(4):65-83. <https://doi.org/10.3743/KOSIM.2011.28.4.065>
 22. Leem SB, Shin JE, Kim JY, Shim SR. Text network analysis to develop a search strategy for a systematic review. *Applied Science*. 2024;14(9):8909. <https://doi.org/10.3390/app14198909>
 23. Jeong NR. Analysis of research trends in elementary english education using text mining-focusing on the academic Journals registered in KCI-[Master's thesis]. Choungju: Korea National University of Education, 2022.
 24. Kwag AR. Analysis of research trends of South Korean master's and doctorate degree dissertations on horticulture therapy using text mining and semantic network analysis[Master's thesis]. Choenan: Dankook University, 2020.
 25. Lee YS. A study on the impact of perceived risk of COVID-19 on health consciousness and the intention to purchase private health insurance: focusing on MZ generation. *Journal of Business Convergence*. 2025;10(4):189-195. <https://doi.org/10.31152/JB.2025.08.10.4.189>
 26. Kim DJ, Lee JY, Kim YR. Association between health information literacy and oral health-related indicators in Korean adults: a cross-sectional study using data from the 2023 National Health and Nutrition Examination Survey. *Journal of Korean Society of Dental Hygiene*. 2025;25(2):143-152. <https://doi.org/10.13065/jksdh.2025.25.2.6>
 27. Kim YJ, Kim SY, Kim SY. An analysis of dental hygiene research trends using semantic network: domestic and international comparisons. *Journal of Korean Society of Dental Hygiene*. 2025;25(1):1-10. <https://doi.org/10.13065/jksdh.2025.25.1.1>
 28. Li L, Fu L, Li H, Liu T, Sun J. Emerging trends and patterns in healthcare-seeking behavior: A systematic review. *Medicine (Baltimore)*. 2024;103(8):e37272. <https://doi.org/10.1097/MD.00000000000037272>
 29. Ahmad P, Arshad AI, Della Bella E, Khurshid Z, Stoddart M. Systemic Manifestations of the Periodontal Disease: A Bibliometric Review. *Molecules*. 2020 Oct 1;25(19):4508. <https://doi.org/10.3390/molecules25194508>
 30. Moosapour H, Saeidifard F, Aalaa M, Soltani A, Larijani B. The rationale behind systematic reviews in clinical medicine: a conceptual framework. *Journal of Diabetes and Metabolic Disorders*. 2021;20(1):919-929. <https://doi.org/10.1007/s40200-021-00773-8>
 31. Kwon O, Kim BS, Jung SK. A study on traffic impact by heavy rain using betweenness centrality analysis. *Journal of Korean Data & Information Science Society*. 2021;32(1):49-61. <https://doi.org/10.7465/jkdi.2021.32.1.49>
 32. Lee DY, Noh GO. Research trends of middle-aged women's health in Korea using topic modeling and text network analysis. *The Journal of the Convergence on Culture Technology*. 2022;8(4):163-171. <https://doi.org/10.17703/JCCT.2022.8.4.163>
 33. Hedges LV, Olkin I. The strengths and limitations of meta-analyses based on aggregate data. *BMC Medical Research Methodology*. 2005;25(5):14. <https://doi.org/10.1186/1471-2288-5-14>
 34. Lee YH. An overview of meta-analysis for clinicians. *Korean Journal of Internal Medicine*. 2017;33(2):277-283. <https://doi.org/10.3904/kjim.2016.195>