



Original Article

An analysis of dental hygiene research trends using semantic network: domestic and international comparisons

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ABSTRACT

Objectives: This study was conducted to understand the research trends in dental hygiene, domestically and internationally. **Methods:** The Journal of the Korean Society of Dental Hygiene (JKSDH) examined 1,689 articles, totaling 7,575 words, whereas the International Journal of Dental Hygiene (IJDH) reviewed 1,089 articles, totaling 10,194 words, employing a semantic network and CONCOR analysis. **Results:** Findings indicated that centrality analysis revealed that the top 10 most frequently used words in journals exhibited high scores in degree, betweenness, and closeness centralities. CONCOR analysis identified four clusters within the JKSDH; 'oral health program', 'professionalism of dental hygienists', 'oral health assessment' and 'dental hygienist work environment'. The four categories of IJDH were 'managing periodontitis', 'managing systemic diseases', 'oral health assessment' and 'oral health prevention initiatives'. **Conclusions:** Future dental hygiene research in Korea should focus on evidence-based practices that can serve as a foundation for enhancing the professionalism of dental hygienists through a unique knowledge system in the field.

Key Words: Dental hygienists, Oral health, Periodontitis, Professionalism, Semantic network

Introduction

Dental hygiene is a discipline centered on preventive oral health care, where managing patient behaviors is crucial for preventing oral diseases and enhancing health [1]. In South Korea, the field of dental hygiene has evolved since the 1960s when the dental hygienist system was established. This development has led to the creation of graduate programs in dental hygiene, facilitating advanced education and research, and helping to establish its academic credibility alongside other fields [2]. In addition, as dental care has transitioned from a curative model to one that emphasizes prevention and maintenance, and as societal perceptions and expectations of dental hygienists have evolved [3], research in the field of dental hygiene has continued to diversify and enhance the practice of dental hygienists [4].

The Journal of Korean Society of Dental Hygiene (JKSDH), which is the official Journal of the Korean Society of Dental Hygiene, is among the 360 registered journals in the medical and pharmaceutical fields [5]. It serves as a key platform for academic discourse in dental hygiene, publishing the highest number of papers annually in this area [6]. Furthermore, it features various experimental studies that focus on improving the job skills and professionalism of dental hygienists, as well as on the prevention and diagnosis of oral diseases. Consequently, the articles published in JKSDH play a significant role in enhancing and sustaining public oral health [6].

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The International Journal of Dental Hygiene (IJDH) is the official Journal of the International Federation of Dental Hygienists (IFDH), which comprises 32 member countries. It is indexed in MEDLINE, PubMed, and SCIE, and has published over 1,200 articles to date. The goal of publishing the IJDH is to establish a platform for sharing scientific knowledge in oral health and dental hygiene, while also encouraging the integration of new findings in clinical practice [7].

Research trend analysis in a discipline involves examining the topics, subjects, and methodologies of research within a specific field. Its aim is to assess the value of previous research and establish a foundation for future studies [8]. Additionally, it identifies trends in the subject matter, which can provide valuable insights for guiding future research directions [9]. In recent years, the advancement of Information and Communication Technology (ICT), particularly in big data and artificial intelligence, has led to a significant increase in the analysis of academic research trends through big data analysis and text mining [10]. Text mining is a technology that extracts meaningful information and uncovers new knowledge from unstructured text data [11]. Therefore, a systematic approach to text mining techniques and methodologies is essential in both business and university education [12]. Common techniques in text mining analysis include semantic networks and CONCOR analysis, which group words based on their similarities. CONCOR analysis helps identify clusters of related keywords, enabling researchers to comprehend the connections between co-occurring keyword nodes [13,14]. This method is commonly applied in studies of academic trends.

Previous study in the field of dental hygiene that employed text mining analysis have identified trends in domestic research concerning the oral health of the elderly from 2000 to 2022 [15]. Furthermore, an examination of research trends in JKSDH over a three-year period (2019-2021) was performed [16], which identified five key topics: oral health in the elderly, the relationship between mental health and oral health, general oral health, periodontal tissue health, and the management of dental caries. This analysis underscores the importance of comprehending research trends on both a national and global scale.

Since the previous studies were insufficient to identify research trends in the field of dental hygiene, this study aimed to conduct the first comparative analysis of domestic and international research trends in dental hygiene using semantic network and CONCOR analysis. To achieve this, we identified keywords in JKSDH and IJDH, two representative journals in the field. We then compared the research trends and major topics of the articles published in these journals to explore the future direction of dental hygiene research.

Methods

1. Research subjects and methods

This study aimed to examine research trends in dental hygiene both nationally and internationally by reviewing articles published in two academic journals from their first issues up to 2023. For the national research trends, 1,729 papers published in the JKSDH were analyzed, with 40 papers lacking English titles excluded, resulting in a total of 1,689 papers and a combined word count of 7,575. For the international research trends, 1,104 papers published in the IJDH were reviewed, with 15 papers without English titles removed, leading to a total of 1,089 papers and a word count of 10,194. The frequency of the selected research topics by year is illustrated in <Fig. 1>.

The methodology of this research is illustrated in <Fig. 2>. To fulfill the research objectives, we gathered the titles of articles published in JKSDH and IJDH. For JKSDH, data from 2008 to 2023 was sourced from the Korea Citation Index (KCI), while data from before 2007 was obtained from the Research Information Sharing Service (RISS) since KCI does not provide that information. The data for IJDH was collected via Pubmed.

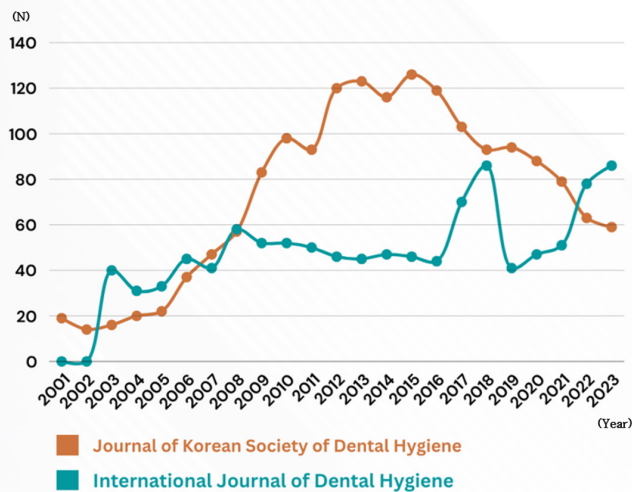


Fig. 1. Research publication status by year

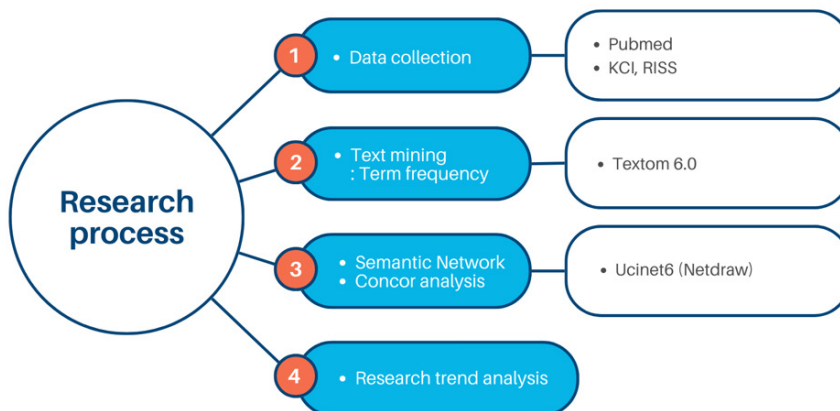


Fig. 2. Research process

2. Data analysis

The collected text data was downloaded as a CSV file and preprocessed using Textom 6.0. During preprocessing, all words were converted to lowercase to ensure consistent interpretation of terms with the same meaning, such as ‘Health’ and ‘health’, and all words were standardized to their singular form, as it was determined that the distinction between plural and singular forms affected the analysis results. The secondary refined data was manually reviewed to remove unused words and extraneous spaces. The final dataset was selected for frequency analysis, and a one-mode matrix was created based on the top 100 words. Network creation, semantic linkage network analysis, and CONCOR analysis were conducted using Textom and UCINET 6.0, with visualizations produced using Netdraw.

The CONCOR analysis identified groups of related words using the findings from the semantic network analysis to examine the arrangement of words. The total number of clusters and their similarity levels were established through dendrogram cutting. This research demonstrated that when the dendrogram was cut at a depth of 2, all words were grouped into a single cluster with a high degree of similarity, leading to the formation of four clusters as illustrated in <Fig. 3>.

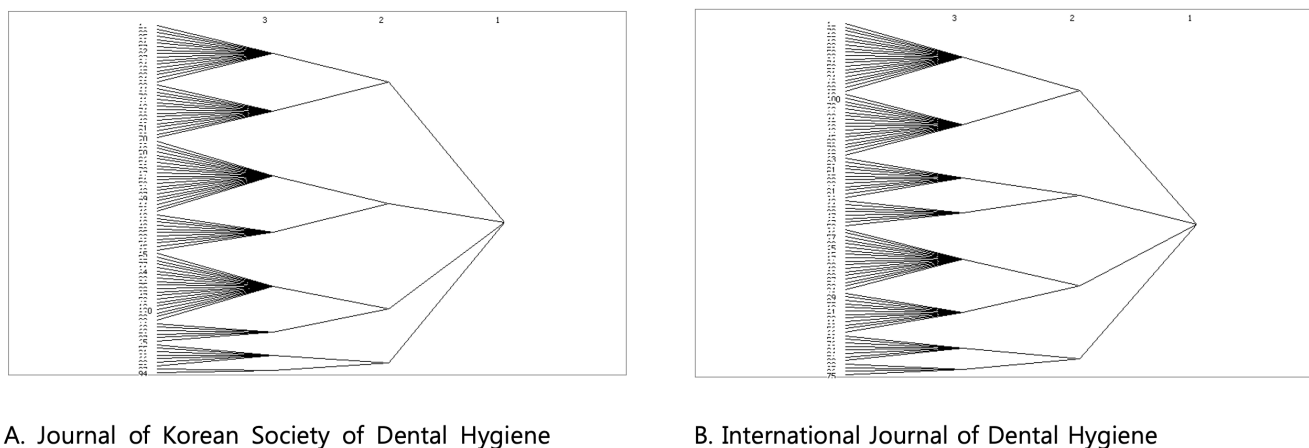


Fig. 3. Cluster diagram by journal

Results

1. Analysis results of the frequency and centrality of key words

In JKSDH, the words that appeared most often included 'health' (708 occurrences), 'study' (371), 'hygiene' (351), 'hygienist' (334), 'student' (321), 'factor' (254), 'effect' (244), 'relationship' (182), 'behavior' (179), and 'care' (157). Meanwhile, in IJDH, the most common keywords were 'health' (214), 'hygiene' (176), 'study' (154), 'hygienist' (122), 'patient' (122), 'effect' (120), 'plaque' (114), 'review' (112), 'trial' (100), and 'care' (82) <Table 1>.

To comprehend the relationships and functions of keywords within the network, the findings from the analysis of degree centrality, betweenness centrality, and closeness centrality are presented in <Table 2, 3>. The top 10 words by frequency demonstrate elevated levels of degree centrality, betweenness centrality, and closeness centrality in both journals.

2. Results of centrality network analysis

<Fig. 4> illustrates the network analysis of degree centrality, which serves as an important analytical measure of the semantic network. In the JKSDH network, an analysis of the node sizes and their positions reveals that nodes like 'health', 'study', 'hygiene', 'hygienist', 'student', 'factor', 'effect', 'relationship', 'behavior', and 'care' are prominent in size and situated at the center. Similarly, in the IJDH network, the examination of node sizes and positions shows that nodes such as 'health', 'hygiene', 'study', 'hygienist', 'patient', 'effect', 'plaque', 'review', 'trial', and 'care' are also significant in size and centrally positioned.

Table 1. Frequent of Key words (Top 20) of domestic and international studies

Rank	Journal of Korean Society of Dental Hygiene		International Journal of Dental Hygiene	
	Key word	Term frequency	Key word	Term frequency
1	health	708	health	214
2	study	371	hygiene	176
3	hygiene	351	study	154
4	hygienist	334	hygienist	122
5	student	321	patient	122
6	factor	254	effect	120
7	effect	244	plaque	114
8	relationship	182	review	112
9	behavior	179	trial	100
10	care	157	care	82
11	satisfaction	156	efficacy	75
12	status	132	child	74
13	patient	116	toothbrush	69
14	school	113	student	56
15	practice	109	chlorhexidine	56
16	analysis	107	treatment	55
17	knowledge	105	evaluation	55
18	education	102	practice	51
19	self	101	caries	49
20	Korea	96	disease	49

Table 2. Centrality of domestic research of key words network

Rank	DC		BC		CC	
	Key word	N	Key word	N	Key word	N
1	health	0.990	study	0.019	health	0.990
2	study	0.990	health	0.018	study	0.990
3	effect	0.960	effect	0.017	hygiene	0.908
4	factor	0.919	factor	0.014	hygienist	0.876
5	behavior	0.919	behavior	0.014	student	0.884
6	hygiene	0.899	hygiene	0.013	factor	0.925
7	student	0.869	student	0.013	effect	0.961
8	care	0.869	hygienist	0.012	relationship	0.868
9	hygienist	0.859	analysis	0.012	behavior	0.925
10	relationship	0.848	care	0.011	care	0.884
11	analysis	0.848	relationship	0.011	satisfaction	0.811
12	status	0.818	status	0.010	status	0.846
13	Korea	0.808	Korea	0.010	patient	0.792
14	awareness	0.798	awareness	0.009	school	0.786
15	self	0.778	experience	0.009	practice	0.762
16	experience	0.778	self	0.009	analysis	0.868
17	satisfaction	0.768	satisfaction	0.008	knowledge	0.773
18	education	0.747	education	0.007	education	0.798
19	patient	0.737	school	0.007	self	0.818
20	school	0.727	child	0.007	Korea	0.839

DC: degree centrality; BC: betweenness centrality; CC: close centrality

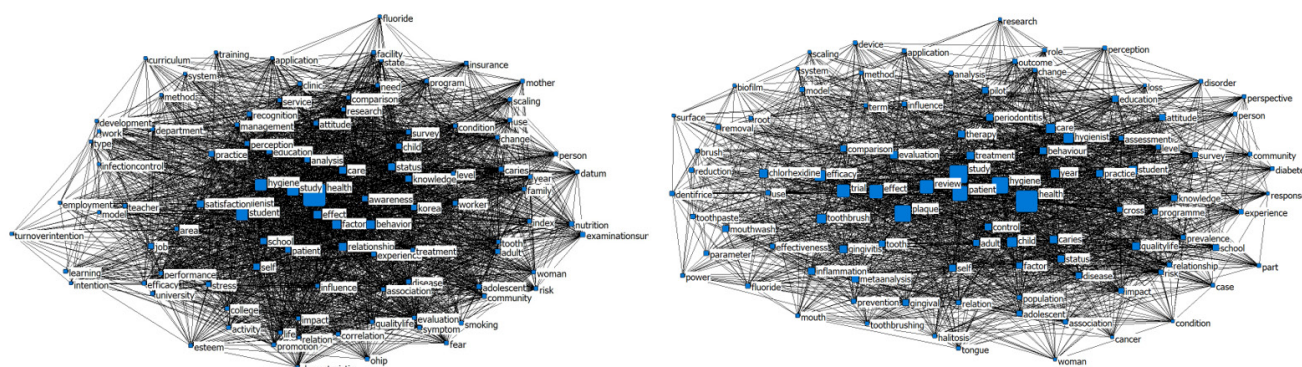
3. CONCOR analysis results

The CONCOR analysis revealed that the clusters obtained from the two journals are displayed in <Fig. 5>, with each journal showing four distinct clusters.

Table 3. Centrality of international research of key words network

Rank	DC		BC		CC	
	Key word	N	Key word	N	Key word	N
1	study	0.939	study	0.033	study	0.943
2	hygiene	0.889	review	0.027	hygiene	0.900
3	patient	0.848	hygiene	0.025	patient	0.868
4	review	0.848	patient	0.023	review	0.868
5	health	0.838	health	0.020	health	0.861
6	plaque	0.798	plaque	0.019	plaque	0.832
7	effect	0.758	effect	0.018	effect	0.805
8	hygienist	0.707	hygienist	0.014	hygienist	0.773
9	trial	0.707	evaluation	0.014	trial	0.773
10	treatment	0.697	treatment	0.014	treatment	0.767
11	year	0.687	trial	0.013	year	0.762
12	child	0.677	control	0.011	child	0.756
13	evaluation	0.677	child	0.011	evaluation	0.756
14	control	0.667	efficacy	0.010	control	0.750
15	care	0.626	year	0.010	care	0.728
16	efficacy	0.626	care	0.010	efficacy	0.728
17	caries	0.616	therapy	0.009	caries	0.723
18	therapy	0.616	tooth	0.009	therapy	0.723
19	factor	0.616	periodontitis	0.009	factor	0.723
20	behaviour	0.606	behaviour	0.008	behaviour	0.717

DC: degree centrality; BC: betweenness centrality; CC: close centrality



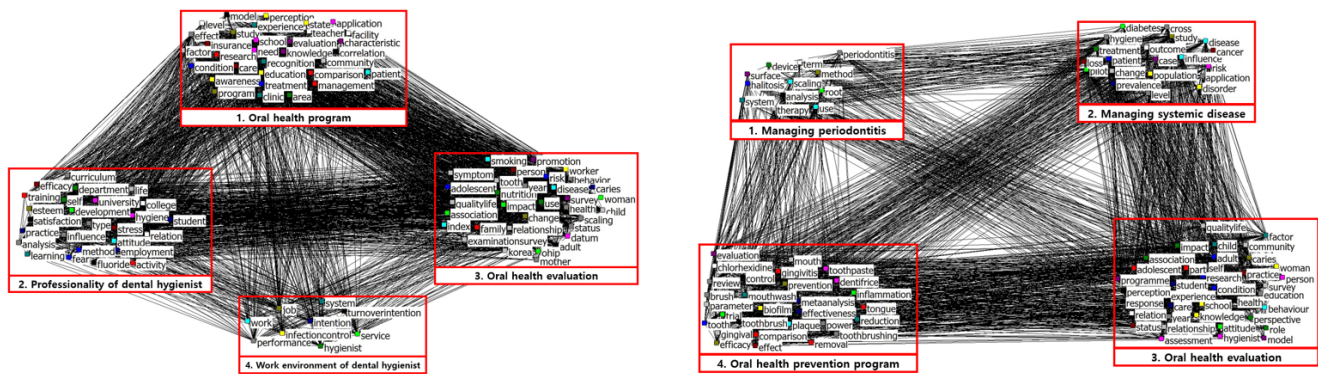
A. Journal of Korean Society of Dental Hygiene

B. International Journal of Dental Hygiene

Fig. 4. Network visualization of degree centrality of domestic and international studies

The four categories identified in JKSDH are ‘oral health program’, ‘professionalism of dental hygienist’, ‘oral health evaluation’, and ‘work environment of dental hygienist’. Cluster 1 pertains to ‘oral health program’ and contains terms like model, level, state, application, effect, study, evaluation, research, comparison, patient, management, treatment, and program. Cluster 2 focuses on ‘professionalism of dental hygienist’ and includes words such as curriculum, efficacy, training, satisfaction, learning, esteem, development, stress, practice, and activity. Cluster 3, which is the largest, relates to ‘oral health evaluation’ and features terms like symptom, person, tooth, nutrition, quality of life, survey, health, index, OHIP, and datum. Lastly, Cluster 4, the smallest, is associated with ‘work environment of dental hygienist’ and includes words like job, system, work, intention, turnover intention, service, and performance.

The four groups of IJDH are titled ‘managing periodontitis’, ‘managing systemic disease’, ‘oral health evaluation’, and ‘oral health prevention program’. The first group, ‘managing periodontitis’, consists of terms like periodontitis, device, scaling, method, halitosis, root, system, and therapy, making it the smallest group. The second group, ‘managing systemic disease’, includes terms such as diabetes, cross, hygiene, study, treatment, patient, loss, pilot, prevalence, and disorder. The third group, ‘oral health evaluation’, contains words like quality of life, impact, community, research, practice, condition, assessment, and model, making it the largest group. The fourth group, ‘oral health prevention program’, features terms such as evaluation, mouth, chlorhexidine, gingivitis, toothpaste, prevention, toothbrushing, dentifrice, biofilm, plaque, gingival, reduction, and comparison.



A. Journal of Korean Society of Dental Hygiene

B. International Journal of Dental Hygiene

Fig. 5. Visualization of CONCOR analysis of domestic and international studies

Discussion

This study examined the frequency, centrality, and clustering of keywords in articles from the JKSDH and the IJDH published from their inaugural issues through 2023, utilizing semantic network analysis and CONCOR analysis.

The objective of this study was to outline the research landscape by analyzing and comparing trends in dental hygiene research both domestically and internationally, utilizing semantic network analysis and CONCOR analysis to identify key research topics. For this purpose, articles published from the first issue up to 2023 in JKSDH and IJDH were chosen for analysis. The study focused on examining the frequency of keyword occurrences, centrality, and cluster composition, categorizing the research into domestic and international studies.

An analysis of the most commonly used words in JKSDH and IJDH over the last two decades showed that the top four words were ‘health’, ‘study’, ‘hygiene’, and ‘hygienist’. Although the rankings of ‘study’ and ‘hygiene’ varied, the overall order remained consistent. In examining the frequency of words within the top ten, ‘effect’ and ‘care’ were also frequently mentioned. Furthermore, certain words were unique to each journal: ‘student’, ‘factor’, ‘relationship’, and ‘behavior’ were exclusive to JKSDH, while ‘patient’, ‘plaque’, ‘review’, and ‘trial’ were unique to IJDH. This suggests that research related to these common terms has been actively pursued. The differences in the frequency of high-occurrence words can be explained by the fact that most studies published in JKSDH focus on promoting behavioral changes in individuals through oral health prevention and education, drawing from various fields such as dentistry, biology, and education, and exhibiting strong social science elements [9].

The centrality analysis results indicated that the words appearing in the top 10 of both journals exhibited strong values in degree centrality, betweenness centrality, and closeness centrality when compared to keyword frequency data. Notably, terms such as 'health', 'study', 'hygiene', 'hygienist', 'effect', and 'care', which frequently appeared in the top 10 of both journals, demonstrated high centrality, suggesting active research in these areas. Furthermore, the significant mediation and connections among these keywords imply that dental hygiene research is focused on and building upon the concepts of 'health', 'effect', and 'care'. The visualization of the connection centrality analysis network showed that the most commonly used words in various studies had larger node sizes and were positioned at the center of the network [17].

The CONCOR analysis identified four clusters related to JKSDH: 'oral health program', 'professionalism of dental hygienist', 'oral health evaluation', and 'work environment of dental hygienist'. The first three clusters- 'oral health program', 'professionalism of dental hygienist', and 'oral health evaluation' -are deemed relevant in a context where dental hygienists are expected to function as care service providers and experts in prevention and education, thereby fulfilling their roles as healthcare professionals dedicated to restoring oral health. Dental hygienists are central figures in dental healthcare, undertaking various responsibilities in clinical settings, such as treatment, prevention, education, patient management, and administration. Nonetheless, the high turnover rate among dental hygienists globally is acknowledged as a critical issue that requires attention[18]. As a result, the cluster titled 'work environment of dental hygienist' suggests that studies have been carried out to explore different factors aimed at retaining skilled personnel who can improve the quality of medical services within the organization [19].

The IJDH research identified four main clusters: 'managing periodontitis', 'managing systemic disease', 'oral health evaluation', and 'oral health prevention program'. Among these, 'oral health evaluation' was the largest cluster, similar to findings from JKSDH, highlighting the significant emphasis on oral health assessment in both national and international studies, with a concentration of related research in this area. However, the other clusters revealed differences in thematic trends between domestic and international research, which contrasts with the JKSDH clusters. Periodontal disease is an infectious condition caused by harmful bacteria found in dental plaque, which can lead to and worsen systemic diseases [20,21]. As a result, the findings from the research on 'managing periodontitis', 'managing systemic disease', and 'oral health prevention program' at IJDH can be understood in terms of the frequency of occurrence, which suggests that adequate related studies have been carried out. Since JKSDH has less research on 'managing periodontitis', 'managing systemic disease', and 'oral health prevention program' compared to IJDH, it is hoped that more evidence-based dental hygiene research will be conducted in the future. This will help build a unique knowledge system in dental hygiene and enhance the professionalism of dental hygienists.

This study aimed to identify the current status of dental hygiene research both in Korea and internationally, while also suggesting future directions for this field. However, a limitation of this study is that we were unable to analyze the chronological progression of the two journals from their first issue to the most recent one. Consequently, it is suggested that future research should carry out a temporal network comparison to offer clearer insights into the evolution and shifts in research topics.

Conclusions

This study aimed to analyze research trends in dental hygiene both nationally and internationally. We focused on papers published from the first issue up to 2023 in JKSDH and IJDH, leading to the following findings.

1. A frequency analysis of keywords revealed that the most common terms in JKSDH were 'health', 'study', 'hygiene', 'hygienist', 'student', 'factor', 'effect', 'relationship', 'behavior', and 'care', listed in that order. In IJDH, the top keywords were 'health', 'hygiene', 'study', 'hygienist', 'patient', 'effect', 'plaque', 'review', 'trial', and 'care', also in that order. Centrality analysis indicated that the words in the top 10 frequency lists exhibited high values for degree centrality, betweenness centrality, and closeness centrality in both journals.

2. JKSDH featured significant central nodes such as 'health', 'study', 'hygiene', 'hygienist', 'student', 'factor', 'effect', 'relationship',

'behavior', and 'care'. Similarly, IJDH also had prominent central nodes, including 'health', 'hygiene', 'study', 'hygienist', 'patient', 'effect', 'plaque', 'review', 'trial', and 'care'.

3. The CONCOR analysis revealed four clusters for JKSDH: 'oral health program', 'professionalism of dental hygienists', 'oral health assessment', and 'dental hygienist work environment'. For IJDH, the four clusters identified were 'periodontitis management', 'systemic disease management', 'oral health assessment', and 'oral health prevention program'.

It is anticipated that future dental hygiene research in Korea will focus on evidence-based practices, which can serve as a foundation for enhancing the professionalism of dental hygienists through a unique knowledge system in the field of dental hygiene.

Notes

Author Contributions

Conceptualization: YJ Kim; Data collection: YJ Kim; Formal analysis: YJ Kim, SY Kim; Writing-original draft: YJ Kim, SY Kim; Writing-review&editing: YJ Kim, SY Kim, SY Kim

Conflicts of Interest

YJ Kim has been a member of editorial committee of the Journal of Korean Society of Dental Hygiene. She is not involved in the review process of this manuscript. Otherwise, there was no conflicts of interest.

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Ethical Statement

Non-human or animal research.

Data availability

Data can be obtained from the corresponding author.

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의미연결망 분석을 활용한 치위생학 연구동향 분석 : 국내 연구와 국외 연구의 비교

초록

연구목적: 본 연구는 치위생학 연구의 국내·외 연구동향을 파악하기 위해 수행하였다. **연구방법:** JKSDH (Journal of Korean Society of Dental Hygiene)는 1,689편(단어 수 7,575개), IJDH (International Journal of Dental Hygiene)는 1,089편(단어 수 10,194개)를 대상으로 의미연결망과 CONCOR 분석을 실시하였다. **연구결과:** 중심성 분석결과, 출현빈도 10위 안에 있는 단어들은 두 저널에서 모두 연결중심성, 매개중심성, 근접중심성이 높은 것으로 나타났다. CONCOR 분석 결과, JKSDH의 4개 군집은 'oral health program', 'professionalism of dental hygienist', 'oral health evaluation', 'work environment of dental hygienist'로 도출되었다. IJDH의 4개 군집은 'managing periodontitis', 'managing systemic disease', 'oral health evaluation', 'oral health prevention program'으로 도출되었다. **결론:** 이상의 결과를 통해 향후 국내 치위생학 연구에서는 치위생학의 고유한 지식체계를 갖추고 치과위생사의 전문성 향상의 밑거름이 될 수 있는 근거기반의 치위생학 연구가 많이 이루어질 것을 기대한다.

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