

Analysis of Dental Hygienist Job Recognition Using Text Mining

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Background: The aim of this study was to analyze the public demand for information about the job of dental hygienists by mining text data collected from the online Q & A section on an Internet portal site.

Methods: Text data were collected from inquiries that were posted on the Naver Q & A section from January 2003 to July 2020 using “dental hygienist job recognition,” “role recognition,” “medical assistance,” and “scaling” as search keywords. Text mining techniques were used to identify significant Korean words and their frequency of occurrence. In addition, the association between words was analyzed.

Results: A total of 10,753 Korean words related to the job of dental hygienists were extracted from the text data. “Chi-lyo (treatment),” “chigwa (dental clinic),” “ske-illing (scaling),” “itmom (gum),” and “chia (tooth)” were the five most frequently used words. The words were classified into the following areas of job of the dental hygienist: periodontal disease treatment and prevention, medical assistance, patient care and consultation, and others. Among these areas, the number of words related to medical assistance was the largest, with sixty-six association rules found between the words, and “chi-lyo,” “chigwa,” and “ske-illing” as core words.

Conclusion: The public demand for information about the job of dental hygienists was mainly related to “chi-lyo,” “chigwa,” and “ske-illing” as core words, demonstrating that scaling is recognized by the public as the job of a dental hygienist. However, the high demand for information related to treatment and medical assistance in the context of dental hygienists indicates that the job of dental hygienists is recognized by the public as being more focused on medical assistance than preventive dental care that are provided with job autonomy.

Key Words: Awareness, Dental hygienist, Job description, Recognition, Text mining

Introduction

The Korean dental hygienist group has come to establish an academic basis for the reestablishment of the legal job of a dental hygienist in order to strengthen the institutional protection of the scope of the dental hygienists’ actual job in Korean clinical settings¹⁾. One of

the external factors driving this movement is the public awareness of the jobs performed by dental hygienists. The job is a main factor recognizing dental hygienists to the public^{2,3)}. It has been reported that medical assistant of dentists’ work⁴⁻⁷⁾, scaling, and other preventive procedures^{3,7)} were the most common work practices that the general population received from dental hygienists. As the public

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awareness of the job of dental hygienists is related to dental treatment procedures which are not clearly defined in law, the public should have a clear awareness of the professional role of dental hygienists so that dental hygienists can perform legal job and ensure the public's oral health under the protection in law. For this, it is necessary to understand the current level of awareness and demand for information about dental hygienists by the public. Given that previous studies on this topic were conducted through interviews or panel surveys, and had disadvantages in terms of access to study participants and limited sample size, it is necessary to investigate information based on a large general population.

Social big data has been generated as a result of the rapid increase in the use of mobile Internet and social media in everyday life⁸⁾, and represents a source of public opinion⁹⁾. The messages in social big data such as social media and text messages contribute to the development of public policy by measuring public understanding and the sentiment of social issues based on the application of text mining, visualization, and statistical analysis¹⁰⁾.

Previous dental hygiene studies using social big data and text mining techniques have mainly reported the results of analysis of general information related to dental hygienists. A previous study analyzed the inquiries retrieved from the Q & A section on an Internet portal site using the Korean names for dental hygienists. This study confirmed that the words used in most inquiries were related to entrance examination, employment, and the job of dental hygienists, depending on age groups¹¹⁾. Another study analyzed inquiries posted by dental hygienists and the general public through various Internet sites, and reported that words relating to the job or career choice were used by the general public, and words relating to dental practice and turnover were used by dental hygienists¹²⁾. This demand for information focused on the job and career of dental hygienists indicates a continued public interest in this job. However, at the same time, it also suggests that detailed information about the job is not widely-known across society. Thus, to facilitate accurate understanding of the jobs of dental hygienists, it is important to understand what information the general public requires, and to what extent. Therefore, we sought

to analyze social big data related to the job of dental hygienists retrieved from online Q & A sections on an Internet portal site using text mining techniques. This study confirmed the public's awareness and demand for information about the jobs of dental hygienists.

Materials and Methods

Text mining is a method of classifying and refining text data, and is used to discover meaningful information hidden in big data by analyzing the frequency of occurrence of keywords and summarizing the results⁹⁾. As the first step after collecting the data of interest online, the text data are transformed to a form that the computer can understand using natural language processing. Next, stop words are removed, leaving only nouns that can be extracted as words. In this study, the frequency of occurrence of keywords, visualization of the frequency, and the association between the words were analyzed using this process.

1. Data collection

Data were collected from inquiries that were posted on the Q & A section of the Naver which is a portal site, called Naver "Jishik-iN" from January 2003 to July 2020 using a web crawling technique. A data search was performed with "dental hygienist role recognition," "dental hygienist job recognition," "dental hygienist medical assistant," and "dental hygienist scaling" as keywords. The keywords were selected to search the contents and titles of inquiries that directly related to the jobs of dental hygienists. The words were also used in consideration of the fact that the most common hygienist services received by the public were medical assistance and scaling^{4,5)}. Only the titles and contents of all retrieved inquiries (2,038 in total) were collected, and responses to the inquiries were excluded.

2. Text preprocessing and analysis

Preprocessing of the collected text data was performed using text mining techniques to extract and refine significant words. The text preprocessing workflow and examples are listed in Table 1.

Table 2. Term Frequency Matrix (TFM) Related to Dental Hygienists' Job by Frequency of Occurrence in Questions Retrieved from Naver "Jishik-IN"

	Term	Frequency	Rank	Term	Frequency	Rank	Term	Frequency	Rank	Term	Frequency	Rank	Term	Frequency	Rank
1	chi-lyo	6,870	21	apni	1,530	41	sangtae	762	61	gongbu	540	81	chwieob	384	
2	chigwa	6,564	22	gung-geum	1,482	42	chigwausa	762	62	gwanlyeon	534	82	visaeng	378	
3	ske-illing	6,486	23	saeng-gag	1,470	43	ganhojomusa	744	63	jomusa	534	83	geummi	372	
4	itmom	5,880	24	daehag	1,308	44	jagyeogjeung	732	64	ganeung	522	84	seolmyeong	372	
5	chia	4,668	25	jegeo	1,260	45	jeonmun	708	65	mibaeg	522	85	sijag	366	
6	chiwisaengsa ^a	3,606	26	seonsaengnim	1,188	46	geogjeong	672	66	crown	522	86	chiwisaenghag-gwa	366	
7	chungchi	3,168	27	implant	1,164	47	yeonjeung	666	67	chai	516	87	ilban	360	
8	ganhosa	3,126	28	man-won	1,092	48	isang	648	68	ganho	510	88	jol-eob	360	
9	skelling	2,958	29	gyojeong	1,056	49	balchi	642	69	seongjeog	492	89	godeunghaggyo	354	
10	uisa	2,688	30	salangni	1,050	50	wisaengsa	636	70	hagsaeng	492	90	jonglyu	354	
11	chiseog	2,670	31	jinlyo	1,044	51	bangbeob	624	71	wonjang	480	91	wolgeub	348	
12	eogeummi	2,226	32	tongjeung	1,026	52	boheom	618	72	gamsa	462	92	chiagyojeong	342	
13	ippal	2,208	33	yangchi	984	53	yangchijil	618	73	chiwi	456	93	imsi	336	
14	singyeong	2,166	34	biyong	972	54	yeoja	594	74	gomin	450	94	gumeong	330	
15	jigeob	2,100	35	itmom-chi-lyo	942	55	hwanja	594	75	pil-yo	450	95	geunmu	330	
16	chiwisaeng-gwa	2,076	36	munje	924	56	gwanli	588	76	hagnyeon	438	96	amalgam	324	
17	byeongwon	1,932	37	resin	894	57	sajin	582	77	chis-sol	414	97	geomjin	312	
18	jilmun	1,932	38	gagyeog	852	58	daehaggyo	564	78	jeog-yong	408	98	sisul	312	
19	jeongdo	1,920	39	salam	816	59	haggyo	558	79	chucheon	408	99	jalmos	312	
20	chigwawisaengsa ^b	1,902	40	sigan	816	60	machwi	552	80	alaenni	396	100	jeonche	312	

^aAn abbreviation for chigwawisaengsa that is Korean for dental hygienist.^bKorean for dental hygienist.

Results

1. Results of word extraction and word cloud

A total of 265,872 Korean words were collected from 2,038 inquiries retrieved from Naver “Jishik-iN.” After composing a TFM by frequency occurrence of each word, a total of 10,753 different Korean words were identified. Fig. 1 shows a word cloud representing the 500 most frequently used words related to the job of dental hygienists. It can be seen that “chi-lyo” (treatment), “chigwa” (dental clinic), “ske-illing” (scaling), “itmom” (gum), “chia” (tooth), and “chiwisaengsa” (an abbreviation for chigwawisaengsa, which is Korean for dental hygienist) were the most frequently used words (Fig. 1).

2. Frequently used words and their classification based on the job area of dental hygienists

Table 2 lists the 100 most frequently used Korean words and their frequencies. By dividing the word by the job area of dental hygienists, “ske-illing” (scaling, 3rd), “itmom” (gum, 4th), “chiseog” (dental calculus, 11th), “itmom-chi-lyo” (treatment of the gingival or periodontal disease, 35th),

and “yeomjeung” (inflammation, 47th) were the most frequently used words related to the treatment and prevention of periodontal disease.

The most frequently used words related to the medical assistant areas were “chungchi” (dental caries, 7th), “singyeong” (nerve, 14th), “implant” (27th), “gyojeong” (orthodontics, 29th), “jinlyo” (dental treatment or appointment, 31st), “resin” (37th), “balchi” (extraction, 49th), “machwi” (anesthesia, 60th), “crown” (66th), “geumni” (gold crown, 83rd), “imsi” (temporary, 93rd), and “amalgam” (96th). The number of words related to this work area was greater than that in other areas.

The most frequently used words related to patient care, cost consultation, and medical insurance claims were “biyong” (cost, 34th), “gagyeog” (price, 38th), “boheom” (insurance, 52nd), and “seolmyeong” (explanation, 84th).

In addition, “jeonmun” (specialty, 45th), “gwanli” (management, 56th), “mibaeg” (whitening, 65th), “gemjin” (examination, 97th), and “sisul” (procedure, 98th) were found as the job of dental hygienists-related words.

Regarding occupational titles, “chiwisaengsa” (Korean abbreviation for chigwawisaengsa, dental hygienist, 6th),

Table 3. Association Rules between Word Pairs in the Top 10 and Word Pairs of the Korean Words for Dental Hygienist (Chiwisaengsa and Chigwawisaengsa)

Rank ^a	Association rules		Support ^b	Confidence ^c	Lift ^d
	Antecedent	Consequent			
1	Seonsaengnim (sir)	Uisa (doctor)	0.01	0.68	14.87
2	Jegeo (removal)	Chiseog (dental calculus)	0.02	0.72	12.91
3	Singyeong (nerve)	Chi-lyo (treatment)	0.03	0.86	8.35
4	Yeomjeung (inflammation)	Itmom (gum)	0.01	0.81	7.13
5	Resin	Chi-lyo (treatment)	0.01	0.64	6.23
6	Biyong (cost)	Chi-lyo (treatment)	0.01	0.54	5.19
7	Uisa (doctor)	Chi-lyo (treatment)	0.02	0.53	5.08
8	Chungchi (dental caries)	Chi-lyo (treatment)	0.03	0.52	5.07
9	Seonsaengnim (sir)	Chigwa (dental clinic)	0.01	0.68	4.90
10	Seonsaengnim (sir)	Chi-lyo (treatment)	0.01	0.50	4.83
...
58	Chiwisaengsa ^e	Chigwa (dental clinic)	0.02	0.35	2.54
...
66	Chigwawisaengsa ^e	Chigwa (dental clinic)	0.01	0.31	2.26

^aRanks were determined according to the degree of lift value. The top 10 word-pairs show the confidence of association greater than 0.5.

^bSupport, probability of simultaneous occurrence of words A and B.

^cConfidence, probability of occurrence of word B when word A is appeared.

^dLift, degree of association between words A and B. The higher lift value means that there is a higher probability of simultaneous occurrence of words A and B, comparing to probability of occurrence of the two words by chance¹⁴⁾.

^eChiwisaengsa and chigwawisaengsa are Korean words for dental hygienist.

“ganhosa” (nurse, 8th), “uisa” (doctor, 10th), “chigwawisaengsa” (dental hygienist, 20th), “seonsaengnim” (sir, 26th), “chigwauisa” (dentist, 42nd), “ganhojomusa” (nurse assistant, 43rd), and “wisaengsa” (hygienist, 50th) were identified as frequently used words.

Although “egseulei” (X-rays, 107th), “chisil” (dental floss, 117th), “bocheol” (prosthetics, 148th), “chiju” (periodontal, 163rd), “dambae” (cigarettes, 171st), “sodog” (disinfection, 180th), and “xylitol” (183rd) were not included in the list in Table 2, they were detected as noteworthy words related to the job of dental hygienists.

3. Association rules between word pairs

Table 3 shows the top 10 word pairs showing association rules according to the degree of association (lift value), in which the confidence of association is greater than 0.5. The table also presents word pairs of the words “chiwisaengsa” and “chigwawisaengsa” (dental hygienist). Sixty-six rules were found as a result of the association

analysis, and the words of each pair were positively associated ($\text{lift} > 1$). This indicates that the occurrence of the two words is related. The degree of association between “seonsaengnim” and “uisa” (doctor) was the highest ($\text{lift} = 14.87$). “Chi-lyo” had associations with multiple words ($\text{lift} = 4.83 \sim 8.35$), so it was more likely to exist with “singyeong,” “resin,” “biyong,” “uisa,” “chungchi,” and “seonsaengnim.” The words “chiwisaengsa” and “chigwawisaengsa” had association with “chigwa,” and it was confirmed that these were likely to exist together.

Fig. 2 shows a networking map showing the information of 66 association rules. The arrow indicates the direction of association, and the circle size indicates the probability of simultaneous occurrence of the two words. The darker the circle color, the higher the association. The core words with the largest circle sizes were “chi-lyo,” “chigwa,” and “ske-illing.” This indicates that the core words are often accompanied by other words. Moreover, high association

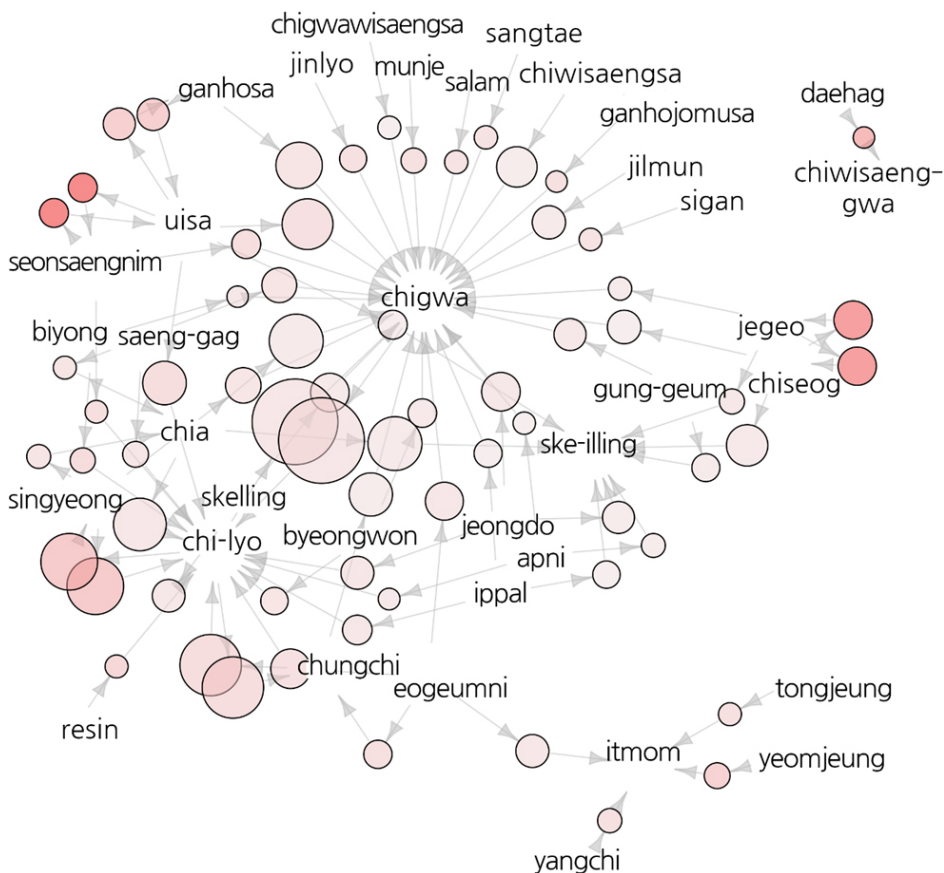


Fig. 2. Networking map reflecting 66 association rules between word pairs.

was observed between “seonsaengnim” and “uisa,” “chiseog” and “jegeo” (removal), and “daehag” (College) and “chiwisaeng-gwa” (Department of Dental Hygiene), based on darker circle colors. Two subgroups of association around the “itmom” and “chiwisaeng-gwa” were also observed in addition to the three core words-oriented associations.

Discussion

This study collected inquiries retrieved from Naver “Jishik-iN” with search words focused on the job and work of the dental hygienist. We extracted meaningful words from the text data using text mining techniques to confirm the public’s awareness and demand for information about the job of dental hygienists. As a result, “chi-lyo” (treatment), “chigwa” (dental clinic), and “ske-illing” (scaling) were found to be the most frequently used words. Moreover, it was confirmed that meaningful words related to treatment and prevention of periodontal disease, medical assistance, patient care and consultation, and others were used with high frequency in the inquiries when the extracted words were classified by the job areas of dental hygienists.

Dental calculus removal or scaling is highly valued by both dentists and dental hygienists¹⁵⁾. Moreover, several studies have reported that calculus removal or scaling is the most commonly performed job^{1,16)}, with 85.9% of medical workers¹⁷⁾ and 86% of prospective dentists¹⁸⁾ recognizing that the job is covered by dental hygienists. Corresponding to the recognition by experts, social recognition about scaling by the public was also found. Among the words extracted by text mining, “ske-illing” was the 3rd most frequently used word, and “skelling,” which also means scaling in Korean, was the 9th most frequently used word. This result is encouraging given the active role of dental hygienists in the clinical setting against the background of institutional changes. The job performed and name tags are the most important factors in distinguishing dental hygienists from other occupational types^{3,5,19)}. In Korea, removal of dental calculus has been provided as an expansion of coverage since July 2013, and the use of name tags has been mandated with the

implementation of medical service acts regarding the contents of name tags for medical personnel²⁰⁾. The expansion of coverage to include scaling resulted in an increase in preventive dental care utilization^{21,22)}, as well as the utilization of national health insurance scaling²¹⁾. Given that scaling is performed by dental hygienists, the wearing of name tags made it possible for the general public to recognize the dental hygienist as a practitioner of scaling, which would have contributed to the increased awareness of the job and the identification of the hygienists themselves¹⁸⁾.

The number of inquiries collected by the search keyword “dental hygienist medical assistance” was 21% of the total number of inquiries collected using all search keywords. Nevertheless, many words directly related to dental treatment procedures were extracted and included in the top 100 most frequently used words, including “chi-lyo,” “chungchi,” “singyeong,” “implant,” “gyojeong,” “itmom-chi-lyo,” “resin,” “balchi,” “machwi,” “crown,” and “amalgam”. In particular, “chi-lyo,” which means treatment, was highly associated with several words, including “singyeong,” “resin,” and “chungchi”. Moreover, the reliability of these associations, i.e., the probability of occurrence of “chi-lyo” in a sentence where the preceding words exist, were relatively high among the 66 association rules (confidence > 0.5; Table 3), suggesting that these words are often used together in sentences. Therefore, we consider that, in the inquiries about the job of dental hygienists, there is a relatively large demand for information related to dental treatment procedures that the public have previously received or are going to receive in the near future. This supports the previous findings that the most frequently received dental services from dental hygienists are preventive care or medical assistance^{5,6)}. However, in terms of the frequency and type of the derived words in the present study, it is worth noting that the terminology related to preventive dental care reflected by scaling is higher in the ranking, but the terminology related to medical assistance work is more quantitative. In addition, fluoride application and sealant have frequently appeared as the jobs of dental hygienists in many studies¹⁾, but the words were not detected in the top 100 frequently used words in this study. This result suggests that even

though preventive dental care is the main job of dental hygienists in the clinical setting, the jobs are not being provided proactively with job autonomy by dental hygienists.

There are some limitations to consider when interpreting the results of this study. First is the consideration for main age group that may generate the collected text data. A previous study investigated inquiries retrieved from Naver “Jishik-iN” using Korean words for dental hygienists as search words, and reported that the proportion of inquiries focused on employment and entrance exams were high, indicating that the collected data were primarily originated from the younger age group¹¹⁾. In the present study, words related to admission to the Department of Dental Hygiene (chiwisaeng-gwa, 16th; chiwisaenghag-gwa, 86th), College (daehag, 24th), and University (daehaggyo, 58th) were extracted as frequently used words, and an association rule was found between the words “chiwisaeng-gwa” and “daehag”. Moreover, career-related words such as “chwieob” (employment, 81st) and “jol-eob” (graduation, 88th) were listed in the top 100 frequently used words. Therefore, it is necessary to consider the possibility that the proportion of data formed by young people in their 10s, 20s, and 30s may have been large.

Second, the collection of text data in this study was only performed through one portal Internet site. We will consider the preferences of portal sites and social media channels according to age in future studies in an effort to ensure more comprehensive data.

In summary, the public demand for information related to the job of dental hygienists was mainly related to “chi-lyo” (treatment), “chigwa” (dental clinic), and “ske-illing” (scaling), demonstrating that scaling is recognized as the job of a dental hygienist by the public. However, from the perspective of the job areas of dental hygienists, the higher demand for information related to dental treatment procedures and medical assistance indicates that the public’s recognition of overall dental hygienists’ job is more focused on medical assistance than preventive dental care that is proactively provided by dental hygienists with job autonomy. The results of this study suggest that the legal scope of the jobs and work of

dental hygienists need to be reestablished to provide institutionally safe dental services; indeed, our findings can be used as the basis for granting its justification. In addition, as this study deals with information relating to the job scope of the dental hygienist as recognized by the public, it is expected that the results could be used as an indication to develop strategies for raising public awareness of the occupation of dental hygienists.

Notes

Conflict of interest

No potential conflict of interest relevant to this article was reported.

Ethical approval

This study is a review-based study and does not require an IRB review.

Author contributions

Conceptualization: Ji-Hyoung Han, Bo-Ra Kim, Eunsuk Ahn, Sun-Mi Kim, Soon-Jeong Jeong, and Soo-Jeong Hwang. Data acquisition: Ji-Hyoung Han, Bo-Ra Kim, Eunsuk Ahn, Sun-Mi Kim, Soon-Jeong Jeong, and Soo-Jeong Hwang. Formal analysis: Bo-Ra Kim, Ji-Hyoung Han, Eunsuk Ahn, Soo-Jeong Hwang, and Sun-Mi Kim. Supervision: Eunsuk Ahn and Ji-Hyoung Han. Writing—original draft: Bo-Ra Kim, Ji-Hyoung Han, Eunsuk Ahn, and Sun-Mi Kim. Writing—review & editing: Bo-Ra Kim, Eunsuk Ahn, and Sun-Mi Kim.

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