The association between visual impairment and dental care utilization in the Korean elderly

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ABSTRACT

Introduction: Individuals with visual impairment cannot recognize early-stage oral diseases, thus fail to receive prompt treatment.
Aims: To evaluate the association between visual impairment and dental care utilization in patients aged ≥ 65 years.
Design: Retrospective analysis.
Materials and methods: We analyzed annual pooled data collected by the Korean Health Panel between 2011 and 2014; a total of 1472 patients and 13,285 dental visits were analyzed. Visual impairment was categorized as follows: normal vision, moderate vision impairment, and severe vision impairment. Dental treatments were categorized as conservative, prosthodontic, implant, periodontal, surgical, preventive, or others. All data were statistically analyzed using a negative binomial regression.
Main outcome measure: Frequency of dental care utilization.
Results: Approximately 50% of the subjects had visual impairment. The frequency of dental care utilization for patients with severe vision impairment was 41% less than patients with normal vision. The dental care utilization for implant treatment was two times higher and periodontal treatment was 1.7 times lower than the conservative treatments among patients who reported moderate and severe vision impairment, respectively.
Conclusions: Visual impairment has a negative association with dental care utilization among older adults. It is imperative to implement systematic interventions to prevent visual impairment from becoming a barrier to dental care in this population.

1. Introduction

Age-related eye health issues are a global problem (Thomas, 2013; Wong, Loon, & Saw, 2006; World Health Organization [WHO], 2010, 2013). Owing to a growing and ageing population, there is a substantial increase in the number of people affected by blindness and visual impairment, and those more than 50 years of age account for 65% of visually impaired individuals (Bourne et al., 2017). However, it is estimated that more than 80% of all visual impairment could be prevented or cured (WHO, 2013), and to this end, countries have been urged to adopt efforts such as Universal Eye Health: A Global Action Plan (2014–2019). Its goals are to reduce the incidence of avoidable vision impairment to about 25% from 2010 to 2019 (Bourne et al., 2017). Because vision affects various aspects of daily living, it is important to manage visual acuity and promote healthy ageing.

The main causes of visual impairment include glaucoma, cataract, age-related macular degeneration, retinal diseases, refractive error, corneal opacities, and diabetic retinopathy (Foster & Resnikoff, 2005; Wong et al., 2006). If these diseases are not properly treated, they can progress to blindness. In South Korea, which became an aged society in 2017 (Ministry of the Interior & Safety, 2017), 61.2% elderly individuals use low-vision aids, and 40% have experienced discomfort with their vision (Ministry of Health & Welfare & Korea Institute for Health & Social Affairs, 2014). In particular, 75.5% of low-income elderly individuals complain of poor eyesight (Jeon, 2009). According to the Health Insurance Review and Assessment Service (2018), between 2012 and 2016, the proportion of patients aged ≥ 60 years who visited the hospital for glaucoma, macular degeneration, retinal diseases, and cataracts increased by 53%, 55%, 39%, and 15%, respectively. This increase in vision-related diseases can affect socialization,

communication, and independence. Moreover, among complications caused by the heightened prevalence of diabetes, hypertension, and cardiovascular diseases, retinal diseases increase the risk of visual impairment (Berry, Mascia, & Steinman, 2004). In addition to daily living, oral health can also be negatively affected by physical and social barriers in visually impaired patients, such as poor accessibility to transport and medical services, insufficient resources or financial support, and lack of social awareness (Edwards & Merry, 2002; Schembri & Fiske, 2001).

The WHO (2006) reported that visual impairment reduces the ability of elderly individuals to maintain oral health and recognize signs of oral diseases. Walsh (2017) claimed that visual and fine motor impairments in elderly individuals are severe problems that lead to difficulties in manual toothbrushing and avoidance of interdental brushing. Furthermore, they are a major cause of restoration failure due to recurrent caries. Watson, Moles, Kumar, and Porter (2010) reported that, when compared with healthy adults, adults with visual impairment are less likely to participate in regular dental examinations and more likely to require tooth extraction over restoration. Moreover, because individuals with visual impairment are unable to detect or recognize oral diseases, such as dental caries or gingival bleeding, in the early stages, it is difficult for them to receive prompt treatment unless they are informed of their oral health status (Petersen & Ueda, 2008; Rogers, 2011; Schembri & Fiske, 2001). Thus, it is important to examine the effects of visual acuity on the maintenance of oral hygiene in this population. In the present study, we used data from the Korean Health Panel (KHP) to examine the association between visual impairment and oral health in individuals aged over 65 years and compared the findings with those published in the literature. We then used our findings to propose future directions for dental care for visually impaired elderly patients.

2. Materials and methods

2.1. Data and variables

2.1.1. Data source

We analyzed annual pooled data collected by KHP between 2011 and 2014. Because of the low number of patients aged over 65 years who utilized dental care or responded to questions about visual problems in the KHP survey, we pooled data by year to improve the stability of the data and increase the sample size; this technique is validated by research based on the US Medical Expenditure Panel Survey (Richard, Alexandre, Lara, & Akamigbo, 2011; Selden & Hudson, 2006; Yu & Machlin, 2005). The analytical units were individual-identified so that there were no duplicate values for the four-year study period. The final data included 13,285 dental visits by 1472 patients in 1238 households.

The KHP is a reliable, government-approved statistical survey (established in Article 18 of the Statistics Act and Article 26 of the Enforcement Decree of the same act [No. 92012]) that aims to construct panel data in order to not only provide data on the type of medical utilization and scale of medical expenditure but also enable comprehensive, in-depth analysis of factors affecting these data. Phase 1 began in 2008; since then, the survey has been conducted every year up to 2017 (Thomas, 2013). This study was reviewed and approved by the Institutional Review Board of Eulji University, Seongnam, South Korea (EUIRB2018-90); the requirement for informed consent was waived because the study comprised a secondary data analysis of the KHP database.

2.1.2. Study variables

The number of visits (i.e., dental care utilization) was used as the dependent variable. As independent variables, we selected sex, age, the marital status, the education level, the income, the number of chronic diseases, the activities of daily living (ADL) status, and type of dental care. With regard to the type of dental care, there were a total of 12

possibilities that were divided into the following categories: conservative treatment, including endodontic treatment, dental caries treatment (e.g., amalgam filling and glass ionomer filling), desensitizing treatment, pulp capping, simple treatment, dental sedative filling, removal of restoration, occlusal adjustment, rubber dam application, restoration polishing, and tooth bleaching; prosthodontic treatment, including denture, implant therapy; periodontal treatment; oral and maxillofacial surgery, including tooth extraction; preventive treatment, including sealant, professional fluoride therapy, fluoride varnish; and others, including oral examination, oral health education and consultation, X-rays (periapical), stomatitis, simple inflammation, halitosis, dry mouth, hot and cold caloric examination, tooth mobility test, etc. (Korea Health Panel Survey, 2016). Orthodontic treatment was excluded because there were no subjects for this category. As demographic characteristics, we examined sex, the marital status, and age, which was categorized into 5-year age groups. For socioeconomic characteristics, we examined education level (categorized as primary school or lower, middle school, high school, and university or higher) and total annual household income (sum of total earned income and total asset income in the household). The household income standard was based on the average household income of 30 million won (1 USD = 1113 won) in households of those 65 years of age or older. Income categories included: less than 999; more than 1000–less than 2999; more than 3000–less than 4999; and more than 5000 (unit: 10,000 won) (Statistics Korea, 2016).

As health-related characteristics, we examined the number of chronic diseases, ADL status, and vision function. The prevalence of chronic diseases in the Korean population is 83.7% for adults aged 60–69 years, who exhibit an average of three chronic diseases, and 91.3% for adults aged 70–79 years, who exhibit an average of 3.5 chronic diseases (Jung et al., 2011); therefore, we looked at the specific number of chronic diseases and categorized it into four bins: 1–2, 3–4, 5–6, and ≥7. To examine whether current disease and health status are associated with medical utilisation in older adults, ADL was included, which includes the following four categories: "independent," "independent with difficulty," "need help," and "dependent." To evaluate vision function, the subjects subjectively reported whether they experienced normal vision, moderate vision impairment, severe vision impairment, or blindness (WHO, 2017) in response to the question: "Do you have any problems with your vision, while wearing glasses or contact lenses, if necessary?" afterwards, during a review of the records. Because few subjects reported blindness, they were included in the group that reported severe vision impairment for analysis.

2.2. Statistical analyses

Medical services utilization and medical expense data have special considerations. First, a large number of subjects did not receive care or treatment during the observation period. Second, among subjects who did receive care or treatment, medical consumers were typically skewed to one side; this pattern can be observed for variables such as frequency of medical care utilization, length of stay, and cost. Third, covariance analysis revealed a nonlinear pattern. Fourth, the level of medical care utilization may have changed, depending on the cost (Deb, Manning, & Norton, 2010). This means that traditional linear regression analyses, such as ordinary least squares, were not sufficient for these data. Generally, when the dependent variable is a count datum, a Poisson or negative binomial model is used. However, a Poisson model requires the assumption that the mean and overdispersion are the same, whereas for observed data, the possibility that overdispersion increases relative to the mean cannot be excluded (Deb et al., 2010; Greene, 2008). Thus, in the present study, we performed negative binomial regression for elderly patients who utilized dental care at least once in order to investigate the association of visual impairment and its extent on the amount and type of dental care utilization by these patients. For the regression coefficient, we used the incidence rate ratio (IRR), with an

Table 1
Sociodemographic characteristics of dental care users.

Characteristics		N = 1472	%
Vision function	Normal vision	707	48.03
	Moderate vision impairment	661	44.90
	Severe vision impairment	104	7.07
Sex	Male	664	45.11
	Female	808	54.89
Age	65–69 years	380	25.82
	70–74 years	544	36.96
	75–79 years	334	22.69
	80–84 years	175	11.89
	≥85 years	39	2.65
Marital status	Married	1026	69.70
	Divorced/widowed /separated/unmarried	446	30.30
Education	Primary school or lower	811	55.10
	Middle school	267	18.14
	High school	279	18.95
	University or higher	115	7.81
Income	≤999	398	27.04
(unit: 10,000 won)	1000–2999	694	47.15
	3000–4999	233	15.83
	≥5000	147	9.99
No. of chronic diseases	1–2	415	28.19
(N = 1372)	3–4	469	31.86
	5–6	332	22.55
	≥7	256	17.39
ADL	Independent	1088	73.91
	Independent with difficulties	327	22.21
	Need help	46	3.13
	Dependent	11	0.75
Dental treatment	Conservative treatment	459	31.18
	Prosthetics	167	11.35
	Implants	57	3.87
	Periodontics	536	36.41
	Oral and maxillofacial surgery	112	7.61
	Preventive treatment	9	0.61
	Others	132	8.97

ADL, activities of daily living.

IRR greater than 1 indicating an increase in the frequency of a given event. All statistical analyses were performed using STATA 12.0 SE (StataCorp LP., College Station, TX, USA). A *P*-value of < 0.05 was considered statistically significant.

3. Results

3.1. Characteristics of patients who utilized dental care

Approximately 52% of the subjects had visual impairment. Those who utilized dental care were more likely to be women, aged 70–74 years, married, primary school graduates or lower, and total annual household income of 1000–2999 (unit: 10,000 won); moreover, they mostly had 3–4 chronic diseases and were capable of independent ADL. Among the types of dental care, periodontal and conservative treatments accounted for over 30% of the cases, with prosthodontic treatment being the next most common (Table 1).

3.2. Dental care utilization according to the type of dental treatment

Among the dental treatments, implant treatment was the most common reason for a dental visit per patient, with a median of 15 patient visits. As a median, patients visited eight times for prosthodontic treatment, seven times for conservative treatment, and five times for periodontal and preventive treatments (Table 2). Fig. 1 shows the frequency of dental care utilization according to visual function; an increased severity was associated with less dental care utilization.

Table 2
Mean and median number of dental care utilization by dental treatment.

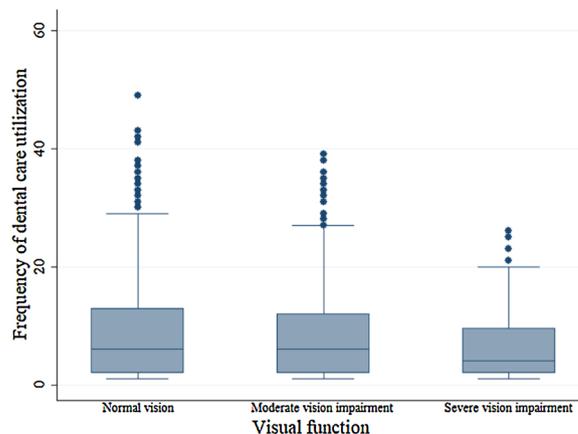|		Dental care utilization		
		Mean	Median	SD
Dental treatments	Conservative treatment	9.399	7	8.103
	Prosthetics	10.701	8	9.281
	Implants	17.860	15	15.966
	Periodontics	8.269	5	9.874
	Oral and maxillofacial surgery	5.607	3	6.935
	Preventive treatment	8.222	5	7.207
	Others	7.818	4	8.835

SD, standard deviation.

Fig. 1. Dental care utilization by visual function.

3.3. The association between visual impairment and dental care utilization

Table 3 shows the results of negative binomial regression, which analyzed the association of visual impairment and dental care utilization by older adults. To examine the impact on dental treatment, we performed the analysis on two different models. Model 1, adjusted for sex, age, the marital status, the education, income, the number of chronic diseases, and ADL, showed that dental care utilization was approximately 46% (1/0.686) lower for subjects with severe vision impairment than for those with normal vision. Model 2, which included dental treatment as a covariate, showed that dental care utilization was approximately 41% (1/0.707) lower for subjects with severe vision impairment. This suggested that visual impairment is negatively associated with dental care utilization.

3.4. The relevance of visual function and the types of dental treatment received

We investigated the relevance of visual function and the types of dental treatment received (Table 4). The subjects with normal vision showed a 1.7 times higher tendency to visit the dentist for implant treatment than for conservative treatment. However, oral and maxillofacial surgery was received less often by these patients (IRR < 1). The subjects with moderate vision impairment were twice as likely to visit the dentist for implant treatment than for conservative treatment, and the tendency to visit the dentist for periodontal treatment and oral and maxillofacial surgery was 1.2 and 1.5 times lower, respectively. Subjects with severe vision impairment tended to visit the dentist for periodontal treatment and others 1.7 times and 2 times less than for conservative treatment, respectively. This finding suggests poor dental care utilization for periodontal treatment in subjects with vision impairment.

Table 3
The association between visual impairment and dental care utilisation.

		Model 1 (N = 1472)				Model 2 (N = 1472)			
		IRR	P > z	CI		IRR	P > z	CI	
Vision function	Moderate vision impairment	0.927	0.140	0.838	1.025	0.935	0.179	0.847	1.032
(ref. normal vision)	Severe vision impairment	0.686	0.000	0.560	0.841	**0.707**	0.001	0.579	0.863
Sex (ref. male)	Female	0.958	0.452	0.856	1.072	0.956	0.427	0.855	1.069
Age	65–69	**1.463**	0.022	1.057	2.024	1.356	0.062	0.985	1.867
(ref. ≥ 85)	70–74	1.288	0.116	0.939	1.767	1.235	0.182	0.906	1.686
	75–79	1.329	0.082	0.965	1.830	1.286	0.117	0.939	1.762
	80–84	1.249	0.188	0.897	1.738	1.194	0.285	0.863	1.652
Marital status	Divorced/widowed	0.966	0.580	0.855	1.091	0.972	0.638	0.862	1.095
(ref. married)	/separated/unmarried								
Education	Middle school	1.000	0.996	0.874	1.144	1.016	0.808	0.891	1.160
(ref. primary school or lower)	High school	1.024	0.736	0.893	1.174	1.045	0.518	0.914	1.195
	University or higher	1.144	0.169	0.944	1.387	1.142	0.169	0.945	1.379
[a]Income	1000–2999	1.107	0.100	0.981	1.249	1.063	0.312	0.944	1.198
(ref. ≤ 999)	3000–4999	0.949	0.528	0.808	1.116	0.921	0.310	0.786	1.080
	≥5000	0.990	0.918	0.825	1.189	0.965	0.697	0.807	1.154
No. of chronic disease (ref. 1–2)	3–4	1.108	0.106	0.978	1.255	1.098	0.137	0.971	1.241
	5–6	**1.248**	0.002	1.088	1.432	**1.243**	0.002	1.085	1.424
	≥7	**1.333**	0.000	1.145	1.553	**1.325**	0.000	1.139	1.541
ADL	Independent with difficulties	0.940	0.316	0.832	1.061	0.903	0.097	0.801	1.019
(ref. independent)	Need help	1.107	0.490	0.829	1.479	1.084	0.578	0.816	1.440
	Dependent	**0.445**	0.009	0.243	0.816	**0.419**	0.004	0.231	0.759
Dental treatment	Prosthetics					**1.179**	0.047	1.002	1.387
(ref. conservative treatment)	Implants					**1.767**	0.000	1.386	2.253
	Periodontics					**0.862**	0.012	0.769	0.967
	Oral and maxillofacial surgery					**0.600**	0.000	0.494	0.729
	Preventive treatment					0.880	0.680	0.480	1.614
	Others					0.840	0.054	0.703	1.003

ADL, activities of daily living.
If the p-value is less than 0.05, IRR had statistically significant.
[a] Unit: 10,000 won; Model 1: adjusted for sex, age, marital status, educational, income, the number of chronic diseases, and ADL; Model 2: Model 1 + dental treatments.

4. Discussion

Visual impairment is one of the most common health problems in older adults (Beck & Hunt, 1985), and it can affect access to dental care and oral health-related information. Regular dental care is recognized as important for maintaining oral hygiene standards. However, older people tend to consider dental disease an inevitable consequence of the ageing process and do not seek dental care until the disease has already progressed or arisen in an emergency situation (Razak et al., 2014). In the present study, we examined the association of visual impairment and dental care utilization in elderly individuals.

Using regression analysis, we found that the frequency of dental care utilization was 41% lower for subjects with severe visual impairment than for those with normal vision. Schembri and Fiske (2001) studied 62 legally blind individuals aged ≥60 years and found that 80% of the subjects were unaware of the need to receive regular oral examinations. Individuals only sought treatment when they themselves were aware of an oral problem. Another study investigating 266 visually impaired Thai individuals aged 35–74 years found that approximately 74% did not seek dental care. The participants were more likely to seek dental care when their perceptions of the oral health status, oral health problems, and the dental service system were high (Wanichsaithong, Chompikul, Mongkolchati, & Chatiketu, 2015). Furthermore, a study of oral health and treatment demand in visually impaired Thai subjects aged 48.8 ± 5.9 years found that the subjects suffered because of impaired oral function (speaking, swallowing, tasting, and chewing problems); 32.1% had never visited a dentist and only 13.2% received regular examinations (Samnieng, Seehaumpai, Wichachai, & Yosookh, 2014). One study recruited a random sample of visually impaired adults from an ophthalmologist in the United Kingdom and found that they were less likely to access private dental care and had more unmet dental needs than did healthy adults.

Furthermore, the authors reported that they were twice as likely to utilize dental services when they developed a dental problem; however, the opposite was found for regular check-ups (Watson et al., 2010).

This study also confirmed negative trends in dental care utilization in subjects with visual impairment identified in previous studies. In 2017, the government improved accessibility and expanded the benefit coverage of dental care utilization through the "The benefit enhancement plan in Korean National Health Insurance" (Sunwoo, 2016), which was the national health insurance coverage extension for implants and dentures for older people. It was provided to reduce the burden of cost for dental care services by solving problems related to high copayment and non-coverage services. In addition, in 2018, when the dental cost for patients 65 years old or older exceeded 15,000 won, the rate of copayment was reduced by applying coinsurance (Ministry of Health & Welfare, 2017). If these measures reduce barriers to dental care utilization, the oral health and quality of life of community dwelling older adults as well as those with visual impairment can be expected to improve.

As the severity of vision problems increased, dental care utilization for periodontal treatment became lower than that of conservative treatment. This is because the oral health status of an individual with visual impairment can be affected by risk factors such as dental caries lesions, gingivitis, and periodontitis (Withagen, Vervloed, Janssen, Knoors, & Verhoeven, 2009). A previous study reported that 50%, 45%, 27%, and 21% of visually impaired individuals exhibited gingivitis, edentulism, chewing problems, and toothache or denture problems, respectively (Schembri & Fiske, 2001). In a study of 80 visually impaired individuals, periodontal conditions, such as gingivitis and periodontitis, were the most common, indicating poor oral hygiene (Maciel et al., 2009). Suhaim and Zahid (2015) also reported that self-care oral hygiene was affected when visual acuity was low. Samnieng et al. (2014) found that the mean decayed and filled teeth (DFT) score for

Table 4
The relevance of visual function and the types of dental treatment received.

		Visual impairment (normal vision) N = 707			Visual impairment (moderate vision impairment) N = 661			Visual impairment (severe vision impairment) N = 104		
		IRR	P > z	CI	IRR	P > z	CI	IRR	P > z	CI
Dental treatment (ref. conservative treatment)	Prosthetics	1.166	0.222	0.911 1.492	1.170	0.190	0.925 1.481	0.960	0.892	0.532 1.732
	Implants	**1.719**	0.001	1.232 2.398	**1.916**	0.001	1.324 2.771	1.373	0.708	0.261 7.213
	Periodontics	0.912	0.299	0.767 1.085	**0.819**	0.019	0.693 0.968	**0.598**	0.021	0.387 0.924
	Oral and maxillofacial surgery	**0.527**	0.000	0.397 0.699	**0.661**	0.005	0.496 0.880	0.681	0.329	0.315 1.472
	Preventive treatment	0.822	0.617	0.381 1.772	0.333	0.118	0.084 1.321	1.216	0.807	0.254 5.813
	Others	0.807	0.110	0.620 1.050	0.904	0.450	0.695 1.175	**0.505**	0.036	0.267 0.955

Adjusted by sex (male, female), age (65–69, 70–74, 75–79, 80–84, and ≥85), marital status (married, divorced/widowed/separated/unmarried), education (primary school or lower, middle school, high school, university or higher), income (≥999, 1000–2999, 3000–4999, and ≥5000), no. of chronic diseases (1–2, 3–4, 5–6, and ≥7), and ADL (independent, independent with difficulties, need help, and dependent). If the p-value is less than 0.05, IRR had statistically significant.

visually impaired patients was 5.8 (decayed teeth, 4.4; filled teeth, 1.4). Furthermore, 35% of the subjects required fillings, 12.3% required tooth extraction, and 34.8% had periodontal diseases. Liu et al. (2013) reported an average DFT score of 2.68 for elderly community residents. If this score is indirectly compared with that for the visually impaired, it can be assumed that the score for visually impaired older adults is higher, which means oral health conditions in older visually impaired people are likely worse than elderly community dwelling residents. Therefore, prophylactic and periodontal treatment for elderly adults with vision impairment will be needed.

This study demonstrates the association between chronic diseases and dental care utilization. According to Schneider, O'Donnell, and Dean (2009), the greater the number of chronic diseases, the higher the mean annual number of physician visits. This suggests that the use of oral medication has increased. Since the risk factors of oral health caused by taking medication are dry mouth with increased risk of caries, periodontal disease, oral infections, and denture problems (Griffiths, 2006), older people with chronic diseases are required to utilize dental care (Carramolino-Cuéllar et al., 2018). Therefore, the timely use of dental care services for visually impaired elderly people with poor oral hygiene should be considered as a factor to help improve general health.

Accordingly, a systematic intervention plan is needed to improve dental care utilization in individuals with vision impairment. This could be accomplished by expanding the benefit coverage of dental care, improving accessibility and transportation for medical/dental care, securing human resources and facilities, and improving public awareness. It is necessary to reduce the non-coverage services by expanding the benefit coverage for dental care by the Korean National Health Insurance to improve the oral health of older adults. In addition, accessibility within the range of daily activities of older adults should be improved. In order to improve transportation for the mobility handicapped, a systematic approach using interactive voice response (Coons et al., 2009) and mobile webpage, and mobile applications (Android and iOS) (Takizawa, Orita, Aoyagi, Ezaki, & Mizuno, 2017) are also needed. There should also be a link between ophthalmology and dental care. This can be achieved through an integrated approach that utilizes a district infrastructure (a team approach in a public health center) within the community that can professionally assess the health status of elderly individuals. There is a need to provide timely and appropriate health care services for older adults with visual impairment. This is because the health promotion of elderly people with visual impairment can be improved by increasing the possibility of using medical or dental services through expansion of the medical cooperation system between private and public organizations. To achieve this, it is necessary to improve the accessibility of audio related media so that the necessary information can be obtained by patients. It should also be accompanied by a brochure that is size-adjusted for levels of visual impairment and provides information to encourage family involvement.

In the dental clinic, for patients with mild problems, it is necessary to provide oral hygiene information leaflets with large and bold fonts. Furthermore, the patients may experience communication difficulty; in this case, appointment cards and information leaflets with large print can be provided to improve communication. (Dougall & Fiske, 2008; Greenwood, Jay, & Meechan, 2010) In patients with severe problems, some residual sight remains, but discoloration such as root caries is difficult to confirm. These patients require scaling and screening through regular recalls, which will prevent disease such as caries or gingival bleeding in advance (Schembri & Fiske, 2001) and should redirect provided services from treatment needs to preventive treatment. Moreover, dental staff should educate and encourage them to brush their teeth (Mohan, Raju, Gubbihal, & Kousalya, 2016). If possible, the use of auditory data such as an audio-tactile performance technique may be considered for providing oral health information (Joybell, Krshnan, & Kumar, 2015). During conversations with the patient, the dental staff should avoid strong lighting, which can interfere with

vision, and patients can be kept calm by providing information about each stage of the procedure before any sudden noises or sensory abnormalities (Dougall & Fiske, 2008).

This study had some limitations. In our study, we used subjective self-reporting rather than clinical measurements to investigate visual acuity. Self-reporting introduces self-reporting bias (e.g., recall bias). This was not used to confirm the subject's vision function at the time of dental care utilization. Instead, visual acuity was confirmed using the data provided from the KHP during the record review after using dental care. Nevertheless, self-rated health is effective in predicting current health status (Manor, Matthews, & Power, 2001). Second, this study does not provide data confirming expectation of dental health services according to the visual acuity of the subject, nor is this study a reflection of the personal demand for health care. In addition, because the specific dental status of the individual was not known, the root cause of the use of dental care could not be identified. Instead, dental care utilization could be predicted through the number of dental visits. Third, the causal relationship between visual impairment and dental care utilization could not be determined. Therefore, only the association between the two is confirmed.

Our study confirmed that visual impairment has a negative association with dental care utilization among elderly Korean individuals, similar to patterns observed in other developed countries. Therefore, there is a need to implement feasible systematic interventions to solve this issue using limited resources. To improve health in elderly individuals with chronic diseases, it is important to continue examining dental care utilization and consider these factors when establishing preventive policies to improve the quality of life.

Declaration of interests

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