

Relationship between the Subjective-Objective Oral Health Status and Oral Health Related Quality of Life in the Elderly

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The purpose of this study was to analyze the relationship between objective oral health status determined by dentists, self-perceived subjective oral health status, and oral health related quality of life (OHRQoL) in the elderly. The related factors affecting OHRQoL in the elderly were also surveyed. Four hundred and thirty elderly individuals who visited the three public health centers and four dental clinics in Busan were selected by convenience sampling. Twelve dental hygienists investigated the subjective oral health status and OHRQoL using the 14-item Oral Health Impact Profile (OHIP-14) and twentyone dentists examined the objective oral health status, including healthy remaining teeth, treated remaining teeth, functional remaining teeth, missing teeth, and non-treated missing teeth. Data were analyzed using SPSS ver. 12.0. OHRQoL was higher when oral and periodontal status was perceived as healthy, when there was no toothache, no interference in mastication, and when study subjects had the ability of food softening. It was also higher when study subjects had ≥ 20 remaining teeth and < 9 missing teeth, and were wearing denture. The related factors affecting OHRQoL of the elderly were the type of medical insurance, toothache, ability of food softening, perception of periodontal status, and the number of healthy remaining teeth. There was a significant relationship between the subjective-objective oral health status and OHRQoL in the elderly. A continuous oral health care system aimed at retaining ≥ 20 healthy remaining teeth is needed to improve oral health and OHRQoL for the elderly, especially for the elderly receiving medical aid.

Key Words: 14-item Oral Health Impact Profile, Elderly, Oral health, Oral health related quality of life

Introduction

South Korea entered an era of 'aging society' in 2000 with 7.2% of the elderly population over 65 years of age, and it is predicted that the proportion will be 14.3% in 2018, becoming an 'aged society,' and then 20.0% in 2025, a 'super aged society'¹⁾.

Oral health is closely related with systemic health conditions, including thyroid disease, arthritis, gastric ulcer, and cardiovascular disease^{2,3)}, and poor oral health causes decline of masticatory function and tooth loss, which leads to limitation of interpersonal relations and social life, and causes psychosocial issues, resulting in a

low quality of life⁴⁻⁶⁾. In particular, oral health is more important for health and quality of life in the elderly. An international study on quality of life found that promotion of oral health improved quality of life in the elderly, such as recovery of confidence and improvement in social relations⁷⁾. In a study in South Korea, the proportions of subjects aged 20 ~ 29 years, 40 ~ 49 years, and ≥ 60 years who answered that oral health was the most important issue than any other health issues for pursuing quality of life were 19.8%, 41.7%, and 64.5%, respectively, indicating that oral health becomes more important with age⁸⁾.

In studies on relationship between oral health status and oral health related quality of life (OHRQoL) in the elderly,

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Chen and Hunter⁹⁾ reported numbers of decayed teeth, missing teeth, filled teeth, and type of dentist visit as factors affecting OHRQoL. McGrath and Bedi¹⁰⁾ reported that tooth loss without removable prosthesis declined OHRQoL. In addition, Wong and McMillan¹¹⁾ reported that tooth loss and use of denture affected oral health related satisfaction of life. Studies in South Korea reported that tooth loss¹²⁾ and oral health level^{13,14)} of the elderly were correlated with the OHRQoL, and factors affecting OHRQoL of the elderly were number of missing teeth, subjective oral health status, and objective oral health status¹⁵⁾.

As such, various studies comparatively analyzed direct and indirect relationships among factors, however, there has been limited data analyzing OHRQoL with subdividing remaining teeth in the elderly by preservation and prosthesis into healthy remaining teeth, treated remaining teeth, and functional remaining teeth, and with subdividing missing teeth by treatment into missing teeth and non-treated missing teeth. Thus, this study investigated self-perceived subjective oral health status and subdivided objective oral health status observed by specialists, in order to identify their relationships with OHRQoL. In addition, we aimed to provide fundamental data for improving oral health and OHRQoL in the elderly by identifying the related factors affecting OHRQoL.

Materials and Methods

1. Subjects

This study was conducted with 430 elderly who were 65 years or older and visited one of the three public health centers and four dental clinics in Busan Metropolitan City between July and September in 2016. Prior to participating, all participants were provided details of the study and written consent form. They understood the objective of the study and gave consent to participate. Finally, 376 questionnaires were used for analysis after excluding 54 questionnaires because of incomplete data. We obtained approval from the Institutional Review Board of Kosin University Gospel Hospital before initiation of the study (IRB no. 2016-07-015).

2. Study methods

The questionnaire consisted of 39 questions, including 8 questions for general characteristics, 5 questions for dental service use behavior, 5 questions for subjective oral health status, 7 questions for objective oral health status, and 14 questions for OHRQoL. Questions for subjective oral health status were about perception of oral status, toothache, interference in mastication, ability of food softening, and perception of periodontal status. For objective oral health status, dentists examined subjects using a dental mirror and a tweezer under the dental exam light, and recorded the number of remaining teeth as below 20 or at least 20 and the number of missing teeth as below 9 or at least 9¹⁶⁾. For the other questions, dental hygienists recorded the responses obtained via individual interviews.

Healthy remaining teeth referred to the number of permanent teeth except for the third molar, which included teeth that more than half of dental crown were visible, and teeth that were preserved or undergoing or with completed root canal treatment. However, tooth stumps or teeth to be extracted (e.g., teeth with 3 or higher degree of mobility) were excluded. Treated remaining teeth was the sum of numbers of healthy remaining teeth, cap crown, and abutment of fixed/removable denture, including teeth which is in the process for abutment formation. Functional remaining teeth were defined as the sum of numbers of treated remaining teeth, artificial teeth of fixed/removable denture and implants. Missing teeth referred to the number of teeth experiencing loss. Non-treated missing teeth was defined as the number of teeth that had not been treated after loss.

For OHRQoL, subjects were questioned how often they were affected by oral issues during the recent one year period, using a simplified Oral Health Impact Profile-14 (OHIP-14)¹⁷⁾, and responses were scored as 0 for never, 1 for hardly ever, 2 for occasionally, 3 for very often, and 4 for fairly often. The highest score for each question was 4 points, and total score of all 14 questions was 56 points, in which a lower OHIP-14 meant a higher OHRQoL.

OHIP-14 in this study was analyzed by Cronbach's α , in which confidence coefficients were 0.846 for functional limitation, 0.796 for physical pain, 0.856 for psycho-

logical discomfort, 0.798 for physical disability, 0.850 for psychological disability, 0.818 for social disability, 0.850 for handicap, and 0.960 for OHIP-14.

3. Analytical methods

For general characteristics, subjective oral health status, objective oral health status, and OHRQoL, frequency and mean were analyzed by descriptive statistics. The difference in OHRQoL depending on general characteristics and oral health status was analyzed by t-test and ANOVA, and then Scheffe test was used for post-hoc analysis. To find out the related factors affecting OHRQoL, Models I and II were constructed, using factors with statistically significant difference as independent variables, followed by multiple regression analysis. Collected data were analyzed by using SPSS ver. 12.0 (SPSS Inc, Chicago, IL, USA), in which statistical significance level was set as 0.05.

Results

1. OHRQoL of subjects

OHRQoL of subjects in seven subcategories was highest in social disability (2.45 ± 1.65), followed by psychological disability (3.05 ± 1.83), handicap (3.17 ± 1.85), physical disability (3.27 ± 1.81), physical pain (3.45 ± 1.75), functional limitation (3.50 ± 2.03), and psychological discomfort (3.80 ± 1.92). The score of OHIP-14 was $22.68 \pm$

Table 1. The OHRQoL of the Subjects

Variable	Mean \pm SD
Domains	
Functional limitation	3.50 \pm 2.03
Physical pain	3.45 \pm 1.75
Psychological discomfort	3.80 \pm 1.92
Physical disability	3.27 \pm 1.81
Psychological disability	3.05 \pm 1.83
Social disability	2.45 \pm 1.65
Handicap	3.17 \pm 1.85
OHIP-14	22.68 \pm 11.28

OHIP items, ranging from 0 (never), 1 (hardly ever), 2 (occasionally), 3 (very often) to 4 (fairly often). Domains (2-items): 0~8, OHIP-14 (14-items): 0~56.

OHRQoL: oral health related quality of life, SD: standard deviation, OHIP-14: 14-item Oral Health Impact Profile.

11.28 (Table 1).

2. OHRQoL depending on general characteristics of subjects

In OHRQoL depending on general characteristics of the subjects, there were statistically significant differences depending on age, education level, presence or absence of spouse, type of medical insurance, and exercise. Regarding age as a variable, individuals aged 65~69 years (18.63 ± 9.22) had the highest OHRQoL with statistically significant difference ($p < 0.05$). For the variable of educational level, OHRQoL was highest in high school

Table 2. The OHRQoL according to General Characteristics (n=376)

Characteristic	n (%)	Mean \pm SD	p-value
Gender			0.974
Male	185 (49.2)	22.70 \pm 11.54	
Female	191 (50.8)	22.66 \pm 11.05	
Age (y)			<0.001
65~69	179 (47.6)	18.63 \pm 9.22 ^b	
70~74	83 (22.1)	25.57 \pm 10.46 ^a	
75~79	69 (18.4)	27.48 \pm 12.89 ^a	
\geq 80	45 (11.9)	26.11 \pm 12.18 ^a	
Education			<0.001
No	65 (17.3)	28.49 \pm 12.92 ^a	
Elementary school	90 (23.9)	25.27 \pm 10.47 ^{a,b}	
Middle school	97 (25.8)	21.95 \pm 9.51 ^{b,c}	
\geq High school	124 (33.0)	18.32 \pm 10.43 ^c	
Spouse			<0.001
Yes	225 (59.8)	20.56 \pm 10.21	
No	151 (40.2)	25.83 \pm 12.07	
Medical insurance			<0.001
Health insurance	202 (53.7)	19.55 \pm 10.51	
Medical aid	174 (46.3)	26.30 \pm 11.08	
Alcohol			0.819
Yes	128 (34.0)	22.49 \pm 11.60	
No	248 (66.0)	22.77 \pm 11.13	
Smoking			0.264
Yes	86 (22.9)	23.87 \pm 11.33	
No	290 (77.1)	22.32 \pm 11.26	
Exercise			<0.001
Everyday	63 (16.7)	21.98 \pm 10.97 ^b	
Sometimes	197 (52.4)	20.91 \pm 10.21 ^b	
No	116 (30.9)	26.06 \pm 12.45 ^a	

OHRQoL: oral health related quality of life, SD: standard deviation.

By independent t-test or one-way ANOVA.

^{a~c}Different characters mean significant difference between groups by Scheffe test.

graduates and higher (18.32±10.43), followed by middle school graduates (21.95±9.51), elementary school graduates (25.27±10.47), and uneducated subjects (28.49±12.92) ($p < 0.05$). Subjects with spouse (20.56±10.21), health insurance policyholders (19.55±10.51), and those who exercised sometimes (20.91±10.21) showed higher OHRQoL ($p < 0.05$, Table 2).

3. OHRQoL depending on oral health status of subjects

OHRQoL depending on oral health status of the subjects was higher in those who perceived their oral status as healthy (15.73±8.73), those who had no interference in mastication (15.95±8.30), and those who were able to soften food (15.13±7.06) ($p < 0.05$). In addition, OHRQoL became higher in those who had toothache less frequently and perceived periodontal status as healthier ($p < 0.05$). OHRQoL was higher in those who had at least 20 healthy remaining teeth, treated remaining teeth, and functional remaining teeth ($p < 0.05$), and had < 9 missing teeth and non-treated missing teeth ($p < 0.05$, Table 3).

4. The related factors affecting OHRQoL

The related factors affecting OHRQoL of subjects were the type of medical insurance ($\beta = 0.12$, $p < 0.05$), toothache ($\beta = -0.30$, $p < 0.05$), ability of food softening ($\beta = 0.25$, $p < 0.05$), perception of periodontal status ($\beta = -0.19$, $p < 0.05$) and healthy remaining teeth ($\beta = -0.13$, $p < 0.05$) in Model I. In Model II, influencing factors were the type of medical insurance ($\beta = 0.12$, $p < 0.05$), toothache ($\beta = -0.29$, $p < 0.05$), ability of food softening ($\beta = 0.24$, $p < 0.05$), perception of periodontal status ($\beta = -0.19$, $p < 0.05$), and healthy remaining teeth ($\beta = -0.13$, $p < 0.05$). Explanatory powers of each model were 55.1% and 55.5%, respectively (Table 4).

Discussion

Poor oral health has a negative impact on systemic health conditions^{2,3}, and restricts interpersonal relations and social life because of the decline in masticatory function and induction of tooth loss, leading to degradation of overall quality of life⁴⁻⁶. Therefore, it is

necessary to promote oral health and OHRQoL of the elderly in order to improve their health and quality of life. Thus, this study investigated the relationship between oral

Table 3. The OHRQoL according to the Oral Health Status (n=376)

Characteristic	n (%)	mean±SD	p-value
Subjective			
Perception of oral status			< 0.001
Not healthy	287 (76.3)	24.83±11.12	
Healthy	89 (23.7)	15.73±8.73	
Toothache			< 0.001
Often	47 (12.5)	35.60±10.53 ^a	
Sometimes	212 (56.4)	22.98±9.95 ^b	
Never	117 (31.1)	16.95±9.30 ^c	
Interference in mastication			< 0.001
Yes	227 (60.4)	37.09±10.80	
No	149 (39.6)	15.95±8.30	
Ability of food softening			< 0.001
Yes	148 (39.4)	15.13±7.06	
No	228 (60.6)	27.58±10.80	
Perception of periodontal status			< 0.001
Not healthy	148 (39.4)	30.11±10.84 ^a	
Moderate	200 (53.2)	18.70±8.63 ^b	
Healthy	28 (7.4)	11.79±5.88 ^c	
Objective			
Healthy remaining teeth			< 0.001
< 20	275 (73.1)	25.35±11.09	
≥ 20	101 (26.9)	15.40±8.17	
Treated remaining teeth			< 0.001
< 20	210 (55.9)	27.10±11.26	
≥ 20	166 (44.1)	17.08±8.49	
Functional remaining teeth			< 0.001
< 20	23 (6.1)	34.87±11.13	
≥ 20	353 (93.9)	21.88±10.84	
Missing teeth			< 0.001
< 9	165 (43.9)	17.23±8.63	
≥ 9	211 (56.1)	26.94±11.29	
Non-treated missing teeth			< 0.001
< 9	350 (93.1)	21.78±10.80	
≥ 9	26 (6.9)	34.81±10.72	
Experience of prosthesis			0.967
Yes	338 (89.9)	22.69±11.05	
No	38 (10.1)	22.61±13.29	
Wearing denture			< 0.001
Yes	189 (50.3)	26.15±10.85	
No	187 (49.7)	19.17±10.62	

OHRQoL: oral health related quality of life, SD: standard deviation.

By independent t-test or one-way ANOVA.

^{a-c}Different characters mean significant difference between groups by Scheffe test.

Table 4. The Related Factors Affecting OHRQoL

Variable	Model I		Model II	
	β (SE)	p-value	β (SE)	p-value
General characteristics				
Age	0.01 (0.48)	0.771	0.01 (0.48)	0.868
Education	-0.04 (0.46)	0.325	-0.04 (0.46)	0.400
Spouse	0.02 (0.95)	0.604	0.03 (0.97)	0.511
Medical insurance	0.12 (1.01)	0.006	0.12 (1.03)	0.009
Exercise	0.07 (0.61)	0.056	0.06 (0.61)	0.093
Dental service use behavior				
Type of dentist visit			0.02 (1.21)	0.595
Experience of no dentist visit			-0.06 (0.94)	0.130
Type of discomfort			-0.01 (0.54)	0.791
Experience of illegal treatment			-0.03 (0.92)	0.519
Subjective oral health status				
Perception of oral status	-0.02 (1.15)	0.639	-0.04 (1.18)	0.414
Toothache	-0.30 (0.75)	0.000	-0.29 (0.77)	<0.001
Interference in mastication	-0.04 (1.15)	0.355	-0.05 (1.11)	0.298
Ability of food softening	0.25 (0.75)	0.000	0.24 (1.08)	<0.001
Perception of periodontal status	-0.19 (1.11)	0.000	-0.19 (0.91)	<0.001
Objective oral health status				
Healthy remaining teeth	-0.13 (1.25)	0.011	-0.13 (1.27)	0.009
Treated remaining teeth	-0.04 (3.82)	0.805	-0.04 (3.83)	0.830
Functional remaining teeth	-0.06 (3.83)	0.440	-0.07 (3.84)	0.398
Missing teeth	0.03 (3.59)	0.841	0.03 (3.60)	0.859
Non-treated missing teeth	0.07 (3.66)	0.382	0.06 (3.68)	0.451
Wearing denture	-0.03 (3.66)	0.657	-0.02 (1.39)	0.709

$R^2=0.551$, $F=27.522$, $R^2=0.555$, $F=22.132$. By multiple regression analysis.
OHRQoL: oral health related quality of life, SE: standard error.

health status and OHRQoL among elderly individuals over the age of 65 years and the related factors affecting their OHRQoL.

Within the total 56 points in OHIP-14, OHRQoL of the subjects was scored 22.68 ± 11.28 points showing slightly higher than the medium level. Of the subcategories, social disability was shown to be associated with the highest quality of life, whereas physical pain, functional limitation, and psychological discomfort was associated with relatively lower quality of life than the other categories, which was partially consistent with a report by Kim et al.¹⁴⁾, which stated that physical pain and functional limitation were felt more prominently than others. In our study, psychological discomfort was associated with lower OHRQoL rather than functional limitation and physical pain. This seemed to be because there were many subjects who had restored teeth and recovered from pain by prosthesis treatment and dentures. Almost 90% and 50%

of the subjects had prosthesis and dentures, respectively, while only 6.9% of the subjects had at least 9 non-treated missing teeth.

In terms of general characteristics of the subjects, OHRQoL was higher in younger age and was correlated with higher education level, which were consistent with a study by Steele et al.¹⁸⁾ showing negative relationship between OHRQoL and age, and a study by Lee¹⁹⁾ that showed a higher OHRQoL as education level became higher. Subjects with spouse had higher OHRQoL than those without spouse, which was consistent with the results of a study by Park et al.¹²⁾ indicating that the elderly cohabitating with spouse were less influenced by oral issues. Health insurance policyholders had higher OHRQoL than recipients of medical aid, which is similar to studies by Park et al.¹²⁾ and Lee and Park²⁰⁾ that stated OHRQoL decreased with lower income. Subjects who exercised had higher OHRQoL, which was inconsistent

with a report by Yom and Han²¹⁾ that stated exercise did not have an effect on OHRQoL.

Regarding subjective oral health status of the subjects, OHRQoL was higher in subjects who perceived their oral and periodontal status as healthier, had no toothache, had no interference in mastication, and were able to soften food. These results matched a report by Takata et al.²²⁾, which stated that masticatory ability was a factor affecting OHRQoL, and a report by Jung and Shin²³⁾ stating the level of oral pain was the most important factor. It was speculated that since subjects who had neither interference in mastication nor toothache feel less discomfort during food intake, hence perceive subjective oral status and periodontal status as healthy; therefore, their OHRQoL is higher.

As for objective oral health status, subjects who had at least 20 healthy remaining teeth, or treated remaining teeth, or functional remaining teeth, respectively showed higher OHRQoL, which was consistent with the results of study by Ryu et al.¹³⁾, which stated that subjects with at least 20 remaining teeth had higher OHRQoL. On the contrary, it was inconsistent with the results from a study by Takata et al.²²⁾, which stated that there was no effect of remaining teeth on OHRQoL. In addition, subjects who had at least 20 healthy remaining teeth (15.40 ± 8.17) had relatively higher OHRQoL than those who had the same numbers of treated remaining teeth (17.08 ± 8.49) and functional remaining teeth (21.88 ± 10.84), indicating that healthy natural teeth without prosthesis treatment should have the highest positive effect on OHRQoL. Subjects with < 9 missing teeth or < 9 non-treated missing teeth showed higher OHRQoL. And subjects with at least 9 non-treated missing teeth (34.81 ± 10.72) had a lower quality of life than those with the same number of missing teeth (26.94 ± 11.29), indicating that the number of untreated teeth after loss had a substantially negative effect on OHRQoL.

To identify the related factors affecting OHRQoL of the subjects, multiple regression analysis was performed using the factors with statistically significant differences as independent variables and OHRQoL as dependent variable. In Model I, which considered only the general characteristics and oral health status, the related factors

affecting OHRQoL were the type of medical insurance, toothache, ability of food softening, perception of periodontal status, and healthy remaining teeth, and the same factors were found in Model II which considered dental service use behavior additionally. These results were different from a report by Chen and Hunter⁹⁾, indicating that there is a relationship between the type of dentist visit and OHRQoL. In both models, OHRQoL was higher in health insurance policyholders, subjects who could soften food, those who had at least 20 healthy remaining teeth, those who felt toothache less frequently, and those who perceived their periodontal status as healthy as compared to others. The type of medical insurance may indicate economical level of the elderly, and economical imbalance in the elderly may also lead to imbalance of OHRQoL, therefore, it is necessary to manage oral health of the financially vulnerable elderly who receive medical aid. In addition, elderly with < 20 remaining teeth could be in low-nutrition state owing to degradation of masticatory ability, suggesting that it should be closely related with systemic health condition¹⁶⁾. Hence, it is required to provide a systematic and continuous oral health care for the elderly.

To improve oral health and OHRQoL in the elderly, the results of the present study suggested that a continuous oral health care system for the elderly should be established with the aim of retaining at least 20 healthy remaining teeth while eliminating prosthesis treatment via prevention and early detection of oral diseases. Medical insurance should cover prosthesis treatment to restore functions of the missing teeth without leaving them untreated, or a prosthesis support system should be established for the elderly receiving medical aid.

There are some limitations of this study. First, subjects were recruited by convenience sampling in a city of South Korea; therefore, the results may not be generalized to the entire elderly population of South Korea. In addition, the elderly who stayed at home because of difficulties in mobility, and the elderly in facilities were not included, which limited the representativeness of the subjects of this study. To minimize deviations caused by oral examinations of many dentists, they should be complemented by single dentist investigator or several dentists thoroughly

trained. Additionally, the study using OHIP-14 should be supplemented by using other tools in parallel. Despite these limitations, the results of this study may be partially accepted because the results of this study were mostly consistent with the previous studies.

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