



The Relationship among the Number of Teeth, Salivary Flow Rate, Oral Health-Related Quality of Life, and Depression in the Elderly Population in Korea

JooHee Lee, Hyo-Jung Jung, Yong-Guang Min, Hyung-Joon Ahn

Department of Orofacial Pain and Oral Medicine, Dental Hospital of Yonsei University College of Dentistry, Seoul, Korea

Received December 7, 2021
Revised December 16, 2021
Accepted December 16, 2021

Correspondence to:

Hyung-Joon Ahn
Department of Orofacial Pain and Oral
Medicine, Dental Hospital of Yonsei
University College of Dentistry, 50-1 Yonsei-
ro, Seodaemun-gu, Seoul 03722, Korea
Tel: +82-2-2228-3112
Fax: +82-2-393-5673
E-mail: hjahn@yuhs.ac
<https://orcid.org/0000-0001-9669-9781>

This work was supported by the National
Research Foundation of Korea (NRF) grant
funded by the Korea government (MSIT) (No.
2016R1A5A2008630).

Purpose: Depression is a condition that weakens psychosocial functioning and reduces quality of life. In Korea, the prevalence of depression among the elderly is 29.2% and depression is a considerable public health concern for the elderly. Depression has a statistically significant relationship with oral conditions such as number of teeth and salivary flow rate. Oral health-related quality of life (OHRQoL) is the concept including subjective evaluations of psychological, physical and social aspects of oral health. Tooth loss and hyposalivation can affect mental health and quality of life. Our study was designed to identify the relationship among the number of teeth, salivation, OHRQoL, and depressive symptoms in the elderly in Korea.

Methods: We recruited 100 participants, aged over 65 years, and assessed their number of teeth, unstimulated salivary flow rate. All participants filled out oral health impact profile 14 (OHIP-14) and Zung self-rating depression score (SDS) for checking OHRQoL and depressive symptoms. Statistical analysis was done by R program.

Results: We found that the positive relationship between OHIP-14 and SDS after Mann-Whitney test ($p=0.03$). The lower SDS group had an OHIP-14 median score of 4. On the other hand, the higher SDS group had a median value of 7.5. The other factors (number of teeth and salivary flow rate) did not show correlations with OHIP-14 or SDS.

Conclusions: OHRQoL and depressive symptoms have significant correlation.

Key Words: Aged; Depression; Quality of life; Saliva; Tooth

INTRODUCTION

Depression is a condition that weakens psychosocial functioning and reduces quality of life [1]. Furthermore, depression is probably the most common cause of emotional suffering in later life [2]. WHO reported that more than 300 million people (4.4% of the world population) were suffered from depression in 2015 [3]. In Korea, the prevalence of depression among the elderly is 29.2% and depression is a considerable public health concern for the elderly [4]. Nevertheless, depression is not a normal process of the

aging and people who are diagnosed with depression can be cured with appropriate treatment [5].

Depression has a statistically significance with other diseases such as cardiovascular disease, obesity, and sleep disturbance in several studies [6-8]. In addition, dentally, previous studies have shown that there is a significant association between depressive symptoms and tooth loss [9,10]. Furthermore, studies have shown that depression affects the unstimulated salivary flow rate [11].

Oral health-related quality of life (OHRQoL) is the concept including subjective evaluations of psychological, physical

and social aspects of oral health [12]. The oral health impact profile 14 (OHIP-14) is a tool often used to measure quality of life and is simplified version of oral impact profile 49 [13,14]. OHIP-14 consists of seven categories: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and disability [15]. Tooth loss and hyposalivation can affect mental health and quality of life [16,17].

The aforementioned studies did not focus on elderly individuals in Korea. Therefore, the purpose of this study was to investigate the relationship among the number of teeth, salivation, OHRQoL, and depressive symptoms in the elderly in Korea.

MATERIALS AND METHODS

1. Study Population

This was a cross-sectional study. Data were collected from 100 individuals aged over 65 years who lived in Seoul and Gyeong-gi province. The participants were recruited from senior citizen centers. The inclusion criteria were ability to understand our instructions, ability to read and speak Korean, and ability to visit our office independently. We excluded volunteers who were not able to communicate with others or move independently. Informed consent was obtained from all participants. This study was approved by the Institutional Review Board of the Yonsei University Dental Hospital (IRB no. 2-2018-0032) and conforms to the standards of the Declaration of Helsinki.

2. Depressive Symptoms

The presence of depressive symptoms in the participants was measured using the Zung self-rating depression score (SDS). Zung SDS has the advantage of being simple to use and scoring, and it has the advantage of selecting depressive tendencies well, so it is widely used in research [18]. Zung SDS consists of 20 questionnaires with total scores ranging from 20 to 80 and each item is in a Likert response format, ranging from 1 to 4 [19]. A higher score indicates a greater level of depressive symptoms.

3. Oral Health-related Quality of Life

OHRQoL was assessed using the Korean translated

OHIP-14 questionnaires. It contains 14 questions and responses were coded as a five-point Likert-type scale as follows: 0, never; 1, rarely; 2, sometimes; 3, constantly; and 4, always [14,15]. The total score of OHIP was obtained by the sum of each, and the total score ranged from 0 to 56 points [15]. Higher score of OHIP-14 means a worse quality of life [13].

4. Number of Teeth

A trained dentist performed an oral examination and used panoramic radiography to confirm the number of teeth.

5. Salivary Flow Test

A qualified dentist performed the unstimulated saliva rate test using the spitting method [20]. The participants were instructed not to eat, drink, smoke, or brush their teeth for at least 1 hour before the test. All participants rinsed their mouths 5 minutes before the test to remove oral debris. Consequently, they sat in an upright position with a slightly forward head posture. The saliva collected in the mouth over 1 minute was collected in pre-weighed containers during the 5-minute tests.

6. Statistical Analysis

All data analyses were performed using the R program version 4.0.0 on the Windows OS (R Foundation for Statistical Computing, Vienna, Austria). Because the parameters did not show a normal distribution as a result of Shapiro-Wilk test, the Mann-Whitney test was used. The level of significance was set at $p < 0.05$.

RESULTS

Table 1 shows basic information on the study population. Out of 100 participants, 73 were females and 27 were males. Age range was 65 to 103 years and mean age was 75.88 (± 6.36) years. The mean number of teeth was 21.66 (± 8.98). Mean salivary flow rate and OHIP-14 were 0.27 (± 0.17) mL/min and 7.25 (± 8.34), respectively. Moreover, mean SDS was 33.42 (± 9.09). Fig. 1 shows the distribution of the number of teeth, unstimulated saliva flow rate, OHIP score and SDS. Table 2 represents the results of the Mann-Whitney

Table 1. Basic profile

Variable	Total (n=100)	Male (n=27)	Female (n=73)
Age (y)	75.88±6.36	76.56±6.22	75.63±6.44
Number of teeth	21.66±8.98	16.05±11.41	23.74±6.91
Salivary flow rate (mL/min)	0.27±0.17	0.36±0.23	0.23±0.12
Oral health impact profile-14	7.25±8.34	8.33±10.86	6.85±7.25
Zung self-rating depression score	33.42±9.09	32.11±9.99	33.9±8.75

Values are presented as mean ± standard deviation.

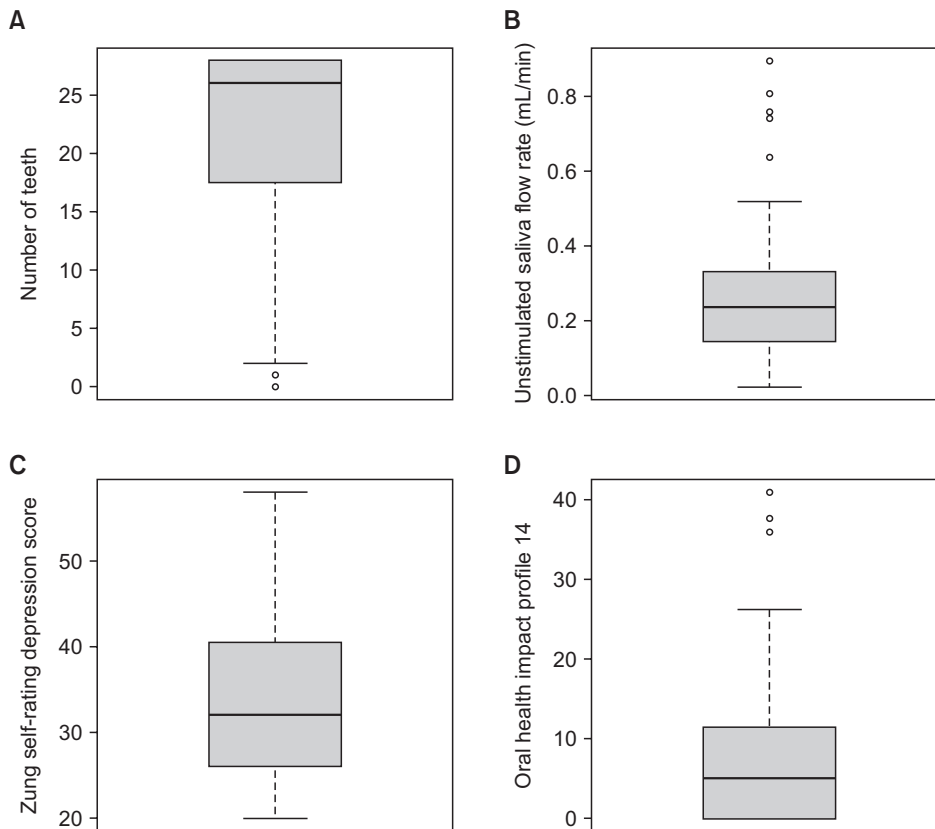


Fig. 1. Distribution of number of teeth (A), unstimulated saliva flow rate (B), Zung self-rating depression score (C), and oral health impact profile 14 (D).

test between number of teeth, salivary flow rate, OHIP-14 and SDS. There was no significant correlation between parameters. Table 3 shows the result of the Mann-Whitney test between SDS and OHIP-14. They had statistically significant correlation ($p=0.03$).

DISCUSSION

The previous studies show the significant association between number of teeth, unstimulated salivary flow rate, ORHQoL, and depressive symptoms [9-11]. In this study was designed to find out those relationship in the elderly population in Korea.

Our study only showed the significant correlation between OHIP-14 and SDS. Oancea et al. [21] also found depression has significant positive correlation with OHIP total score. A previous study stated oral health can affect mood of the individuals and mood can also change one's oral health by modulating lifestyle like smoking and drinking [21,22]. Furthermore, Okoro et al. [9] mentioned that the relationship of mental health, missing teeth, and access to oral health service may be bidirectional. These seems that SDS and oral health influence each other, and ORHQoL may change accordingly.

Aldosari et al. [10] represented depressive symptoms have a correlation with poor oral health, and mild and moderate

Table 2. Mann - Whitney analysis among depressive symptoms, OHRQoL, and other factors

Factor		Number of teeth		Saliva flow rate	
		Median (IQR)	p-value	Median (IQR)	p-value
SDS	Lower	25.5 (14.3-28.0)	0.09	0.215 (0.141-0.382)	0.83
	Higher	27.0 (24.0-28.0)		0.252 (0.137-0.312)	
OHIP-14	Lower	27.0 (20.8-28.0)	0.39	0.228 (0.137-0.331)	0.46
	Higher	26.0 (13.0-28.0)		0.258 (0.146-0.328)	

OHRQoL, oral health-related quality of life; IQR, interquartile range (25th-75th percentile); SDS, Zung self-rating depression score; OHIP-14, oral health impact profile 14.

Table 3. Mann - Whitney analysis among depressive symptoms and OHRQoL

SDS	OHIP-14	
	Median (IQR)	p-value
Lower	4 (0-7.75)	0.03*
Higher	7.5 (1.25-14.75)	

OHRQoL, oral health-related quality of life; OHIP-14, oral health impact profile 14; IQR, interquartile range (25th-75th percentile); SDS, Zung self-rating depression score.

*p<0.05.

depressive symptoms group has more missing teeth than no depressive symptoms group, in addition participants with severe depressive symptoms has high incidence of mild periodontitis than participants without depressive symptoms. Moreover, Ehrenthal et al. [17] said depression can be affected by tooth loss in psychological, social, and biological pathways. However, a previous study found that only male smoker with depression had a high rate of tooth loss, this result suggested that the relationship between tooth loss and depression is limited [23]. Gholami et al. [11] said psychological status can reduce salivation by stimulation of anticholinergic mechanism. Busfield et al. [24] found a tendency to decrease salivation in depressed female.

The systematic review [25] about tooth loss and OHRQoL showed most study found significant associations between these two parameters; however some study did not find significant correlations between them. Niklander et al. [26] mentioned xerostomia has significant association with OHIP-14 by changing talk, taste, mood, and oral health.

However, in our study the significant correlation was not found between the number of teeth or the unstimulated saliva flow rate, OHIP-14, and SDS. Objective oral health status (such as decay or periodontitis) does not always match with one's perception [21]. Therefore, number of teeth and

salivary flow rate can mismatch with OHIP-14. Moreover, our study has several limitations. First, it may be difficult to reflect the characteristics of the entire elderly population in Korea as the study was conducted only with a limited number of 100 people and limited local state. Second, the participants were healthier group than normal elderly population physically and psychologically (i.e., the number of teeth of the participant was relatively large, and the amount of salivation was also high), because we had recruited participants who were healthy enough to attend a senior citizen center. Third, we did not identify other factors that could cause tooth loss and hyposalivation.

Therefore, we hope that this study will serve as a basis for further research on the relationship among these parameters and mental health.

CONFLICT OF INTEREST

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

ORCID

JooHee Lee

<https://orcid.org/0000-0001-5810-8282>

Hyo-Jung Jung

<https://orcid.org/0000-0003-1321-6276>

Yong-Guang Min

<https://orcid.org/0000-0002-3530-8270>

Hyung-Joon Ahn

<https://orcid.org/0000-0001-9669-9781>

REFERENCES

1. Malhi GS, Mann JJ. Depression. *Lancet* 2018;392:2299-2312.
2. Blazer DG. Depression in late life: review and commentary. *J Gerontol A Biol Sci Med Sci* 2003;58:249-265.
3. World Health Organization. Depression and other common mental disorders: global health estimates. Geneva: World Health Organization; 2017.
4. Lee Y, Jang K, Lockhart NC. Impact of social integration and living arrangements on Korean older adults' depression: a moderation model. *Int J Aging Hum Dev* 2018;86:306-321.
5. Casey DA. Depression in older adults: a treatable medical condition. *Prim Care* 2017;44:499-510.
6. Raič M. Depression and heart diseases: leading health problems. *Psychiatr Danub* 2017;29 Suppl 4:770-777.
7. Luppino FS, de Wit LM, Bouvy PF, et al. Overweight, obesity, and depression: a systematic review and meta-analysis of longitudinal studies. *Arch Gen Psychiatry* 2010;67:220-229.
8. Roberts RE, Duong HT. The prospective association between sleep deprivation and depression among adolescents. *Sleep* 2014;37:239-244.
9. Okoro CA, Strine TW, Eke PI, Dhingra SS, Balluz LS. The association between depression and anxiety and use of oral health services and tooth loss. *Community Dent Oral Epidemiol* 2012;40:134-144.
10. Aldosari M, Helmi M, Kennedy EN, et al. Depression, periodontitis, caries and missing teeth in the USA, NHANES 2009-2014. *Fam Med Community Health* 2020;8:e000583.
11. Gholami N, Hosseini Sabzvari B, Razzaghi A, Salah S. Effect of stress, anxiety and depression on unstimulated salivary flow rate and xerostomia. *J Dent Res Dent Clin Dent Prospects* 2017;11:247-252.
12. Miettinen O, Lahti S, Sipilä K. Psychosocial aspects of temporomandibular disorders and oral health-related quality-of-life. *Acta Odontol Scand* 2012;70:331-336.
13. Vilar-Villanueva M, Gándara-Vila P, Blanco-Aguilera E, et al. Psychological disorders and quality of life in oral lichen planus patients and a control group. *Oral Dis* 2019;25:1645-1651.
14. Brennan DS, Spencer AJ. Dimensions of oral health related quality of life measured by EQ-5D+ and OHIP-14. *Health Qual Life Outcomes* 2004;2:35.
15. Sebastiani AM, Dos Santos KM, Cavalcante RC, et al. Depression, temporomandibular disorders, and genetic polymorphisms in IL6 impact on oral health-related quality of life in patients requiring orthognathic surgery. *Qual Life Res* 2020;29:3315-3323.
16. Tanasiewicz M, Hildebrandt T, Obersztyn I. Xerostomia of various etiologies: a review of the literature. *Adv Clin Exp Med* 2016;25:199-206.
17. Ehrental JC, Graetz C, Plaumann A, Dörfer CE, Herzog W. Number of teeth predict depressive symptoms in a longitudinal study on patients with periodontal disease. *J Psychosom Res* 2016;89:16-19.
18. Lee JH. Development of the Korean form of Zung's self-rating depression scale. *Yeungnam Univ J Med* 1995;12:292-305.
19. Choi KR, Kim D, Jang EY, Bae H, Kim SH. Reliability and validity of the Korean version of the lifetime stressor checklist-revised in psychiatric outpatients with anxiety or depressive disorders. *Yonsei Med J* 2017;58:226-233.
20. Navazesh M, Christensen CM. A comparison of whole mouth resting and stimulated salivary measurement procedures. *J Dent Res* 1982;61:1158-1162.
21. Oancea R, Timar B, Papava I, Cristina BA, Ilie AC, Dehelean L. Influence of depression and self-esteem on oral health-related quality of life in students. *J Int Med Res* 2020;48:300060520902615.
22. Alkan A, Cakmak O, Yilmaz S, Cebi T, Gurgan C. Relationship between psychological factors and oral health status and behaviours. *Oral Health Prev Dent* 2015;13:331-339.
23. Anttila SS, Knuutila ML, Sakki TK. Relationship of depressive symptoms to edentulousness, dental health, and dental health behavior. *Acta Odontol Scand* 2001;59:406-412.
24. Busfield BL Jr., Wechsler H, Barnum WJ. Studies of salivation in depression. II. Physiological differentiation of reactive and endogenous depression. *Arch Gen Psychiatry* 1961;5:472-477.
25. Gerritsen AE, Allen PF, Witter DJ, Bronkhorst EM, Creugers NH. Tooth loss and oral health-related quality of life: a systematic review and meta-analysis. *Health Qual Life Outcomes* 2010;8:126.
26. Niklander S, Veas L, Barrera C, Fuentes F, Chiappini G, Marshall M. Risk factors, hyposalivation and impact of xerostomia on oral health-related quality of life. *Braz Oral Res* 2017;31:e14.