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The Relationship between Quality of Life, Periodontitis and Oral Pain in Korean Adults

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ABSTRACT

This study aimed to investigate the relationship between quality of life, periodontitis, and oral pain among Korean adults. The study was conducted to determine the factors that should be considered for the prevention and management of oral diseases. The analysis employed data on the EQ5D, which is a measure of quality of life, periodontal diseases, and oral interviews among oral examinations from the 7th Korea National Health and Nutrition Examination Survey (2016-2018). Data were analyzed using chi-square. Additionally, multiple logistic regression analysis was performed to assess the association between quality of life, periodontitis and oral pain. Statistical significance level was set at <0.05. In the model 2 adjusted for all variables, the odds ratio of periodontitis increased odds ratio (OR): 2.48, 95% confidence interval (CI): 1.18-5.24 for those with great discomfort in daily activities, while the odds ratio of oral pain experience decreased OR 0.45 (95%CI 0.21-0.95). In addition, the odds ratio of periodontitis was OR 0.64 (95%CI 0.46-0.89) and the odds ratio of oral pain experience was OR 2.68 (95%CI 1.83-3.93) in the participants with high pain and discomfort. There was a significant association between quality of life and periodontitis and oral pain in Korean adults, but further studies should be conducted to determine more closely.

1. Introduction

Today, as medical demand increases and health-related services improve, the Korean government has established the 5th National Health Promotion Comprehensive Plan by setting the general goal of extending health life expectancy and enhancing health equity. Healthy life expectancy is set to reach 73.3 years, and health equity is set to be achieved by 2030, to achieve income and geographic

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equity in healthy life expectancy (2022).

The quality of life is considered to determine the duration of a healthy period in our lifetime, and various ailment issues related to the quality of life are being intensified. Consequently, some measures are needed to solve those issues (Baek & Suh, 2010).

The quality of life is a subjective evaluation of satisfaction felt in life and is a complex concept that includes the status of body, society, mind, and economy. In physical health related to the quality of life (Kim & Lee, 2016), oral health can be a factor that worsens overall health as the quality of life decreases due to oral diseases such as periodontitis and oral pain. And conversely, the quality of life can affect oral health and lead to functional impairment (Kim, 2021) EuroQol-5 Dimension (EQ-5D), one of the tools for measuring the quality of life, was developed by EuroQol Group in 1990, which is a tool that can easily measure health conditions related to the quality of life by evaluating mobility, self-care, daily activities, pain/discomfort, and anxiety/depression.

In previous studies on quality of life, the relationship between oral health status and the quality of life in adults has been reported. According to Choi et al.'s (2015) research, tooth pain, mobility, pain, and discomfort were statistically significant as the effect of oral conditions on the quality of life, and mastication discomfort and speaking discomfort were statistically significant in all five EQ-5D dimensions. In the impact of the quality of life of the elderly on oral health issues, it was reported that all five dimensions of EQ-5D affected oral health issues, especially in chewing or speaking areas, and overall health issues could occur (Ju et al., 2020). Therefore, it is believed that the quality of life can affect not only general health but also oral periodontitis and oral pain.

Periodontitis usually starts with gingivitis, and goes through early- and mid-stage to chronic periodontitis in the end, which causes tooth loss due to the loss of periodontal ligament and alveolar bone (Tonetti et al., 2018). According to the 2002 statistics on frequent outpatient diseases released on the public health big data open system of the Health Insurance Review and Assessment Service, "gingivitis and periodontal diseases" were ranked second with 18 million patients and KRW 1.9174 trillion of medical insurance benefits, following "emergency use (COVID-19)" (Health Insurance Review and Assessment Service). Accordingly, prevention of various ailments including periodontitis, becomes important in dental treatment. Oral pain refers to pain related to the hard and soft tissues of the oral structure. This pain affects activities such as food ingestion and language communication (Choi et al., 2006). Therefore, it is necessary to study the association between the presence of periodontitis and oral pain concerning quality of life and oral health. Compared to previous studies, this study used a specific period of the Korea National Health and Nutrition Examination Survey. This study also differentiated itself from other studies in terms of dependent and independent variables and covariance. Furthermore, this study is significant as it sheds light on oral health-related associations among adults.

In this study, raw data from the 7th National Health and Nutrition Survey, which is representative of the Korean population, was used aiming to identify factors related to physical and mental health in the five dimensions of health-related quality of life (EQ-5D): mobility, self-care, daily activity, pain/discomfort, anxiety/depression, and their association with periodontitis and oral pain. The results are intended to set the stage for future oral health program development and to help develop oral health interventions that can improve quality of life in the future.

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2. Materials and Methods

2.1 Study participants

This study was conducted using raw data from the 7th National Health and Nutrition Survey compiled from 2016 to 2018. Utilizing the 7th data was approved by Dankook University Institutional Bioethics Committee (IRB No: DKU 2023-05-020-001) to deliberate on research exemption. In this study, 13,199 people, aged 19 or older were extracted from the total 16,489 examinees of the 7th National Health and Nutrition Survey. In addition, analysis was conducted on 12,689 people who performed a periodontal biopsy. The discrepancy in the total frequency of this study was caused by missing values.

2.2 Periodontitis

Highly trained dentists, who are continuously evaluated for quality, performed the periodontal examinations. Periodontitis was measured at six sites (maxillary right posterior, maxillary anterior, maxillary left posterior, mandibular right posterior, mandibular anterior, and mandibular left posterior) using a WHO probe (3.5 mm and 5.5 mm). The probe tip was gently inserted into the gingival sulcus of the periodontal socket and detected with a force of 20 g. Test for periodontitis of the dependent variable was determined through a screening survey according to the Community Periodontal Index (CPI) test standards presented by the World Health Organization (WHO). In this study, we defined a pocket depth <4 mm as normal (no) (CPI 0-2) and ≥ 4 mm as indicating periodontitis (yes) (CPI 3, 4)(Oral Health Surveys, 1997).

2.3 Oral pain

The dependent variable, oral pain experience, was examined using screening oral survey data obtained through an oral interview, asking the question, “In the past year, have you ever had a toothache?” with a response of yes or no, depending on whether the individual had experienced a toothache in the past year.

2.4 Quality of life (EQ5D)

The quality of life was set as an independent variable to find out the prevalence of periodontitis and oral pain by it. Developed by the EuroQol group in 1990 (Kim, 2021) the five dimensions of quality of life are measured five dimensions as follows; mobility, self-care, daily activity, pain/discomfort, anxiety/depression. The responses were classified into three levels: no problems, moderate problems, and severe problems. Quality of life is also classified as no problems, moderate problems, and severe problems.

2.5 Covariates

Covariant was considered in relation to demographic factors, health factors, and health behavior.

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In terms of demographic factors, gender is recognized as binary, and age is categorized as 19-29 years old, 30-39 years old, 40-49 years old, 50-59 years old, and 60 years old or above. The household income level is classified as low, medium, and high. The level of education is classified as elementary school graduate, middle school graduate, high school graduate, and college graduate or higher. Diabetes was classified from the health factors as diabetic or non-diabetic, and the body mass index was categorized as underweight (18.5kg/m^2), normal (18.5-22.9kg/m^2), overweight (23-24.9kg/m^2), and obesity (>25kg/m^2) (WHO, 2006). The factor of health behavior was categorized by smoking, drinking, and tooth brushing. Smoking was classified as a smoker who smokes more than five packs in a life time and a non-smoker who smokes less than five packs in a life time. Drinking was classified into non-drinkers (less than one drink per month for a life time or the past year) and drinkers (more than one drink per month for the past year). Finally, the number of tooth brushing per day was categorized as less than once, twice, and three times or more (Park et al., 2018; Schoenborn et al., 2013).

2.6 Statistical analysis

All analysis of this study was conducted by reflecting the complex sample design of the original data of the National Health and Nutrition Survey, and by extracting adults aged 19 or older. A chi-square analysis was conducted on the relationship between the general characteristics of the examinees, the prevalence of periodontitis, and the general characteristics and oral pain. Logistic regression analysis was performed on the relationship between EQ5D, periodontitis, and oral pain. Logistic regression analysis model 1 is uncorrected. Model 2 was corrected according to demographic factors such as gender, age, household income, and education level. In addition, health factors such as diabetes and BMI were corrected. Finally, factors related to health behavior, whether or not smoking, drinking alcohol, and the number of tooth brushing per day were considered. The analytical results were presented by the odd ratio and 95% confidence intervals (CI) for periodontitis prevalence. IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, NY, USA) was used for all statistical analyses conducted in this study, and the significance test was based on the first type error level of 0.05.

3. Results

3.1 Prevalence of periodontitis and oral pain according to general characteristics

The prevalence of periodontitis and oral pain according to the general characteristics of the examinees is shown in Table 1. Gender-specifically, men have a higher prevalence than women in terms of periodontitis prevalence ($p<0.001$). However, oral pain was higher in women than in men but was not statistically significant ($p=0.088$). As for the age, periodontitis and oral pain increased as the ages increased ($p<0.001$) and periodontitis and oral pain decreased as household income increased ($p<0.001$). In addition, the higher the level of education, the prevalence of periodontitis and oral

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pain were lowered (p<0.001). Periodontitis and oral pain are high in subjects with diabetes (p<0.001), and BMI had a higher prevalence of periodontitis as the Index increased (p<0.001). Smokers have a higher prevalence of periodontitis and oral pain than non-smokers (p<0.001), the prevalence rate was high in non-drinkers (p=0.216) and oral pain (p<0.001). Higher brushing frequency was associated with a lower prevalence of periodontitis (p<0.001) and oral pain (p=0.008).

Table 1. General characteristics of subjects by periodontitis and oral pain N (%)*

Characteristics	Division	Periodontitis		Total	p**	Oral pain		Total	p**
		No	Yes			No	Yes		
Sex	Man	3,417(62.3)	2,128(37.7)	5,545(100)	< 0.001	4,008(70.1)	1,784(29.9)	5,792(100)	0.088
	Woman	5,291(74.7)	1,853(25.3)	7,144(100)		4,990(68.5)	2,413(31.5)	7,403(100)	
Age (yrs)	19-29	1,501(96.0)	61(4.0)	1,562(100)	< 0.001	1,189(76.6)	373(23.4)	1,562(100)	< 0.001
	30-39	1,806(86.5)	294(13.5)	2,100(100)		1,559(74.8)	543(25.2)	2,102(100)	
	40-49	1,768(74.8)	647(25.2)	2,415(100)		1,678(70.4)	739(29.6)	2,417(100)	
	50-59	1,466(60.6)	1,005(39.4)	2,471(100)		1,573(65.0)	920(35.0)	2,493(100)	
	≤60	2,167(53.0)	1,974(47.0)	4,141(100)		2,999(65.7)	1,622(34.3)	4,621(100)	
Household income	Lower	1,331(57.9)	1,009(42.1)	2,340(100)	< 0.001	1,677(64.5)	964(35.5)	2,641(100)	< 0.001
	Median	4,563(69.4)	2,069(30.6)	6,632(100)		4,654(69.6)	2,153(30.4)	6,807(100)	
	Upper	2,796(76.8)	888(23.2)	3,684(100)		2,638(71.6)	1,071(28.4)	3,709(100)	
Education level	≤Elementary school	1,172(50.7)	1,147(49.3)	2,319(100)	< 0.001	1,588(61.1)	1,041(38.9)	2,629(100)	< 0.001
	Middle school	654(54.9)	522(45.1)	1,176(100)		800(65.9)	431(34.1)	1,231(100)	
	High school	2,827(72.4)	1,134(27.6)	3,961(100)		2,803(70.3)	1,224(29.7)	4,027(100)	
	≥College	3,686(80.0)	968(20.0)	4,654(100)		3,389(73.6)	1,286(26.4)	4,675(100)	
Diabetes	Absence	8,134(71.6)	3,358(28.4)	11,492(100)	< 0.001	8,184(69.8)	3,705(30.2)	11,889(100)	< 0.001
	Presence	574(48.0)	623(52.0)	1,197(100)		814(63.1)	492(36.9)	1,306(100)	
BMI	Underweight	379(81.9)	96(18.1)	475(100)	< 0.001	339(69.3)	161(30.7)	500(100)	0.175
	Normal	3,523(75.0)	1,210(25.0)	4,733(100)		3,428(70.4)	1,490(29.6)	4,918(100)	
	Overweight	1,839(65.9)	955(34.1)	2,794(100)		1,971(68.9)	928(31.1)	2,899(100)	
	Obesity	2,760(64.1)	1,628(35.9)	4,388(100)		3,048(68.0)	1,511(32.0)	4,559(100)	
Smoking	Non-smoker	7,334(71.8)	2,966(28.2)	10,300(100)	< 0.001	7,403(70.1)	3,307(29.9)	10,710(100)	< 0.001
	Smoker	1,292(58.2)	969(41.8)	2,261(100)		1,502(65.2)	845(34.8)	2,347(100)	
Alcohol drink	Non-drinker	3,921(68.8)	1,830(31.2)	5,751(100)	0.216	4,048(67.3)	2,031(32.7)	6,079(100)	< 0.001
	Drinker	4,716(70.0)	2,113(30.0)	6,829(100)		4,864(70.9)	2,122(29.1)	6,986(100)	
Tooth brushing/day	≤1	611(56.1)	470(43.9)	1,081(100)	< 0.001	783(67.1)	409(32.9)	1,192(100)	0.008
	2	3,196(66.4)	1,660(33.6)	4,856(100)		3,337(67.8)	1,661(32.2)	4,998(100)	
	≥3	4,738(74.2)	1,725(25.8)	6,463(100)		4,571(70.6)	1,994(29.4)	6,565(100)	

* Weighted %; ** p-value was calculated by complex sample chi-square test

3.2 Prevalence of periodontitis and oral pain according to the quality of life

The analytical results of periodontitis prevalence and oral pain according to EQ5D, which constitutes the quality of life index, are shown in Table 2.

Among the patients with periodontitis and those who suffered from oral pain, the highest case was found to have no problems with their mobility (p<0.001). In addition, those who experienced

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periodontitis prevalence and oral pain were more likely to have no discomfort or disruption in the dimensions such as self-care (p<0.001), usual activities (p<0.001), pain/discomfort (p=0.001, p<0.001), and anxiety/depression (p=0.112, p<0.001). Moreover, those who experienced periodontitis and oral pain were higher in the 'moderate problems' dimension than in the 'no problems' category.

Table 2. Periodontitis and oral pain of subjects by EQ5D N (%)*

Characteristics	Division	Periodontitis			Oral pain		
		Normal	Periodontitis	p**	No	Yes	p**
Mobility	No problems	7,444(89.5)	3,078(82.0)	< 0.001	7,526(88.0)	3,250(81.9)	< 0.001
	Moderate problems	888(10.1)	671(17.2)		1,037(11.5)	712(17.3)	
	Severe problems	30(0.3)	34(0.9)		41(0.5)	38(0.8)	
Self-care	No problems	8,126(97.4)	3,588(95.1)	< 0.001	8,322(96.8)	3,783(95.0)	< 0.001
	Moderate problems	220(2.5)	182(4.6)		260(2.9)	202(4.7)	
	Severe problems	16(0.1)	13(0.3)		22(0.2)	15(0.3)	
Usual activity	No problems	7,857(94.2)	3,422(90.9)	< 0.001	8,038(93.6)	3,582(90.2)	< 0.001
	Moderate problems	479(5.5)	335(8.4)		525(6.0)	397(9.3)	
	Severe problems	25(0.2)	26(0.7)		40(0.4)	21(0.5)	
Pain/Discomfort	No problems	6,560(78.6)	2,835(75.1)	0.001	6,867(79.9)	2,807(70.2)	< 0.001
	Moderate problems	1,645(19.7)	847(22.5)		1,601(18.6)	1,038(26.0)	
	Severe problems	154(1.8)	99(2.4)		131(1.5)	154(3.8)	
Anxiety/Depression	No problems	7,582(90.9)	3,401(89.9)	0.112	7,892(91.7)	3,477(87.3)	< 0.001
	Moderate problems	734(8.7)	353(9.4)		666(7.9)	481(11.7)	
	Severe problems	41(0.4)	29(0.7)		41(0.4)	40(1.0)	

* Weighted %; ** P-value was calculated by complex sample chi-square test

3.3 The association of quality of life with periodontitis and oral pain

The association of quality of life (EQ5D) with periodontitis and oral pain is shown in Table 3. Model 1 is unadjusted, and the periodontitis odds ratio increased by 2.67 times (95% CI 1.40-5.08) compared to the case when mobility was greatly uncomfortable. In addition, in the oral pain category, the oral pain odds ratio decreased to 0.49 times (95%CI 0.25-0.97) when feeling great discomfort in usual activities, and increased to 2.58 times (95%CI 1.79-3.72) in pain/discomfort.

Model 2 is a model that adjusted all socioeconomic, medical, and behavioral factors. Here, the periodontitis odds ratio increased by 2.48 times (95%CI 1.18-5.24) among people with a great amount of discomfort in usual activities than those without feeling discomfort. And on the contrary,

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periodontitis odds ratio was 0.64 times (95%CI 0.46-0.89) in pain/discomfort. In the oral pain category, it decreased by 0.45 times (95%CI 0.21-0.95) in the usual activity category. On the contrary, the oral pain odds ratio increased by 2.68 times (95%CI 1.83-3.93) with a great amount of discomfort in usual activities than without feeling pain/discomfort.

Table 3. Multivariable association between EQ5D and periodontitis and oral pain (great difficulty. ref. no difficulty)

Variables	Model 1					Model 2				
	MO	SC	UA	PD	AD	MO	SC	UA	PD	AD
Periodontitis (ref.normal)	2.67** (1.40-5.08)	1.41 (0.62-3.20)	1.76 (0.87-3.59)	0.74 (0.55-1.01)	1.05 (0.57-1.95)	1.38 (0.71-2.67)	1.21 (0.48-3.03)	2.48* (1.18-5.24)	0.64** (0.46-0.89)	1.36 (0.70-2.64)
Oral pain (ref.no)	1.18 (0.69-2.03)	0.96 (0.38-2.42)	0.49* (0.25-0.97)	2.58*** (1.79-3.72)	1.48 (0.78-2.81)	0.93 (0.48-1.80)	0.53 (0.21-1.31)	0.45* (0.21-0.95)	2.68*** (1.83-3.93)	1.51 (0.73-3.12)

Data are presented as OR (95% CI). OR: odds ratio; CI: confidence interval, *p<0.05, **p<0.01, ***p<0.001.
Model 1 unadjusted model.
Model 2 adjusted for socioeconomic variables (sex, age, household income and education level), medical variables (diabetes mellitus and BMI) and health behavior variables (smoking, alcohol drinking and toothbrushing).
(MO; Mobility, SC; Self-care, UA; Usual activity, PD; Pain/discomfort, AD; Anxiety/depression)

4. Discussion

This study analyzed raw data from the 7th National Health and Nutrition Survey to determine the relationship between quality of life with periodontitis and oral pain in Korean adults aged 19 years and older, using a nationally representative sample of Korean adults. The main findings are as follows.

As a result of analyzing the prevalence of periodontitis and oral pain according to the general characteristics of the examinees, periodontitis and oral pain increased as age increased. In contrast, the prevalence was lower as household income increased and the brushing frequency increased. Previous studies have reported a higher prevalence of periodontitis with lower levels of education and income and a lower number of missing teeth with higher levels of education and income (Won et al., 2014; Shim et al., 2017). In addition, the drinking category showed a higher prevalence of periodontitis and oral pain in non-drinkers, confirming the findings of previous studies (Hwang & Park, 2022).

According to Choi's findings, oral pain is associated with mobility, pain, and discomfort among the components of the quality of life, and oral pain has a significant impact on pain/discomfort in the human body (Choi et al., 2015). However, when analyzed in relation to periodontitis prevalence and oral pain according to the EQ5D, which constitutes the quality of life index in this study, it was found that those with periodontitis and oral pain were more likely to have unimpeded mobility, and those with periodontitis and oral pain were more likely to have unimpeded or no impediment in self-care, usual activities, pain/discomfort, and anxiety/depression. However, those who experienced periodontitis and oral pain were more likely to be problematic than those who had no pain and normal periodontal tissue. The experience of periodontitis and oral pain did not show much difference

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compared to the normal group.

In this study, when logistic regression analysis was conducted to confirm the relationship between the quality of life and the periodontitis and oral pain, in model 2, which corrected all variables, periodontitis odds ratio was 2.48 times (95%CI 1.18-5.24) and oral pain experience odds ratio was 0.45 times (95%CI 0.21-0.95).

According to Choi's study, Among people with limited daily activities, trauma patients admitted to the intensive care unit may develop xerostomia due to medications that cause dry mouth or prolonged mouth opening due to intubation, and the dry mouth can lead to colonization of the gingival flora, which can cause gingival swelling and bleeding, leading to periodontitis (Choi et al., 2021).

In the case of seniors, there is a problem with chewing due to low residual teeth, which can cause malnutrition, and studies are showing that they feel discomfort and pain in usual activities due to poor pronunciation (Nam & Jang, 2013). Research related to this is expected to be needed in the future, and if there is cancer or systemic serious diseases, oral care is neglected, making it easy to be affected by oral diseases. As such, subjects with great restrictions on daily activities are likely to have difficulty managing the dental bacterial membrane, which is expected to contribute to the development of periodontitis.

In addition, the periodontitis odds ratio was 0.64 times (95% CI 0.46-0.89) and the oral pain experience odds ratio was 2.68 times (95% CI 1.83-3.93) for subjects with high pain/discomfort. As the theory suggests, the odds ratio results for oral pain indicate bodily pain and great discomfort, and the same was found in this study. The pain/discomfort surveyed in this study means pantalgia, including the oral area. Therefore, it is believed that pantalgia and discomfort may not affect all oral and periodontal tissues. In addition, it is believed that such results can be shown in cases where many of the examinees are not in periodontitis due to teeth loss, and further research should be conducted to examine them in more detail.

The study results revealed that in the EQ5D a measure of the quality of life periodontitis was associated with usual activities, whereas oral pain was associated with pain or discomfort. Therefore, various measures should be considered for comprehensive health promotion management, including oral health among the subjects. The study findings determined that dental experts should focus not only on oral health but also on support programs and resources for a better quality of life.

This study was a cross-sectional study from the National Health and Nutrition Survey, so there are limitations to clarify the causal relationship between quality of life and periodontitis and oral pain.

Nevertheless, the significance of this study is that it recognized the association between periodontitis and oral pain with the quality of life of Korean adults using the National Health and Nutrition Survey, which is representative of Korean adults. In the future, the results of this study will contribute to the development of oral health projects and educational programs for oral health including mental health, including the development of oral linkage counseling that can improve the quality of life, the development of education and counseling programs to improve the oral health of subjects, and exploring ways to connect with related organizations.

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5. Conclusions

In this study, the following major results were obtained after analyzing the relationship between periodontitis and oral pain experience in adults over the age of 19 in Korea using the 7th (2016-2018) data of the National Health and Nutrition Survey.

1. Periodontitis and oral pain were high in old age, low-income level, low education level, diabetics, and smokers (p<0.001).
2. Among the patients with periodontitis and those who suffered from oral pain, the highest case was found in those who have no issues with mobility(p<0.001). In addition, self-care (p<0.001), usual activities (p<0.001), pain/discomfort (p=0.001, p<0.001), and anxiety/depression (p=0.112, p<0.001) dimensions showed that those who experienced periodontitis prevalence and oral pain were more likely to have no discomfort or disruption.
3. Logistic regression analysis of EQ5D and periodontitis oral pain showed that in model 2, after adjusting for sociodemographic factors, the odds ratio for periodontitis increased 2.48 times (95%CI 1.18-5.24) and, conversely, the odds ratio for experiencing oral pain decreased 0.45 times (95%CI 0.21-0.95) among those who reported greater discomfort in usual activities.

The study findings suggest a correlation between the EQ5D a measure of quality of life and periodontitis and oral pain. Therefore, various support resources for a better quality of life should be provided to prevent and manage oral diseases.

Conflicts of Interest

The authors declare no conflict of interest.

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