



Research Article

Exploring Factors Affecting Oral Health Changes Among Community-Dwelling Older Adults: A Retrospective Study

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SUMMARY

Introduction: In the era of longevity, oral health has become increasingly important for maintaining the quality of life of older adults. However, the factors that influence their oral health remain unclear. Given that oral health tends to decline with age, it is crucial to identify the early predictors of changes in the oral health of older adults. Therefore, this study identified the factors influencing changes in the oral health of Korean older adults.

Methods: This retrospective study used nationally representative panel data from the 2018 and 2020 waves of the Korean Longitudinal Study of Aging. The study population of 3859 individuals aged 65 years or older was divided into four groups (good-good, good-poor, poor-good, and poor-poor groups) based on changes in their oral health as assessed by the Geriatric Oral Health Assessment Index. Data were analyzed using multinomial logistic regression to examine factors influencing changes in oral health, with the good-good group set as the reference category.

Results: Individuals in the Poor-Poor group were the highest in number (33.7%). Factors affecting oral health changes included age, education level, body weight status, diabetes, heart disease, depression, cognitive impairment, and Medical aid coverage. Being underweight or overweight and having cognitive impairment contributed to declining oral health. Depression showed a dual association, being linked to both improvement and persistence of poor oral health. Furthermore, diabetes, heart disease, being underweight, and insufficient healthcare coverage perpetuated poor oral health. These factors explained 29.9% of the variance in oral health changes among older adults.

Conclusion: Study findings highlight the need for multi-level actions in clinical care, community health promotion, and policy to expand dental insurance. Future research should extend longitudinal analyses, address unmet oral health needs, and draw cross-national insights to inform strategies and policies for healthy aging.

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Introduction

The number of individuals aged 65 years or older is substantially growing [1], and the pace of aging is expected to increase unprecedentedly [2]. Korea, in particular, is witnessing exceptionally rapid aging. More than one-third of its population is expected to be 65 years old or older by 2050, making it a “super-aged society” [2]. Population aging refers to an increased proportion of older individuals in the population and is primarily attributed to extended life expectancy [2]. This demographic shift is accompanied by the accumulation of chronic diseases and conditions such as poor oral health.

Oral health is indispensable because of its pivotal role in essential functions, such as eating, speaking, and smiling [3], and is closely linked to overall health and well-being [4]. However, natural tooth loss and persistent oral conditions, such as dental caries and periodontal diseases, become prevalent among older individuals [5]. These issues pose challenges to fulfilling fundamental daily activities, including chewing and communicating, contributing to subsequent physical and psychosocial issues [5]. Furthermore, as oral diseases advance, they diminish an individual's quality of life (QoL) and increase healthcare expenses [6]. A longitudinal study of older individuals in the US found that tooth loss increases the risk of cardiovascular disease and respiratory mortality. This highlights the significance of oral health in enhancing the survival prospects of older individuals [7].

With the growing emphasis on healthy aging, many studies have examined the determinants of older individuals' oral health. Demographic characteristics such as age, sex, education level, and marital status have consistently been identified as important factors influencing oral health disparities [8,9]. Health-related behaviors, including smoking and drinking, are also strongly linked to oral health outcomes [8,10], with smoking in particular recognized as a risk factor for problems such as toothache and chewing difficulties [9]. Oral health is further associated with physical and psychological health [11]. Poor oral health has been found to correlate with body mass index (BMI) [8,12] and chronic conditions such as diabetes, heart disease, and impaired physical function [13–16]. In addition, age-related medical conditions, including arthritis and palsy, can make oral hygiene maintenance more challenging [17]. Mental health also plays a role as older adults with depression are more likely to experience poor oral health [8,18]. From a cognitive perspective, social deprivation resulting from mild or greater cognitive impairment is associated with poor oral health [16,19]. Environmental and structural factors such as health insurance significantly influence oral health. Having dental insurance increases the likelihood of dentist visits and is associated with better oral health [20], while being uninsured is linked to poor oral and systemic health [21].

These findings suggest that older adults' oral health is influenced by individual attributes, such as demographics, health behaviors, and health conditions, as well as insurance support. Additionally, self-perceived health does not determine physical health; rather, physical health is influenced by individual and environmental factors, such as insurance coverage [22]. However, the impact of these factors on older adults' oral health remains unknown. Furthermore, despite numerous studies on older people's oral health, most have applied a cross-sectional design. A longitudinal approach is needed to capture early predictors of subsequent oral health changes and identify vulnerable groups among older adults [23]. Therefore, this study investigated the factors affecting changes in older adults' oral health from individual and insurance coverage perspectives. The results of this study are expected to help develop preventive and risk assessment oral health policies.

Methods

Study design and data source

This study employed a retrospective design using secondary longitudinal data from the 2018 and 2020 waves of the Korean Longitudinal Study of Aging (KLoSA) [24]. The retrospective aspect refers to the use of pre-existing panel data that had already been collected for other purposes, while the longitudinal aspect reflects the analysis of changes in oral health between two survey waves. We retrospectively identified individuals aged 65 years or older

who completed oral health items in both waves and analyzed baseline characteristics in relation to subsequent oral health changes. The KLoSA is a nationally representative biennial panel survey of Korean residents aged 45 years or older, employing multistage stratified sampling since 2006 to address health challenges in the rapidly aging population.

Study population

Participants were drawn from the seventh wave (2018) of the KLoSA, which included 6940 individuals—6136 existing panel members and 804 newly recruited respondents. Among them, 4325 individuals aged 65 years or older were identified. Of these, 3859 completed oral health-related items in both the seventh (2018) and eighth (2020) waves.

Measurements

Changes in oral health

Changes in oral health were assessed using the Geriatric Oral Health Assessment Index (GOHAI), which was developed by Atchison and Dolan in 1990 to evaluate oral health [25]. The GOHAI comprises 12 items assessing oral health across four domains: functional limitations, pain and discomfort, psychological impact, and behavioral impact. All items are rated on a Likert scale ranging from 0 (always) to 5 (never), and Items 3, 5, and 7 are reverse-coded. The sum of all item scores makes the total score, and higher scores indicate better oral health-related QoL. The Cronbach α of the GOHAI was .83 at the time of its development [25] and .87 in this study.

As no consensus exists regarding the optimal cutoff score for the GOHAI [26], we adopted the median score of 36 as the threshold in this study, consistent with prior research [27–29]. Participants with a GOHAI score ≥ 36 were classified as having good oral health, whereas those with a score < 36 were classified as having poor oral health. Based on their oral health status in the seventh and eighth waves, participants were categorized into four groups: (a) good-good (GG: ≥ 36 in both the seventh and eighth waves), (b) good-poor (GP: ≥ 36 in the seventh wave and < 36 in the eighth wave), (c) poor-good (PG: < 36 in the seventh wave and ≥ 36 in the eighth wave), and (d) poor-poor (PP: < 36 in both the seventh and eighth waves).

Demographic characteristics

The demographic variables included in this study were age, sex, education level (primary or below, or secondary or above), and marital status [married or unmarried (encompassing single, widowed, and divorced individuals)].

Health-related behaviors

The health-related behaviors assessed in this study were smoking (never smoked, former smoker, or current smoker), drinking (never drank, former drinker, or current drinker), and the number of dental treatments received since the last survey.

Health conditions

The health conditions assessed were comorbidities, BMI, depression, and cognitive function. To determine comorbidities, the respondents were asked about the presence of diagnosed chronic conditions (specifically hypertension, diabetes, heart disease, and arthritis or rheumatoid arthritis). BMI was calculated by dividing weight (in kilograms) by height (in square meters) and categorized as underweight (BMI < 18.5), normal ($18.5 \leq \text{BMI} < 23.0$), or overweight (BMI ≥ 23.0) based on the criteria

recommended by the World Health Organization for the Asian population [30].

Depression was determined using the Korean Center for Epidemiologic Studies Depression-10 scale (10 items) [31], which asks how often one experienced depressive symptoms during the past week. There are four response options: just a little bit (less than a day), sometimes (one or two days), often (three or four days), and always (five to seven days). The responses of “just a little bit” and “sometimes” were assigned 0 points and the responses of “often” and “always” were assigned 1 point. A total score of four or more was considered indicative of depressive symptoms [32]. The Cronbach α of the scale was .80 at the time of its development [31] and .79 in this study.

Cognitive function was assessed using the question “Have you ever been diagnosed with dementia (such as senile dementia and Alzheimer’s disease)?” Those who answered “yes” or “cognitive impairment” were included in the cognitive impairment group.

Health insurance

Regarding health insurance, we assessed the type of insurance, which was divided into national health insurance and medical aid. Among these, the medical aid system guarantees access to essential medical services and those that maintain the QoL of people who are unable to make a living or have lost their economic ability [33], similar to Medical aid or Medicare in the US [34].

Data analysis

Descriptive statistics were used to summarize the data. Continuous variables were presented using means and standard deviations and categorical variables using frequencies and percentages. Chi-square tests and one-way analysis of variance were conducted to investigate differences in demographic characteristics, health-related behaviors, health conditions, and health insurance among the four groups of oral health changes. Factors influencing changes in oral health were examined by considering demographic characteristics, health-related behaviors, health conditions, and health insurance. Given that the categories among the groups lacked natural ordering, a multinomial logistic regression model was employed with the GG group as the reference group. The final multivariate model included variables that had a p value $<.10$ in univariate analyses. All analyses were performed using SPSS/WIN 26.0 (IBM Corp., Armonk, NY, USA), and statistical significance was set at a p value $<.05$.

Results

Characteristics of the study population

The mean score for oral health was 34.60 ± 7.30 . The mean age of the study population was 75.12 ± 6.84 years (Table 1), and the GG and PP groups were the youngest and oldest, respectively, with a statistically significant difference. In the total study population, more than half individuals were female (58.5%), married (69.2%), had up to primary education (53.3%), and had never consumed alcohol (53.9%). The most common comorbidity was hypertension (54.9%), and diabetes and heart disease accounted for 24.9% and 12.2% of the cases, respectively. Most individuals were overweight (54.5%) and 12.7% had depressive symptoms. Regarding health insurance, 4.8% were receiving Medical aid.

Compared to the other three groups, the GG group had younger individuals, more females, more educated, married, fewer underweight individuals, fewer depressive symptoms, and a lower prevalence of hypertension, diabetes, heart disease, arthritis or rheumatoid arthritis, and cognitive impairment. Differences in age

and oral health among the groups were assessed using Scheffé’s *post hoc* test. There were differences between the GG and PP groups, and the GP and PG groups differed partially.

Changes in the mean score for oral health across groups

In the total study population, the difference in the mean score for oral health (from the seventh to the eighth wave) was statistically significant at -2.21 ± 8.55 , suggesting that their oral health improved as time went by ($t = -16.07$, $p < .001$) (Table 2). The GG and GP groups showed significant declines in oral health, whereas the PG group showed a steep improvement. The PP group maintained their oral health with no significant changes in the mean score (Figure 1).

Factors associated with changes in oral health

The final multinomial logistic regression model demonstrated an acceptable fit [35] as evidenced by a significant likelihood ratio test ($\chi^2 = 253.334$, $df = 120$, $p < .001$). The model’s explanatory power was moderate, with a Nagelkerke pseudo R^2 of .299, a Cox and Snell R^2 of .279, and a McFadden R^2 of .122. The GG group was more likely to be younger [GP: odds ratio (OR) = 1.03, 95% confidence interval (CI) = 1.02–1.05; PG: OR = 1.02, 95% CI = 1.00–1.04; PP: OR = 1.06, 95% CI = 1.04–1.07] and have up to primary education (GP: OR = 1.26, 95% CI = 1.02–1.54; PG: OR = 1.49, 95% CI = 1.18–1.89; PP: OR = 1.63, 95% CI = 1.34–1.98) compared to the other three groups. The GP group was more likely to be underweight (OR = 2.17, 95% CI = 1.18–4.00) or overweight (OR = 1.25, 95% CI = 1.04–1.52) and have cognitive impairment (OR = 3.36, 95% CI = 1.28–8.81) compared to the GG group. The PG group was more likely to have depressive symptoms (OR = 3.26, 95% CI = 2.13–4.97) than the GG group. The PP group was more likely to have diabetes (OR = 1.44, 95% CI = 1.17–1.77), heart disease (OR = 1.35, 95% CI = 1.04–1.77), and depressive symptoms (OR = 2.46, 95% CI = 1.66–3.65) and be underweight (OR = 2.04, 95% CI = 1.16–3.57) compared to the GG group. Additionally, the PP group was more likely to receive Medical aid (OR = 1.83, 95% CI = 1.18–2.84) than the GG group (Table 3 and Figure 2). In summary, determinants of oral health changes were identified as age, level of education, body weight status, cognitive impairment, presence of depression, diabetes, heart disease, and Medical aid support.

Discussion

To the best of our knowledge, this is the first study to longitudinally investigate changes in older adults’ oral health and identify its determinants using nationally representative data. By confirming the oral health status of Korean older adults, this study is expected to help develop tailored healthcare and governmental policies.

This study identified oral health changes among Korean older adults (GG = 31.4%, GP = 21.1%, PG = 13.8%, and PP = 33.7%), and individuals in the PP group were the highest in number. The findings of this study reveal older adults’ vulnerability concerning their oral health as the mean score for oral health was 36.79 among community-dwelling older adults with a mean age of 75.1 years, much lower than that reported in different settings. A Malaysian study found a mean GOHAI score of 54.5 among adults with a mean age of 63.0 years [36], while a US study involving low-income individuals aged 62 years or older reported a score of 40.4 [37]. Our results also showed that despite belonging to the GG group, older adults’ oral health declined rapidly over one year. This could be due to aging-related changes in oral health [38]. Overall, recognizing oral health as an essential part of overall health, the

Table 1 Demographic Characteristics, Health-Related Behaviors, Health Conditions, and Health Insurance of the Study Population based on Oral Health Changes (N=3,859)

Variable	Total (N=3,859)	GG ^a (n=1,214, 31.4%)	Gp ^b (n=814, 21.1%)	PG ^c (n=531, 13.8%)	PP ^d (n=1,300, 33.7%)	χ^2 or F (p)
Mean $\pm$ SD or n (%)						
Demographic characteristics						
Age (years)	75.12 $\pm$ 6.84	72.73 $\pm$ 5.90	74.65 $\pm$ 6.71	75.06 $\pm$ 6.52	77.66 $\pm$ 7.01	120.51 (<.001) d > a,b,c, b,c > a
Sex						
Male	1,600 (41.5)	556 (45.8)	355 (43.6)	230 (43.3)	459 (35.3)	31.99 (<.001)
Female	2,259 (58.5)	658 (54.2)	459 (56.4)	301 (56.7)	841 (64.7)	
Education level (years)						
Primary or below ($\leq$ 6)	2,057 (53.3)	488 (40.2)	413 (50.7)	291 (54.8)	865 (66.5)	177.89 (<.001)
Secondary or above ($\geq$ 7)	1,802 (46.7)	726 (59.8)	401 (49.3)	240 (45.2)	435 (33.5)	
Marital status						
Married	2,671 (69.2)	943 (77.7)	592 (72.7)	380 (71.6)	756 (58.2)	121.53 (<.001)
Unmarried ^a	1,188 (30.8)	271 (22.3)	222 (27.3)	151 (28.4)	544 (41.8)	
Health-related behaviors						
Smoking						
Never smoked	2,683 (70.0)	836 (69.4)	562 (69.2)	358 (67.8)	927 (71.9)	4.13 (.659)
Former smoker	883 (23.0)	286 (23.8)	192 (23.6)	129 (24.4)	276 (21.4)	
Current smoker	268 (7.0)	82 (6.8)	58 (7.2)	41 (7.8)	87 (6.7)	
Drinking						
Never drank	2,081 (53.9)	604 (49.8)	430 (52.9)	279 (52.5)	768 (59.0)	40.32 (<.001)
Former drinker	798 (20.7)	243 (20.0)	162 (19.9)	118 (22.2)	275 (21.2)	
Current drinker	979 (25.4)	367 (30.2)	221 (27.2)	134 (25.3)	257 (19.8)	
Number of dental treatments received	1.57 $\pm$ 4.06	1.39 $\pm$ 3.66	1.81 $\pm$ 4.24	1.38 $\pm$ 4.28	1.67 $\pm$ 4.20	2.34 (.071)
Health conditions^b						
Comorbidities						
Hypertension	2,118 (54.9)	606 (49.9)	437 (53.7)	299 (56.3)	776 (59.7)	25.13 (<.001)
Diabetes	959 (24.9)	249 (20.5)	203 (24.9)	111 (20.9)	396 (30.5)	38.59 (<.001)
Heart disease	472 (12.2)	117 (9.6)	78 (9.6)	68 (12.8)	209 (16.1)	31.00 (<.001)
Arthritis or Rheumatoid arthritis	1,341 (34.7)	336 (27.7)	277 (34.0)	178 (33.5)	550 (42.3)	60.07 (<.001)
BMI						
Normal	1,591 (42.0)	507 (41.9)	300 (37.0)	225 (42.7)	559 (45.2)	45.81 (<.001)
Underweight	132 (3.5)	19 (1.6)	28 (3.5)	17 (3.2)	68 (5.5)	
Overweight	2,062 (54.5)	685 (56.5)	482 (59.5)	285 (54.1)	610 (49.3)	
Depression	489 (12.7)	58 (4.8)	56 (6.9)	76 (14.3)	299 (23.0)	219.65 (<.001)
Cognitive impairment	78 (2.0)	6 (0.5)	19 (2.3)	11 (2.1)	42 (3.2)	24.30 (<.001)
Health Insurance						
Type of Insurance						
National Health Insurance	3,673 (95.2)	1182 (97.4)	783 (96.2)	512 (96.4)	1,196 (92.0)	44.88 (<.001)
Medical aid	186 (4.8)	32 (2.6)	31 (3.8)	19 (3.6)	104 (8.0)	

Note. BMI = body mass index; GG = good–good; GP = good–poor; PG = poor–good; PP = poor–poor; SD = standard deviation.

^a Unmarried: individuals include those who are single, widowed, or divorced.

^b Missing data were handled using available-case analysis (pairwise deletion); therefore, sample sizes and totals may vary across variables.

Table 2 Differences in the Mean Score for Oral Health from the 7th to the 8th Wave across All Groups

Variable	Groups	7 th wave Mean $\pm$ SD	8 th wave Mean $\pm$ SD	Difference (7 th wave –8 th wave)	t	p
Oral health	Total (N=3,859)	34.60 $\pm$ 7.30	36.81 $\pm$ 8.76	-2.21 $\pm$ 8.55	-16.07	<.001
	GG (n=1,214) ^a	44.14 $\pm$ 5.40	40.30 $\pm$ 2.74	3.83 $\pm$ 5.36	24.90	<.001
	GP (n=814) ^b	41.96 $\pm$ 4.20	31.87 $\pm$ 5.21	10.08 $\pm$ 6.64	43.30	<.001
	PG (n=531) ^c	31.38 $\pm$ 5.05	39.44 $\pm$ 2.17	-8.06 $\pm$ 5.62	-33.03	<.001
	PP (n=1,300) ^d	28.92 $\pm$ 6.20	28.95 $\pm$ 7.50	-0.04 $\pm$ 7.76	-0.17	.863

a>b, c, d; b>c, d; c>d (p <.001); SD = Standard deviation; GG = good–good; GP = good–poor; PG = poor–good; PP = poor–poor.

government and healthcare providers (HCPs) should encourage older individuals to prevent oral health problems [17,38]. Studies have shown that individual counseling or community campaigns, such as health fairs and hands-on oral hygiene instruction, significantly improve older adults' oral health-related QoL [37]. Such strategies should be considered to improve older adults' oral health and, consequently, their QoL.

Our results showed that the PP group is more likely to have diabetes and heart disease than the GG group. We could not establish the causal effect of chronic diseases on oral health changes because the timeframe of these diagnoses was not determined. While retrospective study designs can, under appropriate conditions, provide evidence toward causal

inference, the absence of information on the timing of chronic disease diagnoses in the KLoSA dataset precluded us from establishing a clear temporal sequence between chronic diseases and oral health changes. Therefore, the findings should be interpreted as associations rather than causal effects, highlighting the need for future studies with more detailed temporal data and robust longitudinal designs. Nevertheless, our results are consistent with previous studies reporting that comorbidities such as diabetes and cardiovascular diseases are associated with oral conditions and symptoms, including dry mouth, dental caries, periodontal disease, and salivary dysfunction [39]. More than 90.0% of the individuals with diabetes experience oral health issues. However, most of them do not recognize the link between

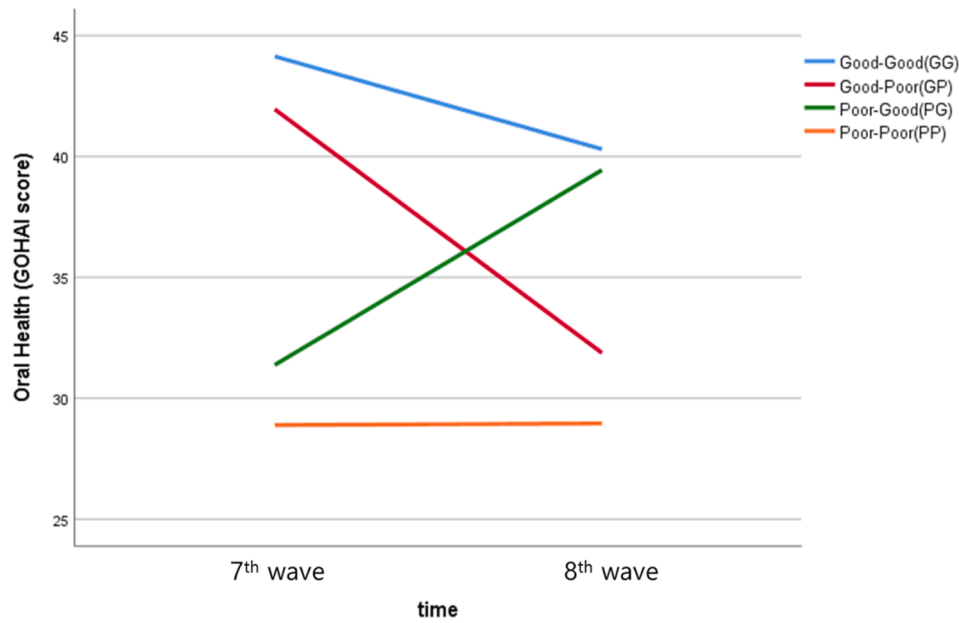


Figure 1. Changes in oral health across the four groups. GOHAI = geriatric oral health assessment index.

Table 3 Factors Associated with the GG, PG, and PP Groups Using Multinomial Logistic Regression Analysis ($n=3,777$)

Variable	GP vs. GG			PG vs. GG			PP vs. GG		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Demographic characteristics									
Age (years)	1.03	1.02–1.05	<.001	1.02	1.00–1.04	.006	1.06	1.04–1.07	<.001
Sex									
Male	1.10	0.86–1.42	.431	1.05	0.78–1.40	.750	0.90	0.70–1.15	.419
Female (ref.)	1.00			1.00			1.00		
Education level									
Primary or below (≤ 6)	1.26	1.02–1.54	.026	1.49	1.18–1.89	.001	1.63	1.34–1.98	<.001
Secondary or above (≥ 7) (ref.)	1.00			1.00			1.00		
Marital status									
Married	0.99	0.78–1.25	.911	0.96	0.74–1.26	.820	0.80	0.65–1.00	.053
Unmarried (ref.)	1.00			1.00			1.00		
Health-related behaviors									
Drinking									
Never drank (ref.)	1.00			1.00			1.00		
Former drinker	0.90	0.69–1.18	.468	1.04	0.77–1.41	.775	0.93	0.72–1.20	.600
Current drinker	0.94	0.73–1.21	.645	0.99	0.74–1.33	.982	1.02	0.80–1.31	.832
Health conditions									
Comorbidity									
Hypertension	1.01	0.83–1.21	.940	1.15	0.92–1.43	.207	1.01	0.83–1.20	.978
Diabetes	1.19	0.96–1.49	.110	0.86	0.66–1.13	.276	1.44	1.17–1.77	.001
Heart disease	0.87	0.64–1.19	.405	1.13	0.81–1.58	.441	1.35	1.04–1.77	.024
Arthritis or Rheumatoid arthritis	1.14	0.92–1.42	.204	0.99	0.77–1.27	.968	1.10	0.90–1.35	.317
BMI									
Normal (ref.)	1.00			1.00			1.00		
Underweight	2.17	1.18–4.00	.012	1.52	0.76–3.04	.228	2.04	1.16–3.57	.012
Overweight	1.25	1.04–1.52	.018	1.03	0.82–1.27	.809	1.09	0.80–1.15	.616
Depression	0.77	0.45–1.29	.321	3.26	2.13–4.97	<.001	2.46	1.66–3.65	<.001
Cognitive impairment	3.36	1.28–8.81	.013	1.37	0.47–4.00	.554	1.26	0.50–3.19	.621
Health Insurance									
Type of Insurance									
National Health Insurance (ref.)	1.00								
Medical aid	1.15	0.68–1.93	.597	0.96	0.53–1.76	.910	1.83	1.18–2.84	.006

Note. BMI = body mass index; SD = standard deviation; OR = odds ratio; CI = confidence interval; GG = good-good; GP = good-poor; PG = poor-good; PP = poor-poor; ref. = reference. The total sample was 3,859; 82 cases were excluded due to missing values, resulting in a final analytic sample of $n = 3,777$.

diabetes and oral health, and only a small proportion seek regular dental checkups [39]. Modifying lifestyle factors, such as maintaining blood glucose levels and practicing self-care, along with routine dental visits focusing on reinforced oral health education can significantly reduce oral complications associated with

diabetes [40]. In the same vein, patients with heart diseases report poorer oral health-related QoL than those without these diseases [41]. Considering that inflammatory and immune conditions, such as periodontitis and poor oral hygiene, can aggravate heart diseases [42], oral health and heart diseases evidently influence each other.

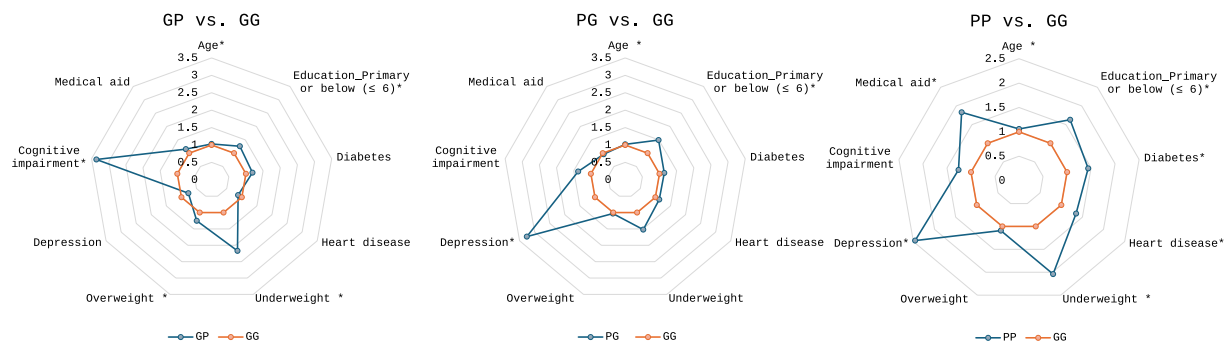


Figure 2. Radar plot of odds ratios for factors affecting oral health changes by groups. GG = good-good; GP = good-poor; PG = poor-good; PP = poor-poor. * $p < .05$.

Therefore, HCPs and healthcare organizations should focus on and screen older adults for chronic diseases, such as diabetes and heart disease, to prevent poor oral health and, consequently, poor overall health and well-being.

BMI was found to determine older adults' oral health. Compared to having a normal weight, being underweight was associated with a 2.17-fold increase in the odds of transitioning from good to poor oral health and a 2.04-fold increase in maintaining poor oral health. Being overweight led to worse oral health over one year with an OR of 1.25. BMI has been extensively employed in epidemiological studies to evaluate older adults' nutritional status [43]. Our findings confirm that overall nutrition determines oral health. One study showed that inflammation-related oral disease increases in overweight or obese individuals [44], and they often use multiple medications for complex systemic diseases, which can cause hyposalivation [45], supporting the findings of this study. Meanwhile, being underweight may entail undernutrition, micronutrient deficiencies [46], a weak immune system [47], and fewer natural teeth, causing poor masticatory performance [48]. These conditions can put underweight individuals at a higher risk of persistent poor oral health, supporting the findings of this study. Oral health can affect chewing ability, causing changes in food choices [12] and affecting older adults' nutritional intake [49]. However, it remains unclear whether BMI and oral health are bidirectionally related [50]. In this context, this study provides evidence that nutritional status negatively impacts oral health.

This study confirms that depression is a risk factor for poor oral health [51]. However, it also demonstrates that, despite the PG group exhibiting a higher likelihood of depressive symptoms than the PP group, oral health improved in the PG group. This suggests that even older adults with depression have the potential to improve their oral health. The results of this study present a different perspective from that of studies confirming the relationship between oral health and depression. Research has shown that oral health declines in cases of depression [52]. However, in this study, depression contributed to improving one's oral health, suggesting that oral health can improve if depression is well managed. Mechanisms underlying the connection between oral health and depression remain unclear [52]. Other factors may play a role in this relationship. For instance, poor oral health may cause discomfort and pain, which can diminish the QoL and worsen depressive symptoms [53]. Poor oral health can also impede social interactions [3], which is a risk factor for depression [54]. Conversely, depression can hamper oral health as individuals with depression are more prone to neglecting oral hygiene [55] and engaging in less physical activity, which can cause oral health issues [56]. To prevent a vicious cycle in which depression leads to

poor oral health and vice versa, HCPs should proactively identify and prevent depressive symptoms in older adults [55]. Even if depression occurs, efforts to improve behaviors that can be induced by depressive symptoms, such as personal hygiene practices (e.g., brushing teeth) and dental checkups, can contribute to improving the QoL and oral health of older adults.

Cognitive impairment was found to worsen oral health, and its likelihood was notably higher in the GP group than in the GG group. This result aligns with that of studies indicating that cognitive impairment contributes to poor oral hygiene and health [57]. Individuals with cognitive impairment have a diminished capacity to maintain oral health, which makes them susceptible to dental decay and gum diseases [58]. Additionally, they encounter challenges in accessing dental care when issues arise, which exacerbates oral health decline [58]. In other words, cognitive impairment, even in older individuals with good oral health, can diminish their ability to manage their oral hygiene over time, potentially deteriorating their oral health [57]. Therefore, it is important to identify cognitive impairment and ensure continuous monitoring and management, even among older individuals with good oral health. Additionally, HCPs must be trained in providing tailored healthcare to older adults with cognitive impairment. These individuals often refuse essential care; this creates an ethical dilemma for caregivers as they must choose between respecting the care recipient's autonomy and providing good care [59]. Such dilemmas can make it difficult for caregivers to prioritize oral health [60].

Our results showed that Medical aid beneficiaries tend to maintain poor oral health, which contradicts previous findings. This raises the question of whether Korea's Medical aid program provides enough aid for dental care. A study conducted in the US using nationally representative state-level data from 2014 to 2018 found a significant association between comprehensive Medical aid benefits and increased dental care utilization among poor older adults [61]. However, our study showed no significant difference in dental visit frequency between the PP and other groups. This further supports the notion that Korea's Medical aid program provides insufficient aid for dental care. In South Korea, the national health insurance system and the medical aid system aim to expand healthcare accessibility by providing continuous coverage [62]. However, dental care coverage remains highly restricted because of limitations in insurance finances [62]. The extensive number of non-covered dental treatments decreases medical accessibility for beneficiaries [62], despite the higher prevalence of dental decay among medical aid beneficiaries [63]. Therefore, this study highlights the importance of providing essential medical resources to medically underserved populations, particularly older individuals.

Limitations

This study has several limitations. First, owing to the nature of the secondary analysis, we could compare oral health at only two time points. The KLoSA data span from 2006 to the eighth wave in 2020, but oral health-related variables were added from the seventh wave. Thus, data on these variables were available in only the seventh and eighth waves. Utilizing more comprehensive longitudinal data will provide a more precise understanding of oral health changes among older adults and their determinants. Second, we used one question on health insurance type to assess oral health-related policies. There were too many missing responses to questions on oral health-related insurance and policies; therefore, they could not be included in our analysis. As answering insurance- and policy-related questions may be difficult for older adults, their needs must be identified using qualitative research and they should be incorporated in oral health-related policies. Finally, although the GOHAI has shown validity and reliability, it involves subjective responses. Objective indicators, such as cavity status or number of teeth lost, should be considered to have more precise information on oral health.

Conclusions

This study demonstrates that body weight status, chronic diseases, depression, cognitive impairment, and insurance coverage are key determinants of oral health changes in older adults. These findings call for practical actions at multiple levels. Clinically, oral health screening should be integrated into chronic disease and geriatric care, supported by interprofessional collaboration among dental and medical providers. In community settings, oral health promotion should be coupled with nutrition and lifestyle interventions, as well as targeted education campaigns to empower older adults to maintain their oral health in community. At the policy level, expanding dental insurance benefits and improving Medical aid coverage are essential to reduce inequities and ensure timely access to dental services.

Future research should extend longitudinal analyses with objective oral health measures to capture long-term trajectories of oral health and to examine the cumulative impact of risk and protective factors over time. Qualitative studies are needed to explore older adults' lived experience and unmet needs regarding oral health and insurance coverage. In addition, cross-national comparative research could provide valuable insights into how different health systems shape oral health outcomes in aging populations. These directions will help refine evidence-based strategies and guide policies to promote healthy aging and oral health.

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Data availability statement

All data supporting the findings of this study are available from the Korean Longitudinal Study of Aging (<http://survey.keis.or.kr>).

Author contributions

Yoonjung Ji and Eunhyung Kim: Conceptualization, Methodology, Formal analysis, Visualization, Writing—Original draft, Writing—Review and Editing; SangA Lee: Conceptualization,

Writing—Original draft, Writing—Review and Editing; Taewha Lee: Conceptualization, Supervision, Project administration, Funding acquisition, Writing—Review and Editing.

Ethical statement

According to the Republic of Korea Bioethics Act, this study received an exemption from deliberation from the Institutional Review Board of the Korea National Institute for Ethics Policy and the National Statistical Office as it involved publicly available data. Therefore, this study did not require separate ethical approval.

Conflict of interest

The authors declare no actual or potential conflicts of interests.

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