RESEARCH ARTICLE

Impact of Masticatory Discomfort on Daily Living Difficulties in Korean Elderly with Cognitive Decline

Kyung-Yi Do[1], Chun-Bae Kim[1,2], and Yeon-Soon Ahn[1,3†]

[1]Department of Preventive Medicine, Yonsei University Wonju College of Medicine, Wonju 26426, [2]Hongcheon County Hypertension and Diabetes Registration and Education Center, Hongcheon 25135, [3]Institute of Genomic Cohort, Yonsei University Wonju College of Medicine, Wonju 26426, Korea

Background: Cognitive impairment has been reported to be closely associated with poor oral health, and the relationship is bidirectional, as older adults with poor oral health and chewing function are at a higher risk of cognitive decline (CD). This cross-sectional study aimed to determine whether masticatory discomfort in Korean elderly increases the risk of daily living difficulty (DLD) related to CD and whether there is a difference in risk according to gender and age.
Methods: The data used were obtained from the Korean Community Health Survey (2019). The final analysis included 22,154 people aged 65 years and older who completed the survey and responded to all items on the variables used in the study. Chi-square test, trend test, and complex sample logistic regression were performed for statistical analysis, to clarify the purpose of this study.
Results: As masticatory discomfort increased, the elderly's DLD tended to increase (p-for trend, p<0.001). For logistic regression, adjusting for all covariates, participants who reported masticatory discomfort as "discomfort" (adjusted odds ratio [AOR]=2.45, 95% confidence interval [CI]=2.11~3.50) and "severe discomfort" (AOR=2.95, 95% CI=2.49~3.50) had a more than a two-fold increased risk of CD-related DLD compared to participants who reported "no discomfort at all." In age-stratified analyses, elderly men aged 75~84 years and elderly women aged 65~74 years had the highest risk of developing CD-related DLD.
Conclusion: Oral care interventions to improve masticatory function in older adults may slow CD and improve CD-related DLD. We hope that this study will raise awareness among caregivers and clinical professionals regarding the importance of oral care for older adults with CD.

Key Words: Chewing, Cognitive dysfunction, Mastication

Introduction

1. Background

If early periodontitis is not treated timeously, it may progress to severe periodontitis and eventual tooth loss, resulting in lowered masticatory function, making it difficult to chew food and eat a balanced diet. This ultimately contributes to morbidity and mortality in older adults[1,2]. Older adults with difficulty chewing tend to eat soft foods, causing a gradual decline in masticatory function. Long-term accumulation of these problems can lead to neuro-degeneration due to nutritional imbalances, as well as a decline in memory and learning, neuroendocrine changes, and hippocampal degeneration[3].

Many recent studies have reported that cognitive impairment is closely associated with poor oral health[4-8], and the relationship between masticatory function and cognitive impairment could be bidirectional, as older adults with cognitive impairment may have difficulty attending regular dental visits or maintaining their oral health. Thus, they are at an increased risk of developing oral health problems, such as natural tooth loss[9,10]. In addition, masticatory

discomfort causes various mental health problems, including depression, aesthetic problems, and human relationship dysfunction, thereby lowering the quality of life of older adults[1,11-14].

Previous studies have reported that older adults with dementia living in nursing homes have a significant accumulation of dental plaque and severe periodontitis compared to those without dementia and not living in nursing homes. Moreover, many older adults who are edentulous or do not undergo proper dental prosthetic treatment after tooth loss have greater difficulty chewing hard food[10,15]. Furthermore, in a large sample cohort study conducted by Lee et al.[16,17], preventive oral prophylaxis and periodontal treatment significantly reduced the onset and progression of dementia. Based on these studies, proper chewing ability is important for maintaining adequate nutrition and cognitive function through a healthy diet in older adults. On the other hand, masticatory dysfunction can lead to a decline in the cognitive function of the elderly, which in turn can cause difficulties in daily living and reduce the overall quality of life of the elderly. However, awareness of the relationship between these two factors requires further evidence, as existing evidence remains insufficient. Older adults with cognitive impairment and their caregivers (including family members and nurses) regard oral health as less important than general health, and there is a tendency to overlook serious oral health problems (severe periodontitis, tooth loss, poor dentures, etc.), which are major causes of mastication discomfort[9,18]. Therefore, careful attention to the oral health of older adults with cognitive impairment and appropriate dental interventions are necessary.

Existing studies have limitations due to small sample sizes and convenience sampling; therefore, they cannot be generalized. Moreover, the research results are inconsistent owing to problems such as different target groups, research methods, and insufficient control of potential confounding factors[19-24]. In addition, existing studies have mainly focused on the relationship between tooth loss and cognitive impairment; studies on whether chewing discomfort in the elderly increases the risk of daily living difficulties (DLD) related to cognitive decline (CD) are rare. In addition, most studies presented only analysis results for age groups over 65 years of age.

2. Objectives

Therefore, this study is based on national data from the Community Health Survey (2019), which can represent the elderly in Korea, and aimed to determine whether masticatory discomfort in elderly people over 65 years increases the risk of CD-related DLD and whether a difference in risk level exists between groups when the analysis is stratified by gender and age.

Materials and Methods

1. Participants

This study was conducted using 2019 data from the third cycle of the Community Health Survey (2018~2021). The Community Health Survey has been conducted annually since 2008 by the Korea Centers for Disease Control and Prevention to establish and evaluate local health and medical plans by identifying the health levels of local residents and establishing a foundation for the implementation of evidence-based health projects. This is the only community-based research survey in Korea, and it was conducted in 17 cities and provinces and 255 public health centers nationwide. To obtain the probability sample, the research population for the survey was obtained by applying a multi-stage stratified sampling method using the survey district and household as the primary sample units. The secondary sample units were adults aged 19 years or older living in the sampled household at the time. The participants were surveyed between August 16 and October 31, 2019. A trained research assistant visited each sample household and conducted a one-on-one electronic survey using a laptop containing the survey questionnaire. The survey consisted of 211 questions covering 21 themes, including health behaviors, such as drinking and physical activity, eating habits, quality of life, oral health, and mental health. The total number of participants in the 2019 Community Health Survey was 229,099, with 102,572 men (44.8%) and 126,527 women (55.2%). Our study sample, obtained from the survey data, consisted of 74,547 participants aged 65 years and older. The final analysis of this study included 22,154 respondents who answered all

three questions on CD-related DLD. Further details are available in the Guidelines for use of Korean Community Health Survey (KCHS) (2019)[25]. A flowchart of the selection of the final subjects is presented in Fig. 1.

2. Measurements

1) General characteristics

The general characteristics of participants included gender, age, educational level, and economic activity. Age was categorized as 65~74 years, 75~84 years, and 85 years and over; education level, as below elementary school, elementary school, middle school, high school, and university (including college) or higher; and economic activity, as "Yes" or "No" based on the question "Have you worked for income in the past week?".

2) Health-related factors

The health-related factors included alcohol consumption, stress level, depressive symptoms, hours of sleep (per day), frequency of tooth brushing (per day), diabetes, and hypertension. These factors are explained as follows:

Alcohol consumption was determined by the answer to the question "Have you ever had more than one drink in your life?" (Yes or No). Stress level was categorized based on the answer to the question "How much stress do you feel in your daily life?" (not much, a little, a lot, or very much). For hours of sleep, daily sleep time was divided into "7 hours or less" and "more than 7 hours." Depressive symptoms were identified using nine items from the Patient Health Questionnaire-9 (PHQ-9) as a measurement tool for depression (interest in work, depression, sleep disturbance, fatigue, appetite, unhappiness, poor concentration, anxiety behavior, and self-deprecation). The participants were asked "In the past 2 weeks, how often did you experience the symptoms listed?". The responses were "Not at all=0," "For several days=1," "For more than a week=2," and "Almost every day=3." Scores from 0 to 27 were calculated. A score of 10 or higher indicated having depressive symptoms (Yes), whereas a score of 10 or lower indicated not having depressive symptoms (No)[26]. If the participants did not respond to one or more
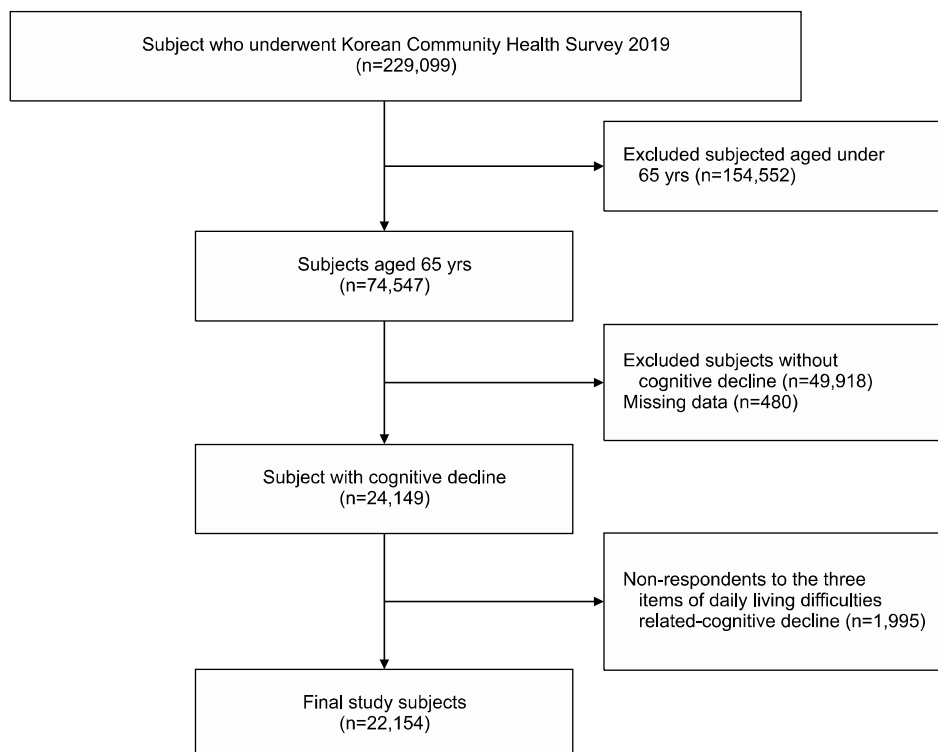

Fig. 1. Flowchart of final subjects selection.

items on the PHQ-9, their responses were excluded from the total score calculation. The frequency of tooth brushing (per day) was divided into "None," "Once," "Twice," or "Three times." Both diabetes and hypertension were classified as "Yes" or "No" based on whether they had been diagnosed by a doctor.

3) Masticatory discomfort

Masticatory discomfort was determined by the answer to the question "Do you currently have difficulty or discomfort in chewing food due to oral problems, involving your teeth, dentures, or gums?". Answers were classified as follows: "No discomfort at all," "No discomfort," "Moderate discomfort," "Discomfort," and "Severe discomfort."

4) Daily living difficulty related to cognitive decline

Only those who answered "Yes" to the question "Have you experienced more frequent or severe confusion or memory loss in the past year?" were asked to respond to three items of the DLD related to CD.

The three items of the CD-related DLD were (1) difficulty in performing daily activities, (2) need for assistance in performing daily activities, and (3) difficulty in social activities.

The detailed descriptions are as follows:

(1) Difficulty in performing daily activities was categorized as "Never=1," "Rarely=2," "Sometimes=3," "Almost always=4," and "Always=5" in response to the question "How often have you been unable to do your usual household chores (cooking, cleaning, taking medicine, driving, paying utility bills, etc.) due to cognitive decline?".

(2) Need for assistance in performing daily activities was classified as "Never=1," "Rarely=2," "Sometimes=3," "Almost always=4," and "Always=5" in response to the question "How often do you need help in your daily life due to cognitive decline?".

(3) Difficulty in social activities was classified as "Never=1," "Rarely=2," "Sometimes=3," "Almost always= 4," and "Always=5" in answering to the question "How often during the past year did you have problems with your work, volunteer work, or social activities due to cognitive decline?".

The three items were summed and scored from 1 to 15 points. Higher scores indicated more severe DLD. For statistical analysis, we used a continuous score (1∼15 points) for DLD, recoded as a dichotomous "Yes (7∼15 points)" or "No (1∼6 points)." In the reliability analysis conducted for the three items on the scale of DLD related to CD, Cronbach's alpha was 0.909.

3. Statistical analysis

Since the KCHS data were collected according to a complex sample design by adopting a stratified two-stage cluster sampling approach to draw nationally representative data from Korean adults aged ≥19 years, we conducted all statistical analyses according to a complex sample design procedure by applying stratification variables, cluster variables, and sample weights. The Rao−Scott chi-squared test was performed to investigate the differences in the distribution of CD-related DLD according to the participants' general characteristics and health-related factors, and a trend test was performed to determine whether the distribution of DLD increased as masticatory discomfort increased. Next, a complex sample logistic regression analysis was performed to determine whether masticatory discomfort increases the risk of CD-related DLD. Model I presented the crude odds ratio (OR) with 95% confidence intervals (CIs). Model II was applied to estimate the adjusted odds ratio (AOR) with 95% CIs after adjusting for general characteristics (gender, age, education level, and economic activity). Model III presented the AOR with 95% CIs after adjusting for all covariates (gender, age group, education level, economic activity, alcohol, smoking, stress level, depressive symptoms, hours of sleep, tooth brushing, diabetes, and hypertension) to examine the true impact of masticatory discomfort on CD-related DLD.

A multicollinearity diagnostic test was performed to diagnose collinearity problems between the confounding variables. The analysis revealed that the variance inflation factor (VIF) indices of all covariates ranged from 1.026 to 2.345, confirming that multicollinearity did not affect the confounding factors. The criterion for the diagnosis of multicollinearity was that if the VIF>10, multicollinearity was considered severe.

Finally, in the subgroup analysis, to examine the differences by gender and age group, multiple logistic regression analysis was conducted by stratifying gender and age groups; the results are presented as AOR with 95% CIs. All analyses were performed using PASW Statistics 18.0. (IBM Corp., Armonk, NY, USA), and statistical significance was set at $p < 0.05$.

Results

1. Differences in daily living difficulty according to general characteristics and health-related factors

Elderly women (40.6%) had greater DLD than elderly men (33.7%), and the extent of their DLD increased with increasing age ($p < 0.001$). The lower their educational level, the greater the participants' DLD ($p < 0.001$). Participants who did not engage in economic activity also had increased DLD compared to those who did ($p < 0.001$).

Regarding health-related factors, participants who did not consume alcohol had greater DLD; the higher the stress

Table 1. Differences in Daily Living Difficulty according to General Characteristics and Health-Related Factors (N=22,154)

General characteristics	Category	Daily living difficulty			
		Yes	No	SE[a]	p-value
Gender	Men	2,777 (33.7)	5,298 (66.3)	0.7	<0.001
	Women	6,003 (40.6)	8,076 (59.4)	0.6	
Age	65~74	2,550 (25.7)	7,069 (74.3)	0.6	<0.001
	75~84	4,511 (44.8)	5,474 (55.2)	0.7	
	≥85	1,719 (67.5)	831 (32.5)	1.4	
Education level	<Elementary school	2,740 (56.5)	2,407 (43.5)	1.0	<0.001
	Elementary school	2,710 (34.5)	5,607 (65.5)	0.7	
	Middle school	794 (26.4)	2,305 (73.6)	1.0	
	High school	568 (22.8)	2,009 (77.2)	1.0	
	University or higher	835 (35.4)	969 (64.6)	1.4	
Economic activity	Yes	1,911 (25.8)	5,440 (74.2)	0.7	<0.001
	No	5,362 (37.1)	7,773 (62.9)	0.6	
Alcohol	Yes	4,657 (32.4)	9,093 (67.6)	0.5	<0.001
	No	3,081 (42.6)	4,273 (57.4)	0.8	
Stress level	Not much	1,866 (27.6)	4,701 (72.4)	0.8	<0.001
	A little	2,700 (29.3)	6,112 (70.7)	0.6	
	A lot	2,173 (47.2)	2,207 (52.8)	1.0	
	Very much	774 (65.3)	341 (34.7)	2.0	
Depressive symptom	Yes	4,313 (31.3)	9,057 (68.9)	0.5	<0.001
	No	1,204 (64.7)	629 (35.3)	1.5	
Hours of sleep (per d)	<7	4,819 (38.4)	7,004 (61.6)	0.6	<0.001
	≥7	3,460 (34.1)	6,367 (65.9)	0.7	
Frequency of tooth-brushing (per d)	None	343 (51.0)	303 (49.0)	2.6	<0.001
	Once	1,243 (42.3)	1,818 (57.7)	1.2	
	Twice	2,549 (33.0)	5,098 (67.0)	0.7	
	≥3 times	2,725 (29.4)	6,143 (70.6)	0.7	
Diabetes	Yes	1,844 (39.6)	2,815 (60.4)	1.0	<0.001
	No	5,404 (32.5)	10,511 (67.5)	0.5	
Hypertension	Yes	4,538 (37.3)	7,386 (62.3)	0.6	<0.001
	No	3,216 (32.7)	5,970 (67.3)	0.7	

Values are presented as n (weighted %) and Rao-scott chi-square test for complex sample.
[a]SE: standard error, significance level, $p < 0.05$.

level, the more difficulties reported (p<0.001). Participants with depressive symptoms (64.7%) had almost two times more DLD than participants without depressive symptoms (31.3%). Participants who slept for less than 7 hours also had more DLD than participants who slept for ≥7 hours (p<0.001). Participants who did not brush their teeth had increased DLD, and those with diabetes and hypertension were slightly more likely to have greater DLD than those without diabetes (p<0.001, Table 1).

2. Trend analysis of the increase in daily living difficulty with masticatory discomfort severity

The distribution of DLD in the elderly whose responses regarding masticatory discomfort were "No discomfort at

Table 2. Trend Analysis of the Increase in DLD with Masticatory Discomfort Severity (N=21,281)[a]

Masticatory discomfort	DLD		p-for trend[b]
	Yes	No	
Not at all discomfort	557 (17.1)	2,402 (82.9)	<0.001
Not discomfort	1,254 (25.7)	3,326 (74.3)	
Moderate	1,121 (36.1)	2,057 (63.9)	
Discomfort	2,753 (39.8)	4,119 (60.2)	
Severe discomfort	2,223 (60.9)	1,469 (39.1)	

Values are presented as n (weighted %) and chi-square test for complex sample.
DLD: Daily living difficulty.
[a]A total of 21,281 subjects were analyzed excluding non-response data.
[b]p-for trend value was presented as a linear by linear association p-value in chi-square analysis.

all," "No discomfort," "Moderate discomfort," "Discomfort," and "Severe discomfort," were was 17.1%, 25.7%, 36.1%, 39.8%, and 60.9%, respectively, indicating that the distribution of DLD increased as the masticatory discomfort increased (p for trend<0.001, Table 2).

3. Logistic regression analysis of whether masticatory discomfort increases the risk of daily living difficulty

In model I (unadjusted), higher crude ORs were found in participants who had "Discomfort" (crude OR=3.19) and "Severe discomfort" (crude OR=7.51) than those who experienced "No discomfort at all." In model II (adjusted for general characteristics) the risk of DLD was higher in participants who had "Discomfort" (AOR=2.87) and "Severe discomfort" (AOR=4.82) than those who experienced "Not discomfort at all." Lastly, in model III (adjusted for all covariates) the risk of DLD was higher in participants with "Discomfort" (AOR=2.45, 95% CI=2.11~3.50) and "Severe discomfort" (AOR=2.95, 95% CI=2.49~3.50) than those who experienced "No discomfort at all."

Therefore, in model III, in which all potential confounding factors were adjusted for, masticatory discomfort had a negative effect on the risk of DLD. In addition, as masticatory discomfort increased, the risk of DLD increased (Table 3).

Table 3. The Impact of Masticatory Discomfort on the Risk of DLD due to Cognitive Decline

Masticatory discomfort	DLD		
	Model I[a] Crude OR (95% CI)	Model II[b] AOR[d] (95% CI)	Model III[c] AOR (95% CI)
Not at all discomfort	1	1	1
Not discomfort	1.67 (1.46~1.92)	1.67 (1.44~1.93)	1.64 (1.39~1.93)
Moderate	2.73 (2.37~3.16)	2.70 (2.31~3.14)	2.30 (1.92~2.74)
Discomfort	3.19 (2.82~3.62)	2.87 (2.51~3.29)	2.45 (2.11~2.83)
Severe discomfort	7.51 (6.54~6.63)	4.82 (4.14~5.61)	2.95 (2.49~3.50)

The data were analyzed by logistic regression for complex sample. Dependent variables reference is "NO".
DLD: daily living difficulty, OR: odds ratio, CI: confidence interval, AOR: adjusted odds ratio, CD: cognitive decline.
[a]Model I: unadjusted OR (95% CI).
[b]Model II: adjusted for gender, age, education level, economic activity.
[c]Model III: adjusted for all covariates (gender, age, education level, economic activity, alcohol, smoking, stress level, depressive symptom, hours of sleep, frequency of tooth brushing, diabetes, hypertension).
[d]AOR (95% CI): adjusted odds ratio (95% confidence interval).

4. Gender and age group differences in the impact of masticatory discomfort on risk of daily living difficulty

The risk of DLD increased the most in the 75～84 year-old age group of the men elderly group and the 65～74 year-old age group of the women elderly group, according to the degree of chewing discomfort (Table 4).

In the 75～84 year-old age group of the men elderly group, those who had "Discomfort" (AOR=2.62, 95% CI=1.94～3.55) and "Severe discomfort" (AOR=3.51, 95% CI=2.48～4.97) were at a higher risk of DLD than those who experienced "No discomfort at all."

Moreover, as masticatory discomfort increased, DLD tended to increase significantly compared to that in the other two age groups. The 65～74 year-old group also had an increased risk of DLD in participants who had severe discomfort, compared with participants with no masticatory discomfort. However, although the OR increased in the ≥85 year-old group, the difference was not statistically significant.

In the 65～74 year-old age group of the women elderly group, the risk of DLD for those who had "Discomfort" (AOR=2.89, 95% CI=2.29～3.66) and "Severe discomfort" (AOR=4.13, 95% CI=2.94～5.81) was higher than that of those who experienced "No discomfort at all." In the 75～

84 year-old group and the ≥85 year-old group, as the masticatory discomfort increased, the risk of DLD increased. However, in those aged ≥85 years, the increase was statistically significant (AOR=2.66, 95% CI=1.30～5.44) for only those with "Severe discomfort."

Discussion

1. Interpretation

Cognitive impairment is a common phenomenon that occurs with age and its global prevalence is increasing significantly[27,28]. This study aimed to determine whether masticatory discomfort in the Korean elderly increases the risk of CD-related DLD and whether there is a difference in risk according to gender and age.

2. Key results and comparision with the results of previous studies

To summarize the findings of this study, first, the prevalence was higher among elderly women than elderly men (men 33.7% vs. women 40.6%) and tended to increase with age. According to previous studies, approximately 30% of older adults in Korea use dentures, and older women use dentures more than older men; however, older women are more sensitive to using dentures and expe-

Table 4. Gender and Age Group Differences in the Impact of Masticatory Discomfort on Risk of DLD

Masticatory discomfort	DLD		
	65～74 AOR[a] (95% CI[b])	75～84 AOR (95% CI)	≥85 AOR (95% CI)
(Men)			
Not at all discomfort	1	1	1
Not discomfort	2.34 (1.68～3.26)	1.59 (1.15～2.20)	1.08 (0.44～2.64)
Moderate	3.08 (2.10～4.50)	2.30 (1.63～3.24)	1.63 (0.65～4.11)
Discomfort	2.51 (1.78～3.56)	2.62 (1.94～3.55)	1.64 (0.66～4.03)
Severe discomfort	2.20 (1.49～3.26)	3.51 (2.48～4.97)	2.00 (0.84～4.80)
(Women)			
Not at all discomfort	1	1	1
Not discomfort	2.05 (1.61～2.61)	1.15 (0.88～1.50)	1.30 (0.63～2.70)
Moderate	2.53 (1.88～3.40)	2.04 (1.54～2.71)	1.19 (0.58～2.43)
Discomfort	2.89 (2.29～3.66)	2.07 (1.64～2.63)	1.70 (0.86～3.35)
Severe discomfort	4.13 (2.94～5.81)	2.24 (1.74～2.90)	2.66 (1.30～5.44)

The data were analyzed by logistic regression for complex sample. Dependent variables reference is all "NO".
DLD: daily living difficulty, AOR: adjusted odds ratio, CI: confidence interval.
[a]AOR: adjusted odds ratio, adjusted for all covariates (gender, age, education level, economic activity, alcohol, stress level, depressive symptom, hours of sleep, frequency of tooth brushing, diabetes, hypertension).
[b]95% CI: 95% confidence interval.

rience more discomfort than older men[12,29]. However, few studies have related DLD to CD; thus, additional research is needed to confirm the results of this study. In addition, the results of studies on gender differences are still inconsistent, and differing results are thought to be due to differences in sample size and measurement tools used to measure cognitive decline[6,8,23,30,31].

Second, as masticatory discomfort increased, the distribution of DLD tended to increase. In addition, logistic regression analysis showed that the risk of CD-related DLD continuously increased as masticatory discomfort increased in the elderly. The relationship between tooth loss and cognitive impairment is well known[24,32-35]. Although it is important to study the relationship between tooth loss and cognitive impairment, there will be many difficulties in daily life due to these two factors in old age, especially as older adults age.

Masticatory discomfort is a modifiable risk factor that can be prevented by early detection and treatment of oral health problems in the elderly. CD begins rapidly; therefore, the elderly at risk of dementia experience many difficulties in daily life. Poor oral health can act as a booster to exacerbate these difficulties. Previous studies have reported that older adults with masticatory discomfort have a lower quality of life in various areas, including anxiety, depression, and discomfort in daily life, self-management, and physical activity, than those without masticatory discomfort[29]. Another study found that the group with cognitive impairment had more difficulties in performing activities of daily living (ADLs) than the group without cognitive impairment. Lee et al.[6] and Cho et al.[36] reported that the lower the Geriatric Oral Health Assessment Index, the greater the increase in the risk of cognitive impairment. Other studies have reported that participants with good chewing efficiency have significantly better cognitive function domains, including word recall, verbal fluency, and numeracy, than those with chewing disorders[37]. In addition, mastication efficiency is a modifiable factor that influences the risk of CD, and normal mastication is the most important factor for functional activation of the central nervous system rather than the presence of teeth[38,39]. Based on existing studies, the underlying mechanism is the presence of natural teeth, and

the resulting chewing ability increases the blood supply to the cerebrum and improves oxygen supply in the cortical area, thereby preventing the onset and progression of Alzheimer's disease[34]. In addition, deterioration of oral health, such as tooth loss, can lead to dietary changes and malnutrition, which are major factors in the incidence of dementia[24,34].

Third, among elderly men, the 75~84 year-old age group had the highest risk of DLD due to mastication discomfort, while the 65~74 year-old age group showed the highest risk of DLD in elderly women. The degree and duration of masticatory discomfort vary depending on gender, age, socioeconomic status, and individual oral hygiene environment[12,40]. In a previous study, the discomfort caused by masticatory disorders was prevented with appropriate dental prosthetic treatment (dentures, implants, etc.)[41]. However, CD can become a barrier to routine ADLs, such as oral hygiene and dental treatment[5,38]. Most older people with dementia have poor oral hygiene, many edentulous teeth, and experience chewing discomfort due to poor prosthetics[15,42]. Therefore, it is important to prevent CD in older adults by restoring masticatory function with appropriate dental treatment so that they can eat normally. It is also possible to improve the quality of life of older adults by reducing difficulties in daily life caused by CD. In particular, the oral health of older adults with cognitive impairment should not be overlooked. It is necessary to pay attention to the deterioration in their quality of life resulting from difficulties in their daily life activities due to CD, and to provide specialized health services.

3. Limitations

As a cross-sectional study, this study has limitations in identifying the direct causal relationship between the independent and dependent variables. The causes of masticatory discomfort are diverse; however, the main cause cannot be determined by asking questions in a single questionnaire. In addition, there may have been a response bias because the duration and intensity of the masticatory discomfort experienced were subjective. Therefore, in future studies, it is necessary to use a measuring tool that can index masticatory function and discomfort through accurate and

quantitative dental examinations (e.g., number of remaining teeth, stage of periodontitis, and defective prosthesis). In addition, this study was conducted only on elderly individuals with CD, and since individuals with cognitive impairment were selected using a single questionnaire used in the KCHS, there may have been a selection bias and misclassification of subjects. In future studies, it will be necessary to use measurement tools (e.g., Mini-Mental State Exam). Further longitudinal studies should be conducted to prove a causal relationship between these two factors.

4. Generalizability

The strength of this study is that it is a representative study using national data from the KCHS (2019), and the results can be generalized to adults aged 65 years or older in Korea. In addition, three items on DLD related to CD (difficulty in daily life, need for assistance in daily life, and difficulty in social life) were measured and studied using a new DLD construct. The reliability of the measurement tool was checked through reliability analysis (Cronbach's alpha=0.909).

5. Suggestions

Through reliable data and analysis methods, this study identified that masticatory discomfort in the elderly increases CD-related DLD. In addition, a stratified analysis of gender and age groups revealed a difference in the risk of CD-related DLD by age and gender. These points are considered important topics that have not been previously examined.

In conclusion, based on the results of this study, oral care for older adults should be included in a dementia prevention program to prevent CD and progression to severe dementia through early intervention for masticatory discomfort caused by oral health problems. This study can also be used as a basis for preparing a specialized oral health insurance policy for older adults, taking gender and age into consideration. In addition, we believe that this study will raise awareness of the importance of oral care for older adults with cognitive impairment among caregivers and related clinical experts.

Notes

Author contributions

Conceptualization: Kyung-Yi Do, Chun-Bae Kim, and Yeon-Soon Ahn. Data curation: Kyung-Yi Do and Yeon-Soon Ahn. Formal analysis: Kyung-Yi Do. Investigation: Kyung-Yi Do and Chun-Bae Kim. Methodology: Kyung-Yi Do, Chun-Bae Kim, and Yeon-Soon Ahn. Writing-original draft: Kyung-Yi Do. Writing-review & editing: Kyung-Yi Do, Chun-Bae Kim, and Yeon-Soon Ahn.

ORCID

Kyung-Yi Do, *https://orcid.org/0000-0002-7690-6314*
Chun-Bae Kim, *https://orcid.org/0000-0002-1979-6833*
Yeon-Soon Ahn, *https://orcid.org/0000-0002-0039-069x*

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