

RESEARCH ARTICLE

# The Relationship between Oral Health-Related Factors and Grip Strength in the Elderly

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**Background:** Among the health problems in old age, oral health is closely related to nutrition intake and digestion, so although it is an important factor in the well-being of the elderly along with general health, studies examining the relationship between oral health-related factors and grip strength of the elderly are insufficient. Therefore, this study intends to examine the relationship between oral health-related factors and grip strength, which are closely related to the general health of the elderly.

**Methods:** This study used data from the 7th period of Korea National Health and Nutrition Survey ( $2016 \sim 2018$ ) approved by the Research Ethics Review Committee of the Korea Centers for Disease Control and Prevention. Complex sample frequency analysis and descriptive statistics were performed, and general linear model analysis was performed to confirm the relationship between demographic characteristics, oral health –related factors and grip strength. The statistical analysis was performed using IBM SPSS Statistics for Windows, Version 23.0, and the significance test was based on type I error level of 0.05.

**Results:** Grip strength was higher in the case of no discomfort than in the case of discomfort in relation to mastication discomfort and grip strength (B=0.927, p < 0.001). In addition, the grip strength was decreased by 1.348 times when not using dental floss (p < 0.001) and when not using mouth wash was 1.480 times (p < 0.001).

**Conclusion:** In this study, in the relationship between oral health-related factors and grip strength, grip strength was found to be high in the absence of mastication discomfort. and in the case of using dental floss and mouthwash the elderly showed high grip strength. Therefore, it is suggested to present a lifestyle to improve hand function and grip strength in the elderly and develop a program to increase grip strength and provide them at the same time during oral health education.

Key Words: Elderly, Grip strength, Oral health

# Introduction

It is a global trend that the elderly population is increasing due to the improvement of living standards, the development of medical technology, and the increase in interest in health. Due to the rapid aging of Korea, it is expected that the population aged 65 years or over will account for 16.5% in 2021, 20.3% in 2025, and 43.9% in 2060 of the total population<sup>1)</sup>.

An increase in age is inevitably accompanied by aging, and aging is a physical, mental, and social change that appears in humans, resulting in a decrease in physical strength and overall physical functions<sup>2</sup>). Usually, it is

known that physical performance gradually decreases after reaching its peak in the late 20s, and muscle strength and muscle mass decrease to about 20% to 25% of the peak at the age of 65 years<sup>3</sup>). In this sense, muscle strength among the physical strength of the elderly is recognized as very important<sup>4</sup>, and in particular, hand grip strength is known as a representative physical strength indicator that can grasp the strength of the body<sup>5</sup>).

It is known that the grip strength gradually decreases after reaching a peak in the  $30s^{5}$ , sharply decreasing after the age of 50 years<sup>6</sup>. According to a previous study, those with grip strength in the lower tercile compared to those with grip strength in the upper tercile of all subjects in

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middle age experienced more physical dysfunction such as walking speed, getting up from a chair, changing clothes, eating, bathing, and using toilets<sup>7)</sup>. As such, grip strength is also an indicator of physical activity, and it can be said that it is related to independence in daily life activities. In addition, it is reported that high grip strength not only prevents various chronic diseases, but also plays a positive role in reducing the risk of premature death due to chronic diseases<sup>8</sup>.

There were many studies mainly related to general health such as grip and cardiovascular disease<sup>8)</sup>, differences in physical strength according to grip strength<sup>9</sup>, dietary and exercise habits according to grip strength<sup>10</sup>, correlation between lower strength of extremity and balance ability according to grip strength<sup>11</sup>, and the effect of muscle strengthening exercise on grip strength<sup>12)</sup>, and the relationship between body function index and grip strength<sup>13</sup>. Although oral health is an important factor for the well-being of the elderly along with general health as it has a deep relationship with nutrition intake and digestion, studies investigating the relationship between oral health factors and grip strength in the elderly are insufficient. In addition, although there has been a study on the relationship between oral health-related factors and grip strength in adults among the previous studies, it seems to be weak to represent the characteristics of the elderly.

Therefore, this study intends to find oral health-related factors that affect the grip strength of the elderly by using the data of the 7th period ( $2016 \sim 2018$ ) of the Korea National Health and Nutrition Examination Survey and provide them as basic data for improving the oral health of the elderly.

# Materials and Methods

### 1. Research subject

This study used data from the 7th period of Korea National Health and Nutrition Survey  $(2016 \sim 2018)$  approved by the Research Ethics Review Committee of the Korea Centers for Disease Control and Prevention (2018-01-03-P-A), and 3,426 out of a total of 16,489 elderly people aged 65 years or older were selected as subjects.

#### Research tool

#### 1) Demographic & sociological characteristics

Sex was classified into 'male' and 'female', and income level was classified into 'low', 'middle-low', 'middle-high', and 'high'.

Marital status was divided into 'married' and 'single'. Educational level was divided into 'less than elementary school', 'middle school graduate', 'high school graduate', and 'university graduate or higher', and the mainly used hand was reclassified into 'right hand' and 'left hand'.

#### 2) Oral health-related factors

Whether or not there was mastication discomfort was classified as 'yes' or 'no', and subjective oral health status was reclassified as 'bad', 'normal', and 'good'. The experience of toothache for one year was divided into 'yes' and 'no'. The number of toothbrush per day was reclassified into ' $0 \sim 2$  times' and '3 or more times', and floss, interdental toothbrushes, mouth wash, and electric toothbrushes were classified into 'yes' and 'no'.

### 3) Grip strength

The grip strength was measured using a digital grip strength dynamometer (T.K.K 5401; Takei, Tokyo, Japan), and the grip strength value was the maximum value of the predominant hand among the two-handed grip strength values measured three times. In this study, the average value of right hand grip strength was used due to the high proportion of right hand use.

### 3. Statistical method

Since the Korea National Health and Nutrition Survey was data collected using the complex sample design method, a complex sample analysis was performed after applying weight, stratification variable (kstrata), and survey group (psu). Complex sample frequency analysis and descriptive statistics were performed, and general linear model analysis was performed to confirm the relationship between demographic characteristics, Oral health-related factors and grip strength. The statistical analysis was performed using IBM SPSS Statistics for Windows, Version 23.0 (IBM Corp., Armonk, NY, USA), and the significance test was based on type I error level of 0.05.

Table 1. General Characteristics

Characteristic	Division	Value	
Sex	Male	1,465 (42.4)	
	Female	1,961 (57.6)	
Age (y)		72.9±0.1	
Marital status	Married	3,398 (99.3)	
	Single	28 (0.7)	
Income quartile	Low	871 (26.0)	
	Middle-low	881 (24.9)	
	Middle-high	840 (24.2)	
	High	814 (24.9)	
Education level	$\leq$ Elementary school	1,906 (57.6)	
	Middle school	476 (15.3)	
	High school	532 (16.8)	
	≥College	302 (10.3)	
Use of hands	Right hand	3,004 (94.3)	
	Left hand	175 (5.7)	
Grip strength (kg)	Right hand (kg)	$22.9 \pm 0.2$	

Values are presented as number (weighted %) or mean±standard deviation.

The discrepancy in the frequency count was due to missing values.

# Results

## 1. General characteristics of study subjects

The general characteristics of the study subjects are shown in Table 1. Of the 3,426 seniors aged 65 years or older, 57.6% were female and 99.3% were married, in the level of education, 'below elementary school graduate' was found to be the highest at 57.6%. As for the hand mainly used, 'right hand' accounted for 94.3%, and 'right hand grip strength' was found to be 22.9 kg on average.

# Relationship with grip strength according to demographic and sociological characteristics

As age increased, grip strength decreased statistically significantly, and male grip strength was 11.735 times higher than that of females (p < 0.001). As for the grip strength according to the educational level, the grip strength of the elderly with elementary school education or less decreased by 1.489 times compared to those with a college degree or higher (p=0.001). When the economic level was 'low' than 'high', the grip strength decreased by 0.942 times (p=0.001) and the grip strength was 1.453

Variable	Estimate	SE	95% Confidence interval		4	
			Lower	Upper	t	p-value
Age	-0.511	0.022	-0.555	-0.468	-23.235	< 0.001
Sex						
Male	11.735	0.263	11.219	12.252	44.691	< 0.001
Female	Reference					
Marital status						
Married	2.001	1.096	-0.153	4.156	1.826	0.069
Single	Reference					
Education level						
$\leq$ Elementary school	-1.489	0.455	-2.383	-0.596	-3.276	0.001
Middle school	-0.266	0.496	-1.242	0.710	-0.535	0.593
High school	0.355	0.520	-0.668	1.377	0.682	0.496
≥University	Reference					
Income level						
Low	-0.942	0.343	-1.616	-0.268	-2.749	0.001
Middle-low	-0.619	0.342	-1.291	0.053	-1.811	0.071
Middle-high	-0.212	0.325	-0.851	0.427	-0.652	0.515
High	Reference					
Use of hands						
Right hand	1.453	0.561	0.349	2.557	2.588	0.001
Left hand	Reference					

Table 2. Relationship between Grip Strength and Socio-Demographic Characteristics

times higher in the right hand than in the left p=0.001) (Table 2).

# Relationship between grip strength and oral health-related factors

According to the results including the correction variable, grip strength was higher in the case of no discomfort than in the case of discomfort in relation to mastication discomfort and grip strength (B=0.927, p< 0.001). In addition, the grip strength was decreased by 1.348 times when not using dental floss (p<0.001), and when not using mouth wash was 1.480 times (p<0.001) (Table 3).

# Discussion

Oral health in old age is a very important and essential

element for maintaining good health as if the oral condition is not good it adversely affects the overall health, such as poor chewing of food, and lowering the digestive function. This study was conducted to confirm the relationship between oral health-related factors and grip strength in the elderly, and the results of this study are as follows.

In this study, male grip strength was higher than that of female, and the average grip strength was 22.9 kg, which was lower than 30.6 kg and 30.4 kg in the adult study<sup>14,15</sup>, showing the same result as previous study that the grip strength decreases with age. As for the grip strength according to the level of education, the grip strength of the elderly with elementary school education or less was statistically significantly reduced by 1.489 times compared to those with a college degree or higher, so it can be estimated that the subjects with elementary school

Table 3. Relationship between Grip Strength and Oral Health-related Factors

Variable	Estimate	SE	95% Confidence interval		4	1
			Lower	Upper	t	p-value
Mastication problems						
No	0.927	0.249	0.438	1.416	3.726	< 0.001
Yes	Reference					
Oral health condition						
Good	0.001	0.449	-0.882	0.884	0.002	0.999
Fair	-0.061	0.286	-0.624	0.502	-0.213	0.832
Poor	Reference					
Toothache						
No	-0.982	0.263	-1.499	-0.464	-3.730	0.900
Yes	Reference					
Dental floss						
Unuse	-1.348	0.390	-2.113	-0.582	-3.459	< 0.001
Use	Reference					
Interdental brush						
Unuse	-0.254	0.349	-0.941	0.433	-0.728	0.467
Use	Reference					
Mouth wash						
Unuse	-1.480	0.309	-2.088	-0.872	-4.787	< 0.001
Use	Reference					
Electric toothbrush						
Unuse	-1.029	0.709	-2.422	0.365	-1.451	0.147
Use	Reference					
Tooth brushing/day						
0~2	-0.252	0.246	-0.736	0.233	-1.022	0.307
$\geq 3$	Reference					

R<sup>2</sup>=0.561, adjusted for age, sex, income, education level, use of hands.

education or less are older, and this was a result similar to Kang's study<sup>14)</sup>. When the economic level was 'low' rather than 'up', the grip strength decreased by 0.942 times. In the case of the elderly with economic stability, it is presumed that the muscle strength is high due to active physical activity or leisure activities for health management. The result that the grip strength of the right hand was higher than that of the left hand was found to be 94.3% of right-handed users of the study subjects, which can be said to be the result of more developed muscle strength in the right hand, which is frequently used. The results were the same as those of Kang's study<sup>14)</sup> targeting Korean adult population over 20 and Jung et al.'s study<sup>11)</sup> targeting the elderly over 70 years of age in Korea.

In the relationship between oral health-related factors and grip strength, grip strength was found to be high in the absence of mastication discomfort, which was similar to the study of lectures for adults<sup>14)</sup>. Judging from the results of previous studies<sup>16)</sup> that complaints about author discomfort cause systemic problems, continuous management is required<sup>17)</sup> and the possibility of lowering the will to participate in society should be considered. It is presumed that discomfort from mastication not only affects overall health, but also reduces physical activity and health behaviors related to grip strength. In addition, when the masticatory function is lowered, it is thought that malnutrition is caused, which leads to a decrease in muscle strength<sup>18)</sup>, and thus affects the grip strength. The use of interdental toothbrushes and electric toothbrushes did not have any relationship with grip strength, and in the case of using dental floss and mouthwash the elderly showed high grip strength. This is a slightly different result from Kang's study<sup>14)</sup> for adults over 20 years old, but the use of dental floss, which requires repeated movements with the act of grasping is closely related to grip strength, so it is not expected that the use of dental floss will be particularly easy for the elderly with weak grip strength. In the case of a person with weak muscle strength, oral disease occurs<sup>19</sup> due to neglect of oral health management, and nutrient intake is restricted due to inconvenient mastication, which appears to continuously repeat a vicious cycle of decreased muscle strength.

In addition, considering the results of previous studies<sup>20)</sup>

that hand function, grip strength, and instrumental daily life were improved after simple hand function training for the elderly, it can be inferred that hand skills training is necessary to help the elderly properly use tooth brushing and oral care products.

Currently, in Korea, a variety of community-based and individualized oral health care programs are being provided with the goal of promoting oral health for the elderly in the local community. However, in order to effectively manage oral health, individual oral health behaviors and practices must be combined. Therefore, it is suggested to present a lifestyle to improve hand function and grip strength in the elderly and develop a program to increase grip strength and provide them at the same time during oral health education. These efforts are considered to be an alternative to coordinating the oral health problems for the elderly caused by oral care, which is neglected due to aging and weakening of physical strength, and will help them to cope effectively without incurring a large cost.

The limitation of this study is that oral health-related factors using the 7th Korea National Health and Nutrition Examination Survey may have been underestimated or overestimated as a self-reported questionnaire rather than an objective measurement, so it is somewhat difficult to generalize. In addition, there is a limitation in not considering the basic health status of the elderly, so additional research is needed.

However, in order to expand the previous studies, which have mostly been related to grip strength and general health such as muscle strength, physical function, and chronic disease, the relationship between oral health-related factors and grip strength in old age was confirmed, and it is thought that it is meaningful in that it can be used as basic data to find an effective method for oral health management in old age.

## Notes

### Conflict of interest

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

### Ethical approval

This study was approved by the Institutional Review Board of Daejeon Institute of Science and Technology (IRB No. 1044342-20210428-HR-020-02).

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