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The Impact of Geriatric Oral Health Assessment Index on Grip Strength in the Elderly

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ABSTRACT

The purpose of this study was to identify the relationship between the Geriatrics Oral Health Assessment Index(GOHAI) and grip strength for the elderly, and to suggest measures to improve the oral health and grip strength of the elderly to overall health. In this study, the 7th aging research panel survey was used to analyze 5,578 middle-aged and elderly groups aged 45 or older excluding missing values. In order to analyze the effect of the oral health evaluation index on grip strength for the elderly, T-test, ANOVA, and multi-linear regression analysis were used. As a result of the analysis, the grip strength increased statistically by 0.002 points (B: 0.002, 95% CI: 0.001-0.003, P-VALUE: <0.001) when the oral health index increased by one unit in the group aged 65 or older.

According to the results of this study, it was found that the better the oral health status of the elderly, the higher the grip strength, and the positive effect on the overall health status. Considering the results of this study, it is necessary to prepare institutionalization such as oral health policies and expansion of support costs to improve the overall health status of the elderly.

Furthermore, it is necessary to provide oral health promotion programs and education by local governments to enable steady health management. This will lead to an improvement in oral health conditions, contributing to the improvement of grip strength and the overall health condition of the elderly.

1. Introduction

The average life expectancy in South Korea has increased by approximately 7.3 years over the past 20 years due to rapid advancements in medicine, social welfare, and economic development.

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However, the increase in healthy life expectancy has been slow, with it rising from 70.9 years in 2010 to 73.1 years in 2019 (Statistics Korea, 2019). With the elderly population reaching 14.02% in 2017, South Korea anticipates entering an ultra-aged society by 2025 (Statistics Korea, 2019). As the rapid growth of the elderly population accelerates population aging, there is a growing concern for elderly health.

Appropriate muscle strength is a crucial factor not only for overall health but also for the quality of life (Kim, 2020). One essential clinical indicator for maintaining the elderly's self-management ability is Activities of Daily Living (ADL), reflecting the comprehensive function of the elderly (Lee & Kim, 2004). Among the various physical functions, upper limb and hand functions are crucial for performing daily activities and tasks (Carrol, 1965). Previous research (Shiffman, 1992) on grip strength patterns in adults aged 24 to 87 indicated a decrease in hand grip strength with increasing age, showing a significant decline in hand function after the age of 75, suggesting age-related weakening of grasp strength (Heo, 2015). Low grip strength has been associated with a decline in health-related quality of life, an increased risk of dementia, cardiovascular and respiratory diseases (Gatz, 2010), and a higher mortality rate (Sasaki et al., 2007), making it an essential variable. Improved grip strength is linked to higher health-related quality of life, and enhancing muscle strength contributes to improving overall quality of life (Kang, 2019). Grip strength is predictive of subjective health in the elderly (Hong et al., 2010), and elderly individuals with weak right-hand grip strength tend to exhibit a pattern of extremely low outdoor activity and spend more time at home (Choi, Park, & Lee, 2012). Therefore, grip strength is considered an indicator of frailty in the elderly (Syddall et al., 2003) and is associated with mortality (Sasaki et al., 2007).

Currently, the rate of impaired masticatory function in Korean seniors is 31.4%, and oral health issues such as periodontal disease rank first in outpatient care (Korea Centers for Disease Control and Prevention, 2018; Health Insurance Review & Assessment Service, 2020). According to the National Oral Health Survey, the permanent tooth loss rate for individuals aged 65-74 is 73.44%, and for those aged 75 and above, it is 84.8%, indicating a higher proportion of the elderly requiring oral health attention than the normal range (Kim, 2011). However, annual healthcare expenses related to oral health in South Korea amount to approximately KRW 5.4 trillion out of the total healthcare expenditure of around KRW 73 trillion (National Oral Health Survey, 2012). Despite the increasing interest in oral health among the elderly in Korea, the reality suggests a paradoxical situation where oral health is deteriorating, and there is a growing need for oral health-related treatments. Brushing teeth is considered the most basic and crucial behavior for oral health. To independently and effectively perform such tooth brushing, various hand movements are required (Inada, 2015). However, aging leads to a decline in physical function, and hand function decreases accordingly (Liu, 2016). The effectiveness of tooth brushing is influenced by manual dexterity, which begins to decrease from middle age and is associated with grip strength, a representative measure of hand function (Ahn, 2020). Another study on the relationship between oral health-related factors and grip strength found that people using dental floss and electric toothbrushes had higher grip strength than those who did not, and grip strength tended to decrease with increased discomfort in chewing and speaking (Kang, 2019).

This study considers that poor oral health in the elderly can lead to a decrease in grip strength,

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a fundamental muscle strength. Recognizing the importance of overall health promotion, it emphasizes the need for oral health management in the elderly. While previous studies have shown the association between oral health and cognitive function, as well as the improvement of quality of life, research on the relationship between oral care and grip strength is lacking. Furthermore, no study has explored the impact of the Geriatric Oral Health Assessment Index (GOHAI) as an independent variable on grip strength. Therefore, this study aims to confirm the relationship between oral health, as assessed by GOHAI, and grip strength. The objective is to promote overall health, positively influence grip strength and general health, and reduce medical expenses related to oral health.

2. Materials and Methods

2.1 Data source

This study utilized data from the 2018 Korea Longitudinal Study of Aging (KLoSA), which aims to provide information fundamental for formulating and implementing effective socio-economic policies in the process of transitioning into an ultra-aged society. The KLoSA has been conducting surveys since 2006, targeting individuals aged 45 and above residing in households, excluding Jeju Island, in even-numbered years. Additional surveys have been carried out in odd-numbered years, focusing on content not covered in the basic surveys, completing the 7th basic survey in 2018.

The survey employed a stratified multistage cluster sampling method based on administrative codes, sorting them in order, and applying systematic sampling to extract the allocated number of population survey districts by region. After setting 1,000 sample survey districts using this method, household sampling was carried out randomly using the household roster from the 2005 Population and Housing Census. Sample households with residents aged 45 and above were considered eligible for the interview survey. The survey targeted individuals born in 1962 or earlier residing outside Jeju Island, with a sample goal of around 10,000 individuals, leading to the establishment of a panel consisting of 10,253 individuals. In 2014, approximately 920 individuals born between 1962 and 1953 were added. The survey was conducted using computer-assisted personal interviews (CAPI), and specific survey methods were determined for special surveys based on the content and items of the survey.

Therefore, in this study, an analysis was conducted on a sample of 5,578 individuals, excluding missing values from the initial 7,491 subjects, to examine the impact of the GOHAI on grip strength in the middle and old age group.

2.2 Independent variables

The independent variable in this study, the GOHAI was newly created to measure health determinants such as oral function, pain, discomfort, and psychosocial factors in the elderly. This was accomplished by adding 12 items in the 7th survey. The Korean version of the GOHAI scale, commonly used, was employed. The 12 items were measured on a 5-point scale (0-5 points) and

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were summed. A higher GOHAI indicates a more positive set of oral health-related health determinants (Yang, 2020).

2.3 Dependent variables

This study aims to investigate the relationship between grip strength, used as the dependent variable, and the GOHAI. Grip strength, which influences hand function, is not only an indicator of muscle quality but is also utilized for the overall assessment of muscle strength. Since 2014, the Korea Centers for Disease Control and Prevention has been measuring grip strength for muscle strength assessment in the Korea National Health and Nutrition Examination Survey (KCDC, 2014). Grip strength is considered a representative indicator of overall muscle strength due to its simplicity and cost-effectiveness among various muscle strength measurement methods. It is highly related to overall health and serves as a representative factor for overall health (Ahn, 2020). The variable created by measuring grip strength twice for each hand using a dynamometer represents the overall average value of grip strength for both left and right hands.

2.4 Control variables

2.4.1 Sociodemographic factors

In this study, sociodemographic variables from the 2018 Elderly Panel Survey were selected as control variables. The predefined data included “Gender”, “Age Group”, “Marital Status”, “Education Level”, and “Health Insurance Type”. “Gender” was categorized as ‘Male’ and ‘Female’, “Age Group” as ‘55-64 years’, ‘65-74 years’, and ‘75 years and older’, and “Marital Status” as ‘Single’, ‘Married’, and ‘Widowed’. “Education Level” was classified as ‘Elementary school or below’, ‘Middle school’, ‘High school’, and ‘College or above’. “Health Insurance Type” was categorized as ‘National Health Insurance’ and ‘Medical Assistance’.

2.4.2 Health status factors

For health status variables, the predefined data for “Subjective Health Status” from the 2018 Elderly Panel Survey was chosen. “Subjective Health Status” was classified into three categories: ‘Good’, ‘Fair’, and ‘Poor’.

2.4.3 Health behavior factors

For health behavior variables, predefined data for “Occupational Restrictions”, “Experience of Alcohol Consumption”, and “Number of Chronic Diseases” from the 2018 Elderly Panel Survey were selected. Occupational restrictions and experience of alcohol consumption were categorized as ‘Yes’ or ‘No’, while the number of chronic diseases was classified into ‘0’, ‘1’, and ‘2 or more’ categories.

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2.5 Analytical approach and statistics

This study employed T-tests, ANOVA, and multiple linear regression analysis as statistical methods. The analysis of association was conducted after controlling for variables such as age, education level, gender, marital status, work restrictions, alcohol consumption, health insurance status, the number of chronic diseases, and subjective health status of the research subjects. Additionally, detailed analyses were performed based on gender and age to assess the risk. Data organization and statistical analysis were conducted using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA), and statistical significance was tested at a 5% significance level.

3. Results

Table 1 presents the general characteristics of the study participants regarding the impact of the GOHAI on grip strength. Based on the data from a total of 5,578 respondents in the baseline survey, the mean score of the GOHAI was 39.55 (SD: 8.49), and the mean grip strength was 25.22 (SD: 8.54). When categorized by age, the 55-64 age group constituted 41.3% of the total (2,305 individuals), with a mean GOHAI score of 42.55 (SD: 7.70), higher than the mean score of 35.60 (SD: 8.40) for those aged 65 and above. For grip strength, the mean for the 55-64 age group was 28.04 (SD: 8.14), while for those aged 65 and above, it was 20.99 (SD: 7.76). When stratified by gender, the mean GOHAI score was 39.76 (SD: 8.44) for males and 39.39 (SD: 8.53) for females. The mean grip strength was 31.61 (SD: 7.42) for males and 20.24 (SD: 5.50) for females. Stratifying by self-reported health status, the group with good subjective health showed a mean GOHAI score of 42.02 and a grip strength mean of 27.60. The group with fair health exhibited a mean GOHAI score of 40.05 and a grip strength mean of 25.39. The group with poor subjective health displayed the lowest scores, with a mean GOHAI score of 34.38 and a grip strength mean of 20.95 across the three groups.

Table 1. General characteristics of subjects included in the analysis

	Total		GOHAI			Grip strength		
	N	%	Mean	SD	P-value	Mean	SD	P-value
Age					<.0001			<.0001
55-64	2,305	41.3	42.55	7.70		28.04	8.14	
65-74	1,679	30.1	39.19	8.01		25.36	8.15	
≥75	1,594	28.6	35.60	8.40		20.99	7.76	
Education level					<.0001			<.0001
≤ Elementary school	1,930	34.6	36.34	8.64		21.29	7.59	
Middle school	966	17.3	39.56	7.75		25.12	8.07	
High school	1,915	34.3	41.74	7.97		27.29	8.24	
≥ College	767	13.8	42.17	7.65		30.04	7.85	

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	Total		GOHAI			Grip strength		
	N	%	Mean	SD	P-value	Mean	SD	P-value
Gender					0.033			<.0001
Male	2,443	43.8	39.76	8.44		31.61	7.42	
Female	3,135	56.2	39.39	8.53		20.24	5.50	
Marital status					0.001			0.43
Married	4,379	78.5	40.32	8.24		26.49	8.30	
Separated, divorced	1,159	20.8	36.65	8.80		20.32	7.60	
Single	40	0.7	39.05	8.71		27.38	9.18	
Working restriction					<.0001			<.0001
Yes	1,694	30.4	35.68	8.61		22.88	8.10	
No	3,884	69.6	41.24	7.87		26.24	8.53	
Alcohol consumption					0.032			0.01
Yes	1,972	35.4	40.87	8.26		29.30	8.30	
No	3,606	64.7	38.83	8.54		22.98	7.81	
Health insurance status					0.001			0.00
National Health Insurance	5,395	96.7	39.70	8.42		25.34	8.53	
Medical aid	183	3.3	35.08	9.41		21.67	8.28	
Number of chronic disease*					0.511			0.35
0	5,091	91.3	39.61	8.46		25.22	8.51	
1	456	8.2	38.96	8.82		25.07	8.81	
≥2	31	0.6	38.84	8.77		26.41	9.21	
Self-rated health					<.0001			<.0001
Good	1,804	32.3	42.02	8.01		27.60	8.05	
Moderate	2,658	47.7	40.05	7.65		25.39	8.24	
Bad	1,116	20.0	34.38	8.98		20.95	8.42	
Total	5,578	100.0	39.55	8.49		25.22	8.54	

Table 2 presents the analysis of the relationship between the GOHAI and grip strength after controlling for covariates. The results of the analysis show that for each one-unit increase in the GOHAI, grip strength statistically significantly increased by 0.002 points (B: 0.002, 95% CI: 0.001-0.003, P-value: <0.001). Regarding age, compared to the 55-64 age group, the grip strength of the 65-74 age group was 0.082 points lower (B: -0.082, 95% CI: -0.096, -0.068, P-VALUE: <0.001), and the 75 and above age group was 0.227 points lower (B: -0.227, 95% CI: -0.245, -0.209, P-VALUE: <0.001). In terms of gender, the grip strength of the female group was 0.427 points lower (B: -0.427, 95% CI: -0.441, -0.413, P-VALUE: <0.001) compared to the male group.

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Table 2. Adjusted effect between the GOHAI and Grip strength

	Grip strength			
	B	95% CI		P-value
GOHAI	0.002	0.001	0.003	<.0001
Age				
55-64	ref			
65-74	-0.082	-0.096	-0.068	<.0001
≥75	-0.227	-0.245	-0.209	<.0001
Education level				
≤ Elementary school	-0.016	-0.036	0.004	0.113
Middle school	-0.002	-0.022	0.018	0.865
High school	0.001	-0.016	0.017	0.954
≥ College	ref			
Gender				
Male	ref			
Female	-0.427	-0.441	-0.413	<.0001
Marital status				
Married	ref			
Separated, divorced	-0.012	-0.030	0.006	0.195
Single	-0.038	-0.101	0.025	0.234
Working restriction				
Yes	-0.017	-0.032	-0.002	0.024
No	ref			
Alcohol consumption				
Yes	ref			
No	-0.009	-0.022	0.004	0.154
Health insurance status				
National Health Insurance	ref			
Medical aid	-0.032	-0.070	0.006	0.096
Number of chronic disease*				
0	ref			
1	0.031	0.010	0.053	0.003
≥2	0.019	-0.055	0.093	0.612
Self-rated health				
Good	0.081	0.061	0.101	<.0001
Moderate	0.070	0.051	0.089	<.0001
Bad	ref			

Table 3 presents a stratified analysis of the relationship between GOHAI and grip strength based on gender and age. The analysis results indicate that for males, a one-unit increase in the GOHAI is associated with a grip strength increase of 0.002 points (B: 0.002, 95% CI: 0.001-0.003, P-VALUE: <0.001). In the female group, a one-unit increase in the GOHAI is statistically significantly associated

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with a grip strength increase of 0.003 points (B: 0.003, 95% CI: 0.002-0.004, P-VALUE: <0.001). For individuals aged 64 and below, the relationship between the GOHAI and grip strength was not statistically significant. However, for those aged 65 and above, a one-unit increase in the GOHAI is statistically significantly associated with a grip strength increase of 0.003 points (B: 0.003, 95% CI: 0.002-0.004, P-VALUE: <0.001).

Table 3. Adjusted effect between the GOHAI and Grip strength by sex or age

	Grip strength			
	B	95% CI		P-value
GOHAI	**Male**			
	0.002	0.001	0.003	0.000
	Female			
	0.003	0.002	0.004	<.0001
	Under 64 years			
	0.001	0.000	0.002	0.070
	Over 65 years			
	0.003	0.002	0.004	<.0001

*adjusted for all confounder variables

4. Discussion

This study aimed to investigate the relationship between the GOHAI and grip strength in a group of middle-aged and older adults aged 45 and above in South Korea, using data from the 7th Elderly Panel Survey. The survey included 5,578 participants. The research results can be summarized as follows: as the GOHAI increased by one unit, grip strength also increased. Stratified analysis by age and gender showed that, for both men and women, an increase in the GOHAI corresponded to an increase in grip strength. In the group aged 64 and below, there was no significant association between the GOHAI and grip strength. However, in the group aged 65 and above, an increase in the GOHAI was associated with an increase in grip strength.

The findings of this study, indicating that grip strength increases with an increase in the GOHAI, align with previous research. Maintaining healthy oral status in old age is reported to play a crucial role in preserving body mass index (BMI) in later years (Sheiham, 2002). The oral health of the elderly is closely related to overall health, and it is considered a priority for maintaining health (Kim, 2011). Oral function significantly influences nutrition intake, digestion, and communication, affecting both oral and overall health. Impaired oral function can lead to nutritional deficiencies, food impaction, and respiratory issues, negatively impacting oral and overall health (Kwon, 2002). The loss of teeth in old age can reduce the ability to chew, limiting food choices and negatively affecting social interactions and daily life. Discomfort during eating due to tooth loss can also diminish the happiness derived from meals, directly influencing the quality of life (Kwon, 2002). Grip strength decreases as self-perceived discomfort in activities such as chewing and speaking

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increases (Kang, 2019).

Sarcopenia, a condition characterized by age-related muscle loss, leads to a decline in physical and muscle function, negatively impacting overall health and independence in daily life (Kim, 2021; Yamada, 2013). Previous studies (Massy-Westropp et al., 2011; Shin, 2012; Kang, 2019) have shown a significant correlation between grip strength and various health outcomes, such as low bone density in postmenopausal women, a higher risk of cardiovascular disease and cancer in men, and an increased risk of dementia in older adults with low grip strength.

Grip strength was found to be lower in elderly groups with mature dental plaque and denture wearers (Shin, 2019). Moriya (2012) reported that grip strength was lower in elderly individuals who perceived their oral health as poor. Previous research on the relationship between the use of oral care products and grip strength revealed that grip strength was 0.94 times lower in individuals who did not use dental floss compared to those who did, and 1.76 times lower in those who did not use an electric toothbrush compared to those who did (Kang, 2019). The use of dental floss and electric toothbrushes requires repetitive movements and a firm grip, leading to the observed association with grip strength.

Low grip strength not only affects physical functions but also has a broader impact on areas such as exercise ability, self-care, daily activities, anxiety, and depression, ultimately compromising overall quality of life (Kim, 2020).

Current literature (Taylor, 2001; Meurman, 2004) indicates a close association between systemic diseases, such as diabetes, and periodontal diseases, emphasizing the interconnection of oral and overall health. Additionally, fewer dental issues, including fewer cavities, missing teeth, and prosthetic teeth, were associated with statistically higher overall health (Kim, 2007). The elderly population tends to experience a decline in nutrient intake with age and maintaining more than 21 teeth is associated with increased nutrient intake and a lower tendency to avoid certain foods (Statistics Korea, 2006; Kang, 2003). The loss of teeth in the elderly hinders the ability to choose a variety of foods, leading to a decrease in health and physical fitness. Therefore, maintaining oral health in the elderly is closely linked to preserving overall health (Park, 2001).

Chewing practice in old age has been suggested as a means to alleviate feelings of depression (Im, 2019). Oral exercises are considered fundamental for maintaining health and enhancing the quality of life (Kang, 2019). However, in South Korea, many citizens, due to societal and economic conditions, often fail to receive dental check-ups and treatments unless it is an emergency situation (Kim, 2010).

To address this issue, there is a need for national initiatives and programs to promote oral health. While various health-related initiatives are being developed, oral health programs are often excluded from the scope of programs targeting chronic conditions (Kim, 2010). Unlike some other countries, South Korea lacks systematic efforts to improve oral health. Japan's long-term care insurance service, for example, includes specific items related to enhancing oral function under preventive and long-term care benefits. The service explicitly designates dental hygienists as practitioners to ensure specialized management (Korean Dental Association, 2002). In Sri Lanka, public oral health education programs using the media have been implemented to lower barriers to oral health education (Korean Dental Association, 2002).

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In conclusion, this study provides valuable insights into the association between oral health and grip strength in the elderly population in South Korea. However, there are limitations to the study, such as potential bias from not including the elderly population in Jeju Island in the survey. Additionally, the generalization of the findings is restricted by the sample size of 5,578 participants, and the cross-sectional nature of the study has inherent limitations compared to longitudinal studies. Despite these limitations, the study contributes to the understanding of the relationship between oral health and grip strength in the elderly. Future efforts should focus on developing oral health promotion programs and education specifically tailored for the elderly in South Korea, with the involvement of dental professionals to provide comprehensive oral health management.

5. Conclusion

This study aimed to investigate the correlation between the GOHAI and grip strength in the elderly, and the results indicated that as oral health in the elderly improves, grip strength increases, thereby exerting a positive impact on overall health. Consequently, this study suggests the importance of implementing oral health promotion programs to enhance the oral health of the elderly, positively influencing overall health. Additionally, it emphasizes the need for oral health policies and health education systems that can consistently manage oral health for the elderly.

Conflicts of Interest

No author has any other conflict of interest to declare.

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