



Indonesian Dental Association

Journal of Indonesian Dental Association

<http://jurnal.pdgi.or.id/index.php/jida>  
ISSN: 2621-6183 (Print); ISSN: 2621-6175 (Online)



Research Article

# Association between Handgrip Strength and Oral Hygiene Skills Among The Older People in Rural Area: A Pilot Study

Kartika Indah Sari<sup>1§</sup>, Friska Nur Rizki<sup>2</sup>, Ira Komara<sup>3</sup>, Paulus Anam Ong<sup>4</sup>, Ambrosius Purba<sup>5</sup>, Sunardhi Widyaputra<sup>1</sup>

<sup>1</sup> Department of Oral Biology, Faculty of Dentistry, Padjadjaran University, Indonesia

<sup>2</sup> Dental Profession Program, Faculty of Dentistry, Padjadjaran University, Indonesia

<sup>3</sup> Department of Periodontia, Faculty of Dentistry, Padjadjaran University, Indonesia

<sup>4</sup> Department of Neurology, Hasan Sadikin Hospital, Bandung, Indonesia

<sup>5</sup> Department of Physiology, Faculty of Medicine, Padjadjaran University, Indonesia

**Received date:** March 31, 2021. **Accepted date:** July 20, 2021. **Published date:** October 31, 2021.

## KEYWORDS

elderly;  
hand grip strength;  
oral hygiene skills;  
rural area

## ABSTRACT

**Introduction:** The aging process is characterized by a decrease in muscle mass and muscle strength. It causes the deterioration of handgrip muscles. Diminishing handgrip strength can impact the activities of daily life, including the maintenance of oral hygiene. A toothbrush handle must be gripped firmly enough to remove plaque. **Objectives:** The aim of this study was to examine handgrip muscle strength and oral hygiene skills in the elderly. **Methods:** This study was a correlational analysis using a cross-sectional study design with a consecutive sampling technique of the elderly. The study was conducted in the rural village of Sinartanjung, Banjar, West Java, Indonesia. Handgrip strength was measured twice using an Electronic Hand Dynamometer Camry EH 101. Oral hygiene skills were assessed using the O'Leary plaque index to measure plaque control. Data were presented in tables and as percentages. A non-parametric statistical Spearman rank test was used to measure the correlation between handgrip strength and oral hygiene skill. **Results:** Forty-two the elderly people participated in this study, 31 females (73.80%) and 11 males (26.19%). The average handgrip strength was in the normal category ( $19.80 \pm 7.2$ ) kg and the average plaque index was in the moderate category ( $0.34 \pm 0.16$ ). The Spearman rank correlation test showed a significant correlation between handgrip strength and oral hygiene skills,  $r=0.521$ ,  $p=0.000$  ( $p < 0.05$ ). **Conclusion:** Maintained handgrip strength in the elderly ensures an adequate toothbrush grip, thereby improving oral hygiene skills and increasing the amount of plaque that can be removed.

<sup>§</sup> Corresponding Author

E-mail address: [kartika.sari@fkg.unpad.ac.id](mailto:kartika.sari@fkg.unpad.ac.id) (Sari KI)

DOI: [10.32793/jida.v4i2.666](https://doi.org/10.32793/jida.v4i2.666)

**Copyright:** ©2021 Sari KI, Rizki FN, Komara I, Ong PA, Purba A, Widyaputra S. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium provided the original author and sources are credited.

## INTRODUCTION

Aging is a process characterized by various physical and functional changes in bodily organs.<sup>1,2</sup> It can cause a decrease in muscle mass and muscle strength, which negatively impacts the activities of daily life, including the maintenance of oral hygiene. One study suggests that age 30 is the peak of muscle strength, which starts to decrease at age 40. By age 80, it decreases around 30–40%.<sup>3</sup> Muscle strength can be assessed by measuring the strength of leg muscles, back muscles, and handgrip muscles.<sup>2,3</sup> Assessment of handgrip muscle strength is an option for evaluating a decrease in muscle strength associated with motor limitations related to daily activities.<sup>4</sup> Assessing handgrip muscle strength is a simple protocol and easy to conduct with older individuals. Handgrip strength decreases as age increases. Study conducted by Stevens et al confirmed handgrip strength is a good marker of physical performance in this age group.<sup>5,6</sup> In addition to age, the handgrip muscles are also influenced by other factors, namely gender, physical activity, protein intake, and other systemic factors.<sup>5-7</sup>

Oral hygiene is one of the most important issues to be considered, especially in the elderly.<sup>8,9</sup> Plaque control can be done mechanically or chemically. A toothbrush handle must be gripped firmly enough to effectively remove plaque mechanically. A study by Shin revealed that an electric toothbrush is more effective at removing plaque than a manual toothbrush.<sup>10</sup> A few studies have shown the correlation between functional handgrip muscle strength and a history of falling in Indonesia's elderly population.<sup>4,8</sup> Other studies have correlated handgrip strength with nutritional intake and muscle strength generally.<sup>11,12</sup> To the best of our knowledge, no study on the topic of hand grip strength (HGS) and oral hygiene skills (OHS) has been conducted in Indonesia.

The village of Sinartanjung is located in the Pataruman district of Indonesia. Geographical characteristics include agricultural and plantation areas with rice fields and hills. The total population of Sinartanjung above 60 years is 616 people consisting of 280 males and 226 females in 2020. This study aimed to explore the performance of daily occupational activities involving the hand, forearm, and tools in this rural community. The population of Sinartanjung generally participate in the same physical activities, mostly using their hands while working. Sinartanjung is an accessible rural area in Banjar, West Java. Sinartanjung was selected because the physical work there is homogenous, thereby reducing bias in the type of daily activities conducted.<sup>13</sup>

## MATERIALS AND METHODS

This study used a cross-sectional design with a correlational analytic method. The village of Sinartanjung was selected for the study using a stratified random sampling technique. The village is located in the district of Pataruman, Banjar. We collected data in the eastern region of Sinartanjung because agriculture is their primary daily activity.

### Sample Size

The population of this study was elderly individuals aged  $\geq 60$ . Using a consecutive sampling technique with a minimal sample size formula. We collected data until the minimum sample size was met. The exclusion criteria were systemic diseases, such as diabetes and arthritis, which could affect muscle strength, ambidexterity, musculoskeletal and neurological deformities that could interfere with hands when using a hand dynamometer. Elders who were missing teeth 16, 11, 26, 36, 31, or 46 were excluded from the study. The remaining root is defined as the missing tooth.

### Hand grip strength measurement

This procedure was explained before data was collected and the participants agreed to participate with signed informed consent. HGS was measured using the electronic hand dynamometer (Camry EH 101; Camry Scale, South El Monte, CA, USA), designed for auto-capturing the maximum HGS and recording it in kilograms (kg). HGS is instantly categorized on the display as strong, normal, or weak, as shown in Table 1, as instructed by manufacturer. A hand dynamometer can be used for measuring upper extremity strength by a hand grip test. Therefore, it can evaluate upper extremity muscular strength and function. HGS is an anthropometric measurement that is usually used to determine functional limitations in the elderly. HGS is useful as a diagnostic and prognostic tool in clinical and research settings.<sup>14</sup>

The procedure performed was similar to that performed by Nawangsasi et al, with some modifications.<sup>15</sup> Before using the tool, settings were adjusted according to age and gender. The participant was in a relaxed sitting position with both feet on the floor, leaving the arms straight down by the side of the body. Participants were asked to hold the electronic hand dynamometer as firmly as possible for 5 seconds in the dominant hand. Measurements were made twice with a 60 seconds rest between trials. The highest values were analyzed.

**Table 1.** Handgrip strength standard classification.

No.	Age	Man			Woman		
		Weak	Normal	Strong	Weak	Normal	Strong
1	60-64	<30.2	30.2 - 48.0	>48.0	<17.2	17.2-31.0	>31.0
2	65-69	<28.2	28.2 - 44.0	>44.0	<15.4	15.4-27.2	>27.2
3	70-99	<21.3	21.3 - 35.1	>35.1	<14.7	14.7-24.5	>24.5

### Plaque control measurement as indicator of oral hygiene skills

OHS were examined using plaque control records with a modified O'Leary index, but not all existing teeth were checked. Only six teeth, 16, 11, 26, 36, 31, and 46, were examined. Recording plaque control with the O'Leary index is a simple process of recording the presence of plaque on individual tooth surfaces (mesial, distal, facial, and lingual) in the dento-gingival region of the examined teeth.<sup>16</sup> There is no intervention in the method of brushing the teeth. All participants received a set of oral hygiene care kits. Participants did one minute of brushing their teeth in their own way. Subsequently, the operator dropped a drop or two of the disclosing solution into the mouth. The participant allowed it to mix with saliva, swished the mixture over dental surfaces for 30 seconds, and then spit out the solution. The operator examined the plaque and recorded (+) for plaque present and (-) for plaque absent. The total plaque control accounted based on modified plaque control by O'Leary Index as followed:

$$\frac{\text{amount of tooth surface that accumulated by plaque}}{\text{amount of all surface}} \times 100\%$$

The category of oral hygiene skill refers to the category of oral hygiene index as a good (0–20%), moderate (21–40%), bad (41–60%), or very bad (>60%).<sup>16</sup> Data were analyzed with a non-parametric statistical test and the Spearman rank correlation test. The significance level was  $p < 0.05$ . The data were presented in tables and as percentages. The data were processed using Statistical Product and Service Solutions IBM

version 25 (IBM, Armonk, NY). Ethical approval was obtained from the Health Research Ethics Committee Faculty of Medicine of Universitas Padjadjaran (No.05/UN6.KEP/EC/2020).

## RESULTS

This research was conducted in the village of Sinartanjung in Banjar. Forty-two elderly individuals, consist of 31 (73.8%) females and 11 (26.19%) males were participated in this study. All participants had a limited education level, that of elementary school (100%). Most of the participants brushed their teeth twice a day (90.48%), 4.76% brushed three times a day, and 4.76% brushed once a day. Most were farmers (80.95%), gardeners (2.38%), or housewives (16.67%). The average HGS of the participants was  $19.80 \pm 7.23$  kg categorized as normal. While the average oral hygiene index (OHI) was  $0.34 \pm 0.16$  or 34% categorized as moderate.

Table 2 was presented HGS values for participants according to age and gender. Most participants were in the normal clinical criteria of HGS for all age range, 60–64 years old (23.8%), 65–69 years old (19.1%) and 70–99 years old were (23.8%) respectively. No participant had strong clinical HGS criteria. Most of the participants had normal clinical HGS criteria both female (45.2%) or male and males (21.4%). On the other hand, we found variations in OHS at female group, but male had only good and moderate OHS criteria as showed in Table 2.

Among the total participants in normal clinical HGS criteria (66.67%), 33.33% participants had moderate OHS criteria and 23.80 % had good OHS criteria as presented in Table 3. Meanwhile, participants with weak HGS mostly were within poor OHS (16.67%), one (2.38%) were very poor OHS and none of weak HGS were good OHS. A Spearman rank correlation test suggested there was a significant positive moderate correlation between HGS and OHS ( $r = 0.521$ ,  $p = 0.000$  ( $p < 0.05$ ), as shown in Table 4.

**Table 2.** Distribution of age and gender according to Handgrip Strength (HGS) and Oral Hygiene Skills (OHS) among participants

Variable	Hand Grip Strength (HG)			N	Oral Hygiene Skill (OHs)				N	
	Strong n(%)	Normal n(%)	Weak n(%)		Good n(%)	Moderate n(%)	Poor n(%)	Very Poor n(%)		
<b>Age</b>										
60-64	0	10 (23.8)	5 (11.9)	15	8 (19.1)	5 (11.9)	2 (4.8)	0	15	
65-69	0	8 (19.1)	4 (9.5)	12	2 (4.8)	8 (19.1)	1 (2.4)	1 (2.4)	12	
70-99	0	10 (23.8)	5 (11.9)	15	0	7 (16.7)	8 (19.1)	0	15	
Total				42					42	
<b>Gender</b>										
Female	0	19 (45.2)	12 (28.6)	31	7 (16.7)	12 (28.6)	11 (26.2)	1 (2.4)	31	
Male	0	9 (21.4)	2 (4.8)	11	3 (7.1)	8 (19.1)	0	0	11	
Total				42					42	

**Table 3.** Distribution of Handgrip Strength (HGS) according to Oral Hygiene Skill (OHS)

Hand Grip Strength (HGS)	Oral Hygiene Skill (OHS)								Total	
	Good		Moderate		Poor		Very Poor			
	n	%	n	%	n	%	n	%	n	%
Strong	0	0.00	0	0.00	0	0.00	0	0.00	0	0
Normal	10	23.8	14	33.33	4	9.52	0	0.00	28	66.67
Weak	0	0.00	6	14.29	7	16.7	1	2.38	14	33.33
Total (%)	10	23.8	20	47.61	11	26.19	1	2.38	42	100

**Table 4.** Spearman rank correlation test

		Hand Grip	Oral Hygiene
Hand grip	Correlation Coefficient	1.000	.521**
	Sig. (2-tailed)	.	.000
	N	42	42
Oral hygiene	Correlation Coefficient	.521**	1.000
	Sig. (2-tailed)	.000	.
	N	42	42

## DISCUSSION

The result was showed that most of the elderly participants had a relatively normal HGS and no participants who had a relatively strong HGS. Meanwhile, most of participant had moderate criteria OHS and some had good and a few in poor OHS. Most of the participants with a weak HGS had poor OHS. Our study found that there was a significant correlation between HGS and OHS. The stronger the HGS among the elderly the better OHS they had.

Vitriana and Kristina et al demonstrated that low muscle strength using handgrip measurement in the elderly was associated with poor physical performance. Our finding was supported by previous studies suggested participants had normal HGS had better physical performance compare to an individual with weak HGS.<sup>17,18</sup> Both studies above showed improve in physical performance due to an active lifestyle can impact on delayed functional disabilities.

In our study, there were no participants who had strong HGS. The study revealed the elderly had decreased muscle strength due to the aging process. Contrast to a study involved young teens by Dina et al demonstrated that the teens had strong handgrip muscle strength.<sup>11</sup> A study by Rosmalina et al suggested a similar result that older people experience a lower handgrip strength.<sup>12</sup> Yunita et al. also found a significant correlation between handgrip and age. Those under age 60 have higher handgrip muscle strength than those above age 60 ( $35.8 \pm 10.2$  kg vs.  $24.1 \pm 6.4$  kg). This is caused by a decrease in muscle mass that occurs more

rapidly after the age of 60.<sup>19</sup> A deterioration of muscle strength with increased the age has proved through the current study, but surprisingly those are still in normal criteria.

Physical activity is a factor that can influence muscle performance. Most of the population of Sinartanjung are farmers.<sup>13</sup> Based on our data, most of the elderly work in agriculture, including as farmers (80.95%) and as gardeners (2.38%). Some of the females did activities as a housewife (16.67%). Most of the people who live in this area primarily do physical work using their hands. The elderly does daily activities as farmers, gripping hoe or other agriculture tools, starting every morning and working until lunchtime.<sup>13</sup> This physical activity may help the elderly in Sinartanjung maintain a healthy lifestyle and relatively normal handgrip muscle strength.

This study was also supported by a study by Rosmalina et al that suggested there were significant differences between participants who worked as farmers and those who did not work.<sup>12</sup> Our result is different with a study by Tatin. Tatin conducted a study in the village of Darsono in the Jember district of East Java. The study revealed that most elderly individuals had poor oral hygiene and most of them are farmers. The elderly participants did not brush their teeth properly even though most of them brushed twice in a day. Frequency of brushing the teeth and a behavior in maintaining oral health should be improved.<sup>20</sup>

Our results proved that as a person gets older, the muscle strength can be maintained with doing an active lifestyle. Most participants are farmers, their muscles strength decrease more slowly than usual. The study showed most of the elderly participants have normal handgrip muscle strength and maintain their ability to remove plaque by gripping the brush handle well. Most of the participants brush the teeth twice a day (90.48%), 4.76% brushes three times a day, and only 4.76% brushes once a day.

A study conducted by Weijden et al demonstrated the effectiveness of self-performed mechanical plaque

removal in adults with gingivitis using a manual toothbrush. The study suggested the quality of self-performed mechanical plaque removal is not sufficiently effective in adults. The results showed that 50-60% of plaque on all tooth surfaces was successfully removed but the remaining 40-55% of plaque is usually removed with assistance. Weijden et al proposed a powered toothbrushes to assist mechanical plaque removal.<sup>21</sup> Different with our study used a manual toothbrush to clean up and removed the plaque. Our result shows the OHI is  $0.34 \pm 0.16$  (34%, moderate criteria) in the elderly in this study.

A study conducted by Morris et al suggested that oral hygiene decreases as the proportion of teeth with plaque increases from 30% in the age group of 25–34 and to 44% in those aged 65 and over.<sup>22</sup> Our study presented that elderly in rural area has moderate OHS and 66% of plaque has successfully removed by manual toothbrush. Generally, females tend to have weaker HGS compared to males. Our data confirmed that females tend to have weaker HGS than males, but we did not perform a statistical test to prove the difference in HGS due to a disproportional number of female and male participants in our study. Putrawan et al suggested that males have higher HGS than females ( $p < 0.001$ ). The difference in HGS between males and females is due to differences in muscle mass.<sup>23</sup>

Our study found that elders with normal HGS tended to have moderate to good OHS. Meanwhile, the participants with weak HGS had a poor OHS. This study is in line with a study by Komulainen et al. that suggested there was a correlation between weak HGS and a poor oral hygiene in the elderly.<sup>24</sup> The elderly individuals with weak HGS often have difficulty removing plaque when compared to those with normal HGS. Our study shows there was a correlation between HGS and OHS and concluded that the stronger the handgrip, the more plaque can be removed during the process of brushing. Thus, the amount of plaque persisting within the oral cavity is reduced and good oral hygiene is maintained when the level of HGS is high.

Study performed by Kang et al. suggested that males and females (mean age  $42.52 \pm 0.41$ ) with low HGS had a poor quality of life (QoL) scores on mobility and pain/discomfort dimensions. Female with low HGS had poor QoL on mobility and pain/ discomfort dimensions, but still doing activities.<sup>25</sup> In our study, individuals with weak or low HGS tended to have poor OHS, potentially at risk for decreased quality of life later in life.

This is a pilot study with a limited sample size. We examined a plaque index control once to observe oral hygiene skills after participants brushed their teeth in

their own way. The effectiveness of the brushing can be observed in the examination of plaque control before and after brushing using an adequately defined method. The impact of HGS on the condition of the teeth also needs to be explored because brushing teeth in an improper way can cause damage to the teeth, not only removing plaque. Further studies should have a larger sample size and generalize the results.

## CONCLUSION

Maintenance of handgrip muscle strength in the elderly can ensure an adequate grip on a toothbrush, thereby improving oral hygiene skills and increasing the amount of plaque that can be removed.

## Acknowledgment

All authors are grateful to the participants who participated in this study.

## Conflict of Interest

There is no conflict of interest in this study.

## REFERENCES

1. Amarya S, Singh K, Sabharwal M. Ageing process and physiological changes. Gerontology, D'Onofrio G, Greco A and Sancarolo D (eds). Intechopen, London, U.K. 2018, pp. 1–23.
2. Siparsky PN, Kirkendall DT, Garrett WE. Muscle changes in aging: understanding sarcopenia. Sports Health. 2014;6(1):36–40.
3. Nair Sreekumaran K. Aging muscle. Am J Clinical Nutrition. 2005;81:953–63.
4. Ekowati D. Kekuatan genggam tangan pada wanita usia lanjut di posyandu lansia Kecamatan Kalasan dengan riwayat jatuh dan tidak jatuh [Thesis]. Yogyakarta: Universitas Gadjah Mada; 2014.
5. Stevens PJ, Syddall HE, Patel HP, Martin HJ, Cooper C, Aihie Sayer A. Is grip strength a good marker of physical performance among community-dwelling older people? J Nutr Health Aging. 2012;16(9):769-74.
6. Visser M, Deeg DJH, Lips P. Low vitamin d and high parathyroid hormone levels as determinants of loss of muscle strength and muscle mass (sarcopenia): The longitudinal aging study Amsterdam. J Clin Endocrinol Metab. 2003;88(12):5766-5772.
7. Ryoto V. Hubungan antara kekuatan otot genggam dengan umur, tingkat kemandirian, dan aktivitas fisik pada lansia wanita klub geriatric terpilih Jakarta

- Utara [Skripsi]. Jakarta: Universitas Indonesia (Progam Stud Ilmu Gizi); 2012.
8. Putri DAKTA, Purnawati S. Hubungan kekuatan otot genggam dan kemampuan fungsional pada lansia wanita di posyandu lansia Desa Dauh Puri Kelod Denpasar Barat. *E-Jurnal Med.* 2017;6(4):20-27.
  9. Portella FF, Rocha AW, Haddad DC, Fortes CB, Hugo FN, Padilha DM, et al. Oral hygiene caregivers' educational programme improves oral health conditions in institutionalised independent and functional elderly. *Gerodontology.* 2013:1-7.
  10. Shin HS. Handgrip strength and the number of teeth among Korean population. *J Periodontol.* 2019;90(1):90-97.
  11. Andarbeni DP, Sugiarto S, Prasetyo AA. Asupan energi dan protein dengan kekuatan otot genggam pada remaja putri. *Darussalam Nutr J.* 2018:11-18.
  12. Rosmalina Y, Permaesih D, Rustan E, Ernawati F, Moelock D, Herman S. Faktor-faktor yang mempengaruhi muscle strength pada laki-laki lanjut usia. *Bulet Penelit Kesehat.* 2001;29(4):1-21.
  13. Badan Pusat Statistik Kota Banjar. Kecamatan Pataruman Dalam Angka 2017. Banjar: Badan Pusat Statistik Kota Banjar; 2017. p. 9.
  14. Rodríguez-García WD, García-Castañeda L, Orea-Tejeda A, Mendoza-Núñez V, GonzálezIslas DG, Santillán-Díaz C, et al. Handgrip strength: Reference values and its relationship with bioimpedance and anthropometric variables. *Clin Nutr ESPEN.* 2017;19:54–8.
  15. Nawangsasi P, Kalanjati, VP, Irawan R, Risdiansyah, Tirthaningsih NW. Correlation of hand grip strength and body height amongst young adults in Indonesia. *Mal J Med Health Sci.* 2021; 17 Suppl: 9–12.
  16. O'Leary TJ, Drake RB, Naylor JE. The plaque control record. *J Periodontol.* 1972;43(1):38.
  17. Vitriana, Defi IR. Physical factors in age-related physical performance decline in older adults at lembaga lansia Indonesia, West Java Branch. *Maj Kedokt Bandung.* 2020; 52 (3): 160–66.
  18. Kristiana T, Widajanti N, Satyawati R. Association between muscle mass and muscle strength with physical performance in elderly in Surabaya. *Surabaya Phys Med Rehabil J.* 2020; 2(1): 24-34.
  19. Christiandari DP, Pramantara Yunita, Korelasi usia dengan kekuatan otot pada lanjut usia di desa Sumber Porong Malang. *Proceedings of the national work at the national congress of the Indonesian Association of Internal Medicine Specialists.* 2018, July 11-15. Surakarta, Central Java. 2018. p. 1-4.
  20. Ermawati T. Profil kebersihan dan perilaku menjaga kesehatan gigi dan mulut pada lansia di Desa Darsono Kabupaten Jember. *IKESMA.* 2016;12:77-83.
  21. van der Weijden GA, Hioe KP. A systematic review of the effectiveness of self-performed mechanical plaque removal in adults with gingivitis using a manual toothbrush. *J Clin Periodontol.* 2005;32 Suppl 6:214-28.
  22. Morris AJ, Steele J, White DA. The oral cleanliness and periodontal health of UK adults in 1998. *Br Dent J.* 2001;191(4):186-92.
  23. Putrawan BP, Kuswardhani RAT. Faktor-faktor yang menentukan kekuatan genggam tangan pada pasien lanjut usia di Panti Wredha Tangtu dan Poliklinik Geriatri RSUP Sanglah-Denpasar. *J Penyakit Dalam.* 2011;12(2):87-91.
  24. Komulainen K, Ylöstalo P, Syrjälä AM, Ruoppi P, Knuuttila M, Sulkava R, Hartikainen S. Associations of instrumental activities of daily living and handgrip strength with oral self-care among home-dwelling elderly 75+. *Gerodontology.* 2012;29(2):e135-42.
  25. Kang SY, Lim J, Park HS. Relationship between low handgrip strength and quality of life in Korean men and women. *Qual Life Res.* 2018 Oct;27(10):2571-2580.