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Correlation between hand grip strength and functional mobility in elderly patients

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Abstract Aging is a normal process that can be indicated by muscle mass reduction or sarcopenia. Sarcopenia is problematic, since it is correlated with a higher risk of falls. Therefore, early measurement of physical performance in the elderly is necessary. Hand grip strength can be measured to assess hand muscle strength, while the timed up-and-go test (TUGT) is used to assess functional mobility. However, the correlation of both variables has not been clearly explained. We measured average hand grip strength and functional mobility in elderly patients and found a significantly meaningful moderate correlation between them ($P = 0.000$, $r = -0.568$). Average mean hand grip strength was 19.1 ± 7.00 kg and average median functional mobility was 12.8 (5.9–30.9) seconds.

1. Introduction

Aging is a naturally-occurring process. As age increases, physical ability will gradually decrease. Reduction in physical ability and muscle mass is called sarcopenia. Sarcopenia is a major problem in the elderly due to its strong relationship with higher risk of falls, resulting in increased morbidity and mortality [1].

Some physical ability components can be measured in the elderly, including walking speed, stability, standing from a chair in 30 seconds, physiological profile assessment values, short physical performance battery values, timed up-and-go test (TUGT) results, and hand grip strength [2]. The TUGT is used frequently to assess mobility in elderly patients because it can measure many aspects of functional mobility, such as strength, walking speed, stability, and cognitive ability at once [3]. The TUGT is also an efficient instrument to screen for risk of falls in the elderly [4] and has been used routinely by the American Geriatrics Society/British Geriatric Society [5]. Hand grip strength is correlated with fall incidence, health-related quality of life, hospitalization duration, and disability. It is the simplest and only method recommended to assess muscle mass strength [6].

The association between functional mobility and muscle mass strength is important because it can illustrate physical ability reduction in the elderly and in general. However, the correlation between the two variables still varies. Garcia et al. reported a correlation among hand grip strength, walking speed, and lower extremity muscle function [7]. The correlation between hand grip strength and walking speed is also supported by Bijlsma et al. Bohannon also reported a correlation between low hand grip strength and increased functional disability [8,9]. On the other hand, Singh et al. [2] reported no correlation between hand grip strength and functional mobility measured by TUGT.

Despite numerous previous studies, few have specifically focused on the correlation between hand grip strength and functional mobility measured using TUGT. Moreover, to our knowledge, no study



has illustrated the correlation of the two variables in the Indonesian population. Therefore, we attempted to determine the correlation between hand grip strength and functional mobility measured with TUGT in elderly patients.

2. Methods

A cross-sectional study was done on 76 patients at the outpatient Geriatry Clinic, Internal Medicine Department, Cipto Mangunkusumo Hospital, Jakarta, from June to September 2016. The study protocol had been approved by the Health Research Ethics Committee of Faculty of Medicine, Universitas Indonesia-Cipto Mangunkusumo Hospital. Inclusion criteria were patients aged >60 years without pain in the extremities, extremity fracture, extremity sensory disturbance, neurosensory disease, depression, alcohol consumption, or apparent acute diseases. Data regarding age, sex, nutrition status (based on the Mini Nutritional Assessment questionnaire), comorbid diseases, hand grip strength, and functional mobility were obtained by interview and direct measurement.

Hand grip strength was measured using the Jamar dynamometer. Subjects were asked to sit on a chair and use of the Jamar dynamometer was demonstrated. Subjects were instructed to grip the dynamometer comfortably with their right hand and squeeze it as hard as they could until the pointer needle stopped at a certain number. The test was repeated using the other hand. Measurements were repeated three times for each hand. Highest hand grip strength value was used for calculation. Functional mobility measurement by TUGT began with the subjects sitting on a chair and leaning against the back support. Subjects were instructed to stand up and walk straight for three meters as comfortably as possible. Then, they turned around and walked back to the chair.

The results were analyzed using SPSS version 20 (SPSS, Inc., Chicago, IL, USA). Hand grip strength and functional mobility data were each analyzed univariantly with the Kolmogorov-Smirnov test to determine data distribution. The correlation between the two variables was measured using the Pearson and Spearman tests for normally and abnormally distributed data, respectively.

3. Results

The demographic data of the subjects are shown in Table 1.

Table 1. Study Subject Characteristics ($n = 73$).

Variable	Frequency (%)
Number of subjects based on age (year)	
60–69	28 (38.4)
70–79	34 (46.6)
>80	11 (15.0)
Sex	
Male	41 (56.2)
Female	32 (43.8)
Comorbidities	
Hypertension	45 (61.6)
Diabetes mellitus	31 (42.5)
Dislipidemia	19 (26.0)
Prostate enlargement (male)	7 (9.6)
Dyspepsia	6 (8.2)
Kidney disorders	4 (5.5)
COPD	2 (2.7)
Nutritional status	
Normal	29 (39.7)
A risk of malnutrition	35 (48.0)
Malnutrition	9 (12.3)

Normality tests using Kolmogorov-Smirnov test for data on hand grip strength and functional mobility data using SPSS Statistics 20.0 for Windows (IBM, Armonk, NY, USA). Correlation calculation was done using nonparametric Spearman correlation test.

Mean hand grip strength measured in elderly patients in the clinic is shown in Table 2. Median functional mobility measured with TUGT in study subjects is shown in Table 3.

Table 2. Mean Hand Grip Strength

Mean Hand Grip Strength	Number (kg)
Overall (kg)	19.1 ± 7.0
Male patients (kg)	22.3 ± 6.99
Female patients (kg)	15.1 ± 4.55

Table 3. Median Functional Mobility

Median Functional Mobility Mean	Seconds (range)
Overall (s)	12.8 (5.9–30.9)
Male patients	11.6 (5.9–30.9)
Female patients	13.4 (10.5–26.4)

A significant correlation between hand grip strength and functional mobility was shown ($P = 0.000$, $r -0.568$; Fig. 1).

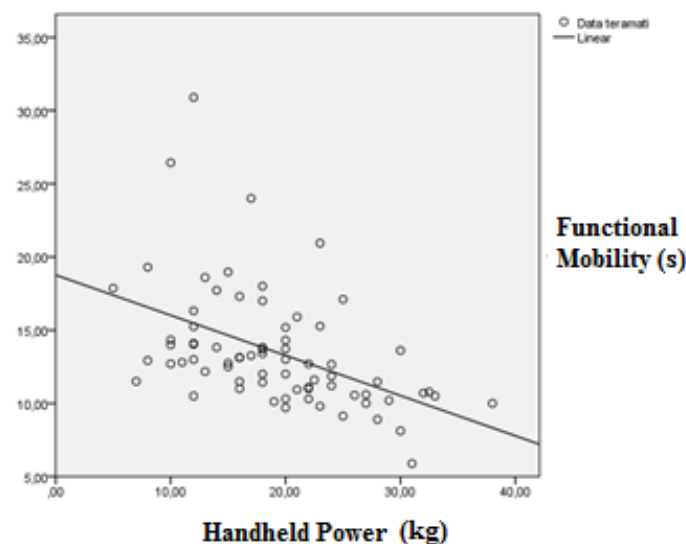


Figure 1. Correlation between hand grip strength and functional mobility.

4. Discussion

4.1. Hand Grip Strength

Based on the consensus of the Asian Working Group for Sarcopenia (AWGS), the threshold for hand grip strength was 26.0 and 18.0 kg for male and female patients, respectively [10,11]. Our study subjects had mean hand grip strengths below the threshold of Asian hand grip strength. When

compared to Singaporean hand grip strength, our data were also lower. Average hand grip strengths of males and females in Singapore were, respectively, 30.9 and 17.9 kg for age 60–64 years, 28.8 and 16.8 kg for age 65–69 years, 27.3 and 15.7 kg for age 70–74 years, 25.2 and 14.6 kg for age 75–79 years, and 22.9 and 13.7 kg for age 80–84 years [12]. The subjects in that study were obtained from the community, whereas our subjects were obtained from the polyclinic. Therefore, presence of diseases can affect hand grip strength.

In addition, ethnic differences of the study subjects can affect hand grip strength due to differences in body size, body shape, nutrition, physical activity patterns, culture, and prevalence of fragility [13]. The same can be seen from the study of Koopman et al. [14] who compared hand grip strength in subjects from Ghana and The Netherlands, and reported that differences in height, weight, and body mass index were associated with differences in hand grip strength in both populations. The difference in hand grip strength in different world regions is noted between developed and developing countries [14]. Because the difference in hand grip strength is based on region, Asian countries set their own standard thresholds for hand grip strength.

Based on the meta-analysis of Bohannon et al. [15] hand grip strength is influenced by sex, hand dominance and age. Our findings regarding the influence of sex on hand grip strength agreed with those of Bohannon et al. [15] who reported greater hand grip strength in men than in women. They reported hand grip strengths of 41.7 and 25.9 kg, respectively, in men and women aged 60–64 years, 41.7 and 25.6 kg for ages 65–69 years, 38.2 and 24.2 kg for ages 70–74 years, and 28 and 18.0 kg for age >75 years, respectively. However, the effect of age on hand grip strength was not apparent in our study. This can be due to nutrition status difference in every age group in our study. Nutrition status changes are moderately correlated with hand grip strength changes, as noted by Flood et al [16].

4.2. TUGT

Unlike hand grip strength, the reference value for TUGT was unavailable, both in Asia and Europe. Although AWGS does not recommend use of the TUGT to measure physical performance, the European Working Group on Sarcopenia in Older People stated that TUGT can be used to measure physical performance. Therefore, the TUGT value in our study was compared to reference values in other studies. Compared to the meta-analysis by Bohannon et al. [17] our TUGT value was greater, indicating that our subjects required more time to complete the TUGT. Nevertheless, their study subjects and inclusion criteria varied, and they were also of diverse ethnicities; thus, their TUGT results also varied [17]. Our TUGT value was also greater than the TUGT reference value among Japanese elderly (8.86 seconds during normal walking, as stated in the operational definition in this study). This is predictably related to the ethnic difference in this study compared to the meta-analysis performed by Kamide et al. [18] That ethnic difference specifically caused the difference in lipid mass that influenced muscle mass, and lifestyle influenced the activities performed [18].

4.3. Correlation between Hand Grip Strength and Functional Mobility

The correlation between hand grip strength and functional mobility in our study was different from that reported by Singh et al. [2] who did not find a significant correlation between dominant hand grip strength and TUGT. This difference can be due to the fact that our study subjects were from the polyclinic, and TUGT is a sensitive test for elderly with some functional weakness [2]. However, besides this finding, both studies have the same criteria and operational conditions.

Other than that study, to our knowledge, no other studies have correlated hand grip strength with TUGT directly. Singh et al. [2] studied the correlation between various physical performance tests and physiologic fall risk, including hand grip strength and TUGT, and found a low significant correlation with TUGT ($r = 0.27$). No correlation was found with hand grip strength, indicating no significant correlation with physiologic fall risk [2]. This result differed from the findings of Wang et al. [19] who reported a significant difference in hand grip strength and TUGT between elderly subjects with and without a fall history during the last 12 months, and from those of Singh et al. [2] who found that TUGT is associated with fall.

The correlation between hand grip strength and functional mobility was indirectly studied by Macedo et al. [20] who evaluated the relationship between hand grip strength and functional mobility with physical activity. They found that hand grip strength and functional mobility may be related [20]. The same was also noted by Kannegieter et al. [21] in a study correlating the two variables with fragility in the elderly. In their study, hand grip strength was significantly lower in elderly subjects with than without frailty, and functional mobility was significantly higher in the fragile elderly [21]. Therefore, hand grip strength and TUGT were correlated, because they were related to risk of fall, fragility, and physical activities performed.

We concluded that hand grip strength and functional mobility have a moderate correlation ($r = -0.568$). Therefore, increase in hand grip strength will result in shorter time needed to complete the TUGT. With that correlation, hand grip strength or functional mobility measurement with TUGT only is sufficient to demonstrate the physical strength of a person holistically. Between the two variables, functional mobility is easier to apply because the instruments needed are simpler and, therefore, this test is easier to apply in a geriatric health facility with limited resources. Therefore, functional mobility measurement with TUGT only is sufficient to demonstrate hand grip strength without measuring hand grip strength directly.

5. Conclusion

There is a significant correlation between hand grip strength and functional mobility in the elderly ($r = -0.568, p = 0.000$).

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