Three-Year Study of Geriatric Skeletal Muscle Strength at a Top Referral General Hospital, West Java, Indonesi

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Abstract

Background: One of the aging effects is the decrease of skeletal muscle strength. The objectives of this study was to analyze the geriatric skeletal muscle strength by hand grip strength according to the characteristics of the elderly.

Methods: An analytic retrospective study was carried out to 99 medical records of elderly who sought medication at the Geriatric policlinic of Dr. Hasan Sadikin General Hospital as the top referral hospital in West Java, Indonesia from 2012–2014. The result of hand grip strength measurement were grouped based on the characteristics of gender, age, body mass index (BMI), Barthel Index score, Mini Nutritional Assessment (MNA) score, number of disease and number of medication. All data were taken from patient's medical records. The collected data were statistically analyzed with unpaired T-test and one way ANOVA test.

Results: Among the 99 subjects, most of the subjects were male, under 80 years old, independent living persons, had normal BMI, and normal nutritional level according to Mini Nutritional Assessment. Most of the subjects had more than 3 diseases per person and less than 5 sorts of medication. Male had higher hand grip strength compared to female and it was statistically significant (p=0.04). Based on ADL score, Independent living had higher hand grip strength compared to other level (p=0.008).

Conclusions: From all the variables measured, only gender and Activity Daily Living level contibute to the hand grip strength.

Keywords: Elderly, hand grip strength, muscle strength

Introduction

The world today is entering the era of aging population with the number of older people increasing significantly throughout the world. In 2010, there are 18.043.712 of older adult or 9% of the entire population in Indonesia.[1] As a human gets older, the body experienced the process of aging toward a worse level of health condition followed by decrement of body function which cause people more prone to disease or even death.[2,3] One of the declining body function is the body musculoskeletal system. The skeletal muscle as part of the system also experience a decrease through loss of muscle mass and muscle quality as it lost its contractile tissues followed by massive fat deposition.[4] These conditions directly affect the muscle strength and muscle performance in conducting the functions which can cause limitations to older adult in performing their daily living day-to-day activities (activity daily living/ADL). The final effect is the decline of the quality of life which caused loss of independence in the advanced age people. In general, the muscle strength of the hand could be used to see the skeletal muscle strength.[5]

This study aimed to measure the skeletal muscle strength by measuring the hand muscle strength based on the characteristics of gender, age, body mass index (BMI), level of independence, nutritional status, number of disease and number of medication taken in geriatric patients. Furthermore, geriatric patients have characteristics which distinct them from other general older adults since geriatric patients have more than one disease (multi-morbidity) resulting from disruption of

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body functions and/or physiological systems as well as problematic social conditions. All of these contribute as the risks of accelerated muscle strength loss.[6]

Methods

A retrospective descriptive study design with population of outpatients in the Geriatric polyclinic at Dr. Hasan Sadikin General Hospital Bandung was conducted from May to September 2014. Data collection was obtained from medical records of patients from 2012 to 2014 (3 years data). The sample was obtained through total sampling technique. The collected data were results of the hand grip strength test by using the hand grip dynamometry, which were then grouped into several characteristics based on gender, age, BMI, Barthel Index of activity daily living (ADL) score, Mini Nutritional Assessment (MNA) score, number of disease and number of medication taken by the patients.

The result of the measurement with the hand grip dynamometry was compared to the cut–off produced by the Asian Working Group of Sarcopenia (AWGS) in Japan. The results were considered low if the subject had the hand grip strength <30.3 kg in man and <19.3 kg in woman.[7] Age was grouped into three age groups which were young-old (60–69 years of age), middle old (70–79 years of age) and very old (80 years of age or above). The BMI was classified into four groups based on gender which were underweight (<17 kg/m2 for female, <18 kg/m2 for male), normal (17–23 kg/m2 for female, 18–25 kg/m2 for male), overweight (>23–27 kg/m2 for female, >25–27 kg/m2 for male) and obesity (>27 kg/m2 for male and female). Barthel index or ADL Barthel Score is a tool consisting of 10 questions aimed at measuring the performance of older adult in conducting the activity of daily life. Based on the span of score from 0–20, the results of measurement/ADL score were divided into four groups, namely the independent group for a score of 20, light dependence for score of 12–19, dependence for score of 9–11 and total dependence for score of 0–4.[8] The MNA score was a tool consisting of 18 questions which was designed and validated to quickly assessed the nutritional status of older adults. The MNA scores were then grouped into three groups based on the score that were normal (24–30), risk of malnutrition (17–23.5) and malnutrition (≤16.5).[9] The number of diseases were grouped into 2 groups of <3 and ≥3 diseases. The number of medication taken by

the patients (polypharmacy) was divided into 2 groups, namely which used ≤5 medications and >5 medications. All the informations were obtained through the patient's medical records.

Furthermore, the inclusion criteria in this study were the medical records that had information of the hand grip strength

Table 1 Subject Characteristics Based on Age Groups, Body Mass Index (BMI), Activity Daily Living (ADL) Level, Mini Nutritional Assessment (MNA) Level, Number of Diseases and Number of Medication

Characteristics	n (%)
Gender	
Male	57(57.6)
Female	42(42.4)
Age group	
60–69 years old	43 (43.4)
70–79 years old	44 (44.4)
≥80 years old	12 (12.2)
Body mass index (BMI)	
Underweight	7 (7.1)
Normal	45 (45.5)
Overweight	18 (18.2)
Obese	29 (29.3)
Activity daily living (ADL) level	
Independent	80 (80.8)
Light Dependent	17 (17.2)
Dependent	1 (1.0)
Total Dependent	1 (1.0)
Mini nutritional assessment (MNA) level	
Normal	77 (77.8)
Risk of malnutrition	18 (18.2)
Malnutrition	4 (4.0)
Number of disease	
<3 diseases	24 (24.2)
≥3 diseases	75 (75.8)
Number of medication	
≤5 medication	59 (59.6)
>5 medication	40 (40.4)

through the hand grip dynamometry test, characteristics of the patients, namely gender, age, BMI, ADL score, MNA score, number of disease and number of medication. The exclusion criteria were medical records with incomplete data needed in this study. This study had obtained the permission from the Health Research Ethics Comittee of Dr. Hasan Sadikin General Hospital. The analysis of the data was conducted by determining the data distribution for the handgrip strength using the Kolmogorov-Smirnov method, and the result showed that the data were normally distributed (p=0.200).The data were further analyzed with unpaired T-test and one way ANOVA test.

Results

Out of 223 samples, 99 or only about 44.3% of the medical records had complete data that was needed in the study. The subjects were then divided into two groups based on gender of the subjects. There were 57 (57.5%)

Table 2 Means and Standard Deviation of Hand Grip Dynamometry Result Based on Gender, Age Group, Body Mass Index, ADL Level, MNA Level, Number of Diseases and Number of Medication.

Characteristics	Hand grip strength $\bar{x}$ (SD)		Combined means	p value*
	Male	Female		
Gender	25.92 (6.02)	17.35 (4.37)	21.85 (6.80)	0.04**
Age group				
60–69 years old	29.60 (6.95)	17.96 (4.60)	21.75 (7.71)	0.905***
70–79 years old	25.01 (5.68)	16.58 (4.14)	22.13 (6.55)	
≥80 years old	23.14 (2.13)	15.30 (2.76)	21.18 (4.15)	
Body mass index (BMI)				
Underweight	19.62 (2.99)	15.56 (1.45)	17.88 (3.14)	0.260***
Normal	27.30 (6.78)	17.51 (4.50)	22.85 (7.62)	
Overweight	25.87 (3.43)	17.36 (4.70)	22.03 (5.82)	
Obesse	25.31 (5.77)	17.48 (4.66)	20.99 (6.45)	
Activity daily living (ADL) level				
Independence	26.31 (6.13)	18.18 (4.14)	22.76 (6.69)	0.008***
Light Dependence	22.76 (5.07)	15.57 (3.85)	18.11 (5.46)	
Dependence	17.10 (0)	-	17.10 (0)	
Total Dependence	-	7.90 (0)	7.90 (0)	
Mini nutritional assessment (MNA) level				
Normal	26.91 (5.99)	17.22 (3.96)	22.26 (7.04)	0.309***
Risk of malnutrition	22.55 (4.80)	19.43 (4.99)	21.16 (5.00)	
Malnutrition	20.90 (8.34)	11.40 (5.93)	17.15 (8.89)	
Number of disease				
<3 diseases	25.30 (4.02)	17.80 (4.00)	21.61 (6.37)	0.285**
≥3 diseases	26.08 (6.48)	17.18 (4.55)	22.00 (7.10)	
Number of medication				
≤5 medication	25.04 (5.23)	16.34 (4.63)	21.06 (6.58)	0.702**
>5 medication	27.3 (7.02)	18.71 (3.67)	23.02 (7.04)	

Notes: *P-value: <0.05 = significant result, >0.05 = insignificant result, **Unpaired t-test,*** ANOVA test, $\bar{x}$: Means of hand grip dynamometry test, SD= Standard deviation

male and 42 (42.5%) female included in this study and grouped into several characteristics (Table 1).

This study discovered that most of the subjects were male, under 80 years old, independent persons, had normal BMI, and normal nutritional level according to MNA. Hence, most of the subjects had more than 3 diseases per person.

The results of hand grip dynamometry test were then grouped into the subject's characteristics such as age group, BMI, ADL level, MNA level, number of disease and number of medication taken by the patient based on gender of the subject (Table 2).

Furthermore, this study discovered that only gender and Activity Daily Living level contibuted to the hand-grip strength. Male had higher hand-grip strength compared to female which was statistically significant (p=0.04). Based on ADL score, Independent level had higher hand-grip strength compared to other levels (p=0.008).

Discussion

Based on the cut-off according to AWGS from Japan, the subjects of the study both men and women have a lower hand-grip strength than the AWGS cut-off. There was significant difference in the hand-grip strength of both sexes. Male subjects have greater skeletal muscle strength as showed by bigger hand-grip strength compared to female, as male subjects tend to have bigger muscle strength and were better in terms of usage of the hands and fingers that involves the function of nerves as in a study conducted by Kubota and Demura.[10] In a study conducted by Irawan and Kuswardhani in Denpasar, Bali, Indonesia[11], it also stated that men have a better hand-grip strength than women because of the larger muscle mass in men and better physical performance than women. Besides, the hormone factor also plays a role in these differences. Higher testosterone in men give the effect of increasing of mass and muscle power as well as bone in a parallel way while women being with a higher estrogene hormone than testosterone, tend to have a faster bone growth only compared to the muscle mass growth which makes females have a lower muscle mass and thus lower muscle strength.[12]

Based on age group, the results of hand-grip strength test were better in the younger age group compared to the older age group without a significant difference between the groups. A study conducted by Vianna et al.[13] reported, there is a curvalinear relationshipbetween muscle strength and age where the muscle strength significantly increase with age and peak at 30 years of age. This condition is later followed by declining of muscle strength due to the aging of the body. The declining of hand-grip strength occurs at the age of 30 years in males and 50 years old in females[13] with higher hand-grip strength compared to the other three groups, which were without a significant difference between each group. According to the study conducted in India[14], the value of hand muscle strength was better in the group with a normal bodyweight in both gender groups because nutritional status affects the muscle strength and quality. In the group with an underweight BMI, the muscle strength has declined due to lack of energy, while in the group of overweight and obese, it is probably due to the change in muscle tissues as it is infiltrated by the body fat and change in type I and type II muscle fibre distributions which change the muscle strength.[14]

There was significant difference in the result of hand-grip strength test between the groups of ADL scale. The subjects in the independent group have a better result than the sample from the other status of ADL. In the study conducted by Cuesta-Vargaz and Pérez-Cruzado[15], there were a positive correlation between ADL score and hand-grip strength. The study of Taekema et al.[16] also stated that there is a correlation between the low result of hand-grip strength with low ADL score and low independency. It is assumed that ADL or low level of daily activity will further speed up the declining of the muscle strength.[16]

In both genders, the means of hand-grip strength was higher in the subjects with normal nutritional status compared to the group of either with the risk of malnutrition or even malnutrition. In the study of I Wayan Ambartana[17], it is found that nutritional status positively correlates with hand muscle strength. The subjects with malnutrition possess a lower mass and function of muscle despite age. Chronic loss of nutrition and energy will decline either the body fat tissue or muscle mass which later affect the strength of the muscle.[17]

Moreover, the number of diseases could not represent the equivalent between the number of diseases and declining of hand muscle strength. This is also the limitation of this study as we only consider the number of disease without looking into the type and severity of the diseases which might affect the hand-grip strength either directly or indirectly.

The number of consumption of drugs could not show a parallel with the hand-grip strength. This conditon showed that the drugs consumed by the subjects in the clinic did not provide any adverse effect in the change of muscle strength. This also meant that the number of drugs did not interact with the muscle strength. The fact that this study was conducted in a policlinic, made it possible that the subjects were well-controlled and maintained which might slow the effect in the change of muscle strength.

The less complete medical records caused a limitation in the number of data which can be used, and may also reduce the quality of the study so that an increase in the number of medical record data is necessary for improvement in the quality and provision of basic data essential for a further study.

It can be concluded that gender and ADL level contribute to hand-grip strength in elderly.

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