Quadriceps and Hamstring Muscle Strength in Elderly based on Lifestyle

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Abstract

Background: Studies have shown that muscle strength will decline with aging and inactivity, with 1% to 3% loss of muscle strength each day. Nevertheless, different lifestyles have different effect on muscle strength. This study was conducted to analyze the differences in quadriceps and hamstring muscle strength in elderly from 60–79 years olds according to lifestyle.

Methods: A cross-sectional study was conducted from September to November 2015. The subjects were 31 older persons from community who voluntarily participated the research procedure and were divided into 2 groups, active group and sedentary group according to International Physical Activity Questionnaire (IPAQ). Quadriceps and hamstring muscle strengths were measured using the push and pull dynamometer. The collected data were analyzed using the Wilcoxon rank sum test and the unpaired t-test.

Results: This study discovered that the mean difference in hamstring muscle strength was 6.09 ± 0.70, $p< 0.001$; median difference in Quadriceps muscle strength was 5.00 (13.00, 6.50), $p<0.001$.

Conclusions: There is a higher Quadriceps and Hamstring muscle strength in elderly active lifestyle compared to elderly sedentary lifestyle.

Keywords: Active lifestyle, elderly, hamstring muscle strength, quadriceps muscle strength, sedentary lifestyle

Introduction

In the 21st century, the life expectancy of human being had been increasing. National development in Indonesia has improved the health quality and the social conditions of the country, which then increases the life expectancy. Based on Law of the Republic of Indonesia Number 13 Year 1998, old age is defined as individual of 60 years old and above. According to Elderly Statistics 2013, older adults can be classified into three categories, which are young old group, adults aged 60–69 years old; middle old group, adults aged 70–79 years old; and old age group, adults aged 80 years old and above.[1]

There will be changes in older person which will decrease strength and lead to a decline in physical activities in older person. With aging, the lower extremity muscle loses muscle strength of 14% to 16% every 10 years and upper extremity muscle loses 2% to 12% every 10 years.[2] The decrease in muscle mass can be seen more significantly in larger muscle.

To improve mobility, the most crucial muscles involved are the quadriceps and hamstring muscle. In order to avoid the decrease in physical function of muscles in older person, we can reverse the factors that cause the condition by avoiding living a sedentary and inactive lifestyle. This study was conducted to observe the differences in quadriceps and hamstring strength in two groups of older persons, the young old group, aged 60–79 years old, according to gender and lifestyle.

Methods

This study used crosssectional design and was conducted from September 2015 to November 2015. The data were collected from older person aged 60–79 years old. An ethical clearance letter was obtained from

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the Health Research Ethics Committee of Faculty of Medicine Universitas Padjadjaran. In Bandung, older persons with sedentary lifestyle were mostly found at home, whereas older persons with active lifestyle were mostly found at *Taman Lansia* and Dr. Hasan Sadikin General Hospital where there are exercise sessions on certain days. The method for subject sampling was using random sampling. The criteria to determine which lifestyle the subjects belong to were based on International Physical Activity Questionnaire (IPAQ).[3] In this questionnaire, there were three cut point values, which were low, medium, and high. The subjects of low category were grouped into sedentary lifestyle, while the subjects of medium and high category were grouped into active lifestyle.

The inclusion criteria for research subjects were older persons aged ranging from 60 to 79 years old, and the ability to understand and perform instructions. Meanwhile, the exclusion criteria were subjects with uncontrolled systemic diseases, malnutrition, Body Mass Index (BMI) of less than 18.5 or having deformities in the leg. After selection based on inclusion and exclusion criteria, the subjects were asked to sign an informed consent form and the objectives and procedures of the test were explained and understood.

To calculate the sample size, a two-tailed test with alpha value of 0.01 and the power of 0.8 were used. With three predictors, and coefficient of determination (R2) of 0.3, the total minimal sample calculated was 30 subjects.

To measure the strength of Quadriceps muscle, the subjects were asked to sit on a stool and a push-pull dynamometer was placed 5cm proximal to the distal aspect of lateral malleolus. The dynamometer was compressed against the leg, the subjects were asked to stretch the knee, so the force generated would be measured. For the Hamstring muscle, the subjects were asked to lie down in a prone position while a push-pull dynamometer was placed 5cm proximal to the distal aspect of lateral malleolus. The dynamometer was compressed against the leg, subjects were asked to stretch the knee to 90 degrees, so the force generated was measured.

The collected data were analyzed using the Wilcoxon rank sum test for Quadriceps muscle strength and the unpaired t-test was used for Hamstring muscle strength. Statistically significant result was considered when $p<0.05$.

Results

There were 31 older persons included in the study. The Wilcoxon rank sum test and unpaired t-test were performed to determine whether there was a difference in muscle strength.

Table 1 shows the mean value of age BMI and gender of subjects from active lifestyle and sedentary lifestyle. The age, BMI, as well as gender were not significantly different, therefore comparison could be made between different lifestyles.

Table 2 shows that the Quadriceps muscle strength was normally distributed in sedentary lifestyle group, but not normally distributed in active lifestyle group. As for Hamstring muscle strength, it was normally distributed in both types of lifestyle groups. To calculate the p-value, the Wilcoxon rank sum test was used for Quadriceps muscle strength and the unpaired t-test was used for Hamstring muscle.

The p value for the difference of the muscle strength for both groups was <5%, hence the null hypothesis was rejected. Meanwhile, the p value for ratio of both muscle strengths was more than 5%, hence null hypothesis was accepted. From the data analysis above, the

Table 1 Mean Value of Active and Sedentary Group based on Age and BMI, and Frequency of Gender

	Active (n=16)	Sedentary (n=15)	P-value
Mean (SD)			
Age	67.00 (6.11)	70.60(6.79)	0.184 *
BMI	23.51 (3.29)	22.75 (2.76)	0.406 *
Gender, frequency(%)			
Female	14 (87.5%)	11(73.3%)	0.394 **
Male	2 (12.55)	4 (26.7%)	

Note: * The p-value obtained using Mann Whitney test, **The p-value obtained using Fisher's Exact test.

Table 2 Normality Test for Quadriceps Muscle Strength and Hamstring Muscle Strength

Normality Test		Sig. value*
Quadriceps	sedentary	0.200
	active	0.002
Hamstring	sedentary	0.200
	active	0.200

Note: *Sig. value stands for significant value, obtained using normality test.

Table 3 Comparison of Effects of Different Lifestyle on Quadriceps Muscle Strenghth and, Hamstring Muscle Strenghth

Muscle Strength	Active (n=16)	Sedentary (n=15)	Standard Error	P value
Hamstring Muscle Strength Mean (SD)	14.63 (2.09)	8.53 (1.767)	6.092	< 0.001 *
Quadriceps Muscle Strength Median (interquartile range)	15.50 (3)	12.00 (5)	5.00	< 0.001 **

Note: * p value obtained using unpaired t-test, ** p value obtained using Wilcoxon rank sum test

conclusion was that there was difference in quadriceps and hamstring muscle strength in older persons from sedentary and active lifestyle.

Discussion

This study discovered that there were significant difference in quadriceps and hamstring muscle strengths in older persons from sedentary lifestyle group. According to IPAQ, an active lifestyle requires moderate or vigorous physical activities like exercising, walking, bicycling, gardening, and heavy lifting.[3] If ones do not exercise, they can perform other kinds of physical activities as stated above.[4] There was a study in 2012 that proved this theory, where prolonged resistant type exercise training benefits both men and women equally.[5] Other study showed that older persons aged more than 80 years old do not show significant improvements after an exercise intervention, hence, older people from 60 to 79 years old can still improve muscle strength after exercise intervention.[6,7] The ratio remains the same in both lifestyle groups. This suggests that both muscles that work correspondently will either improve or deteriorate together at the same rate.[8]

The lower muscle strength in older persons with sedentary lifestyle can be caused by the atrophy of muscle due to old age and limited activity, hence causing decrease in muscle mass and muscle strength. After 50 years of age, the human muscle mass will decrease in size to about -1 to -2% every year.[9] Although so, the significance of muscle mass in affecting muscle strength is not as prominent as alteration of muscle strength due to the old age.[6,10]

At home, older persons will spend most of their time sitting, watching television, reading, lying down, and resting. These decreases in physical activities may cause a low energy expenditure and, hence, decrease of basal metabolic rate.[11] This will not only decrease lean muscle mass and strength, but there will be a more sped up rate of loss due to bed rest.[12,13] In order to overcome loss of muscle strength, one of the ways is to remain active.

Many studies have been conducted to prove that exercise can improve muscle strength and mobility in older persons.[14-16] Even without exercise, maintaining an active lifestyle can also strengthen muscles for older persons.[4] Hence, this supports the result that older persons from active lifestyle have a higher muscle strength compared to older persons from sedentary lifestyle.

There are a few limitations in this study; one of them is the usage of the push-pull dynamometer. By using this, force must be used to push against quadriceps or hamstring strength and if the examiner strength is not enough, this will decrease the sensitivity. Some older persons followed this study after they were done with their exercise sessions; hence, this will influence the muscle strength reading by a little due to exhaustion after exercising. The height and weight of the subjects were

asked but not measured; hence this will decrease the sensitivity of the BMI score as the subjects might recall their height and weight wrongly. These limitations can be taken into account in further studies.

In conclusion, with these positive results, there is stronger muscle strength in older persons from active lifestyle compared to sedentary lifestyle. With these, we suggest that older persons should exercise and those who do not exercise can remain an active lifestyle in order to delay muscle strength deterioration and improve physical mobility.

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