ASSOCIATION BETWEEN LOWER BODY STRENGTH AND RELATED FACTORS IN COMMUNITY-DWELLING OLDER ADULTS

Tran Viet Luc[1,✉], Nguyen Thi Hoai Thu[2]
Nguyen Lan Anh[2], Vu Thi Thanh Huyen[2]
[1]Hanoi Medical University
[2]National Geriatric Hospital

The aim of this study is identify the association between lower body strength and some related factors in community-dwelling older adults. This is a cross-sectional study with people ≥ 60 years old. Variables including demographic information, body mass index, 30-second chair stand test, frailty, time up and go test, cognitive function, falls risk, depression risk, functional independence and nutrional status, and history of fall. Lower body strength was defined by 30 seconds stand test. A total of 396 participants with mean of age was 69.6 ± 7.9 were tested. The mean of thirty second chair stand test was 11.44 ± 2.9. Cognitive function impairment and time up and go test < 12s were significant associated with lower body strength in multivariate logistics (p < 0.05). Evaluating the strength of the lower body is important to identify imbalance problems and falls. It is essential to have early screening for cognitive function and time up and go test.

Keywords: lower bogy strength, older people, community-dwelling, 30-second chair test.

I. INTRODUCTION

Vietnam's population is ageing quickly. The population projections by the General Statistics Office (GSO, 2010) show that the proportion of people 60 years and older reached 10 percent in 2017. Vietnam life expectancy at birth increases from 75.4 in 2010 to 78 and 80.4 in 2030 and 2050, respectively.[1] Moreover, the majority of elderly people (72,9%) reside in rural areas with difficulty living conditions.[2,3] The approach to health services have different between urban and rural areas, ethnic minority groups, and religions. Similar to rapid population growth, rapid population aging creates various pressures on economic growth, infrastructure and social protection services. Thirty second chair stand test (30sCST) is used to assess the strength of lower body which determines activities of daily living (getting out of chair, climbing stairs, and transfer in bed).[4] Impaired lower body strength is the primary cause of the balance problems and fall in elderly people.[5] Each year, an estimated approximately 30% of community-dwelling over the age of 65 years and 50% of elderly over the age of 85 years will fall and 12 to 42% will have a fall-related injury.[6] Injury due to falls is the leading cause of death in older adults however injury is not major reason of death, but death resulted from complication of the injury such as pressure ulcer, pneumonia, loss of independence, urinary incontinence, and infection.Therefore evaluating the strength of the lower body is an important measurement to assess the functional status of elderly people and identify and treat those at risk for imbalance problems and fall.

There was a sizable number of older adults

Corresponding author: Tran Viet Luc
Hanoi Medical University
Email: tranvietluc@hmu.edu.vn
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who cannot complete 10 sit to stands therefore cannot be evaluated on this test. However, the 30-second chair stand test uses inexpensive equipment such as a stopwatch and a chair and only requires thirty seconds to complete. It can be recorded as the elderly people sit-to-stand without an assistive device. However, in Viet Nam, the assessment of lower body strength in elderly patient using thirty second chair stand test was rare and no review had analyzed the use of this test as a measurement of functional limitations in elderly people. Thus, we conducted this research to identify the association between lower body strength by 30-second chair stand test and some related factors in community-dwelling older adults.

II. METHODS

1. Subjects

Older people who are 60 years old and over in community-dwelling Soc Son district from December 2016 to March 2017.

Recruited criteria

- Live in Soc Son district.
- Aged 60 years old and over.
- Consent to join the study.
- Able to hear and follow the instructions.

Exclude criteria

- Disability, impossible to hear and follow the instructions.
- Terminal diagnosis such as stroke and could not do the test.
- Leg pain, lower body injury, heart failure… could not do the test.

2. Study design

This was primarily a cross-sectional epidemiological study which conducted data in five communities of Soc Son, Hanoi, Vietnam.

Sample size and sampling

The sample size for this survey was 396 respondents who were 60 years old and more from five communities of Soc Son district.

Sampling: convenience sampling

Equipment

The main equipment for measuring 30-second chair stand test was a stopwatch and a chair without the arms (height: 0.4m, wide: 0.5m back supported high 1m), Time up and Go test and answer questions.

Variables

Demographic information (age, gender, marital status, family caregiver)

Body mass index (BMI)

Actual BMI was calculated using the following equation: Body mass index = weight (kg)/ [Height (m)]^2.

Anthropometric: Height (cm), weight (kg).

BMI was divided into 4 groups: Low weight, normal weight, overweight, and obesity.

30-second chair stand test

- Location: The test was conducted at commune health stations.
- Prepare for equipment: stopwatch, chairs without arms with a seat height of 44cm. The chair was placed against a wall to prevent it from moving during the test.
- Prepare for subjects studying:

+ Comfortable clothes and Footwear suitable for sit to stand activity.

+ Guidance for breakfast before testing.

+ No strenuous activity for 2 hours before testing.

Assessment Instructions: the test began when the participant was seated at the middle of the chair, back straight, feet approximately shoulder-width apart and placed on the floor at an angle slightly back from the knees with one foot slightly in front of the other to help maintain balance when standing. Their arms were crossed against the chest. The participants were encouraged to complete as many full stands as possible within thirty second time limit. The exercise scientist held the watch and only communicated verbally with the instructions

"Go" and "Stop" at the beginning and end of each test. A chair rise was counted when the participant reached full hip and knee extension from the seated position.

The times to sit-to-stand of 30sCST: ______ (times)

Frailty assessment

Frailty was assessed by REFS score. Each participant answered all questions following the test. REFS score assessed domains such as cognitive, general health status, functional independence, social support, medication use, nutrition, mood, continence, functional performance.[7]

Cognitive function

Cognitive function was assessed by mini-cog test. The Mini-Cog uses a three-item recall test for memory and a simply scored clock-drawing test.

Falls risk assessed by Balance and Gait (Time Up and Go test).

Depression risk assessment

The depressive symptoms was assessed by the Geriatric Depression Scale (GDS-4) with 4 questions. Depression risk assessment was divided into 2 levels: high risk, low risk.[8]

Functional independence

Activities of daily living (ADLs) was used in healthcare to assess to ability of people's daily self-care activities. It included 6 questions: eating, toileting, dressing, grooming, transferring, and bathing.

The Lawton Index of Independence in Activities of Daily Living (IADLs) was used to assess functional status as a measurement of the client's ability to perform activities of daily living independently.

Nutritional assessment short form

Mini nutritional assessment short form (MNASF) was used to assess nutrition condition.

History of fall

Record against: subjects have fallen in the last 12 months

Poly-pharmacy: assess participants who used more than 5 types drug together

Score: 1- yes / 2- no

Data analysis

The process of data coding, entry and analysis would be done using SPSS software version 22.0.

Descriptive statistics were adopted to examine data characteristic: number, %, mean, median, and minimum, maximum, range. Inferential statistics would be done to compare between groups, using χ^2, ANOVA (if compare between more than 2 mean groups, use ANOVA and ≥ 2 groups, use χ^2).

The correlation between lower body strength and its related factors was determined by using crosstabs method for classified variables.

The correlation between handgrip strength and factors was also analyzed by using simple binary regression and multiple binary regressions to see the relative.

Statistical significance was defined as any p-value is less than 0.05.

3. Research ethics

The participants were explained clearly about the purposes of the study and they consented to take part in the study.

III. RESULTS

A total of 369 participants recruited in this study at the community dwelling.

The group of 90 years old and over participants had the lowest mean of lower body strength (9.63 times) and the group from 60 to 69 years old had the highest mean value (12.6 times). This difference has statistical significant (with $p < 0.01$).

The group of normal weight individuals had the highest mean of lower body strength (11.60 times). The mean of underweight participants

(11.10 times) was higher than overweight participants (10.84 times). However, this difference has not statistical significant (with p > 0.05).

Table 1. Association between Lower body strength and Age, BMI, gender (n = 369)

Variables		Number of participants	Test-30 second chair stand test x̄ ± SD)	p value (ANOVA)
Age	60 - 69	235	12.06 ± 2.7	< 0.01
	70 - 79	102	11.06 ± 2.9	
	≥ 80	59	9.63 ± 3.0	
BMI	Underweight (< 18.50)	40	11.10 ± 3.0	> 0.05
	Normal weight (18.50 - 24.99)	298	11.60 ± 3.8	
	Overweight (≥ 25.00)	58	10.84 ± 3.3	

Table 2. The association between Lower body strength and cognitive function (n = 396)

Mini-cog scores	Normal lower body strength		Impaired lower body strength		p value (chi-square)	Mean ± SD
	n	%	n	%		
Normal cognitive	200	89.3	24	10.7	< 0.01	12.11 ± 2.9
Cognitive decline	124	72.1	48	27.9		10.57 ± 2.8

The result showed the percentage of lower body strength with cognitive decline individuals was higher than normal cognitive participants, accounting for 27.9% and 10.7%, respectively. On the other hand, mean of lower body strength in cognitive decline participants is lower than normal cognitive participants. This difference has statistical significant (with p < 0.01).

Table 3. The association between Lower body strength and history of fall and risk of fall (with high risk when TUG test > 12s) (n = 396)

Variables		Normal lower body strength		Impaired lower body strength		p value (chi-square)	Mean ± SD
		n	%	n	%		
History of fall	Fall in 12 months	50	70.4	21	29.6	< 0.01	10.76 ± 3.3
	No fall in 12 months	274	84.3	51	15.7		11.59 ± 2.8

Variables		Normal lower body strength		Impaired lower body strength		p value (chi-square)	Mean ± SD
		n	%	n	%		
Risk of fall (TUG test)	TUG > 12s	84	68.9	38	31.1	< 0.01	9.65 ± 2.7
	TUG ≤ 12s	240	87.6	34	12.4		12.24 ± 2.7

According to the history of fall, the percentage of impaired lower body strength was 29.6% in fall in the last 12 months group, making it double the rate of no fall in the last 12 months participants (15.7%). There was a close relation between history of fall and lower body strength ($p < 0.01$).

Follow to TUG score, 31.1% of impaired lower body strength participants was risk of fall group who had TUG score more than 12 second. It is higher than the percentage of impaired lower body strength with no risk of fall group (12.4%). This difference has statistical significant ($p < 0.01$).

Table 4. The associated factors with Lower body strength binary logistic analysis

Variables	OR	95%CI	SE	p
Gender	0.91	0.48 - 1.72	0.32	0.794
Age	0.78	0.50 - 1.21	0.22	0.276
BMI	1.53	0.86 - 2,73	0.29	0.148
Frailty	0.80	0,36 - 1.77	0.40	0.585
Cognitive function	2.63	1.28 - 5.26	0.35	0.008
TUG > 12s	2.80	1.44 - 5.45	0.34	0.002
Depression	1.60	0.86 - 2.99	0.31	0.135
ADLs	1.34	0.69 - 2.56	0.33	0.377
IADLs	0.66	0.34 - 1.29	0.33	0.231
Nutrition condition	0.92	0.55 - 1.53	0.25	0.767
History of fall	0.53	0.27 - 1.03	0.33	0.062
Poly-pharmacy	1.13	0.52 - 2.44	0.39	0.741

By using multiple binary regression method, factors that had correlated with lower body strength measurement were cognitive function and TUG > 12s. The result showed that participants who had cognitive decline had 2.63 times increased risk of impaired lower body strength (OR = 2.63, 95%CI from 1.28 to 5.26, SE = 0.35 and p = 0.008), compare to normal cognitive condition group. Participants who had time of TUG test more than 12s were increased 2.8 times risk of impaired lower body strength strength (OR = 2.8, 95%CI from 1.44 to 5.45, SE = 0.34 and p = 0.002).

Factors which include age, gender, BMI, frailty, depression, ADLs, IADLs, nutrition condition, history of fall and poly-pharmacy were not correlated with lower body strength.

IV. DISCUSSION

In 396 subjects in the study, the mean of lower body strength was decreased with age. The result indicated the association between lower body strength and age and had significance meaning due to p value < 0.01 (p value was analyzed by ANOVA). Our results was similar to almost other researches has been published that indicated that increased with age was defined closely related to lower body strength. Venugopalan Gunasekarana's research in India showed that the mean of thirty chair stand test for elderly people with the age of 60 - 65, 66 - 70 and above 70 years old were 10.84 ± 2.55 (times), 10.09 ± 2.96 (times), 2.75 ± 2.87 (times) respectively for male and 9.33 ± 2.28 (times), 8.56 ± 2.12 (times) and 8.3 ± 2 (times) respectively for female.[9] In comparison with the similar age groups (60 - 69, 70 - 79 and above 80 years old) Jessie Jones' results, the mean of 30sCST was higher than our study. However, the average age in our study (69.6 ± 7.9 years old) was lower than the average age of her study (72.6 ± 6.6 years old). We can understand this difference because our study was performed at rural area which elderly people performed hard labor which simply affect lower body strength.

The impact of obesity on physical function in community-dwelling older adults has been recorded and a recent research found that older adults with a BMI ≥ 30 kg/m^2 are 60% more likely to experience functional declines than their normal weight counterparts.[10] Following the study of Schaap LA, the results showed that Muscle quality varies across BMI groups in older women. The mean of 30sCST of normal BMI and overweight participants were 13.7 ± 3.6 and 11.4 ± 4.8 respectively, this difference has statistical significant duo to p value < 0.05.[10] However, in the other study in Asia area, Venugopalan Gunasekarana showed that Thirty seconds chair stand test was also lower with increasing age, with no consistent relation with change in BMI; and the cut-off of 30sCST was constant between BMI groups for both of male and female.[9] In our study, there was no-significant changed trend between BMI groups. There is no association between lower body strength and BMI factor (p value >0.05). This was understood because Western people have BMI normally higher than Vietnamese. In addition to natural changes in body morphology, cultural and socioeconomic status, environment, sedentary life style after retirement, lack of regular exercise and unbalanced diet can be other factors contributing to the difference between studies.

Greater muscle strength is associated with better cognitive function in ageing men and women. Lower-extremity disturbances are also present in milder stages of the disease and may be related to level of cognitive impairment.[11,12] In elderly people, lower-extremity function (eg, sit-to-stand activity) involves intention and the integration of higher cortical sensory information, and thus impairment in cognition may also impair sit-to-stand. Following to other study, author Laura H. Eggermont showed that mean of 30sCST with cognitive healthy normal older persons (11.61 ± 4 times) was higher than mild cognitive impairment participants (9.63 ± 3.2).[13] In addition, a Finnish study involving 338 older adults (average age 66) has found that greater muscle strength is associated with better cognitive function [52] which was similar with our result; the percentage of lower body strength with cognitive decline individuals was higher than normal cognitive participants, accounting for 27.9% and 10.7%, respectively. In conclusion, lower body strength was close associated to impaired cognitive function and had statistical significant (with p value < 0.01).

Risk of fall was assessed by history of fall and Time Up and Go test (TUG test) with TUG > 12s were also showed the close statistic significant meaning to handgrip strength measurement due to both p-values lower than 0.01. Following the other study, Skelton et al. (2002) observed lower extremity muscle power in fallers compared to non-fallers, ages 65 and older. Results indicate the individuals with a history of falls are 24% less powerful for his or her weight than individuals who did not fall (p = 0.04). In our study, 29.6% in fall in the last 12 months participants had impaired lower body strength.

Follow to TUG score, 31.1% of impaired lower body strength participants was risk of fall group who had TUG score more than 12 second. Any study showed a significant association between reduced lower body strength and higher incidence of falls. For example:

Ewa Zasadzka found that participants who older than 60 years had increased risk of falling based on the prolonged TUG test time, which strongly correlated with weak muscle strength of the lower extremities, evaluated using 30sCST.[14]

Lower body strength can be improved with tailored, progressive exercise, even in advanced ages. Exercise has many advantages in the preventative combat against the increasing number of falls and injuries in older people by improving power and strength, but also coordination, reaction time, gait and balance, all of which are risks factors for future falls.

Falls are a common and serious problem for the elderly, causing an enormous amount of morbidity, mortality and burden to both the immediate family and society in terms of healthcare utilization and costs. Most injuries in the elderly are the result of falls; fractures of the hip, forearm, humerus, and pelvis usually result from the combined effect of falls and osteoporosis. Our study showed a strong correlation between impaired lower body strength and falls risk. Therefore, impaired lower body strength can be a good predictor of falls.

Among 396 participants, by using multiple binary regression method, only cognitive function and TUG > 12s were correlated with lower body strength. It was similar with the research of author Ewa Zasadzka; the result showed that people older than 60 years with confirmed diagnosis of hip and knee osteoarthritis are at an increased risk of falling based on the prolonged TUG test time, which strongly correlated with weak muscle strength of the lower extremities, evaluated using 30 CST. A correlation between the TUG test and the 30 CST scores (r = 0.7368; p = 0.000) was detected.[14]

V. CONLCUSION

Evaluating the strength of lower body is an important measurement to identify risk for imbalance problems and fall. It is essential to have early screening of cognitive function and time up and go test.

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