

# The Correlation among 2-Minute Step Test, Time Up and Go Test, and Sit to Stand Test in Phayao Hypertensive Older Adults

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**Objective:** To investigating the correlation among the functional capacity using 2-minute step test (2MST), the functional mobility using the time up and go (TUG) test, and the sit to stand test (STS) in hypertensive elderly people.

**Material and Methods:** The correlational research design was used to evaluate the correlation among 2MST, TUG test, and STS test in 60 hypertensive elderly people. Each subject performed one trial in 2MST, and then performed three trials in TUG test, STS10 test, and STS60 test. A 5-minute rest period was given between each test.

**Results:** Functional capacity was correlated with functional mobility in hypertensive elderly people. The results revealed that 2MST was negatively correlated with TUG test and STS10 test ( $r=-0.635$  and  $-0.266$ , respectively). Whereas, the 2MST was positively correlated with STS60 test ( $r=0.521$ ).

**Conclusion:** The functional capacity was correlated with functional mobility in hypertensive elder subjects.

**Keywords:** 2-minute step test; Time up and go test; Elderly; Sit to stand test; Hypertension

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Currently, the incidences of chronic illnesses including neurodegenerative diseases, cardiovascular diseases, and musculoskeletal diseases are increasing in elderly people<sup>(1,2)</sup>. The previous studies have revealed that hypertension is the most common non-communicable chronic disease found in elderly people<sup>(1,2)</sup>. In addition, hypertension was associated with functional capacity, which lead to reduced functional capacity<sup>(3)</sup>. Moreover, the reduction in functional capacity causes impaired activities of daily living (ADLs), resulting in decreased

quality of life in older adults with hypertension<sup>(4)</sup>. Furthermore, hypertensive elderly people showed a low cardiorespiratory fitness, resulting in increased morbidity and mortality<sup>(5)</sup>. A previous study reported that low cardiorespiratory fitness was correlated with decreased functional mobility<sup>(6)</sup>. Additionally, several studies have focused on the determination of functional capacity and found many interventions to prevent its decline in elderly people<sup>(4,7)</sup>. However, there are few studies that assess the functional capacity combined with functional mobility, at least partly due to the difficulties to perform both.

It is known that functional capacity was determined by using six-minute walk test (6MWT) and 2-minute step test (2MST)<sup>(8,9)</sup>. The 6MWT is an uncomplicated field test that assess functional capacity at submaximal level in personal status during walking on a flat, hard ground for minutes<sup>(8)</sup>. Several studies have used 6MWT to determine the functional capacity in older adults<sup>(8,10)</sup>. The 2MST is also the test that can determine the functional capacity, and this test simply requires personal stride in place as fast as possible for two minutes at the same time lifting the knees to midway between the patella and the iliac crest

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while standing. The functional capacity is indicated by the score of right-side steps of the criterion height finished in two minutes<sup>(11)</sup>.

The functional mobility can be assessed by using time up and go test (TUG) and sit to stand test (STS)<sup>(12,13)</sup>. The TUG test is used to evaluate the function mobility, and when combined with STS, it can measure power, velocity, agility, and dynamic balance<sup>(12)</sup>. In addition, a sit-to-stand-to-sit test for 10 repetitions (STS10) and sit-to-stand-to-sit test for 60 seconds (STS60) were used to determine the functional mobility<sup>(14,15)</sup>. The lower extremity muscle strength determined by using STS10<sup>(13,14)</sup>. Furthermore, STS60 was used to determine lower extremity muscle endurance<sup>(14,15)</sup>. A previous study has reported that STS was used to determine functional mobility in elderly populations, and this test is dependent on timing<sup>(16)</sup>.

There is no current report regarding, the correlation among 2MST, TUG test, and STS test especially in the hypertensive elderly people. Therefore, the present study aimed to determine the correlation among functional capacity using 2MST, functional mobility using TUG test and STS test in hypertensive elderly.

## Materials and Methods

### Research design

The correlational design was used to evaluate the correlation among 2MST, TUG test, and STS test in hypertensive elderly.

### Study population

Sixty hypertensive older adults at Dok Kam Tai District, Phayao Province, Thailand, voluntarily participated in the present study. Subjects were medically screened by doctors. If the elderly people could walk at least six meters without assistive walking devices and had normal body mass index calculated using a BMI between 18.5 and 24.9 kg/m<sup>2</sup>, they were recruited as the subjects. Subjects who have problems of visual and hearing communication and musculoskeletal disease, neurological diseases with imbalance problem, and unstable cardiorespiratory diseases were excluded. The subjects required for the present study were 60 individuals. The sample size was calculated using a power of 0.80, power analysis with an alpha of 0.05 and the effect size  $r$  of 0.36<sup>(5)</sup>. The present study was approved by the Clinical Research Ethics Committee of the University of Phayao, Phayao, Thailand, granted on January 20, 2021. The IRB code was 1.3/026/64.

## Procedures

All subjects performed the assessment test in the same day. First, all subjects filled in a general health information form. Next, each subject performed 2MST, TUG test, STS10 test, and STS60 test, respectively. Each subject performed one trial in 2MST, and then performed three trials in TUG test, STS10 test, and STS60 test. The average findings of the three trials were used to analyze the data. A 5-minute rest period was given between each test. All tests were evaluated by physical therapists.

The general health information form was used to collect the demographic characteristics of the subjects.

For the 2MST, the subjects were instructed and encouraged to stride in place as fast as possible for two minutes at the same time lifting the knees to a height between the patella and the iliac crest while standing. The number of right-side steps of the criterion height finished in two minutes were counted for test record in each subject<sup>(9)</sup>. The 2MST is regarded as one of the reliable tests to assess the cardiorespiratory performance (intraclass correlation coefficient [ICC] 0.90)<sup>(11)</sup>.

For the TUG test, the subjects were informed to get up from the chair at the signal, walk to a marker, go around it, return to the chair and sit down as quickly as possible. The subject began the test in a seated position with vertical posture, hands on thighs and feet flat on the ground. The subjects were reminded that this was a timed test and that the goal was to walk as quickly as possible without running<sup>(5)</sup>. The TUG test is regarded as one of the reliable tests to assess the functional mobility (ICC 0.95 to 0.99)<sup>(17)</sup>.

For the STS10 test, the subjects were instructed stand up until the knee and hip are fully extended and sit down as upper limbs were folded across the chest. After that, subjects were asked to perform this maneuver as fast as possible for ten times. The time required to complete the test was recorded<sup>(18)</sup>. The STS10 test is regarded as one of the reliable tests to assess the functional mobility (ICC 0.78 to 0.94)<sup>(18)</sup>.

For the STS60 test, the subjects were instructed to stand up all the way until their knee and hip are fully extended and sit down while upper limbs were folded across the chest. After that, subjects were instructed to perform this maneuver as fast as possible for 60 seconds. The number required to complete the test was recorded<sup>(18)</sup>. The STS60 test is regarded as one of the reliable tests to assess the functional mobility (ICC 0.94 to 0.98)<sup>(18)</sup>.

**Table 1.** Characteristics of the subjects

Variables	Mean±SD (n=60; F=34, M=26)
Age (years)	70.00±5.29
Weight (kg)	54.23±8.46
Hight (cm)	156.27±7.82
BMI (kg/m <sup>2</sup> )	22.17±2.66
Systolic blood pressure (mmHg)	148.08±6.91
Diastolic blood pressure (mmHg)	79.01±9.40
Comorbidities; n (%)	
None	38 (63.3)
Diabetes mellitus	10 (16.7)
Dyslipidemia	11 (18.3)
Kidney disease	1 (1.7)
Knee osteoarthritis	3 (5.0)
F=female; M=male; BMI=body mass index; SD=standard deviation	

### Statistical analysis

Descriptive statistics were used to report the demographic data. The relation among the 2MST, TUG test and STS test were analyze using Pearson's correlation test. All statistical analyses were conducted using IBM SPSS Statistics, version 22.0 (IBM Corp., Armonk, NY, USA). A p-value of less than 0.05 was set to denote significance.

### Results

There were 60 hypertensive elderly people who voluntarily participated in the present study. The characteristics of the hypertensive elderly people are shown in Table 1. The mean age was 70 years old, mean BMI was 22.17 kg/m<sup>2</sup>, mean systolic blood pressure was 148.08±6.91 mmHg, and mean diastolic blood pressure was 79.01±9.40 mmHg. The present data revealed that comorbidities were diabetes mellitus, dyslipidemia, kidney disease, and osteoarthritis of knee.

All hypertensive older adult subjects completed 2MST, which indicated functional capacity, and TUG, STS10, and STS60, which indicated functional mobility. The data of functional capacity and functional mobility test for hypertensive older adult subjects are shown in Table 2.

The correlation between functional capacity and functional mobility test for hypertensive elderly people are shown in Table 3. The results showed that 2MST was negatively correlated with TUG and STS10 ( $r=-0.635$  and  $-0.266$ , respectively). In contrast, there was a positive correlation between 2MST and STS60 ( $r=0.521$ ).

**Table 2.** Data for functional capacity and functional mobility test

Variables	Mean±SD (n=60; F=34, M=26)
2MST (score of steps)	80.87±19.82
TUG (seconds)	11.41±2.12
STS10 (seconds)	28.14±5.91
STS60 (times)	25.74±6.05
F=female; M=male; 2MST=2-minute step test; TUG=time up and go test; STS=sit to stand test; SD=standard deviation	

**Table 3.** The correlation between functional capacity and functional mobility test

Variables	r	p-value
2MST and TUG	-0.635	<0.01
2MST and STS10	-0.266	0.04
2MST and STS60	0.521	<0.01
2MST=2-minute step test; TUG=time up and go test; STS=sit to stand test		

### Discussion

The major findings in the present study indicated that functional capacity was correlated with functional mobility in hypertensive elder subjects. The 2MST showed a strong negative correlation with TUG test and STS10 test. Higher scores of 2MST were related with shorter duration of TUG test and STS10 test. In addition, higher score of 2MST found a correlation between a greater number of STS60 test. Therefore, these results pointed out that hypertensive elderly people who had higher functional capacity had a greater functional mobility too. The present study found that hypertensive elderly people had normal functional capacity and ability of balance. A previous study had found that cardiovascular endurance was associated with functional mobility<sup>(5)</sup>. The decrease in cardiovascular endurance leads to poor functional mobility<sup>(5)</sup>. Moreover, the decreased functional capacity and functional mobility also lead to increased morbidity and mortality in elderly individuals<sup>(19)</sup>.

The 2MST is used to determine functional capacity<sup>(9)</sup>. A previous study revealed that 2MST was correlated with 6MWT<sup>(5)</sup>. This suggested that 2MST can be used to assess functional capacity in elderly people. In addition, elderly people who had the score of 2MST less than 65 times indicated that they had low functional capacity<sup>(11)</sup>. In the present study, the authors found the average score of 2MST in hypertensive elderly people was about 80.87 times. Therefore, hypertensive elderly people in the present study had normal functional capacity.

The TUG test was used to evaluate the ability of balance, especially in older adults<sup>(20,21)</sup>. This test also evaluated the mobility, posture, agility, transferring the position from sitting to standing, stability in walking, and gait speed<sup>(21)</sup>. Previous studies reported that the duration of TUG test over 13.5 seconds indicated high risk of falls in elderly individuals<sup>(22,23)</sup>. However, the present study results found the average duration of TUG test for hypertensive elderly people is about 11.41 seconds. Therefore, these findings pointed out that hypertensive elderly subjects in the present study had normal ability of balance.

The STS10 times is used to assess the lower limb muscle strength, indicated physical performance and functional mobility, especially in elderly people<sup>(16)</sup>. In addition, the cut off duration for the performance of lower limb muscle strength in older individuals has no report. There are currently only available reports that STS10 times was correlated with 6MWT, and if individuals used longer duration in STS10, it was associated with shorter distance of 6MWT, which indicated low functional capacity and mobility<sup>(15)</sup>. In the present study, the authors did not used 6MWT to determine the functional capacity, but used 2MST to assess the functional capacity, and the results showed that 2MST was significantly correlated with STS10 in hypertensive elderly people. These findings suggest that functional capacity was correlated with performance of lower limb muscle strength in hypertensive older adults.

The STS60 test was used to determine lower limb muscle endurance, indicating the performance of lower limb and functional mobility<sup>(13)</sup>. However, there is no report on the cut off times for the performance of lower limb muscle endurance in elderly people. There are only reports that STS60 was correlated with 6MWT and the individuals with higher number of STS60 were correlated with longer duration of 6MWT, which indicated good functional capacity and mobility<sup>(15)</sup>. In addition, the present study results showed that 2MST was correlated with STS60 in hypertensive elderly people. Therefore, these findings suggested that functional capacity was correlated with performance of lower limb muscle endurance in hypertensive elderly people.

The evaluation of functional capacity is important for elderly peoples because it can affect the functional mobility as indicated by decreased functional mobility in older adults with low functional mobility<sup>(19,24)</sup>. In addition, previous studies showed that the decreased levels of cardiorespiratory endurance were found in elderly people with chronic diseases

including coronary artery disease, diabetes, and hypertension<sup>(25,26)</sup>.

It is known that individuals with hypertension have reduced functional capacity<sup>(3)</sup>. Furthermore, lower functional capacity was associated with poorer functional mobility<sup>(27,28)</sup>. Interestingly, the present study results help to confirm that functional capacity (2MST) was strongly correlated with functional mobility (TUG,  $r=-0.635$ ; STS10,  $r=-0.266$ ; STS60,  $r=0.521$ ; respectively) in hypertensive elderly peoples.

## Conclusion

The 2MST could be used to evaluate the functional capacity in hypertensive elderly subjects. Moreover, the 2MST showed a strong correlation with TUG, STS10, and STS60. Therefore, the present study results indicated that functional capacity was correlated with functional mobility in hypertensive elderly subjects.

## Limitation

The information of hypertensive drugs consumption of each subject was not presented in the current study. Further research will need to investigate this information to provide the severity of hypertension in the elderly people regarding cardiorespiratory fitness.

## What is already known on this topic?

The 2MST could be used to evaluate the functional capacity in hypertensive elderly people. In addition, the functional capacity was correlated with functional mobility in these people.

## What this study adds?

Hypertension is the most common non-communicable chronic disease found in older adults, which is associated with reduced functional capacity. Moreover, the decreased functional mobility could lead to poor functional capacity. Therefore, these outcomes will provide valuable information that will help determine the health status in hypertensive elderly people.

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## Conflicts of interest

The authors declare that they have no competing interests.

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