

# Comparative Analysis Study of Different Positions by Hands and Feet on Functional Mobility Assessed by Five Times Sit to Stand Test on Post-Stroke Patients

Nini Natalia Li<sup>1</sup>, Bayu Santoso<sup>2</sup>, R. A. Meisy Andriana<sup>3</sup>

<sup>1</sup>Department of Physical Medical and Rehabilitation, Faculty of Medicine, Universitas Airlangga, Dr. Soetomo Teaching Hospital, Surabaya 60131, Indonesia, <sup>2</sup>Doctor of Physical Medicine, Department of Physical Medical and Rehabilitation, Faculty of Medicine, Universitas Airlangga, Dr. Soetomo Teaching Hospital, Surabaya 60131, Indonesia, <sup>3</sup>Doctor of Physical Medicine, Department of Physical Medical and Rehabilitation, Faculty of Medicine, Universitas Airlangga, Dr. Soetomo Teaching Hospital, Surabaya 60131, Indonesia

## Abstract

**Background:** Five times sit to stand test (FTSTS) has been recognized for its validity and reliability in assessing muscle strength of the lower extremities functionally, evaluating functional mobility, balance and risk of falling in post-stroke individuals. However, there is no standard protocol for FTSTS implementation.

**Objectives:** To analyze the differences in functional mobility assessed with FTSTS results in various post-stroke post-stroke hand posture and posture changes.

**Method:** There were 11 patients ischemic stroke patients enrolled in the study. The age ranked from 40-60 years old. This study used an observational and cross-sectional study. The characteristic and FTSTS data was recorded in the Five times sit to stand test form that designed for this study. The data will then be analyzed using paired t-test in groups with SSPS 16.0 program.

**Results:** The paired t-test results show that there are significant differences between the FTSTS results in both hand positions, either on the spontaneous feet position or asymmetric feet position ( $p = 0.038$  and  $0.020$ ). There are no significant differences in FTSTS results with changes in spontaneous or asymmetric feet position ( $p = 0.779$  and  $0.278$ ).

**Conclusion:** The augmented hand position gives the best result to shift the center of the body mass on the post-stroke patient with post-hand changes. Then, there was no difference in functional mobility assessed by FTSTS in feet position changes of the post-stroke patient.

**Keywords:** FTSTS, Stroke, Hand position, Feet position

## Introduction

Clinically the most common symptom in stroke patients is the presence of hemiparesis, which results

in the loss of normal postural reflex mechanisms for balance and body rotation for functional movement of the extremities 1,2. The previous study in 161 elderly stroke patients, showed 37% fell during a change in position such as getting up from a chair. As a consequence, improving the symmetry of body load distribution and balance becomes the goal of rehabilitation in stroke 3–6. Related to the purpose of stroke rehabilitation, the clinician requires a valid and reliable measurement to know and evaluate the motor status and functional mobility of the patient<sup>7</sup>. The ability to get up from the chair is a prerequisite for independent ambulation and more functional daily life activities such as meals,

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### Corresponding Author:

**Bayu Santoso, dr., Sp.KFR-K**

Departement of Physical Medical and Rehabilitation,  
Faculty of Medicine, Dr. Soetomo Teaching Hospital,  
Universitas Airlangga, Jalan Mayjen Prof. Dr.  
Moestopo 47, Surabaya 60131, Indonesia.

Email: bayusantosounair@gmail.com

attending an activity and while on public transport. This transition movement becomes more difficult in individuals with post-stroke hemiparesis 8.

FTSTS has been recognized for its validity and reliability in assessing functional lower extremity muscle strength, evaluating functional mobility, balance and risk of falling in healthy elderly individuals, stroke and Parkinson's 9. Although it has been commonly used as an output parameter, there is no standard of FTSTS implementation protocol 3,10. The position of the hand when the subject performs the FTSTS is inconsistent. In most studies, subjects were asked to fold or cross their arms in the chest 10–15. While, in another study, subjects were asked to place their hands on their laps 9 or simply stand without using hands during FTSTS 15. In fact, some studies do not mention the position of the hand at all 16,17. Similarly, for the position of the feet when performing FTSTS was not mentioned clearly in previous research 9,10,14,16–18.

In this study, our aim is to compare the results of FTSTS with the various hand and feet position after stroke when performing the FTSTS. We also add a condition where the augmented hand positions with asymmetry feet positions have not been studied together before. It is hoped that this research could provide information to physicians and physiotherapists in improving services in post-stroke patients at Dr. Soetomo General Hospital Surabaya, Indonesia.

## Method

This research was an observational analytic with cross-sectional study approach that performed in outpatient unit of Medical Rehabilitation Installation at Dr. Soetomo Teaching Hospital Surabaya, Indonesia. The characteristic and FTSTS data were taken from August to November 2015. The subjects were first chronic ischemic stroke-patients, with hemiparesis aged 40-60 years, understanding the command, able to stand independently from the chair without the help of hands, stable general medical conditions, and willing participant in this research by the signing of informed consent.

The subjects were consecutive sampling and the number of samples obtained by 11 patients. Ethical appeals were submitted to the Ethics Commission for basic science / clinical clearance research at Dr. Soetomo General Hospital Surabaya, Indonesia. The data was recorded in the Five times sit to stand test form that designed for this study. The data will then be analyzed

using paired t-test in groups with SSPS 16.0 (SPSS, Inc., Chicago, IL) program.

## Results

Functional mobility capability (FTSTS results) of post stroke

All study subjects performed by FTSTS according to the study protocol in the following order: condition 1 was the position of the spontaneous feet and arms across the chest; condition 2 was the position of the spontaneous feet and the position of the hand augmented; condition 3 was the position of the feet of asymmetry and the position of the hand across the chest; and condition 4 was the position of the feet asymmetry and hand positions augmented. The average FTSTS results for 4 conditions ranged from  $9.2 \pm 2.8$  to  $10.3 \pm 2.9$  seconds (4.8 to 16.1 seconds). However, in condition 2 was the spontaneous feet position and the augmented hand gave the FTSTS the shortest result with  $9.2 \pm 2.8$  seconds.

### FTSTS Results at Different Hand Positions

Based on paired t-test results, there was a significant difference between FTSTS results in both hand positions, either on the spontaneous feet position or asymmetric feet position ( $p = 0.038$  and  $0.020$ ) (Table 3).

### FTSTS Results at Different Feet Positions

In this study, there was no significant difference in FTSTS results with changes in spontaneous or asymmetric feet position. The paired t-test of the change of the position of the feet against the FTSTS results is shown in Table 4.

**Table 1. Subject Characteristics of Ordinal Data Research**

Variables	Amount (%)
Sex	
Male	7 (6.36)
Female	4 (36.4)
Hemiparesis Sides	
Right	5 (45.5)
Left	6 (54.5)
Atrophy AGB parese	
Yes	2 (18.2)
No	9 (81.8)

**Cont... Table 1. Subject Characteristics of Ordinal Data Research**

Ankle spasticity	
0	5 (45. 5)
1	4 (36. 4)
+1	2 (18. 2)
A walker tools	
Cane	1 (9. 1)
None	10 (90. 9)

**Table 2. Subject Characteristic of Age, Weight, Height, Mass Index, Length of lower feet, and Post-stroke Duration**

Variables	Mean of ±SD Interval
Age (y/o)	51.0 ± 5.5 [40 – 58]
Body weight (Kg)	64 ± 17.01 [39 – 91]
Body height (cm)	157.54 ± 7.10 [148 – 170]
Body Mass Index (Kg/m2)	26.04 ± 6.55 [16 – 39]
Length of the lower feet (cm)	37.63 ± 3.14 [33-42]
Duration of post-stroke (week)	74.50 ± 24.0 [41 – 104]

**Table 3. The paired t-test results in hand position changes to the FTSTS results**

No. Feet position	Hand position	FTSTS results Comparing	p-value
1 Spontaneous	Crossed in the chest	10 .1 ± 2. 8	
		Condition 1 - Condition 2	0.038*
2 Spontaneous	Augmented	9 .2 ± 2. 8	
3 Asymmetry	Crossed in the chest	10 .3 ± 2. 9	
		Condition 3 - Condition 4	0.020*
4 Asymmetry	Augmented	9 .5 ± 2. 9	

Note: \* = significant, *p* < 0. 05

FTSTS: Five times sit to stand test

**Table 4. The changes feet position result of the t-test’s pair to the FTSTS**

No.	Feet position	Hand position	FTSTS results	Comparing	p-value
1 3	Spontaneous Spontaneous	Cossed in the chest Augmented	10 .1 ± 2. 8 9 .2 ± 2. 8	Condition 1 - Condition 2	0.779
2 4	Asymmetry Asymmetry	Cossed in the chest Augmented	10 .3 ± 2. 9 9 .5 ± 2. 9	Condition 3 - Condition 4	0.278

FTSTS: Five times sit to stand test

**Discussion**

Based on paired t-test results, there were significant differences in FTSTS results with hand position changes in post-stroke patients. Between the two hand positions assessed in this study, the augmented hand positions

gave shorter results than the crossed position in the chest (Table 3). This result was in accordance with research by Kwong and his friends <sup>3</sup> that augmented hand positions help shift the centre of the body mass forward more efficiently<sup>1</sup>. Previous research on sitting

to standing movements is often performed by limiting the use of the hands<sup>1</sup>. The centre of the body mass moves forward at the end of the sitting to stand while the subject is pointing with their hands. Hand restrictions cause different patterns of angular changes in ankle joints, a much higher standard deviation than in the free arm that obtained<sup>1</sup>. The position of the augmented arm is the position of both hands interlocked with shoulder flexion 90° and full extension elbow. This augmented hand position is often used in functional mobility exercises with the Bobath method<sup>3</sup>.

The mean of time to complete the FTSTS in this study was ranged from  $9.2 \pm 2, 8$  seconds to  $10.3 \pm 2.9$  seconds. These results were shorter than those of Mong study who received mean FTSTS in post-stroke patients was  $17.1 \pm 7.5$  seconds in the mean post-stroke subjects aged  $60.0 \pm 4.8$  years<sup>9</sup>. Similar results were obtained in the previous study that the mean of FTSTS was  $15.2 \pm 17.1$  seconds, with age of study subjects ranging from  $60 \pm 5.6$  years<sup>3</sup>. Similarly, research by Ng in post-stroke patients with mean age between  $60.0 \pm 5.56$  (50-70 years) obtained FTSTS results between 15.81 to 18.20 seconds (7). FTSTS results in this study could be due to post-stroke patients that included the younger age of  $51.9 \pm 7.3$  years (40 - 58 years).

Previous study did not take into account the height of the chair and using a standard chair by 43 cm (15). However, in this study using an especially adjustable seat height between 41 - 47 cm with seat height was 100% of the length of the lower limbs of the study subjects. According to Ng, the lower the seat, the longer it takes to complete the FTSTS<sup>10</sup>. The lower seats the lower the centre of body mass and increase the degree of togok flexion and the angle of flexibility movement of togok, hip joints, knee joints and ankles while sitting to standing<sup>19</sup>. As it moves from sitting to standing, it takes a greater increase of greater moments on the hip joint and knee joint<sup>10</sup>.

It is obtained that sitting down to standing was required shorter time. The posterior positioning of the feet also gives the hip joint flexion and flexion speed of the smaller hip joint. Another study examined the effect of early posterior feet placement. The posterior position of the feet causes the maximum mean moment of extension of the lower hip joint. Early feet placement also affects the travel distance of the centre of gravity (CoG). Upon awakening, the movement of the centre of gravity of the body forward during standing was

significantly longer on normal feet placement when compared to posterior feet placement, with reference to 10 cm behind the normal position<sup>20</sup>.

In this study, there was no significant differences in FTSTS results with 2-feet positions, spontaneous and asymmetric feet position with parse feet that placed behind. Similar Lecours et al. study, on subjects with hemiparesis that has 2 possibilities when the asymmetry of the feets was positioned on the task of sitting to stand and standing up to sit. First, the subjects do a weight bearing on the position of the feet that was in the posterior as well as healthy people. Second, naturally subjects still place weight bearing on healthy feet, although "forced" weight bearing on parent feets. In this study, the second possibility has occurred<sup>8</sup>.

According to previous study, it suggested the presence of weight-bearing asymmetry in patients with hemiparesis. These results are supported by evidence of togok asymmetry towards the healthy side. In this study, the patient performs a sitting motion to stand by uniforming the starting position by starting leaning on the back of the chair, but not instructing to return again on leaning back in the seat during sitting motion, during the FTSTS. According to the researchers, there could be asymmetry togok toward the healthy side that helps stability when subjects perform FTSTS and give short results, without affected feet position.

## Conclusion

There was a difference in functional mobility assessed by FTSTS on the post-stroke patient with post-hand changes where the augmented hand position gives the best result to shift the center of the body mass. Then, there was no difference in functional mobility assessed by FTSTS in feet position changes of the post-stroke patient.

**Ethical Clearance:** This research involves participants in the process using a questionnaire that was accordant with the ethical research principle based on the regulation of research ethic regulation. The present study was carried out in accordance with the research principles. This study implemented the basic principle ethics of respect, beneficence, non-maleficence, and justice.

**Conflict of Interest:** The authors have not found any conflict of interest related to this research so far.

**Source of Funding:** All of the cost and fees related with this research are paid by the authors only with no sponsorship nor external funds.

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