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EVALUATION OF WALKING REHABILITATION OUTCOMES USING A COMBINED APPROACH WITH BODY-WEIGHT-SUPPORTED TREADMILL TRAINING IN PATIENTS WITH ACUTE ISCHEMIC STROKE AT PHU THO GENERAL HOSPITAL

Nguyen Huy Ngoc[1,2*], Vu Thi Minh Thanh[3]

[1]*University of Medicine and Pharmacy, Vietnam National University, Hanoi - 144 Xuan Thuy, Dich Vong Hau Ward, Cau Giay Dist, Hanoi City, Vietnam*
[2]*Phu Tho Department of Health - Tran Phu, Gia Cam, Viet Tri City, Phu Tho Province, Vietnam*
[3]*Phu Tho Provincial General Hospital - Nguyen Tat Thanh Street, Tan Dan Ward, Viet Tri City, Phu Tho Province, Vietnam*

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ABSTRACT

Objectives: Evaluation of outcomes and associated factors in walking rehabilitation using Body-Weight-Supported Treadmill Training (BWSTT) in patients with acute ischemic stroke.

Subjects and methods: A prospective, interventional study comparing pre- and post-treatment outcomes over a 3-week period of walking rehabilitation using the BWSTT method in 71 inpatients with acute ischemic stroke at the Stroke Center, Phu Tho General Hospital.

Results: The most common age group was > 65 years, with a male-to-female ratio of 1.45:1. Mild NIHSS scores accounted for 78.9%, and 95.8% of patients underwent BWSTT intervention within ≤ 7 days after stroke onset. After 3 weeks of BWSTT intervention, significant improvements were observed across all four scales: FAC, FMA-LE, BBS, and TUG ($p < 0.05$). Factors associated with walking rehabilitation outcomes included younger age (< 45 years), which showed better walking function improvement on the FAC scale compared to other age groups, and patients with lower NIHSS demonstrated better improvement in walking function on the FMA-LE scale compared to those with moderate NIHSS.

Conclusion: BWSTT method improved in FAC, FMA-LE, BBS, and TUG scores in patient with acute ischemic stroke. Younger patients (< 45 years) showed better walking function improvement on the FAC scale, while patients with mild stroke revealed greater improvement on the FMA-LE scale compared to those with severe stroke.

Keywords: Acute ischemic stroke; BWSTT; FAC; FMA-LE; BBS; TUG.

1. INTRODUCTION

Stroke is a vascular disorder that occurs when blood flow to the brain is disrupted or when bleeding occurs within the brain parenchyma, leading to the loss of brain function. In the United States, over 795,000 individuals experience a stroke each year, approximately 610,000 of whom suffer a first stroke, while 185,000 cases occur in patients with a history of previous strokes. [2]. In Vietnam, more than 200,000 cases of stroke occur annually, with a mortality rate ranging from 10% to 20%. Approximately 40% of patients require rehabilitation following stroke onset, and 15%–30% experience impairments in mobility, sensation, cognition, and language [4]. Among these patients, over 85% experience hemiplegia and reduced limb motor function [4]. Therefore, promptly optimizing walking ability in stroke patients is crucial for achieving functional independence and enabling participation in social activities.

Body-weight-supported treadmill training (BWSTT) is a physiotherapy intervention designed to improve walking ability in post-stroke patients. BWSTT is a training system that simultaneously addresses weight support, posture, balance, and task-oriented early rehabilitation. A systematic review by Mehrholz et al (2017–2018), based on the Cochrane Library database, concluded that treadmill training significantly improves walking speed and distance compared to non-

*Corresponding author
Email: huyngoc888@gmail.com **Phone:** (+84) 985179888 **Https:**//doi.org/10.52163/yhc.v65i13.1876

intervention groups [3]. In Vietnam, this method has been applied in the treatment of stroke patients; however, no oficial studies have assessed its effectiveness specifically in patients with acute ischemic stroke. Therefore, we conducted this study to evaluate the outcomes and related factors associated with walking rehabilitation using body-weight-supported treadmill training in acute ischemic stroke patients at Phu Tho General Hospital.

2. METHODS

2.1. Research subjects: A study conducted on 71 patients diagnosed with acute ischemic stroke who were hospitalized for treatment at the Stroke Center, Phu Tho Provincial General Hospital, from February 2024 to August 2024.

- *Inclusion criteria:*

+ Patients with a first-time diagnosis of acute ischemic stroke.

+ Patients able to walk 3 meters with assistive devices and/or the support of one person.

+ Patients without motor deformities or other neuromuscular disorders affecting motor function, such as Parkinson's disease, multiple sclerosis, amyotrophic lateral sclerosis, or peripheral neuropathy.

- *Exclusion Criteria:*

+ Patients with bilateral hemiplegia.

+ History of heart failure or chronic obstructive pulmonary disease.

+ Patients who did not attend the required number of intervention sessions.

+ Patients or family members who declined participation in the study.

2.2. Research methods: A prospective study comparing outcomes before and after intervention.

- All patients were evaluated at two time points: at the start of the study and after three weeks of training.

- Each participant underwent identical training sessions guided and directly supervised by a technician. Each session lasted 60 minutes per day, five days a week, for three consecutive weeks. In addition to general rehabilitation training, patients practiced with BWSTT for 20 minutes per day under the technician's supervision.

2.3. Research Variables: Demographic and clinical variables: age, gender, BMI, type of intervention, time since stroke onset. Functional and motor performance metrics: NIHSS score (National Institutes of Health Stroke Scale). FAC score (Functional Ambulation Classification). FMA-LE score (Lower Extremity Fugl-Meyer Assessment). BBS score (Berg Balance Scale). TUG test (Timed Up and Go test). Assessments were performed before and after three weeks of BWSTT training.

2.4. Statistical methods and data Analysis: Data were collected from study records and analyzed using SPSS version 20.0. Qualitative variables were analyzed for frequency and percentage. Quantitative variables were analyzed for mean and standard deviation. The Chi-square test was used to compare two proportions, with statistical significance set at $p < 0.05$.

2.5. Study ethics: The study ensured the safety of participants and maintained the confidentiality of their information. The research was approved and endorsed by Phu Tho General Hospital. Patients had the right to withdraw from the study at any time for any reason.

3. RESULTS

Table 1. General characteristics of research subjects

Characteristics		Amounts (n=71)	Rate (%)
Age groups	<45	3	4.2
	45 - 65	23	32.4
	>65	45	63.4
Gender	Male	42	59.2
	Female	29	40.8
NIHSS	Mild (1-4)	56	78.9
	Moderate (5-14)	15	21.1
Time for initiate BWSTT after stroke onset	≤ 7	68	95.8
	8 - 14	3	4.2

The most common age group in the study was patients over 65 years old. Males predominated, accounting for 59.2% of the participants. The majority of patients (78.9%) had mild NIHSS scores, and 95.8% of the interventions with BWSTT were initiated within 7 days after stroke onset.

Table 2. Improvement in rehabilitation scores after intervention

Scale	Pre intervention	Post intervention	Level of improvement (post and pre)	p
FAC	1.62±0.49	3.03±0.58	1.41±0.49	<0.05
FMA-LE	22.01±3.15	28.38±3.47	6.37±2.03	<0.05
BBS	31.39±4.88	38.58±6.09	7.18±2.79	<0.05
TUG	31.10±4.68	24.13±5.20	6.97±2.47	<0.05

All four scales FAC, FMA-LE, BBS, and TUG showed statistically significant improvements after three weeks of intervention.

Table 3. The factors affecting walking rehabilitaion outcomes

Factor	Subgroup	Level of improvement FAC	Level of improvement FMALE	Level of improvement BBS	Level of improvement TUG
Age	< 45	2.00±0.00	8.00±1.00	8.33±2.52	8.67±3.21
	45 - 65	1.61±0.54	6.39±1.90	8.13±3.06	7.52±2.74
	> 65	1.27±0.45	6.37±2.12	6.62±2.56	6.58±2.22
	p	0.002	0.353	0.82	0.157
Gender	Male	1.38±0.49	6.38±2.08	6.86±2.86	6.90±2.43
	Female	1.44±0.50	6.34±1.98	7.66±2.68	7.07±2.56
	p	0.326	0.809	0.906	0.673
NIHSS	Moderate (5-14)	1.41±0.49	6.09±1.86	7.12±2.91	6.96±2.56
	Mild (1-4)	1.40±0.50	7.40±2.35	7.40±2.41	7.00±2.14
	p	0.941	0.025	0.738	0.961
Time for initiate BWSTT after stroke onset	≤ 7	1.41±0.50	6.37±2.06	7.31±2.79	6.88±2.46
	8-14	1.33±0.58	6.33±1.53	4.33±0.58	9.00±2.00
	p	0.465	0.455	0.101	0.517

The improvement in the mean FAC score across age groups was significant ($p < 0.05$). However, the improvement in the mean FAC, FMA-LE, BBS, and TUG scores between genders did not show a statistically significant difference with $p>0.05$.

The improvement in the FAC, FMA-LE, BBS, and TUG scores across groups classified by the timing for initiate BWSTT after stroke onset did not show a statistically significant difference with $p > 0.05$. However, the improvement in the FMA-LE score across groups classified by the severity of stroke according to the NIHSS scale showed a statistically significant difference with $p < 0.05$ (Kruskal-Wallis test), with the mild NIHSS group showing greater improvement compared to the moderate NIHSS group.

4. DISCUSSION

In our study, the majority of patients were over 60 years old, accounting for 63.4%, while the younger age group represented only 4.2%. This is similar to the study by Nguyen Thi Hue [1], where the group over 60 years old accounted for 80.6%. Stroke is a condition closely related to aging. After the age of 55, the risk of stroke doubles every 10 years [5]. Our study also found that the majority of patients were male, with a male-to-female ratio of 1.45:1, which is quite similar to Nguyen Thi Hue 's study, where the ratio was 1.38:1 [1]. The study participants were patients with hemiplegia, diagnosed with acute ischemic stroke, and receiving inpatient treatment at the Stroke Center. Therefore, most patients were treated early, starting within the first few days after stroke onset, with the earliest intervention occurring after 2 days and the latest after 9 days. The results showed that 68 patients initiated BWSTT intervention in the first week, accounting for 95.8%, and only 3 patients, or 4.2%, started intervention in the second week after the stroke. Regarding the severity of stroke assessed by the NIHSS, our study included patients with moderate and mild NIHSS scores, with mild cases accounting for 78.9%.

There are several scales to evaluate different aspects of walking rehabilitation in patients. In this study, we used three rating scales and one test: the Functional Ambulation Classification (FAC), the Fugl-Meyer Assessment of Lower Extremity (FMA-LE), the Berg Balance Scale (BBS), and the Timed Up and Go (TUG) test. We evaluated these scales at two time points: before and after 3 weeks of rehabilitation intervention combined with BWSTT. The results of the study showed that the average FAC score before intervention was 1.62 ± 0.49, and after 3 weeks of intervention, the FAC score was 3.03 ± 0.58. The improvement in FAC (post – pre) was 1.41 ± 0.49. The average FMA-LE score before intervention was 22.01 ± 3.15, and after 3 weeks of intervention, the FMA-LE score was 28.38 ± 3.47. The improvement in FMA-LE (post – pre) was 6.37 ± 2.03. The average BBS score before intervention was 31.39 ± 4.88, and after 3 weeks of intervention, the BBS score was 38.58 ± 6.09. The improvement in BBS (post – pre) was 7.18 ± 2.79. The average TUG score before intervention was 31.10 ± 4.68, and after 3 weeks of intervention, it was 24.13 ± 5.20. The improvement in TUG (post – pre) was 6.97 ± 2.47. This improvement was statistically significant ($p<0.05$). Thus, the combined BWSTT showed a clinically significant improvement in functional outcomes.

There are several factors related to walking rehabilitation combined with Body Weight Supported Treadmill Training in patients with acute ischemic

stroke. In the analysis of factors that may affect walking function improvement, we found that there was a significant difference in the improvement of the average FAC score across different age groups. However, no significant difference was observed in the improvement of FMA-LE, BBS, and TUG across the factors analyzed ($p>0.05$). Patients in the <45 age group showed the highest improvement in the scores and tests, followed by those in the 45-65 age group, and the lowest improvement was seen in the >65 age group. Although a statistically significant difference was found only in the FAC scale with $p < 0.05$, our study's findings did not reveal a clear influence of age on improvements in walking function regarding balance. The risk of falls could be attributed to the small sample size and the relatively short intervention period. Additionally, recovery is influenced by many other factors, such as the location of the lesion and the time since the stroke.

In the analysis of the relationship between stroke severity as assessed by the NIHSS, it was found that the FAC, BBS, and TUG scores did not show significant differences between the mild and moderate stroke groups. However, in the evaluation of the FMA-LE score, the mild stroke group demonstrated better lower limb motor improvement than the moderate stroke group. This could be related to the fact that lighter neurological damage allows for faster motor recovery. In the assessment of other related factors, such as gender and time for initiate BWSTT after stroke onset, we did not observe any correlation with the FAC, BBS, and TUG scores.

5. CONCLUSION

After 3 weeks of combined walking rehabilitation using a Body Weight Supported Treadmill at the Stroke Center, Phu Tho General Hospital, patients with acute ischemic stroke revealed significant improvements in FAC, FMA-LE, BBS, and TUG scores. The age was found to be related to walking rehabilitation outcomes, and the NIHSS severity score showed an improvement in the FMA-LE score during BWSTT-based rehabilitation.

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