



THE EFFECTIVENESS OF BODY WEIGHT SUPPORTED TREADMILL TRAINING IN IMPROVING THE LOWER LIMB FUNCTIONS IN ACUTE STROKE PATIENTS

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ABSTRACT

Background: A stroke can profoundly affect the functionality of the lower limbs. It can greatly influence a person's ability to walk and maintain balance. Disruption of the brain's ability to control muscle movements, which is often a consequence of a stroke. No published studies focused on Body weight-supported treadmill training in improving lower limb functions. However, body weight treadmill training has proven successful in improving the lower limb functions of acute stroke patients.

Aim: To examine the effects of body weight-supported treadmill training in improving the gait and balance in acute stroke patients.

Methods: A comprehensive research on Pubmed, Medline, Google Scholar, and Science Direct databases using specific keywords stroke, interventions used in stroke, lower limb functions, and physiotherapy evidence-based database was utilized for quality assessment.

Results: This review included ten studies; the findings of this review demonstrate that body weight-supported treadmill training will improve the lower limb functions of acute stroke patients.

Conclusion: The results of this review offer abundant proof that body weight-supported treadmill training improves lower limb function in patients suffering from acute stroke.

KEYWORDS: Treadmill training with weight support, stroke, evidence-based practice, lower limb functions, and evidence-based physiotherapy

INTRODUCTION

A stroke is commonly characterized as a neurological impairment resulting from a sudden, localized injury to the central nervous system. This injury can be vascular events are cerebral infarction, or intra cerebral Hemorrhage is a medical term that refers to excessive bleeding, either internally or externally. (ICH), or subarachnoid Hemorrhage is a medical term that refers to excessive bleeding, either internally or externally. (SAH). It stands as one of the foremost reasons for disability and mortality on a global scale. ⁽¹⁾ Stroke is a significant and escalating global health issue. It stands as a leading cause of physical disability acquired in adulthood globally, and it holds the second position as a cause of death in middle- to high-income nations. In these countries, the total incidence of ischemic and hemorrhagic stroke has increased over the past decade to 85–94 per 100,000, but it is substantially higher (1151–1216 per 100,000) in individuals aged over 75 years. Furthermore, low-income countries account for 85% of all stroke-related deaths and 87% of disability-adjusted life years related to stroke ⁽²⁾

The incidence of stroke is on the rise, from 0.84 out of every 1,000 individuals are at a high risk of experiencing a stroke. This can result in conditions such as hemiplegic and hemiparesis. Following a stroke, the resulting weakness can make daily activities challenging and significantly impact the individual's quality of life. ⁽³⁾

Stroke often leads to a variety of pathological symptoms that result in functional disorders, including disturbances in gait. Consequently, a primary objective of rehabilitation is to restore optimal gait. The abnormal gait observed in stroke patients is influenced by several factors such as asymmetrical stride time and length, reduced speed, poor control of joints and posture, Weakness in muscles and irregular muscle tone, and irregular muscle activation patterns. Among these, muscle weakness is a common impairment following a stroke and is a significant contributor to abnormal gait patterns in patients. The strength of the lower limbs is intricately connected to walking capability. Consequently, a primary objective of stroke rehabilitation is to bolster muscle strength, thereby enhancing the patient's walking capacity. ⁽⁴⁾



Body weight-supported treadmill training represents a task-oriented approach to gait restoration following stroke. It provides clear benefits over traditional therapy by enabling higher intensity, more repetitive, and task-specific practice within the same duration. Numerous studies have illustrated the superiority of BWSTT in enhancing gait speed compared to traditional physiotherapy. Additionally, BWSTT brings about changes in cortico motor excitability, leading to improved balance and gait performance in acute stroke patients. Some studies suggesting that BWSTT does not surpass conventional gait training. BWSTT can improve walking endurance in the sub acute stage post-stroke, enhancements in balance and 10-meter gait speed may not be substantial.⁽⁵⁾

However, there remains a dearth of studies employing gait analysis to elucidate the mechanisms underlying improvements in gait parameters following BWSTT or conventional therapy. A fundamental understanding of how gait training impacts lower limb motor patterns is crucial, given that gait impairments stem from deficient neuromuscular control. Improvements in specific biomechanical aspects of walking, such as leg swing and balance control, correlate positively with overall walking performs.⁽⁶⁾

Body weight supported (BWS) treadmill training is a rehabilitation technique aimed at retraining walking abilities. During BWS, individuals are supported either by a metal frame or suspended from the ceiling, reducing the weight borne by their feet while walking on a treadmill. The level of support can be adjusted gradually based on individual requirements. For instance, if the treadmill speed increases, more support may be needed momentarily to maintain balance and posture. This approach is especially advantageous for individuals experiencing difficulties with walking after a stroke. BWS treadmill training offers a safe starting point for walking when independent walking is not yet feasible. It enables some individuals to initiate walking sooner after a stroke, especially those who currently rely on assistance from two individuals for

over-ground walking. Additionally, it provides an opportunity for practice when walking over ground is not yet achievable.⁽⁷⁾

METHODOLOGY

Study Design

Search Methods and Eligibility Criteria

A thorough literature search was conducted; the search engines used were Pub Med, Google Scholar, Medline, and Pedro. Based on the available study there is an improvement of lower limb functioning by body weight supported treadmill training. Keywords used are stroke, lower limb rehabilitation, and body weight supported treadmill training. The study encompassed solely articles that focused on enhancing lower limb function through Body weight-supported treadmill training assistance, while excluding articles not published in English.

Sample Size

A sample size of 30 articles was searched with the keywords of stroke, lower limb rehabilitation, and body weight supported treadmill training. Out of these articles, papers obeying the criteria for inclusion and exclusion were filtered and finally, 10 were obtained for the review.

Inclusion Criteria

Articles explaining stroke Rehabilitation were included.

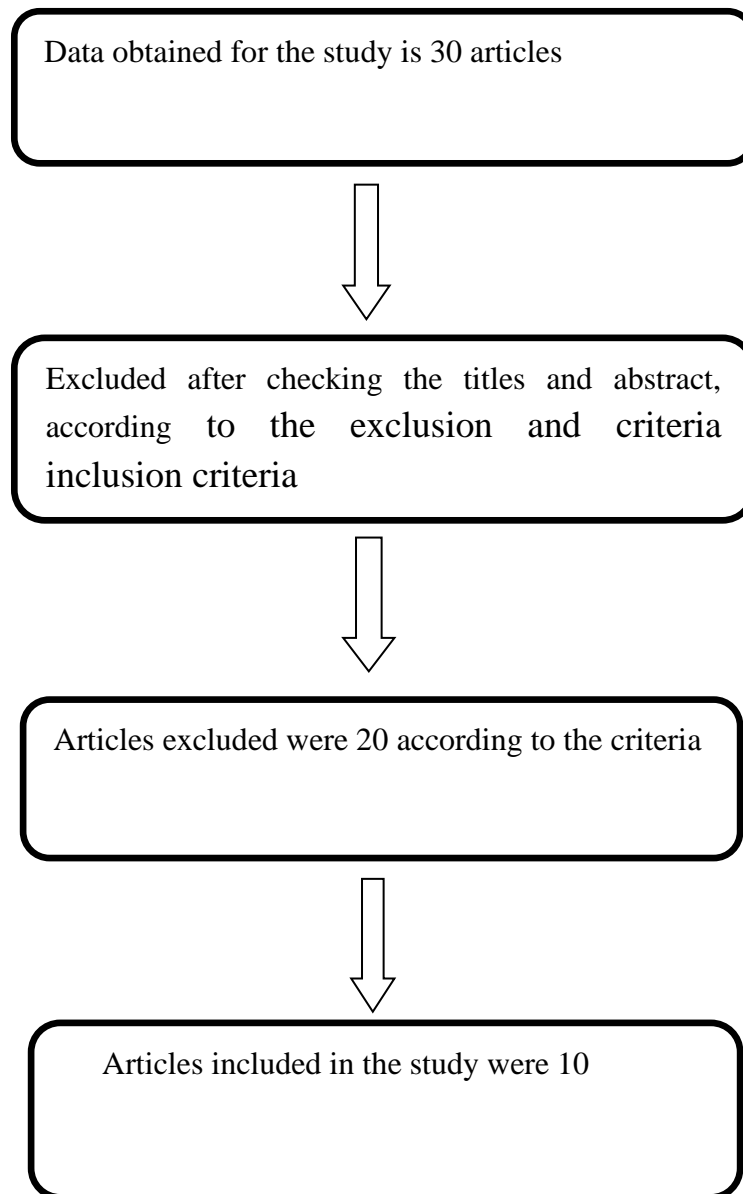
- Articles published in recent years.
- Full-text articles.
- Articles published in English.

Exclusion Criteria

- Articles of past 2014.
- Articles explaining other than stroke were excluded.
- Articles addressing subjects beyond than body weight-supported treadmill training were excluded.
- Articles not containing relevant discussion were excluded.



Flow Chart





LITERATURE REVIEW

S No.	Author\ year	Title	Study method	Study design	Conclusion
1.	Elif Tarihci Cakmak 2024	The Effectiveness for Training on the treadmill with body weight support. In Stroke Patients.	The patients were divided into two groups: (1) a control group undergoing conventional rehabilitation (CR) only, consisting of 14 individuals, and (2) an experimental group undergoing CR along using body weight support during treadmill training, comprising 16 individuals. Both groups underwent CR for 3 weeks continuously, with sessions held 5 days per week, each lasting 30 minutes. In addition to CR, the experimental group received an extra 30 minutes of BWSTT per session. Prior to and following the intervention, patients underwent assessments using various measures including the 10-meter walk test (10MWT), the six-minute walk test (6MWT) the Tinetti Balance and Gait	Randomized control trail	In summary, integrating traditional physiotherapy with gait training conducted on over ground presents a comprehensive method to improve mobility in various aspects. This approach provides a cost-efficient and equipment-free option compared to treadmill support, requires specialized treadmill and support systems, leading to increased expenses. Nonetheless, incorporating BWSTT as a supplementary therapy may entail additional costs but offers extra advantages in enhancing functional mobility.



			Assessment, Timed Up and Go (TUG) test, Rivermead Mobility Index (RMI), and Stroke-Specific Quality of Life Scale (SS-QOL).		
2.	Abdullah Ibn Abul Fazal 2022	Effectiveness of body weight supported treadmill training among Patients with Stroke	The study aimed to assess the effectiveness of body-weight-supported treadmill training (BWSTT) for stroke patients through a review of relevant literature. Five articles were examined to achieve this aim. Participants underwent BWSTT sessions lasting an average of 30 minutes per day, conducted five days a week, over a period of three weeks.	A review study	To ascertain the optimal intensity and frequency of training sessions necessary for restoring normal gait, Both study groups demonstrated enhancements in lower limb motor function and improved balance measures ($P < 0.05$), with kinematic improvements notably observed in the BWSST group ($P < 0.05$). This review underscores the significant effects of BWSTT on aspects related to balance, mobility, and fear of falling. Notably, infrequent isolated BWSTT sessions were found to be equally beneficial as more frequent conventional therapy sessions for ambulatory.
3.	Ponnada Ramakrishna 2021	Effect of Body Weight Support Treadmill Training on Gait Speed in Acute Stroke Rehabilitation	A quasi-experimental study involved screening 25 stroke patients, of which 20 willing participants were recruited. These individuals were segmented into two groups randomly.	A Quasi Experimental Study	The quasi-experimental study revealed that incorporating 30 minutes involving treadmill Training with support of body weight alongside regular conventional physiotherapy over a span of 4 weeks was both feasible and safe, demonstrating significant improvements in gait



			Group A (n=10) underwent regular individual physiotherapy, while Group B (n=10) underwent only regular individual physiotherapy. The outcome was measured using the 10-meter walk test.		speed during acute stroke rehabilitation.
4.	Yu-Rong Mao 2015	The Effect of G Treadmill Training with Support of Body Weight Recovery, Motor Patterns of the Proximal Lower Limb and Balance in Subacute Stroke Patients	Participants with sub acute stroke (18 to 76 days post-stroke) were enrolled study and randomly assigned to either the BWSTT or CT groups (refer to Figure 1). Inclusion criteria for hemi paretic individual were as stated : (1) confirmation of stroke through computed tomography or MRI; (2) unilateral hemi paresis lasting no more than 3 months following the initial stroke; and (3) presence of residual gait impairment, as indicated by abnormal 10-meter walk times adjusted for age.	RCT	In patients with sub acute stroke, BWSTT shows potential for enhancing gait quality compared to conventional gait training. Both approaches demonstrate the ability to enhance balance and motor function.
5.	Kyunghoon Kim 2014	Effects of Progressive	Thirty-six chronic stroke, Patients were	RCT	The study results indicate noticeable alterations in the



		Body weight-supported treadmill training Walking Ability of the Lower Extremity Affected by Stroke	assigned to three groups each consisting of 12 subjects. Every group participated in progressive body weight-supported treadmill training methods for 30 minutes, six times per week, spanning three weeks. Subsequently, they underwent general physical therapy without further intervention until the follow-up evaluations.		traits Across all three groups, the mobility of the lower extremity that was affected was evaluated. Following the three-week training period. Although among the affected side's support, and symmetry index, significant disparities were noted in the affected side's step length and step time in the PBWSTFBWP group compared to the PBWSTFWT and PBWSTBWT groups after completing the three-week training.
6.	Lee H-J 2013	The Impact of Treadmill training with support from body weight. Power Assisted Functional Electrical Stimulation on Functional Movement and Walking in stroke patients	Thirty stroke patients were randomly assigned to two groups: the experimental group (n = 15) and the control group (n = 15). All participants underwent the same standardized rehabilitation program. Additionally, engaged in BWSTT with Functional electrical stimulation assisted by power for 30 minutes daily, five days per week, over a span of 4 weeks, whereas the control group	RCT	The objective of the study was to investigate impact of BWT-PAFES on functional Movement and walking patterns in stroke were assessed following a 4-week period of Body Weight Support Perturbation Assistance and Functional Electrical Stimulation. Notable enhancements in both functional movement and gait were noted when comparing the BWT-PAFES group with the BWSTT group.



			underwent BWSTT equal duration and frequency.		
7.	Catherine M Dean 2010	Walking on the treadmill with support of body weight in Sub acute non-ambulatory Stroke improves g Enhanced walking ability compared to traditional round walking	Inpatient rehabilitation comprised 126 stroke Patients who were unable to walking within 4 weeks after their stroke. The experimental group engaged in treadmill walking with received body weight support utilizing an overhead harness for a maximum of 30 per day, whereas the control group engaged in up to 30 minutes of walking on over ground.	RCT	Treadmill-based training with support for body weight leads to enhanced walking capacity and perception In comparison to walking on the ground, without any adverse effects on the quality of walking.
8.	Louise Ada 2010	Randomized Trail of Walking on the Body weight-supported treadmill to Establish Walking in Subacute stroke Patients	A study employing concealed allocation, blinded assessment, and intention-to-treat analysis was carried out. One hundred and twenty-six stroke patients, all unable to walk, were enrolled and randomly divided into either an experimental or control group within 4 weeks of their stroke onset. In the experimental group,	Randomized control trail	Proves to be feasible and safe, with a tendency to facilitate earlier and increased independent walking post-stroke.



			<p>participants engaged</p> <p>Walking on the treadmill with support from body weight support via an overhead harness for up to 30 minutes daily, the control group participated in up to 30 minutes of walking on regular ground.</p>		
9.	Marco Franceschini 2009	Walking After Stroke: What Does Training on a Treadmill with Support for Body Weight Add to Training in Over ground Gait for Patients Early After Stroke	<p>This study was conducted to single-blind, randomized, controlled trial spanning a 6-month follow-up period. Ninety-seven participants were enrolled within 6 weeks of experiencing a stroke and The participants were randomly assigned to two groups: one receiving conventional rehabilitative treatment combined with gait training One group solid ground without additional support (control group; n = 45). Participants attended 60-minute sessions on weekdays for a duration of 4 weeks. Assessments were conducted at</p>	Randomized control trail	<p>For individuals experiencing sub acute stroke, gait treadmill-based Training with support from body weight is both feasible and comparably effective to traditional gait training methods. Nevertheless, the requirement for additional personnel during treadmill training emphasizes the growing appeal of utilizing robotically assisted systems.</p>



			the beginning and after completing 20 treatment sessions, 2 weeks post-treatment, and at the 6-month mark following stroke onset.		
10.	Marc C. Kosak 2015	Comparing Partial Body Weight Supported Treadmill Gait Training versus Aggressive Bracing Assisted Walking post Stroke	Patients received treatment sessions lasting up to 45-minute sessions daily, occurring five days per week, based on their tolerance level, throughout their inpatient stay or until they could walk over ground unassisted. Additionally, all patients underwent a 45-minute session of functionally oriented physical therapy each day, with or without bracing, as deemed suitable by their individual therapist.	Randomized control trail	Both PBWSTT and ABAW demonstrate comparable effectiveness in gait training, except for a specific group of significant hemispheric stroke who present challenges in mobility solely with ABAW.

DISCUSSION

Elif Tarihci Cakmak et al 2024: This research investigated of conventional rehabilitation (CR) alone versus CR combined with treadmill training with support from body weight. (BWSTT) on mobility and the quality of life in individuals recovering from stroke. The research revealed that incorporating BWSTT into the therapy regimen resulted in more substantial enhancements in comfortable walking speed, evaluated through the 10-Meter Walk Test (10MWT), and functional mobility rehabilitation alone. Furthermore, in a study examining In sub acute stroke patients, improvements were observed in lower extremity motor functions, balance, and gait parameters with both body weight-supported treadmill training

(BWSTT) and over ground gait training. However, the BWSTT group exhibited notable enhancements in kinematic parameters of lower limb joints and gait patterns, a distinction not observed in the control training group.⁽⁸⁾

Ponnada Ramakrishna et al 2021: The study aimed to gauge the efficacy of treadmill training supported by body weight improving gait speed among ambulatory stroke patients. All 20 subjects successfully completed the entire four-week training protocol. Assessment of treatment impact prior to and following the intervention, conducted using paired t-tests, ten meter walk used as the outcome measure. Comparison between body weight and conventional physiotherapy was administered using



paired sample t-tests, revealing a significant enhancement with treadmill training supported by body weight in comparison to traditional physiotherapy. Stroke patients underwent progressive body weight-supported forward and backward walking training, and the impact of these programs on their walking abilities was evaluated. Significant improvements were observed in training period, with notable differences noted in affected walking time among the groups.⁽¹⁰⁾

After reviewing these articles, it's evident treadmill training with support from body weight Proves effective. Research indicates that in post-stroke patients, traditional physiotherapy, BWSTT, and a combination therapy group all enhance balance and mobility while reducing fear of falling. Particularly, the combination therapy demonstrated superior performance In comparison both CT and BWSTT terms of balance and mobility. Despite CT and BWSTT having different training frequencies, both positively impacted the measured outcomes. In a study by after 30 sessions, there was no notable distinction in balance function between the CTG (five times per week) and the BWSTTG (three times CT plus two times BWSTT per week). However, in our present study, we observed that the Combination therapy (five times CT per week + twice BWSTT per week over 30 sessions) significantly surpassed the CTG in enhancing balance.

CONCLUSION

The articles referenced above have demonstrated the significant the efficacy Treadmill training supported by body weight assistance and modified therapy in enhancing gait, balance, motor functions, and ambulation among acute stroke patients. Therefore, it is recommended that therapists incorporate treadmill training with support from body weight into their treatment plans for acute stroke patients.

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