

Sri Lanka Journal of Physiotherapy and Rehabilitation Sciences

Case study

Effectiveness of the Otago exercise programme in reducing fall risk in stroke survivors: A case study

R A M D Ranatunga^{1*}, N W W P G K S Senanayake², D C Munasinghe³

*Correspondence: menujadr@gmail.com

 <https://orcid.org/0009-0003-0484-8578>

Received on 03 June 2025

Accepted on 16 July 2025

ABSTRACT

Background: Stroke is one of the leading causes of long-term disability worldwide. Depending on the affected region of the brain, a stroke can cause a wide range of functional deficits, with motor impairments being among the most prominent. Evaluating balance and gait abnormalities is crucial as post-stroke survivors often experience significant impairments, leading to a high risk of falls and compromised independence. The Otago exercise programme (OEP) focuses on 3 key components: muscle strengthening, balance training, and walking. Therefore, this study aimed to investigate the effectiveness of the OEP in reducing fall risk among stroke survivors.

Case: A 68-year-old male with a history of right-sided ischemic stroke presented to the clinic with complaints of persistent imbalance, frequent near-falls, and difficulty initiating walking, especially on uneven surfaces. He also reported unsteadiness during routine activities such as standing and walking. On neurological examination, he exhibited mild spasticity in the left upper and lower limbs, moderate motor impairment in the left lower limb (Fugl-Meyer score: 23/34), and mild dysmetria on coordination testing. Balance assessment revealed difficulty in standing with eyes closed and a narrow base of support, inability to maintain tandem stance with eyes closed, reduced time on single-leg stance (especially on the left), and impaired heel and toe walking. The Tinetti Performance-Oriented Mobility Assessment score was 14/28, and the Dynamic Gait Index score was 13/24, both indicating a high fall risk. The patient underwent eight weeks of rehabilitation, which included 45-minute physiotherapy sessions for three days per week. The OEP included five strengthening exercises, 12 balance exercises, and a walking programme. Outcome measures were recorded on day 1, at the end of week 4, and at the end of week 8. The outcome measures were evaluated using the 30-Second Chair Stand Test (CST), Four-Stage Balance Test (FSBT), Timed Up and Go test (TUG), and Dynamic Gait Index (DGI). Post-intervention after 8 weeks, FSBT, 30-second CST, TUG test and DGI scores were improved by 8 points (pre-3 seconds, post-11 seconds), 7 points (pre-15seconds, post-8seconds), 7 points (pre-17seconds, post-10seconds) and 6 points (pre-13/24, post-19/24), respectively. The patient could perform standing with eyes closed and a narrow base of support, turning around and standing on one foot, and walking on toes and heels after eight weeks.

Conclusions: This case study concludes that the Otago exercise programme can be beneficial and safe for stroke survivors in reducing fall risk and improving balance and gait.

Keywords: *fall prevention, balance, Otago exercises, stroke, weakness*

Introduction

Stroke is a clinical syndrome that is believed to be caused by a vascular problem and is characterised by the abrupt development of localised neurological symptoms that last longer than 24 hours or cause death. This definition covers stroke brought on by haemorrhage as well as infarction (1). Stroke is the third most common cause of mortality and one of the main causes of adult disability worldwide, and a global health problem (2). An estimated 80.1 million individuals worldwide suffer from strokes each year, and 6.2 million of them tragically lose their lives. Stroke primarily affects adults and is a significant cause of mortality and disability (3). Stroke patients with balance issues have limitations in their daily living activities, which reduces their degree of independence and community involvement (4).

Stroke patients typically demonstrate impaired balance and compensatory movements in various portions of their bodies while walking, have difficulty in performing activities of daily living, and may sustain injuries from falls. Various interventions have been studied to improve the gait and balance ability of stroke patients (2).

Exercise training is a major component of stroke rehabilitation, which aids in regaining lost functions (5). Exercise programmes are commonly used to improve muscle strength and balance, as evidence suggests they can reduce the risk of falls (2). The Otago exercise programme (OEP), developed by the Otago Medical School, is an evidence-based, home-based fall prevention programme delivered under clinical supervision (4). The Otago exercise programme focuses on three key domains: muscle strengthening, balance training, and walking. The OEP starts with exercises targeting head, neck, back, trunk, and ankle movements. These are followed by muscle-strengthening exercises for the knee flexors, extensors, hip abductors, ankle plantar, and dorsiflexors. Balance training includes knee bends,

backwards walking, turning while walking, sideward walking, heel-toe standing and walking, single-leg standing, heel walking, toe walking, backwards heel-toe walking, sit-to-stand transitions, and stair walking. The programme involves 45-minute sessions, 3 times per week, over 8 weeks (3).

Overall, the Otago exercise programme improves walking ability, posture control through enhanced muscle activation and movement patterns, and balance by improving control of the centre of gravity (3). Therefore, this study aimed to investigate the effectiveness of the OEP in reducing fall risk among stroke survivors.

Case

A 68-year-old male patient presented for neurological physiotherapy in January 2024 with complaints of persistent weakness in his left upper and lower limbs, along with an unsteady gait and difficulty in maintaining balance during routine activities. His symptoms began in August 2023, when he experienced sudden-onset left-sided weakness and facial droop in the early morning hours. He did not seek immediate medical attention, assuming the symptoms would resolve. However, due to persistent weakness, he was brought to a tertiary care hospital the following morning. An MRI brain at that time revealed an acute right-sided capsular lacunar infarct involving the posterior limb of the internal capsule, along with chronic ischemic changes in the bilateral periventricular white matter. He received inpatient care for 8 days, including medical stabilisation and physiotherapy. On discharge, he was advised to continue outpatient rehabilitation; however, follow-up and compliance were poor.

In January 2024, he returned to the outpatient department (OPD) due to ongoing imbalance, frequent near-falls, and difficulty initiating steps, especially when walking on uneven surfaces. On neurological examination, he demonstrated mild

spasticity in the left upper and lower limbs, consistent with a Modified Ashworth Scale score of Grade 1+. Voluntary motor control of the lower extremity was assessed using the Fugl-Meyer Motor Assessment, where he scored 23 out of a possible 34, indicating moderate impairment. Coordination testing revealed mild dysmetria in the left extremities, as evidenced by inaccurate finger-to-nose and heel-to-shin manoeuvres. Cranial nerve examination was unremarkable.

Balance testing showed a positive Romberg sign, with the patient swaying significantly and requiring support when standing with his feet together and eyes closed. He was able to maintain a tandem stance for 10 seconds with eyes open, but was unable to do so with eyes closed. On single-leg stance testing, he managed 9 seconds on the right leg but only 2 seconds on the left. The Tinetti Performance-Oriented Mobility Assessment showed a balance sub-score of 9 out of 16 and a gait sub-score of 5 out of 12, with a total score of 14 out of 28, indicating a high fall risk. Additionally, his Dynamic Gait Index score was 13 out of 24, further confirming an increased risk for falls. On the Timed Up and Go test, he took 17 seconds to complete the task, which exceeds the normal threshold and supports an elevated fall risk profile.

The patient exhibited an abnormal gait pattern with reduced left step length, asymmetrical arm swing, inconsistent foot clearance, and difficulty walking on heels and toes. Balance was notably impaired during directional changes. The patient had a history of right-sided capsular lacunar infarct leading to left hemiparesis, impaired motor control, and significant balance and gait issues, requiring a focused rehabilitation programme targeting gait, muscle strength, and dynamic balance.

Physiotherapy intervention

The patient was scheduled for physiotherapy sessions, each lasting 45 minutes, 3 days a week, over 8 weeks during rehabilitation. The primary

short-term goals of the intervention were to enhance muscle strength and improve the patient's balance and gait pattern. As the long-term objective, the treatments aimed at minimising fall risk and enhancing the patient's overall quality of life. The Otago exercise programme was implemented as the intervention. It started with warm-up exercises including head and neck movements, trunk rotations, back extensions, and ankle and toe mobility routines. This was followed by progressive resistance training using weights targeting key muscle groups: knee flexors and extensors, hip abductors, and ankle plantar flexors and dorsiflexors in the left lower limb. Balance training was also incorporated and included activities such as knee bends, varied walking patterns (backwards, turning, and sideways), heel-to-toe standing and walking, single-leg stands, as well as functional transitions like sit-to-stand and stair walking. The outcome measures were recorded on day 1, week 4, and week 8.

The Otago exercise programme was tailored and progressed based on the patient's functional status, tolerance, and clinical responses during each session. Initially, exercises were introduced at a basic level to ensure safety and familiarity, particularly focusing on achieving proper form and confidence with movements. In the first two weeks, the patient performed strengthening exercises without additional resistance to assess baseline motor control and endurance. Balance tasks were also adapted in complexity and support over time. Similarly, walking tasks (heel-toe walking and backward walking) were first practiced in a parallel bar setting, then progressed to overground practice on varied surfaces. Progression was also guided by subjective patient feedback and objective improvements in performance metrics such as increased standing time or reduced need for external support.

Outcome measurements

The Tinetti Performance-Oriented Mobility Assessment (POMA) is a validated tool used to assess balance and gait in stroke patients, helping

determine fall risk. A study by Jennifer Canbek et al. (2013) demonstrated good test-retest reliability (ICC=0.84) of the Tinetti POMA scale in stroke patients undergoing rehabilitation (8). It includes two components: a gait subscale (maximum score 12) and a balance subscale (maximum score 16), with a total maximum score of 28. Higher scores indicate better performance and lower fall risk. The Dynamic Gait Index (DGI) assesses gait, balance, and fall risk under various walking conditions using 8 tasks, each

scored from 0 (severe impairment) to 3 (normal), with a maximum score of 24. The 30-Second Chair Stand Test (CST) evaluates lower body strength and endurance. Lower scores reflect higher fall risk; a cutoff of ≥ 12 is expected for individuals aged 65–69. The Timed Up and Go (TUG) test assesses mobility and fall risk. In older stroke patients, scores >14 seconds suggest higher fall risk due to impaired balance and mobility.

Table 1. Pre- and post-balance and mobility measures for the Otago exercise programme

Assessment scale/ Test	Pre intervention score/grade	Post intervention score/grade (End of 4th week)	Post intervention score/grade (End of 8th week)
Tinetti Poma Scale	14/28	18/28	24/28
Dynamic Gait Index	13/24	16/24	19/24
30 Second Chair Stand Test (CST)	15 seconds	12 seconds	8 seconds
Timed Up and Go test (TUG)	17 seconds	15 seconds	10 seconds
Four Stage Balance Test (FSBT)- Task 3	3 seconds	5 seconds	11 seconds
Standing with eyes closed	2	2	3
Standing with narrow base	3	4	4
Standing on single leg	0	1	2
Walking on heels	0	1	2
Walking on toes	0	1	3

Results and Discussion

This study aimed to evaluate the impact of the Otago exercise programme on fall prevention in patients recovering from stroke. The findings reveal that Otago exercises were effective in minimising the fall risk of this patient.

After the 8-week intervention, the patient demonstrated significant improvements in both balance abilities and gait. This programme integrated resistance-based strengthening exercises utilising weight cuffs in order to maintain functional mobility. These exercises focused on strengthening essential muscle groups, including the knee flexors and extensors, hip abductors, and the plantar flexors and dorsiflexors of the ankle.

Furthermore, balance training was a core element of the programme. The patient engaged in exercises such as knee bends, backward and sideways walking, turning while walking, tandem standing and walking, heel and toe walking, single-leg stance, sit-to-stand transitions, and stair climbing. These activities are aimed to help stroke survivors regain motor control, crucial for reducing fall risk. The patient showed a considerable improvement in balance and gait performance following the Otago exercise regimen. However, there was no marked improvement in activities of daily living or overall quality of life. These findings are consistent with those of Park et al., (2016) who also reported that while the Otago programme effectively enhanced fall-related confidence in elderly stroke patients, its influence on quality of life did not reach statistical significance (3).

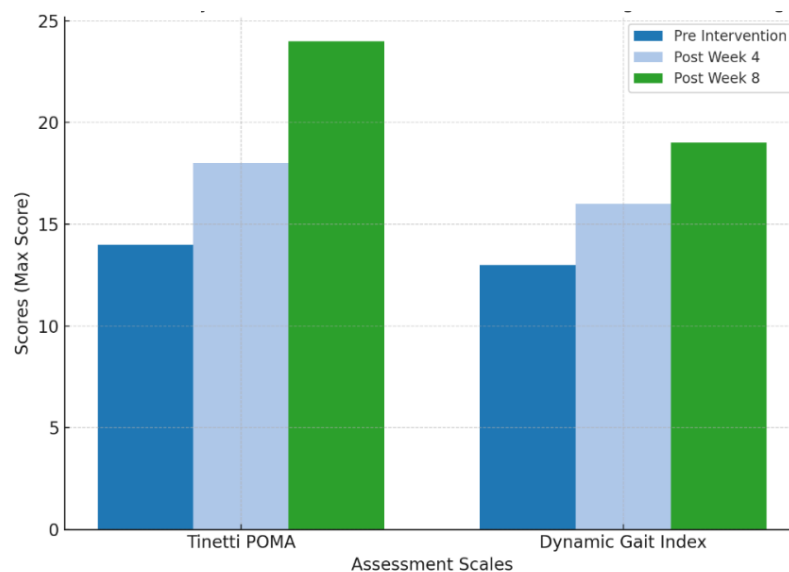


Figure 1. Pre- and post-intervention scores on the Tinetti Performance-Oriented Mobility Assessment (POMA) and Dynamic Gait Index following the Otago exercise programme

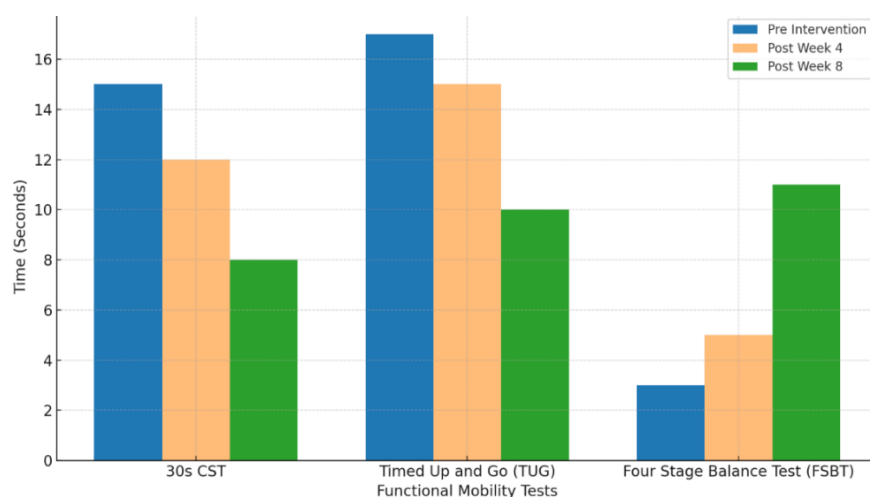


Figure 2. Pre- and post-intervention mobility test scores following the Otago exercise programme

The Otago exercise programme has demonstrated superior or comparable outcomes to other established stroke rehabilitation interventions, particularly in reducing fall risk and enhancing balance. A recent randomized controlled trial found that group-delivered OEP was not inferior to individual-based OEP in reducing fall rates among older adults over 12 months, with added benefits in adherence and cost-effectiveness (6). Similarly, Wu et al. (2024) reported in their meta-analysis that OEP significantly improves lower limb strength, dynamic balance, and gait performance in older populations, surpassing

many conventional fall-prevention protocols (7). Therefore, considering its simplicity, evidence-based structure, and adaptability for both home and clinical use, the OEP remains a robust and practical choice for fall prevention in stroke rehabilitation.

Regular participation in the OEP improves mobility and balance of stroke survivors. Based on the results, the Otago exercise programme reduced the fall risk in this patient. However, more comprehensive studies are needed to determine its effectiveness over other rehabilitation approaches. The OEP

intervention was conducted over 8 weeks, which limits the generalizability of the findings. Future studies with larger sample sizes, longer durations, varied outcome measures, and different exercise types are recommended to enhance the reliability and generalizability of findings. Comparative trials evaluating alternative interventions are also necessary to identify the most effective approach for fall prevention in stroke survivors.

Conclusions

The Otago exercise programme is effective in improving balance and gait in post-stroke patients and in reducing their risk of falls. However, further studies are needed to evaluate its long-term benefits and comparative effectiveness.

Author Affiliations

¹Faculty of Medicine, University of Colombo, Sri Lanka, ²Department of Allied Health Sciences, Faculty of Medicine, University of Colombo, Sri Lanka, ³Department of Psychiatry, Faculty of Medicine, University of Colombo, Sri Lanka

Author Declarations

Competing interests: The authors declare no conflicts of interest related to this research.

Funding: self-funded.

Acknowledgements: We thank the participant who was involved in this study.

Author contributions: All authors have contributed to the manuscript through data collection, data analysis, and writing.

References

1. Kim K, Jung SI, Lee DK. Effects of task-oriented circuit training on balance and gait ability in subacute stroke patients: a randomized controlled trial. *Journal of Physiotherapy Science*. 2017;29(6):989–92.
2. Park Y, Chang M. Effects of the Otago exercise program on fall efficacy, activities of daily living and quality of life in elderly stroke patients. *Journal of physical therapy science*. 2016;28(1):190-3.
3. Lee HY, Kim YL, Lee SM. Effects of virtual reality-based training and task-oriented training on balance performance in stroke patients. *Journal of physical therapy science*. 2015;27(6):1883-8.
4. Pirayesh F, Karimi Z, Ghatee MA, Yazdanpanah P, Razmeh S, Hossini SM. Comparison of the effect of core stability exercises and Otago exercises on quality of life in patients with stroke. *J Clin Care Skills*. 2021;2(2):51.
5. Kyrдалen IL, Moen K, Røysland AS, Helbostad JL. The Otago exercise program performed as group training versus home training in fall-prone older people: a randomized controlled trial. *Physiotherapy Research International*. 2014 Jun;19(2):108-16.
6. Albornos-Muñoz L, Blanco-Blanco J, Cidoncha-Moreno MÁ, Abad-Corpa E, Rivera-Álvarez A, López-Pisa RM, Caperos JM, Moreno-Casbas MT. Efficacy of the Otago-Exercise-Programme to reduce falls in community-dwelling adults aged 65-80 when delivered as group or individual training: Non-inferiority-clinical-trial. *BMC nursing*. 2024 Oct 1;23(1):705.
7. Wu S, Guo Y, Cao Z, Nan J, Zhang Q, Hu M, Ning H, Huang W, Xiao LD, Feng H. Effects of Otago exercise program on physical function in older adults: a systematic review and meta-analysis of randomized controlled trials. *Archives of Gerontology and Geriatrics*. 2024 May 3:105470.
8. Canbek J, Fulk G, Nof L, Echternach J. Test-retest reliability and construct validity



of the Tinetti performance-oriented
mobility assessment in people with stroke.
J Neurol. Phys. Ther. 2013 Mar;37(1):