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EFFECTS OF PROGRESSIVE TASK SPECIFIC TRAINING AND CONVENTIONAL PHYSICAL THERAPY ON FUNCTIONAL MOBILITY AND BALANCE IN PATIENTS WITH CHRONIC STROKE: A RANDOMIZED CONTROLLED TRIAL

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Abstract

Stroke frequently leaves persistent limitations in mobility and balance that reduce independence in daily activities. A randomized controlled study that examined Progressive Task Specific Training (PTST) and Conventional Physical Therapy (CPT) for functional mobility and balance. Chronic stroke patients between the ages of 40 and 60 were equally randomized to receive either PTST or conventional therapy treatment (sealed envelope technique), and treatment was given for 4 weeks. Functional mobility was assessed using the Timed Up and Go (TUG) test and balance, using the Berg Balance Scale (BBS). There was a significant improvement for both groups ($p<0.001$ for each group). In the PTST group, TUG time fell from 17.20 ± 1.89 to 13.01 ± 1.88 seconds and BBS scores rose from 34.18 ± 5.29 to 42.55 ± 5.41. In the conventional group, TUG time fell from 17.39 ± 2.46 to 15.69 ± 2.62 seconds and BBS scores rose from 35.20 ± 4.70 to 39.51 ± 4.83. For both outcomes scores were different between the groups ($p < 0.001$) in favor of PTST. Thus, progressive, functional tasks training could be beneficial to individuals with chronic stroke, though it requires validation in larger multicenter trials that follow.

I. INTRODUCTION

Stroke is a leading cause of long-term disability. The World Stroke is one of the top causes of chronic disability. It is the second biggest killer and leading cause of disability in adults globally (Li et al., 2024; for the WHO, 2023). In fact, stroke is the third largest non-communicable disease with over 160 million DALYs lost every year, and the World Stroke Organization and Lancet Neurology Commission predict over 200 stroke survivors and over 300 million DALYs lost annually by 2050 (Chen et al., 2026).

Among the most disabling consequences of the motor system, loss of balance is a condition. Coordinated visual, vestibular, somatosensory and musculoskeletal input to the correct brain stem, cerebellar and motor cortex is critical for maintaining the center of mass within the base of support (Wang et al., 2024). After stroke, disordered tone and voluntary control often result in balance disorders and gait, which are usually asymmetrical with imbalance in length of steps, swing time and limb angles, and slower in stride (Zhang et al., 2023). Special consideration should be given to trunk control. Deficits are frequently presented; trunk muscle weakness, increased central stability loss while seated, and trunk posture and stability loss during walking are asymmetrical, contributing to an increased fall risk and reduced participation (Khallaf, 2020). The Berg Balance Scale (BBS), Timed Up and Go test (TUG) and the Functional Independence Measure (FIM) index are routinely used in clinical assessment, demonstrating a correlation between balance and functional independence (Saraiva et al., 2023).

The chronic stage is defined as having occurred approximately 6 months after the onset, when improvement is likely to have been reached. Some functional improvements can be achieved at this phase, and the recovery process needs to be further continued to tackle remaining deficits and to restore/optimize stability and balance; the rehabilitation process can rely on neuroplasticity, restitution, substitution and compensation mechanisms (Paolucci et al., 2023). In chronic stroke, hemiparesis and the lack of mobility, balance and gait abnormalities continue to be present and contribute to falls and dependence (Park et al., 2021).

Rehabilitation techniques vary with emphasis. Within conventional physical therapy, strengthening, mobility, postural and balance exercises and trunk training (such as selective trunk training, core stability training, sitting reaching tasks and weight shifting) is usually recommended as part of the conventional physical therapy for this context (Ahmed et al., 2021). Trunk stabilization training is reported to have positive effects on trunk control, and sitting, standing and walking (Lee & Yim, 2025). Task specific trainings increase practice within functional, goal directed tasks through repeated practice that is increased in difficulty as required. It is commonly used after stroke and was found to have a positive effect on gait and

decreased gastrocnemius and soleus spasticity (Kim & Jang, 2021). Dual task practice is also widely adopted in stroke rehabilitation as a number of daily tasks require simultaneous performance of two or more tasks or sensory modalities (Shu et al., 2022).

The findings are not consistent regarding the benefits of exercise in chronic stroke; some meta-analyses suggest that exercise has positive effects on mobility, balance and gait, whereas others do not (Amanzonwé et al., 2023). There is limited direct evidence to compare direct physical therapist (DPT) with progressive task specific training (PTST) when used for the rehabilitation of balance and postural control in chronic stroke, leaving it to the individual to choose. The current randomized controlled trial thus assessed the differences between the efficacy of PTST and traditional PTE in improving functional mobility (based on TUG test) and balance (based on BBS) in chronic stroke patients. The null hypothesis assumed there would be no difference in effectiveness between the two approaches and the alternative hypothesis that there would be significantly more improvement by the PTST approach.

II. RELATED WORK

There have been a number of more recent trials that focus on a task based or ‘trunk-based' program. Sixty patients with stroke underwent a task specific trunk exercise group (TST-E) with a plinth and physiotherapy ball and a conventional physiotherapy group for 3 weeks - 4 sessions per week, which was performed by Akter et al. (2026). The experimental group showed more improvement on the BBS, the Trunk Impairment Scale total score, static and dynamic sitting balance and trunk coordination ($p<0.05$). There were 15 sessions in 5 weeks with 28 participants, randomized to task specific training plus usual physiotherapy (TSRT) or to usual physiotherapy alone (UPT), with differences between groups found in favor of TSRT for balance ($p = 0.001$) and trunk coordination ($p = 0.030$). (Masum 2025).

Mohsin and Fadhil Lateef (2026) trained 52 chronic stroke patients (CS) (26 patients per group) for 8 weeks using neuromuscular balance training. The training group gained 7.91 ± 3.11 BBS points against 2.25 ± 0.78 in controls, and TUG time improved by 3.21 ± 1.39 seconds against 1.14 ± 0.58 seconds (both $p < 0.001$). Kim and Jang (2021) randomly split 37 participants into cognitive sensorimotor exercise, task specific training or conventional physiotherapy groups for an 8-week period of training. The global score for proprioception was increased in the combined program and the interference variables relating to the effects of spasticity were different from those of the conventional physiotherapy treatment ($p < 0.05$).

The reviews provide context and identify gaps. In a systematic review of 26 trials, over 1,431 participants, dose-response relationships (such as frequency, number of sessions, duration and

repetitions) were found to have no significant impact on most outcomes in task specific training, graded the evidence as very low, and found that the optimal dose was not clear (Ibrahim et al., 2025). In a review of 13 trials Bobath therapy did not seem to be more effective than task specific training for arm activity, and transcranial direct current stimulation with task specific training did not appear to improve walking speeds relative to same amount of baseline evidence (Dorsch et al., 2023; Miranda de aquino Miranda et al., 2025). A review was conducted on core stability training, and it was concluded that CST could benefit the participants in a variety of ways including balance, gait, upper limb function and daily activities, with no effect sizes reported (Huang & Song, 2026).

III. METHOD

A. Design and Setting

This was a randomized controlled trial (RCT) with two groups conducted in the Neurorehabilitation Unit at Laeeque Rafiq Hospital, Multan, Pakistan. The study ran for 4 months starting from the institutional review board (IRB) approval.

B. Participants

The subjects were male and female aged 40-60 years and who have clinical diagnosis of chronic stroke for more than 6 months having motor deficit on clinical assessment ranging from mild to moderate and could walk without using any assistive devices in their walking (Alsubiheen et al., 2022). Patients with conditions that affected gait or motor function as multiple sclerosis, epilepsy, recent fractures or surgery, an uncontrolled cardiovascular or systemic disease that would preclude exercise, significant visual or vestibular deficits that would interfere with balance or interest in rehabilitation or other clinical research protocols were excluded from the study.

C. Sample Size and Allocation

There was total 60 participants, 30 were identified in each group. Minimum sample size was calculated using G*Power and an $\alpha = 0.05$, a power = 0.60, an effect size of 0.5. The participants were identified by purposive non-probabilistic sampling and then randomized by the sealed envelope technique to Group A (PTST) or Group B (conventional physical therapy).

D. Outcome Measures

A demographic form was completed, documenting age, gender, duration of stroke and neurological condition. The TUG was used as the tool for functional mobility, a standard chair

with arm rests (seat height 45cm), stop watch and walkway of length 3 m. When the word “Go” was given, the participants got up and walked 3 m, turned and returned to their seats and the time in seconds was measured (Podsiadlo & Richardson, 1991). Evaluated using the BBS, a 14-item validated scale that involves performing aspect of a transfer, standing with eyes closed, reaching stretched arm forward, picking up from the ground, turning 360, crossing one foot on a stool, tandem and single leg stance (Mao et al., 2022). The items are independently scored from 0 (incapable) to 4 (independent) to get a total score of 0 to 56. The interpretation bands for both the instruments are given in Table I

Table I. Interpretation bands for the TUG test and the BBS

Measure	Score	Interpretation
TUG	Under 10 s	Normal mobility in a healthy adult
TUG	11 to 20 s	Independent mobility with slight functional impairment
TUG	Over 20 s	Loss of mobility and greater functional impairment
TUG	Over 30 s	High risk of falling and severe functional dependency
BBS	41 to 56	Low fall risk
BBS	21 to 40	Moderate fall risk
BBS	0 to 20	High fall risk

TUG: Timed Up and Go test (lower is better). BBS: Berg Balance Scale (higher is better).

E. Interventions

The training sessions were 45-60 minutes long, three sessions a week for 4 weeks for both groups. Group A were given PTST, which focused on functional tasks and practiced repeatedly, then progressed from sitting tasks to standing tasks, then walking tasks and finally walking while also attempting a functional task (dual-task training), tasks became more difficult by increasing speed, resistance, base of support (BOS), task complexity. Group B Rehabilitation was "conventional" and consisted of general balance, strength and mobility exercises without progression of task complexity.

F. Procedure

After IRB approval, recruitment was initiated. The objective of the study, the procedure, the risks associated with participation and its possible benefits were explained to the participants and informed consent in writing was given. The pre-allocation and post allotment assessment was conducted to measure baseline TUG and BBS scores at the beginning of the 4-week program, and to assess the same at the end of the program.

G. Statistical Analysis

The data were analyzed using SPSS version 26.0. Continuous variables were presented in a mean ± SD and tested for difference in genders by a chi square test. Normality was tested on Shapiro Wilk test and QQ plot. Paired t tests and independent t tests were used to test the differences within and between the groups, respectively, in normally distributed data, with the Wilcoxon signed rank and Mann Whitney U tests also stated for nonparametric data. Cohen's d was calculated as the effect size for the within group changes. For every scale, the change scores were computed between pretest and posttest scores, with % change calculated by dividing by the pretest score mean. The values of p which were less than 0.10 were considered statistically significant.

H. Ethical Considerations

The study (IRB) was conducted per IRB standards. The participation was voluntary, the procedures, the risks and possible disadvantages was explained and the participants were informed about their right to stop participating at any time. Identities were anonymized and data was kept in a secure and password protected area.

IV. RESULTS

A. Participant Characteristics

All 60 (30 each) data were analyzed. No differences were found at baseline between age or gender distribution in the two groups (Table II).

Table II. Baseline demographic characteristics

Variable	PTST (n = 30)	Conventional PT (n = 30)	p value
Age (years)	49.67 ± 4.99	51.10 ± 4.77	0.260
Male, n (%)	14 (46.7)	16 (53.3)	0.796
Female, n (%)	16 (53.3)	14 (46.7)	

Age is given as mean ± SD. The *p* value for gender comes from a chi square test ($\chi 2 = 0.067$).

B. Distribution of the Data

All Shapiro Wilk statistics were nonsignificant for TUG and BBS both before and after the intervention for both groups (all $p > 0.05$), so enabling the use of parametric tests.

C. Changes Within Groups

Paired t tests showed significant gains in both groups on both outcomes (Tables IIIa and IIIb). The effects were large, with Cohen's d ranging from 2.73 to 4.84 across the two groups.

Table IIIa. Pre-post changes in TUG and BBS in the PTST group (paired t test)

Outcome	Pre (mean ± SD)	Post (mean ± SD)	Change (mean ± SD)	t (29)	d	p
TUG (s)	17.20 ± 1.89	13.01 ± 1.88	4.18 ± 1.09	21.04	3.84	<0.001
BBS (points)	34.18 ± 5.29	42.55 ± 5.41	8.38 ± 1.73	26.50	4.84	<0.001

TUG in seconds; BBS in points; SD: standard deviation; d: Cohen's d.

Table IIIb. Pre-post changes in TUG and BBS in the conventional PT group (paired t test)

Outcome	Pre (mean ± SD)	Post (mean ± SD)	Change (mean ± SD)	t (29)	d	p
TUG (s)	17.39 ± 2.46	15.69 ± 2.62	1.70 ± 0.62	14.97	2.73	<0.001
BBS (points)	35.20 ± 4.70	39.51 ± 4.83	4.31 ± 1.23	19.24	3.51	<0.001

TUG in seconds; BBS in points; SD: standard deviation; d: Cohen's d.

D. Differences Between Groups

The groups did not differ at baseline on either outcome. After the intervention, TUG time was shorter and BBS score higher in the PTST group, with the between group difference larger for

TUG than for BBS (Table IV). Change scores showed the clearest separation, with PTST producing greater improvement on both measures (Fig. 1).

Table IV. Between group comparison (independent t test, df = 58)

Outcome	PTST (mean ± SD)	Conv. PT (mean ± SD)	t	p
TUG before	17.20 ± 1.89	17.39 ± 2.46	0.34	0.735
TUG after	13.01 ± 1.88	15.69 ± 2.62	4.55	<0.001
TUG change (reduction)	4.18 ± 1.09	1.70 ± 0.62	10.86	<0.001
BBS before	34.18 ± 5.29	35.20 ± 4.70	0.79	0.430
BBS after	42.55 ± 5.41	39.51 ± 4.83	2.30	0.025
BBS change (gain)	8.38 ± 1.73	4.31 ± 1.23	10.50	<0.001

TUG in seconds; BBS in points.

E. Percentage Change

There were approximately two to two and a half times greater improvements in the PTST group compared to the conventional group on both measures (Table V).

Table V. Percentage change from baseline

Outcome	PTST (%)	Conv. PT (%)
TUG reduction	24.32	9.76
BBS improvement	24.51	12.24

V. DISCUSSION

Although it is recognized that both programs had measurable increases in functional mobility and balance, the alternative hypothesis of the larger increases for PTST on both measures was supported. The results of the age and gender were also similar across the groups, providing further support for a difference in the intervention group that is separate from their inequality at the start rather than due to bias. Group level BBS refers to: describe the real-life implications of the disparity. The two groups were in the intermediate range of fall risk (21 to 40). After 4 weeks, the mean of the PTST was in the low-risk zone (41 to 56), whereas the conventional

mean was in the moderate risk zone (39 to 56). This is just an observation about the group means and does not represent the number of individuals who actually moved categories.

The most likely reason may be related to the material presented in the PTST program. Sit to stand transitions, reaching, weight shifting, stepping and walking both challenged participants as they improved and required the same postural adjustments as tasks occurred in real life. The standard program focused on balance, strength and mobility, and exercises were not gradually increased in difficulty. This trial did not measure anticipatory postural adjustments and sensorimotor mechanisms as described in the core stability literature (Huang & Song, 2026) but it is suggested that task-specific, goal-directed practice may affect them as well.

The results of the findings are in agreement with previous trials. Greater balance gains were experienced with the task specific trunk as opposed to the conventional physiotherapy by Akter et al. (2026), while Masum (2025) reported a between group balance difference favoring to the task specific training + usual physiotherapy. After 8 weeks of Neuromuscular Balance training, significant improvement was also found in both TUG and BBS in the group with chronic stroke (Mohsin & Fadhil Lateef, 2026). The agreement is not only with regard to the direction of the effect, but also the type of intervention, in terms of duration (three, five and eight weeks versus four) and sample size. The wider literature also supports the idea of task specific approaches over some of the more traditional frameworks, such as the system level review of Bobath therapy (Dorsch et al., 2023) which involved arm outcomes.

The average score of the conventional group also improved considerably. This validates the continued relevance of regular exercise-based therapy in the chronic stage, in line with the overall observation that benefits of functional therapy are still possible after 6 months of post stroke period (Paolucci et al., 2023). The dosage of task specific training remains a point of contention (Ibrahim et al., 2025); therefore, the present data are not meaningful in answering the question of what would happen if either duration or intensity of either program is changed.

VI. LIMITATIONS

There are a few limitations. Some of the results have to be qualified. The sample size was small of 60 and the sampling methods of purposive nonprobability sampling may have resulted in selection bias. Limited generalizability to other populations and health care settings due to participants being from one neurorehabilitation unit. Quality of life, falls, specific trunk control and community mobility were not evaluated, as only TUG and BBS were utilized. Follow up was short, and the durability of the gains is unknown.

VII. CONCLUSION

In a nut shell, for adults with chronic stroke, 4 weeks of PTST resulted in bigger functional mobility and balance improvements compared to conventional physical therapy, however, both therapies resulted in significant improvements. With the above limitations in mind, progressive, repetitive and task specific activities can therefore be encouraged in a chronic stroke rehab program. In future study, larger and more diverse samples could be recruited to engage in multicenter randomized trials with follow up assessment to determine persistence of benefits; outcomes measures for trunk control and gait function, fall risk and quality of life could be added; and PTST could be compared to other, task oriented and technology-based interventions.

REFERENCES

Ahmed, U., Karimi, H., Amir, S., & Ahmed, A. (2021). Effects of intensive multiplanar trunk training coupled with dual task exercises on balance, mobility, and fall risk in patients with stroke: A randomized controlled trial. *Journal of International Medical Research, 49*(11), 03000605211059413.

Akter, M. S., Hossain, S., Ahmmed, F., Ferdus, J., Haque, M. S., Al Amin, H. M., Sutradhar, R., Khan, H., & Azim, S. F. (2026). Effectiveness of trunk exercises for improving balance and trunk control among patients with stroke in Bangladesh. *Complementary Therapies in Clinical Practice, 63*, 102053.

Alsubiheen, A. M., Choi, W., Yu, W., & Lee, H. (2022). The effect of task-oriented activities training on upper limb function, daily activities, and quality of life in chronic stroke patients: A randomized controlled trial. *International Journal of Environmental Research and Public Health, 19*(21), 14125.

Amanzonwé, E. R., Tedesco Triccas, L., Codjo, L., Hansen, D., Feys, P., & Kossi, O. (2023). Exercise dosage to facilitate the recovery of balance, walking, and quality of life after stroke. *South African Journal of Physiotherapy, 79*(1), 1846.

Chen, L., Wei, X., & Zheng, S. (2026). Effects of task-oriented circuit class training on walking ability after stroke: A meta-analysis. *Frontiers in Neurology, 17*.

Dorsch, S., Carling, C., Cao, Z., Fanayan, E., Graham, P. L., McCluskey, A., Schurr, K., Scrivener, K., & Tyson, S. (2023). Bobath therapy is inferior to task specific training and not superior to other interventions in improving arm activity and arm strength outcomes after stroke: A systematic review. *Journal of Physiotherapy, 69*(1), 15 to 22.

Huang, Y., & Song, J. (2026). Core stability training for post stroke recovery: A multifaceted approach to enhance postural control and motor function. *Physiotherapy Research International, 31*(3), e70242.

Ibrahim, R. u., Abdullahi, A., Salihu, A. T., & Lawal, I. U. (2025). Intensity of task specific training for functional ability post stroke: Systematic review and meta-analysis. *Clinical Rehabilitation, 39*(9), 1133 to 1155.

Khallaf, M. E. (2020). Effect of task specific training on trunk control and balance in patients with subacute stroke. *Neurology Research International, 2020*(1), 5090193.

Kim, K. H., & Jang, S. H. (2021). Effects of task specific training after cognitive sensorimotor exercise on proprioception, spasticity, and gait speed in stroke patients: A randomized controlled study. *Medicina, 57*(10), 1098.

Lee, S., & Yim, J. (2025). Effect of virtual reality-based training, including preceding trunk stabilization education, on postural control and balance in patients with stroke: A randomized controlled trial. *Applied Sciences, 15*(13), 7620.

Li, X., He, Y., Wang, D., & Rezaei, M. J. (2024). Stroke rehabilitation: From diagnosis to therapy. *Frontiers in Neurology, 15*, 1402729.

Mao, Y., Gao, Z., Yang, H., & Song, C. (2022). Influence of proprioceptive training based on ankle foot robot on improving lower limbs function in patients after a stroke. *Frontiers in Neurorobotics, 16*, 969671.

Masum, K. A. A. (2025). Effectiveness of task specific training on trunk balance in patients with stroke.

Miranda de Aquino Miranda, J., Sousa de Andrade, P. H., Henrique, M. E. S. A., Henrique de Souza Fonseca, B., Bazan, R., Sande de Souza, L. A. P., & José Luvizutto, G. (2025). The effect of transcranial direct current stimulation combined with task specific training on spatio temporal gait parameters and functional mobility in individuals with stroke: A systematic review and meta-analysis. *Topics in Stroke Rehabilitation, 32*(4), 438 to 457.

Mohsin, T. S., & Fadhil Lateef, H. (2026). Neuromuscular balance training enhances motor coordination and postural control in post stroke patients: A randomized controlled trial. *Iranian Rehabilitation Journal, 24*(2), 231 to 242.

Paolucci, T., Agostini, F., Mussomeli, E., Cazzolla, S., Conti, M., Sarno, F., Bernetti, A., Paoloni, M., & Mangone, M. (2023). A rehabilitative approach beyond the acute stroke event: A scoping review about functional recovery perspectives in the chronic hemiplegic patient. *Frontiers in Neurology, 14*.

Park, C., Son, H., & Yeo, B. (2021). The effects of lower extremity cross training on gait and balance in stroke patients: A double blinded randomized controlled trial. *European Journal of Physical and Rehabilitation Medicine, 57*(1), 4 to 12.

Podsiadlo, D., & Richardson, S. (1991). The timed "Up & Go": A test of basic functional mobility for frail elderly persons. *Journal of the American Geriatrics Society, 39*(2), 142 to 148.

Saraiva, J., Rosa, G., Fernandes, S., & Fernandes, J. B. (2023). Current trends in balance rehabilitation for stroke survivors: A scoping review of experimental studies. *International Journal of Environmental Research and Public Health, 20*(19), 6829.

Shu, Y., Bi, M. M., Zhou, T. T., Liu, L., & Zhang, C. (2022). Effect of dual task training on gait and balance in stroke patients: An updated meta-analysis. *American Journal of Physical Medicine & Rehabilitation, 101*(12), 1148 to 1155.

Wang, J., Li, Y., Yang, G. Y., & Jin, K. (2024). Age related dysfunction in balance: A comprehensive review of causes, consequences, and interventions. *Aging and Disease, 16*(2), 714 to 737.

Zhang, M., Liang, Z., Li, Y., Meng, J., Jiang, X., Xu, B., Li, H., & Liu, T. (2023). The effect of balance and gait training on specific balance abilities of survivors with stroke: A systematic review and network meta-analysis. *Frontiers in Neurology, 14*, 1234017.