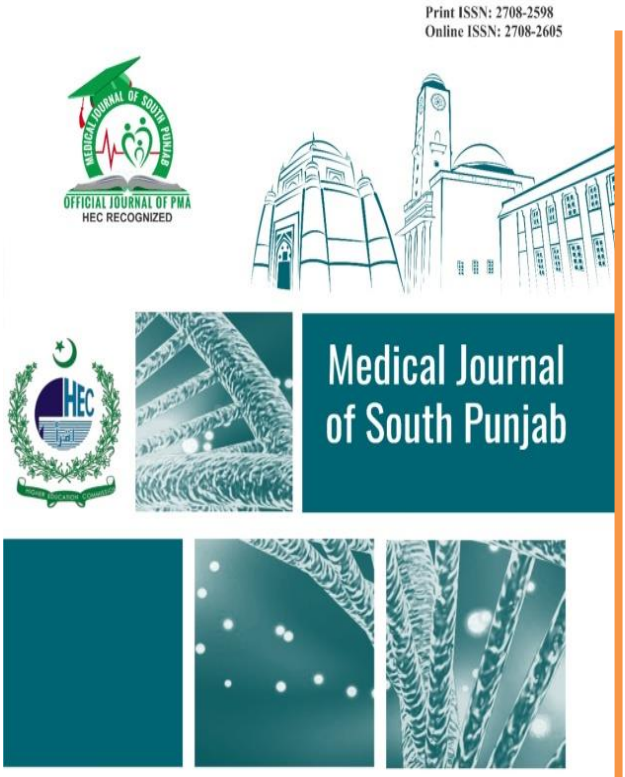
ISSN (E): 2708-2601
ISSN (P): 2708-2598

Medical Journal of South Punjab
Article DOI:10.61581/MJSP.VOL07/03/02
Volume 7, Issue 3, 2026



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Publication History

Received: Aug 31, 2026 Revised: Sept 15, 2026
Accepted: Sep 24, 2026 Published: Sep 30, 2026

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Conflict of Interest:

Author(s) declared no conflict of interest.

Acknowledgment:

No Funding received.

Citation: Nisar MM, Sajjad MH. Effects of dual-task training and conventional physical therapy on upper extremity motor functions among individuals with subacute stroke. Medical Journal of South Punjab. 2026 Septemeber 30; 7(3):8-13.

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An official publication of
Medteach Private Limited, Multan, Pakistan.
Email: farman@mjsp.com.pk, Website: https://mjsp.com.pk/index.php/mjsp

Medical Journal of South Punjab
Volume 7, Issue 3, 2026; pp: 8-13
Original Article

Effects of dual-task training and conventional physical therapy on upper extremity motor functions among individuals with subacute stroke

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ABSTRACT

Objective: To compare the effects of dual-task training (DTT) with dose-equivalent conventional physical therapy for improving upper extremity motor function in people with subacute stroke.

Methods: Randomized controlled trial was conducted at Ibne Siena Hospital and Research Institute and BARKI Advanced Physiotherapy, Multan, Pakistan; four-week intervention from 2nd May 2026 to 31 August 2026. The randomized controlled trial was conducted at Ibne Siena Hospital and Research Institute and BARKI Advanced Physiotherapy, Multan, Pakistan. Sixty-two participants were randomized into two groups with 56 completing the four week intervention (28 per group). Both groups had four 1-hour sessions per week. Conventional therapy was supplemented by functional upper limb tasks in sitting position on a Swiss ball for the DTT group, whereas the comparison group received conventional exercises only. Motor recovery was assessed with the Fugl-Meyer Assessment–Upper Extremity (FMA-UE) before and after treatment.

Results: The mean FMA-UE increased in the DTT group from 25.07 ± 4.35 to 45.29 ± 3.86, and in the conventional group from 24.68 ± 3.80 to 35.07 ± 3.92. Mean change was 20.21 ± 4.52 vs 10.39 ± 2.66 points respectively. The difference in change between groups was 9.82 points (95% CI, 7.83–11.82; $p < .001$).

Conclusion: Across four weeks, the dual-task training was related to greater gains in upper extremity motor scores than the dose-equivalent conventional program. Further follow-up and functional outcome measures are needed to establish whether these improvements are durable and translate into everyday independence.

Keywords: Dual-Task Training, Conventional, Physical Therapy,Stroke, Upper Extremity, Motor Functioning.

1. INTRODUCTION

Stroke is leading cause of long-term neurologic disability globally. When blockage in blood vessel or bleeding stops blood flow to brain, it can damage areas of brain responsible for voluntary movement, sensation, language, thinking and posture[1]. Medical care increases the likelihood of survivors experiencing long-term difficulties, particularly if the arm and hand are weak and unable to move selectively, or if injuries are left untreated. These restrictions might still apply even though the mobility began to return, at a basic level. Limited use of the affected arm makes activities of daily living like eating, dressing, bathing and handle familiar objects slower and harder and sometimes impossible without assistance[2, 3]. A problem unique to such settings is the lack of consistent availability for neurological rehabilitation and follow-up after stroke that causes disability and contribute to the quality of life. Burden of cerebrovascular disease is worsened in Pakistan by the presence of common vascular risk factors and inequity of access to prevent and rehabilitate services[4]. Thus, care in a stroke rehab is necessary interventions which are viable and affordable and can be implemented in a regular setting. Upper extremity function is a critical element of this effort because regaining even some of the affected hand's function can lessen dependence in daily activities, and enable return to family and social roles [4, 5]. Upper extremity dysfunction is to some degree dependent upon the location and severity of the brain injury. When the middle cerebral artery is damaged, the lesions will affect the nerve tracts that control the face and upper limb[6]. Symptoms include weakness, abnormal movement synergies, poor coordination, impaired grasp and reduced dexterity[7]. These issues aren't just strength of the muscles. Simple movements are difficult to carry out due to poor attention, sensory processing and motor planning. Patients may have to coordinate trunks with arm when grasping an object, use environment for visual guidance, and their arms with trunks stability[8]. Subacute is a very vulnerable stage for rehab. Initial spontaneous neurological recovery and experience-dependent motor network changes are found during this timeframe, as well as reward effects during repeated practice[9]. Adjusted positioning, stretch, active and assisted mobility exercises, strengthening exercises, weight bearing and progressive functional training are frequent components of physiotherapy[10]. These approaches help to maintain joint movement, to assist with muscle activation and to restore basic movement patterns. However, the improvement in isolated movement does not always result in the confident use of the arm in demanding everyday activities, when several actions have to happen at the same time[11].

Dual task training is a strategy that seeks to alleviate this mismatch. Dual-task refers to a person doing a motor task in combination with another motor (cognitive or postural) task[12]. Common examples are sitting balanced when holding a cup, reaching for an object while keeping an eye on your body position and sorting things while listening to instructions. Such combined requirements can reveal subsyndromes which are not clearly manifested in a single, isolated exercise following stroke. While patients are improving their coordination and attention control in the clinic, a gradual increase in the number of simultaneous tasks introduced and task complexity may help patients begin to practice that same coordination and attention control in other environments outside of the clinic[13]. The benefits of dual-task rehabilitation in several motor and cognitive outcomes. The benefits on upper limb and cognitive abilities after using dual task approach in occupational therapy[12, 14]. Conventional treatments combined with dual task activities with good results in the upper limb[15]. Recently, dual task training for the upper-limb of chronic stroke survivors was studied and increased the upper-limb function relative to conventional training [16].

A clinically relevant question is whether or not a dual-task approach results in an accentuation of arm motor improvement when total time in therapy is the same between the two groups. This is often helpful if only the physiotherapy treatment cannot be extended due to routine treatments. Therefore, the present study compared two dose-equivalent combined doses of treatment utilizing dual-task training and dose-equivalent conventional physical therapy and dose-equivalent traditional physical therapy alone for people who have a stroke that has been occurring for between three and six months. The primary outcome was the effect on upper extremity motor function as assessed by the Fugl-Meyer Assessment–Upper Extremity (FMA-UE).
yearly.[3,4]

2. METHODOLOGY

The study was conducted at Ibn-e-Siena Hospital and Research Institute and BARKI Advanced Physiotherapy Complex, Multan, Pakistan for 4 months in a Randomized Controlled Trial. The sample size of 62 was calculated using G*Power (effect size = 0.729) based on a previous study (13). Adults aged 40-79 years were recruited using purposive sampling who had experienced a first ischemic stroke 1-6 months prior to the study and could follow instructions, actively extend the wrist and sit independently in 30 seconds on a Swiss ball. There were 83 patients who were screened, and 62 were randomly assigned via the sealed envelope into one of two groups, the dualtime group (DTG) or the dose equivalent, but traditional group (DECG). 56 participants (28 in each group) completed the study after missing 6 of the meetings. The two groups were given one hour per day 4 days each week for 4 weeks on consecutive days. The DTG consisted of conventional physiotherapy and functional dual-task activities, such as drinking from drinking straws, wiping table surface and transferring cubes while sitting on a Swiss ball. The conventional upper limb exercises, stretching exercises, active and assisted movements and weight bearing exercises were received by the DECG.

The Fugl-Meyer Assessment–Upper Extremity (FMA-UE) was used to evaluate motor function before and after the treatment with scores ranging from 0 to 66 points representing a maximum motor function of an UE extremity. The SPSS version 26.0 was used to analyze the data obtained. Shapiro-Wilk test and Q-Q Plots were used for normality assessment. Within group changes were assessed using paired-samples t-tests and between group changes were evaluated using independent-samples t-tests for baseline, post-treatment scores and changes.

3. RESULTS

Among For the 62 randomized participants, 56 of them were analyzed, 28 in DECG and 28 in DTG. Mean age was 47.54 ± 5.38 years in DTG and 50.96 ± 4.66 years in DECG. The DTG group had 22 (78.6%) men and the DECG group had 19 (67.9%) men. The mean FMA-UE score at baseline was 25.07 ± 4.35 in DTG and 24.68 ± 3.80 in DECG as shown in table 1.

The scores at 4 week post intervention for the mean FMA-UE scores were 45.29 ± 3.86 and 35.07 ± 3.92 for the dual-task and the conventional groups, respectively. The mean scores for the groups were 10.21 points apart on post treatments. This was a statistically significant difference between the two groups based upon an independent-samples t-test ($t(54) = 9.834$, $p < .001$, 95% CI [8.13, 12.30]). This effect size estimate was presented as .801. Focusing on the upper extremity motor domain, results indicate that the DTT group had significantly higher scores after 4 weeks as compared to the conventional group after treatment.

Both group scores were successful in improvement from baseline scores. For DTG, the mean increased from 25.07 ± 4.35 to 45.29 ± 3.86, a gain of 20.21 points (pair t =

−23.684, df = 27, p < .001; effect size 0.977). The DECG improved from 24.68 ± 3.80 to 35.07 ± 3.92, a gain of 10.39 points (paired t = −20.694, df = 27, p < .001; reported effect size 0.970). Both treatment programs led to improvement, and there were greater mean changes in DTG.

Prior to treatment 5 (17.9%) of the DTG participants and 9 (32.1%) of the DECG participants were severe impairment and 23 (82.1%) and 19 (67.9%) were moderate to severe respectively. Clinical status of all 28 patients in the DTG group was moderate or mild to moderate at post-treatment: 6 (21.4%) severe (moderate), 22 (78.6%) mild to moderate. In DECG, 5 (17.9%) were in moderate to severe and 23 (82.1%) were in moderate category. These description changes align with the overall increase in the increase of FMA-UE scores seen with the DTG.

Table-1: Baseline characteristics of study participants

Characteristic	DTG (n = 28)	DECG (n = 28)
Age, years (mean ± SD)	47.54 ± 5.38	50.96 ± 4.66
Men, n (%)	22 (78.6%)	19 (67.9%)
Women, n (%)	6 (21.4%)	9 (32.1%)
Baseline FMA-UE (mean ± SD)	25.07 ± 4.35	24.68 ± 3.80

Table-2: Comparison of FMA-UE Scores before and after treatment

FMA-UE score	DTG (mean ± SD)	DECG (mean ± SD)	p-value
Pre-treatment	25.07 ± 4.35	24.68 ± 3.80	.720
Post-treatment	45.29 ± 3.86	35.07 ± 3.92	< .001
Mean Change	20.21 ± 4.52	10.39 ± 2.66	< .001

Table-3: FMA-UE impairment categories before and after treatment

Impairment category	DTG pre	DTG post	DECG pre	DECG post
Severe (0–22)	5 (17.9%)	0	9 (32.1%)	0
Moderate-severe (23–32)	23 (82.1%)	0	19 (67.9%)	5 (17.9%)
Moderate (33–42)	0	6 (21.4%)	0	23 (82.1%)
Mild-moderate (43–52)	0	22 (78.6%)	0	0
Mild (53–66)	0	0	0	0

4. DISCUSSION

The present study concluded that dual task training (DTT) and dose equivalent conventional physio therapy resulted in more improvement among subacute stroke patients in motor function of upper extremity than conventional physiotherapy alone. After 4 weeks, the dual-task group improved their mean Fugl-Meyer Assessment – Upper Extremity (FMA-UE) scores by 20.21 ± 4.52 points while the conventional group improved by 10.39 ± 2.66 points. This amount of increase was 9.82 points (p < .001) between groups, reflecting a greater improvement in motor function in the dual-task training group. It is found that the functional dual-task training and the conventional physiotherapy both significantly improved from baseline, suggesting the benefit of traditional physiotherapy, and the integration of functional activities with dual tasks may have benefits.These results were similar to those of Tasseel-Ponche (2023), which found positive results from dual-task rehabilitation on motor and cognitive outcomes after stroke[17]. In the same way, An and Kim (2021) found that the addition of 2-duty to OT exercises helped to increase the upper limb and cognitive performance[15]. The present results confirm these observations by showing greater improvement with a dual-task approach of combining a traditional physiotherapy program with the same amount of treatment time, resulting in changes in motor function of the upper limb. That's clinically important as they may not have enough time to build up session time in rehab, and therefore functional activities are a viable method for introducing them in the current treatment programmes.

The results also corroborate those of Choudhary et al. (2024), which indicated that top-frontal rehabilitation plus dual task indicated positive upper extremity outcome for the discharge [16]. In addition, Tun et al. (2025) showed enhancement after upper limb dual task training in chronic stroke patients as compared to traditional training [18]. These

studies lend support to the possible benefits of dual-task rehabilitation, but should account for some differences in study demographics, rehabilitation techniques and outcome measures to compare the results with the current study. Overall, these results point in a similar direction as to how motor practice, plus extra task demands can increase the functional relevance of stroke rehabilitation.These improvements during simultaneous practice of upper-limb movements, postural control, attention to the visual context, and coordination of the tasks might relate to a single observed improvement. Participants were required to control arm movements while maintaining stability and control in the context of functional tasks when seated on a Swiss ball, such as drinking from a glass, wiping a table and transferring cubes[19]. This method could have been instrumental in helping to promote movement patterns associated with real-life tasks, instead of just specific exercises. The current study, however, didn't directly assess cognitive performance, attention, or even underlying changes in the plastic event; hence they are only speculated mechanisms and not actual findings.All of the participants in the dual-task group were deemed to be in the moderate or the mild to moderate group after the treatment, while the conventional remained mostly in moderate group. The categories should be used in addition to ongoing FMA-UE scores, however, and should not be considered as a standalone measure for functional independence[20].

The limitations of this study were that it was not a large study, it did not have long term follow up and only went for four weeks. Results might not be applicable to patients who do not meet inclusion criteria (severe disability associated with stroke). Future research can assess the sustainability of these improvements and assess their impact on the activities of living of athletes. In summary, dual-task training seems to be a promising method which can be used as an adjunct to traditional physiotherapy in the subacute phase of stroke rehabilitation to enhance motor function of the UE.

5. CONCLUSION

Across four weeks, the dual-task training was related to greater gains in upper extremity motor scores than the dose-equivalent conventional program. Further follow-up and functional outcome measures are needed to establish whether these improvements are durable and translate into everyday independence.

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