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Dual-Task Specific Training or Conventional Physiotherapeutic Interventions, Which one is more Effective?

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ABSTRACT

Background: Physiotherapeutic interventions play a crucial role in motor re-learning and functional recovery for stroke patients with upper and lower limb motor impairments. Among these interventions, dual-task training (DTT) has demonstrated significant effectiveness in enhancing the functional recovery of stroke patients.
Objective: This study aims to compare the effectiveness of DTT and conventional physical therapy in ambulating right-hemiplegic stroke patients.
Material and Methods: A randomized control trial (RCT) was conducted at the Department of Rehabilitation Medicine, Saidu group of Teaching Hospital, 2nd March 2020 to 3rd August 2020. Chronic right-hemiplegic stroke patients meeting set inclusion criteria were randomly assigned to two groups: the treatment group (TG) receiving DTT and the control group (CG) undergoing conventional physical therapy. DTT interventions included walking forward, backward, and sideways on a smooth surface while holding an 80-gram sandbag. The CG received conventional physiotherapy involving mat activities, strengthening, stretching exercises, and ambulation/gait training. Pre- and post-tests collected clinical data analyzed on SPSS 22 included spatial and temporal variables, 10-Meter Walk Test (10MWT), Time Up & Go Test (TUG), step length, cadence, cycle time, and stride length.
Results: Out of 18 patients, each group had 50%, comprising 5 males (28%) and 4 females (22%). The mean age in CG was 57.20± 5.20, and in TG, it was 57.27± 6.10 years. Baseline clinical parameters were nearly identical between groups (P>0.05). Post-test scores revealed significant improvements in spatial and temporal gait variables, 10MWT score, cadence, step length, stride, and cycle time in TG compared to CG (P<0.05).
Conclusion: Dual-task training and conventional physical therapy both significantly enhance the functional ability of right-hemiplegic patients across all gait temporal and spatial parameters.
Keywords: Conventional physical therapy, Dual task training, Gait & ambulation, Stroke.

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INTRODUCTION

Stroke, a critical medical condition, stands as a significant global health concern. From 1990 to 2019, the prevalence of stroke has shown alarming trends, with a noticeable increase in both incidence and associated risk factors. As of 2022, the World Health Organization (WHO) estimates that annually, 15 million people worldwide experience a stroke. Tragically, this results in 5 million deaths and an additional 5 million individuals left permanently disabled. These statistics underscore the immense burden stroke places on affected individuals, families, and healthcare systems globally.

Stroke is the 3rd cause of death globally; from 1990-2007 age standardized year of life lost (YLL) increased by 12.9% (10.6-15.2) & from 2007-2017 by 12.1%[1,2] while the stroke incidence increased 5.29Million (5.22-5.40) to 6.17 Million (6.4-6.33) from 2007-2017[1] thus, it increased DALYs (disability adjusted life years) due to multifaceted morbidity & effects of longevity from 3.54 to 9.66% in the period 1990-2013 as reported GBD statistic(Global burden of the Diseases)[3,4] High income countries (HIC) recorded a 42% decrease in the stroke while on the other hand low- & middle-income countries (LMIC) showed 100% increase in the last 3-4 decades(. The statistics records that there are around 62 million stroke survivors globally while 1/3rd among them is living with severe disabilities[4] It has been estimated that more than 80% DALYs occurs in LMIC.[2,4]

In spite of the recent effective advancement made in the management of the stroke such as; thrombolytic & endovascular interventions stroke remains one of the most common cause of disability worldwide.[5,6] Post-stroke disability is still a major health burden.[7,8] There is variation in the rehabilitation programs provided to the stroke patients worldwide & the quality & content of the program depends mostly on the medical & financial resources.[9,10]

Stroke post-acute- care is given usually in the inpatient rehab centers or in the patient home & sponsored by Medicare in the USA[9] Medicare expenditure on stroke is 15% of all other health-related expenditure.[10] The outcome measures & the effectiveness of stroke rehabilitation programs has been surveyed through different registries such as; EROS (European register of stroke) & CERISE (Collaborative evolution of rehabilitation in stroke across Europe), however, greater variations exist among the countries in the union in their stroke specific rehabilitation programs.[1,11-13]

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In Asian Countries including Pakistan post-stroke rehabilitation is carried out in inpatient rehabilitation facilities for the period of 4-6 months after the patient discharge from the acute hospital. Optimal functional recovery are the goals of these centers for the stroke patients but due to the unstructured rehab program, greater variations are usually found by studies.[14,15] Physiotherapeutic interventions help in the motor-relearning & functional recovery of the stroke patients with the motor impairments of upper & lower limbs.[1,2] Among the various physiotherapeutic interventions dual task training has been proved significantly effective in the functional recovery of the stroke patients.[16] DTT involves performing dual task at the same time & its impact is examined on the gait parameters (spatial& temporal variables).[16] It has been reported that DTT improves step-stride length & walking speed of the stroke patients.[16,17] It has been reported that DTT along with the conventional physical therapy such as; mat activities, strengthening & stretching exercise, balance training & gait training in the chronic stroke patients is statistically effective in improving the ambulatory capacity of the stroke patients.[18,19] The aim of this study is to compare the effectiveness of dual-task training (DTT) & conventional physical therapy in ambulation Right-hemiplegic stroke patients. Prevalence and Impact: Right hemiplegic stroke patients often face challenges in ambulation due to motor deficits, impacting their quality of life and independence.

Efficacy Comparison: This study aims to compare the effectiveness of dual-task specific training, focusing on multitasking abilities during ambulation, against conventional physiotherapy methods.

Customized Approach: Addressing the specific needs of right hemiplegic stroke patients in Swat, Khyber Pakhtunkhwa, ensures relevance and applicability of the findings to the local population.

Randomized Control Trial (RCT): By employing an RCT design, the study ensures rigorous methodology and minimizes bias, enhancing the validity and reliability of the results.

Outcome Measures: Evaluation of ambulation improvement serves as a primary outcome measure, providing insights into the efficacy of the interventions in enhancing functional mobility. Implications for

Rehabilitation: Findings from this study can inform rehabilitation practices, guiding clinicians in selecting optimal interventions to enhance ambulation outcomes for right hemiplegic stroke patients in similar settings

MATERIAL & METHODS

Study Design and Setting: The Randomized Controlled Trial (RCT) was conducted at the Department of Rehabilitation Medicine at Saidu group of Teaching Hospital from 2nd March 2020 to 3rd August 2020. The primary objective was to assess the effectiveness of Dual-Task Training (DTT) compared to conventional physical therapy in improving spatial and temporal variables in chronic Right-hemiplegic stroke patients.

Ethical Considerations and Informed Consent

Ethical approval was obtained from the hospital administration, and informed consent was acquired from all study participants. The research adhered to ethical guidelines throughout the study period.

The operational definition of "right hemiplegic stroke" refers to a neurological condition characterized by paralysis or significant weakness on the right side of the body due to damage to the brain's left hemisphere. This paralysis typically affects the muscles of the face, arm, and leg on the right side, leading to difficulties in movement, coordination, and sensation. Right hemiplegic stroke is commonly caused by a blockage or rupture of blood vessels in the left side of the brain, resulting in impaired blood flow and oxygen delivery to areas responsible for motor function. Clinically, individuals with right hemiplegic stroke may exhibit symptoms such as difficulty walking, grasping objects, speaking, and performing daily activities with their right limbs. The diagnosis of right hemiplegic stroke is typically confirmed through medical imaging techniques such as CT scans or MRI scans, which reveal brain abnormalities consistent with stroke in the left hemisphere

Participant Selection

Criteria Inclusion Criteria: Chronic Right-hemiplegic stroke patients Age: 40-64 years Medically stable and willing to participate

Exclusion Criteria: Left-hemiplegic patients with complications like bed ulcers or contractures Cognitive impairments or speech and language impairments Orthopedic lower limb problems (fractures) Transient Ischemic Attack (TIA).

Patients Randomization and Group Assignment (Figure 01).

Participants meeting inclusion criteria were randomly assigned (lottery method) into two groups: Treatment Group (TG): Received Dual-Task Training (DTT) along with stretching and strengthening exercises. Control Group (CG): Received conventional physiotherapy including mat activities, strengthening and stretching exercises, and ambulation/gait training.

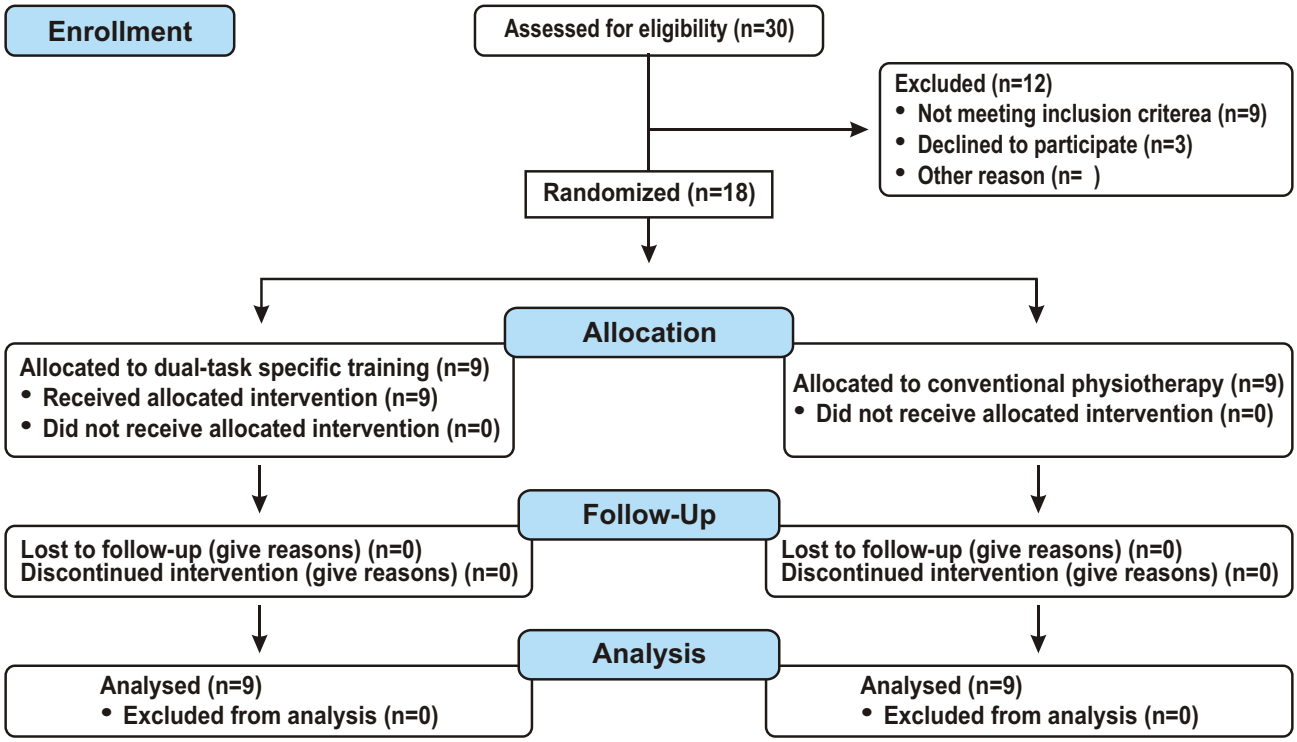


Figure 01. CONSORT Flow Chart

To calculate a sample size of 18 for a study comparing dual-task specific training and conventional physiotherapeutic interventions in ambulation of right hemiplegic stroke patients in Swat, Khyber Pakhtunkhwa, a sample size calculator specific to the study design and objectives was utilized. These calculators typically take into account factors such as:

Effect Size: The magnitude of the difference between groups that the study aims to detect.

Significance Level (α): The probability of rejecting the null hypothesis when it is true, often set at0.05.

Power (1 - β): The probability of correctly rejecting the null hypothesis when it is false, often set at 0.80 or 0.90.

Standard Deviation (SD): The variability of outcomes within the population.

Type of Analysis: Whether the study is designed for continuous or dichotomous outcomes, and whether it's a one-sided or two-sided test.

Intervention Details: TG underwent DTT, involving walking forward, backward, and sideways on a smooth non-slippery surface while holding an 80-gram sandbag for 30 minutes, four times a week for four weeks. CG received conventional physiotherapy for the same duration, including mat activities, strengthening and stretching exercises, and ambulation/gait training.

Outcome Measures
Pre- and post-tests were conducted, and clinical data were collected and analyzed using SPSS 22. Spatial and temporal variables, including step length, cadence, cycle time, and stride length, were assessed for both CG and TG. Additional measurements included the 10-Meter Walk Test (10MWT) and the Time Up & Go test (TUG).

Statistical Analysis
Statistical analysis included independent t-tests for demographic information and paired t-tests for pre- and post-intervention comparisons within the groups. Significance level (P) was set at 0.05. This operational definition outlines the comprehensive methodology employed in the RCT, emphasizing the careful selection of participants, randomization, intervention protocols, and outcome assessments.

RESULTS

Out of total 18 patients, there were 9 (50%) in each of the group that both had 5 males (28%) & 4 females (22%). Mean age recorded in CG was 57.20± 5.20 years & in the TG 57.27± 6.10 years. Baseline clinical parameters among both groups were almost identical (P>0.05). Post-test score showed improvement of gait variables (temporal & spatial), 10MWT-score, cadence, step-length, stride & cycle time in TG as compared to CG with P<0.05). (Table 01).

Table 01. Comparison of the patient's demographic data of CG & TG

Variables	Treatment Group (TG) N=9	Control Group (CG) N=9
Age	57.27± 6.10 (P=0.72)	57.20± 5.20
Gender (Male) (10)	5 (28%)	5 (28%)
(Female) (8)	4 (22%)	4 (22%)
R-Hemiplegic side	9 (100%)	9 (100%)

Pre-intervention mean step length of TG was 48.40 ± 3.5 cm & for the CG 47.77±4.6cm while post-intervention stride length for the TG 96± 7.2cm & for the CG was 95.50±8.4 cm. (Table 02)

Table 02. Comparison of the gait parameters score of CG & TG before treatment (Baseline score)

Variables	Treatment Group (TG) N=9	Control Group (CG) N=9	P-value
Step length(cm)	48.40 ± 3.5	47.77±4.6	0.35
Stride length (cm)	96± 7.2	95.50±8.4	0.43
10MWT (cm/s)	85.24± 10.20	82.40± 11.8	0.54
TUG (s)	25.14± 2.3	26.78 ±1.36	0.41
Cycle time (s)	1.28±0.08	1.15±0.09	0.40
Cadence (steps/min)	95.50± 3.44	94.50± 3.50	0.12

* independent t-test

Post-intervention mean step length of TG was 56.48 ± 9.5cm & for the CG 48.87±3.4 cm while post-intervention stride length for the TG 102± 8.1cm & for the CG was 98.50±7.4 cm. (Table 03)

Table 03. Comparison of the gait parameters score of CG & TG after treatment

Variables	Treatment Group (TG) N=9	Control Group (CG) N=9	P-value
Step length(cm)	55.44 ± 9.4	48.87±3.4	0.001
Stride length (cm)	102± 8.1	98.50±7.4	0.01
10MWT (cm/s)	103.38± 8.27	80.38± 9.9	0.001
TUG (s)	10.15± 2.9	18.74 ±2.39	0.001
Cycle time (s)	1.08±0.035	1.15±0.089	0.001
Cadence (steps/min)	103.60± 4.44	97.55± 3.95	0.001

* independent t-test

DISCUSSION

The result of this RCTs showed that gait speed of the Right hemiplegic patients improved significantly which is consistent with a study carried on the chronic stroke patients (irrespective the side involved) with motor impairments.[14,21] It has been reported that walking speed of 110-150 cm/s is considered sufficient in the most common social & environmental context.[20] The walking speed significantly improved in this study from 85 cm/s to 103cm/s (18cm/s increment) which is consistent with the findings of Dean et al & Iqbal et al in which they have reported 12.6cm/s & 16cm/s speed improvement respectively.[1,13] The mean age of the stroke patients enrolled in this study were 57.27± 6.10 (P=0.72) in the TG & 57.20± 5.20 in the CG which almost identical to other studies carried on the stroke patients.[7-9] The results of this RCTs shows that all gait parameters improved due to the interventions of DTT except TUG which is consistent with the findings of other studies carried on stroke patients,[12,13] however, it is in contrast with the findings of another study which is carried out with 20 stroke patients 3 times/week for 4 weeks with the intervention of DTT & reported improved TUG score.[6]

A quasi-experimental study reported considerable improvement in the cadence while no statistically significant improvement in other gait parameters such as; step length & stride length with the DTT interventions for a 40minuits session/day, 3time/week for4 weeks.[4] The difference in the findings of this quasi-experimental study can be explained as A) small sample size b) right hemiplegic stroke patient c) reduced DTT dose as compared to this RCTs where the a) sample size was 32 b) the DTT dose given were 4 times/week for 4 weeks.

Significant motor dual task improvement has been reported by another study with the intervention of DTT which is consistent with the findings of this RCTs,[4] Inter-group analysis for the gait temporal & spatial parameters (step length, stride length & cadence) showed significant improvement which is comparable to the findings of this RCTs.[3,4]

Limitations

It includes a) small sample size b) single center recruitment c) Uncontrollable confounding variables such as; medications, nutritional status, psychosocial status of the enrolled stroke patients.

These limitations should be considered when interpreting the study's findings and designing future research to address these potential shortcomings.

Small Sample Size: The study has a limited number of participants, potentially affecting the generalizability of the findings and reducing statistical power.

Selection Bias: There may be biases in participant selection, potentially influencing the representativeness of the sample and introducing confounding variables.

Duration of Intervention: The duration of the intervention period was relatively short, which could impact the ability to observe long-term effects of the treatments.

Outcome Measures: The study relies on subjective outcome measures, which could introduce variability and potential bias in the results.

Follow-up Period: The study lacks a sufficient follow-up period to assess the long-term efficacy and sustainability of the interventions.

Adherence to Treatment: Variability in participant adherence to the prescribed interventions could affect the interpretation of the results and treatment efficacy.

CONCLUSION

Dual-task training & conventional physical therapy significantly improves functional ability of the right-hemiplegic patients on all gait temporal & spatial parameters.

Ethical Consideration

This study was approved by the ethical board of Saidu Group of Teaching Hospital, Swat, Pakistan.

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Conflict of Interest

Authors declared no conflict of interest

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DATA SHARING STATEMENT: The data that support the findings of this study are available on request from the corresponding author. The data is not publicly available due to privacy or ethical restrictions.

AUTHORS' CONTRIBUTION

The following authors fullfill authorship criteria as per ICMJE guidelines;

Nisaruddin:	Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.
Khan M:	Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.
Rahman S:	Analysis and interpretation of data, drafting the manuscript, final approval, agreed to be accountable for all the work.
Muslim I:	Analysis and interpretation of data, critical revision,final approval, agreed to be accountable for all the work.

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