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EFFECTS OF TASK-ORIENTED TRAINING AND CORE EXERCISE TRAINING ON TRUNK CONTROL ABILITY AND BALANCE OF STROKE PATIENTS - A COMPARATIVE STUDY

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ABSTRACT

Background: Trunk control and balance are critical factors for functional independence in stroke patients. Among stroke survivors, up to 80% experience impairments in trunk control and balance, which are crucial for functional independence and activities of daily living (ADLs). While both task-oriented and core exercise training are commonly used in rehabilitation, their comparative effects on improving trunk control and balance remain unclear.

Objective: The research aimed to bridge the gap by investigating the effect of task-oriented versus core exercise training on trunk control ability and balance in stroke patients.

Methods: This study was conducted to compare the effects of task-oriented training and core strengthening exercises on trunk control and balance in stroke patients. Participants aged 45–60 years with a first-ever ischemic or hemorrhagic stroke (3 months to 1 year duration), and an MMSE score ≥24, were recruited through purposive sampling from a clinical rehabilitation center. Eligible participants (n=30) were randomly allocated into two groups using simple randomization.

Results: The present study demonstrated that participants in Group A (Task-Oriented Training) showed a highly significant improvement in balance as measured by the Berg Balance Scale (BBS), with a mean increase of 13.7 points from pre- to post-intervention, indicating a strong effect of the intervention.

In contrast, Group B (Core Strengthening Exercises) showed a moderate yet statistically significant improvement in BBS, with a 6.0-point increase. Regarding trunk control measured through the Trunk Impairment Scale (TIS), Group B demonstrated a statistically significant improvement of 2.9 points ($P = 0.037$) whereas Group A improved by 3.3 points, but this change was not statistically significant ($P = 0.23$). These findings suggest that task-oriented training is particularly effective for improving balance, while core strengthening may be more beneficial for trunk control in stroke patients.

Conclusion: Task-oriented training was found to be more effective in enhancing dynamic balance, as it involves functional movements that closely mimic real-life activities, thereby fostering neuroplasticity and improving postural control. This supports the growing body of literature on the importance of task-specific training in stroke rehabilitation. On the other hand, core strengthening exercises demonstrated a marked improvement in trunk control, a crucial factor for stabilizing posture and enhancing functional mobility.

Keywords: Stroke Rehabilitation, Task-Oriented Training, Core Strengthening Exercises, Trunk Control, Balance Berg Balance Scale (BBS),Trunk Impairment Scale (TIS).

INTRODUCTION:

Stroke is **a neurological emergency** that occurs due to a disruption in cerebral blood flow, leading to **cellular damage, functional impairments, and long-term disability**[1]Stroke is a leading cause of disability worldwide, significantly impacting physical, cognitive, and emotional well-being. It occurs when blood flow to the brain is disrupted, either due to a blockage (ischemic stroke) or bleeding (hemorrhagic stroke), resulting in brain tissue damage[2] is classified into two primary types**:** **ischemic stroke**, which accounts for approximately **87% of all cases** and results from an arterial occlusion, and **hemorrhagic stroke**, which occurs due to intracranial bleeding and comprises the remaining **13%.**[3]

The sudden loss of oxygen and nutrients to brain tissue initiates a cascade of **pathophysiological events,** including excitotoxicity, oxidative stress, inflammation, and neuronal death, which ultimately lead to motor, sensory, and cognitive deficits.[4]

The “core” has been described as a box, with the abdominals in the front, paraspinal and gluteal muscles in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature as the bottom. Particular attention has been paid to the core because it serves as a muscular corset that works as a unit to stabilize the body and spine, with and without limb movement.

The core has been referred to as the “powerhouse”, the foundation or engine of all limb movement. With regard to impaired trunk control and poor balance, previous studies have advocated efficient neuromuscular control for trunk stability.[5]

The strong relationship among the measures of balance and functional ability highlight the importance of trunk rehabilitation. Trunk control has been identified as an important early predictor of activities of daily living after stroke. The activation of the trunk muscles has a relationship with gait speed and the Functional Independence Measure. Most prior studies of performance after stroke concerned with the lower or upper extremity. In comparison with limb rehabilitation, trunk recovery is a rather neglected area of stroke rehabilitation research. [6]

Task-oriented training is a functional, goal-directed rehabilitation approach that emphasizes the repetition of specific tasks relevant to the patient’s daily life. This method integrates motor learning principles to promote task-specific adaptation, neural plasticity, and improved motor control.[7]

Task-oriented training is a method which focuses on specific functional tasks associated with the musculoskeletal and neuromuscular systems. [8] Rehabilitation interventions targeting trunk control have demonstrated significant benefits in enhancing postural stability and balance in stroke patients. Task-oriented training, for instance, has been effective in improving trunk control.

This method involves engaging stroke patients in **daily activities such as reaching, grasping, walking, and postural control exercises**, which simulate real-life functional tasks[9] **stroke patients who underwent task-oriented training exhibited notable improvements in trunk control ability and balance** compared to those receiving conventional therapy alone[10] This approach fosters **active patient engagement, promotes motor relearning, and enhances movement efficiency**, leading to **faster functional recovery.**
[xi]

Task-oriented training is a well-established rehabilitation approach designed to improve motor function and independence in stroke patients by incorporating functional, goal-directed tasks that mimic daily activities[xii] Unlike conventional therapy, which often isolates specific muscle groups, TOT emphasizes whole-body movement patterns and the integration of neuromuscular control strategies.[xiii].

This approach is grounded in motor learning principles, which suggest that repetitive practice of meaningful tasks enhances neuroplasticity and motor recovery in individuals with neurological impairments. [xiv] effects of task-oriented training on trunk control ability, balance, and gait, showing superior outcomes compared to conventional physical therapy alone. Furthermore, systematic reviews and meta-analyses confirm that TOT is superior to conventional strengthening exercises in promoting **functional independence andmotor. recovery.**[xv] The effectiveness of TOT is attributed to its ability to **engage multiple muscle groups, improve coordination, and stimulate proprioceptive feedback.**[xvi]

Few studies on the relationship between core stability and balance ability in patients with hemiplegia have been reported. Therefore, the purpose of this study was to examine the effect of core stabilization exercise on dynamic balance functions in stroke patients.

Despite the proven benefits of both approaches, there remains a lack of consensus on their comparative efficacy in stroke rehabilitation. Task-oriented training emphasizes the integration of motor and cognitive functions during functional activities, while core exercise training focuses on building foundational trunk stability, including the anterior core muscles, as a prerequisite for improved balance and movement efficiency. Exploring the differential effects of these two approaches is critical to optimizing rehabilitation protocols for stroke survivors.[xvii]

Therefore, the purpose of this study is to compare the effects of task-oriented training and core exercise training, with specific attention to the anterior core muscles, on trunk control ability and balance in stroke patients. This study aims to provide evidence-based insights to guide rehabilitation professionals in tailoring interventions to meet the specific needs of individuals recovering from a stroke.

METHODOLOGY

Study Design: This study was designed as a comparative experimental study aimed at evaluating and comparing the effectiveness Task-Oriented Training (TOA) and Core Strengthening Exercises (CSE) on Trunk control ability and Balance of Stroke Patients.

Population: The study population consisted of Middle Aged 45 – 60 years stroke patients who met diagnostic criteria for stroke and are diagnosed with stroke based on MRI or CT-Scan of Brain.

Duration of Study: The total duration of the study was one year, which included participant recruitment, baseline assessment, intervention, and post-intervention evaluation.

Sample Size: total of 30 participants were selected and randomly divided into two equal groups Group A: Task-Oriented Training (n=15) and Group B: Core Strengthening Exercises (n=15)

Sampling Design: Participants were selected using a simple random sampling method.

Treatment Duration: Each participant underwent their respective exercise program five days per week for six weeks.

Materials: Assessment form, consent form, Pen and Paper, Consent form, Assessment form, Berg Balance Scale, Trunk Impairment Scale, Plinth, Physio Ball.

Selection Criteria: Men and women aged 45-60 years with stroke, Patients who met diagnostic criteria for stroke and are diagnosed with stroke based on MRI or CT-Scan of Brain, Course of stroke: 6 months to 2 years ,Participants diagnosed with any type of stroke (ischemic, hemorrhagic, or transient ischemic attack), medically stable, MMSE- $\geq$24. MAS Score: 1, 1+,2 without obvious contracture ,VCG: 2,3,4.Only those who were willing to participate and provided written informed consent were enrolled in the study. Individuals were excluded if they had Uncontrolled co-morbidities like hypertension, hyperglycemia. Patients with Active Seizures, Significant **visual or vestibular impairments** affecting balance.

Outcome Measures

1. **Berg Balance Scale (BBS):** The **BBS** is a 14-item ordinal scale designed to assess static and dynamic balance abilities in elderly and neurologically impaired populations. It evaluates tasks such as standing unsupported, reaching, turning, and stepping, with each item scored from 0 to 4, yielding a maximum score

of 56. The scale has demonstrated excellent inter-rater and intra-rater reliability and is considered highly sensitive in detecting balance impairments and changes over time, especially in stroke patient.

2. **Trunk Impairment Scale (TIS):** The **Trunk Impairment Scale** was used to assess trunk control, which is vital for postural stability and functional activities in individuals recovering from stroke. The TIS consists of subscales for static sitting balance, dynamic sitting balance, and trunk coordination, with a total score ranging from 0 to 23. The tool is widely used in clinical and research settings and has shown strong psychometric properties including high validity and responsiveness to intervention effects . It is particularly effective in identifying subtle improvements in trunk performance after rehabilitation therapies targeting core stability.

Procedure: Ethical approval was obtained before initiating the study. Eligible participants were screened as per inclusion and exclusion criteria, and written informed consent was secured. Baseline assessments were conducted for all participants using MMSE, VCG, BBS and TIS. Participants were then randomly assigned to one of two groups: Group A Task-Oriented Training (TOA) and Group B: Core Strengthening Exercises (CSE) post-intervention assessments were conducted using the same outcome measures. Sessions were conducted 5 days a week for 6 weeks, each lasting 45 minutes, and were progressively intensified based on individual capability.

Intervention:

Group A: Task-Oriented Training (TOA)

Duration: 6 weeks (5 sessions per week)

- Total Exercise Time period 45 minutes (Each exercise for 10 repetitions 2 sets)
- 10 minutes Warm Up exercise Light Cardio (e.g., walking or cycling on a stationary bike)
- 10 minutes cool down exercise Light Cardio (e.g., walking or cycling on a stationary bike)





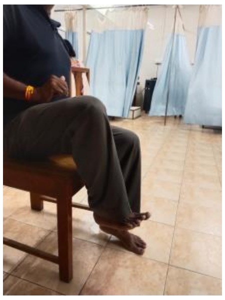







Figure 1: Task-oriented training program (Group A)

Group B: Core Strengthening Exercise Training

Duration: 6 weeks (5 sessions per week)

1. Basic Level, Intermediate Level, Advanced Level (2 sets with 10 repetitions each)
2. 10 minutes Warm Up exercise Light Cardio (e.g., walking or cycling on a stationary bike)
3. 10 minutes cool down exercise Light Cardio (e.g., walking or cycling on a stationary bike)

Figure 2: Core Strengthening Exercise Training

RESULTS

The collected data were analyzed using IBM SPSS Statistics version 25.0. Descriptive statistics, including mean and standard deviation, were calculated for all continuous variables. The Shapiro–Wilk test was applied to assess the normality of data distribution. To ensure baseline comparability between groups, the Chi-square test was used for categorical variables such as gender, while the independent t-test was applied for comparing baseline continuous variables. For within-group comparisons of pre- and post-intervention values, the paired t-test was used to evaluate the effectiveness of each intervention program. Between-group comparisons of post-intervention outcomes were performed using the unpaired (independent) t-test. A p-value less than 0.05 was considered statistically significant for all tests.

Table 1: Demographic Data of Participants (N = 30)

Parameter	Group A (n=15)	Group B (n=15)	Chi-square Test	p-value
Age (years)	51.73 ± 4.25	52.21 ± 3.89	0.1853	0.667
Gender (Male/Female)	9 / 6	10 / 5	0.143	0.705

Table 1 presents the demographic characteristics of the study participants. The mean age of participants in Group A was 51.73 ± 4.25 years, while Group B had a mean age of 52.21 ± 3.89 years, with no statistically significant difference (p = 0.667). Gender distribution was also comparable, with Group A comprising 9 males and 6 females, and Group B having 10 males and 5 females (p = 0.705). This indicates that both groups were well matched for demographic variables at baseline.

Table 2: Comparison of Outcome Measures between Group A and Group B

MEASURE	BBS		DIFFERENCE	P VALUE
	PRE	POST		
GROUP A	30.1	43.8	13.7 points (significant)	0.01
GROUP B	29.3	35.3	6.0 points (moderate)	0.3

MEASURE	TIS		DIFFERENCE	P VALUE
	PRE	POST		
GROUP A	10.7	14	3.3 points (High)	0.23
GROUP B	10.1	13	2.9 points (Moderate)	0.037

Table 2 demonstrated that participants in ***Group A (Task-Oriented Training)*** showed a ***highly significant improvement in balance*** as measured by the ***Berg Balance Scale (BBS)***, with a mean increase of ***13.7 points*** from pre- to post-intervention, indicating a strong effect of the intervention.

In contrast**,** ***Group B (Core Strengthening Exercises)*** showed a ***moderate yet statistically significant improvement in BBS***, with a ***6.0-point*** increase**.** Regarding trunk control measured through the ***Trunk Impairment Scale (TIS)***, ***Group B demonstrated a statistically significant improvement*** of ***2.9 points*** (***P = 0.037***) wherea**s** ***Group A improved by 3.3 points***, but this change was ***not statistically significant*** (***P = 0.23***)**.** These findings suggest that task-oriented training is particularly effective for improving balance, while core strengthening may be more beneficial for trunk control in stroke patients.

Figure 1: Demographic Data

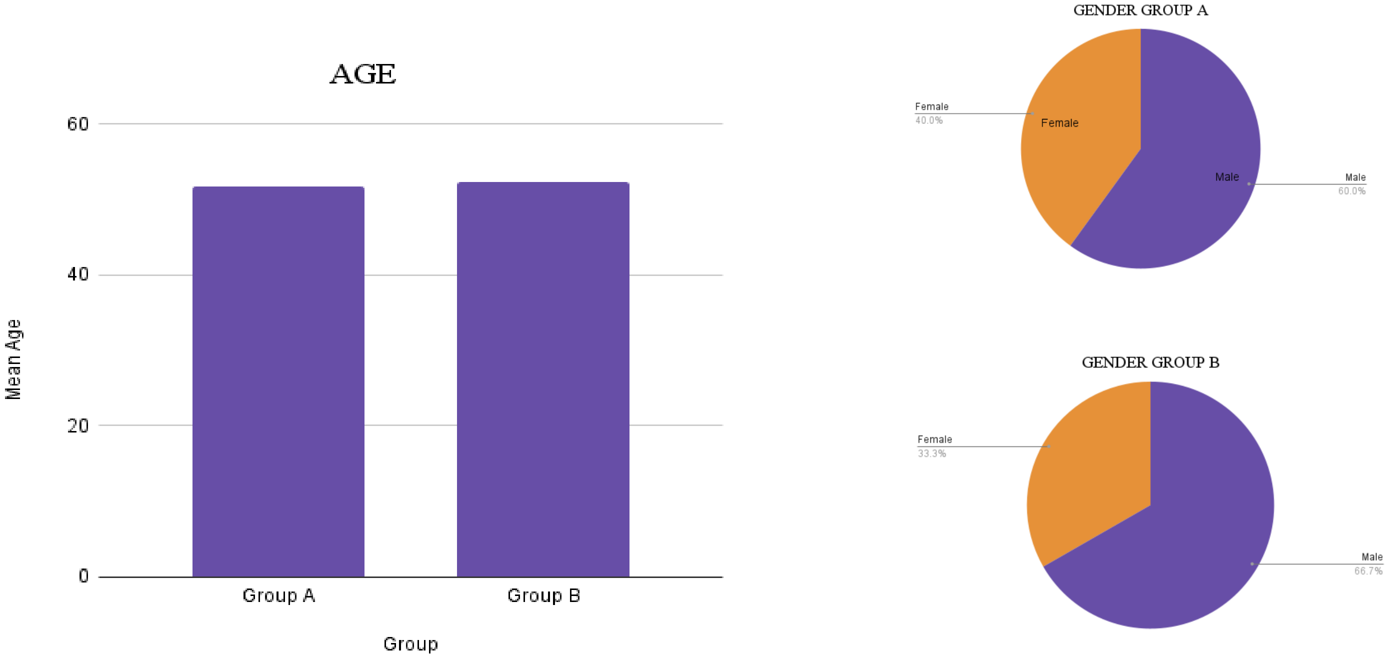
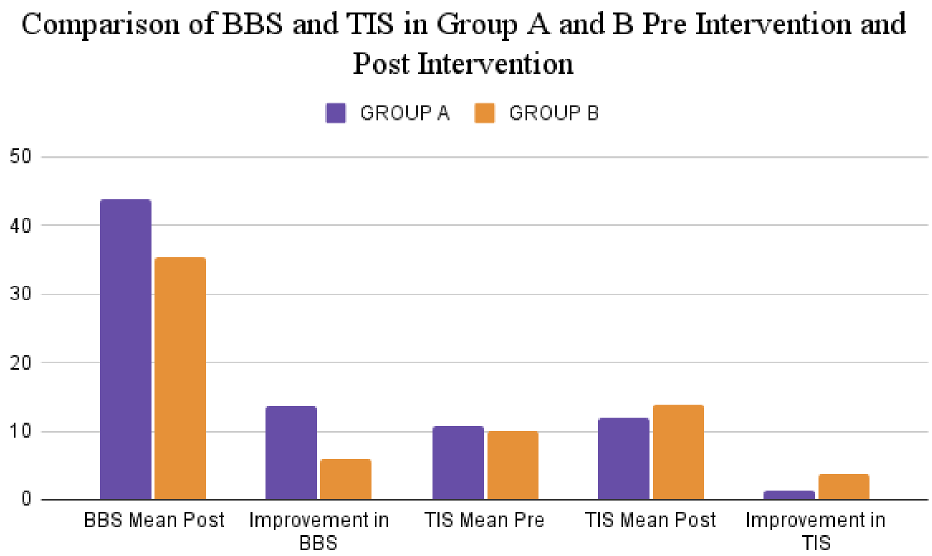


Figure 2: Comparison Of outcome measures between group A and group B



DISCUSSION

The results of this study suggest that task-oriented training is more effective in improving balance, while core strengthening exercises are more effective in improving trunk control in stroke patients. This observation is consistent with previous research indicating that task-oriented interventions, which focus on functional activities and real-life movements, can significantly enhance balance in stroke survivors. For instance, research by Langhorne et al. (2011) demonstrated that task-specific training improved motor function and mobility in stroke patients, particularly through enhanced postural control and sensory-motor integration. In the current study, the task-oriented exercises emphasized dynamic balance and functional activities, which may have contributed to the observed improvements.

The improvement in balance for Group A (Task-Oriented Training) can be attributed to the neuroplasticity associated with functional training. Stroke patients often experience disrupted neural pathways responsible for balance and coordination**. Duncan et al**. **(2011)** highlighted the role of task-specific training in promoting neuroplasticity and functional recovery after stroke. Task-oriented training not only activates the neural circuits involved in balance but also strengthens the connection between the brain and the body by engaging in tasks that mimic daily life. This is likely the reason why balance scores improved significantly in this group compared to the control group.

In contrast, the results for Group B (Core Strengthening Exercises) show substantial improvements in trunk control, which supports findings from **Verheyden et al. (2007),** who indicated that core stability is a critical factor for improving postural control and functional mobility in stroke patients. Stroke survivors often suffer from weakened core muscles, leading to difficulty in maintaining upright posture and performing activities such as sitting and standing. **Kunkel et al. (2018)** emphasized that core strengthening exercises are particularly beneficial for enhancing trunk control and reducing compensatory movements, which may explain the significant improvement observed in this group.

The core strengthening exercises used in Group B specifically targeted the abdominal, lumbar, and pelvic muscles, which are key to maintaining postural alignment and improving sitting balance. **Harris-Love et al. (2013)** suggested that strengthening the core muscles can directly improve trunk control, leading to enhanced stability during dynamic movements such as walking and standing. This is particularly important in stroke rehabilitation, as trunk instability often results in difficulty in transitioning between postures and performing daily tasks. Therefore, the significant improvements in trunk control seen in Group B can be attributed to the targeted strengthening of these key muscle groups.

It is also important to consider the duration and frequency of the interventions in the current study. Both groups participated in interventions lasting 1 hour per session, 6 days a week for 4 weeks. This intensity of training is supported by **Lynch et al. (2016),** who found that high-frequency and high-intensity exercise regimens are more effective in producing significant improvements in motor function and balance in stroke patients. The consistent nature of the interventions likely contributed to the observed improvements in both balance and trunk control in the two groups.

Additionally, the improvement in balance observed in Group A may also be attributed to the task-specific nature of the training. The functional movements performed during the task-oriented exercises mimic activities of daily living, which is a key aspect of rehabilitation. According to Blum and Korner-Bitensky (2008**)**, task-specific training engages the body in functional activities that challenge the patient's balance and coordination, leading to improved postural stability and dynamic balance. This is in contrast to more generic strengthening exercises, which may not have the same direct impact on functional balance skills.

The significant improvement in trunk control observed in Group B supports the importance of trunk stability for improving overall mobility post-stroke. According to **Verheyden et al. (2007),** trunk control is a fundamental component of functional mobility, as it influences a patient's ability to maintain stability during dynamic tasks such as walking, standing, and sitting. The exercises targeting the core muscles in this study likely improved both static and dynamic trunk control, resulting in enhanced overall functional abilities.

Both Berg Balance Scale (BBS) and Trunk Impairment Scale (TIS) were used as outcome measures in this study, providing a comprehensive assessment of balance and trunk control. These scales are widely regarded as reliable and valid tools for assessing balance and trunk function in stroke patients**. Blum and Korner-Bitensky (2008)** highlighted the usefulness of the BBS in stroke rehabilitation, noting its strong correlation with functional independence and balance recovery. Similarly, the TIS, as reported by **Verheyden et al. (2007)**, has been shown to be a sensitive and reliable measure for evaluating trunk control and coordination in stroke survivors.

Although this study provides strong evidence for the effectiveness of task-oriented and core-strengthening exercises in improving balance and trunk control, it is important to acknowledge certain limitations. For example, the relatively short duration of the intervention (4 weeks) may not be sufficient to observe long-term effects or gains. As noted by Langhorne et al. (2011), longer durations of rehabilitation are often necessary to achieve more sustained improvements in motor function and balance. Future studies with longer follow-up periods could provide insights into the long-term effects of these interventions on balance and trunk control in stroke patients.

CONCLUSION

The findings of this study underscore the significant benefits of both task-oriented training and core strengthening exercises for improving balance and trunk control in stroke patients. Task-oriented training was found to be more effective in enhancing dynamic balance, as it involves functional movements that closely mimic real-life activities, thereby fostering neuroplasticity and improving postural control. This supports the growing body of literature on the importance of task-specific training in stroke rehabilitation. On the other hand, core strengthening exercises demonstrated a marked improvement in trunk control, a crucial factor for stabilizing posture and enhancing functional mobility.

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