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EFFECT OF STATIC AND DYNAMIC BALANCE EXERCISE ON EXECUTIVE FUNCTION AND GLOBAL COGNITION IN OLDER ADULTS WITH MILD COGNITION IMPAIREMENTS

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KEYWORDS :

INTRODUCTION

1.1 Aging and Physiological Changes

Aging is a complex biological process characterized by progressive structural and functional decline across multiple physiological systems. With increasing age, the human body undergoes several neuromuscular, musculoskeletal, sensory, and cognitive alterations that significantly affect physical independence and quality of life. Globally, the geriatric population is increasing rapidly due to improved healthcare facilities and increased life expectancy. Consequently, age-related disorders, particularly cognitive impairment and balance dysfunction, have emerged as major public health concerns.

Physiological aging is associated with sarcopenia, reduced muscle mass, decreased muscle strength, diminished flexibility, impaired proprioception, and delayed neuromuscular responses. These changes contribute to reduced postural stability and increased susceptibility to falls. Furthermore, age-related degeneration of sensory systems including visual, vestibular, and somatosensory systems adversely affects balance and mobility.

At the neurological level, aging is associated with cortical thinning, neuronal loss, synaptic degeneration, decreased neurotransmitter activity, and reduced neuroplasticity. Structural brain changes include shrinkage of the hippocampus, cerebellum, frontal cortex, and basal ganglia, which are critically involved in motor planning, executive functioning, and postural control. These alterations negatively influence cognitive performance and motor coordination in older adults(1).

3.2 Objectives of the Study

1. To evaluate the effect of static balance exercises on executive function and global cognition in older adults with MCI.
2. To evaluate the effect of dynamic balance exercises on executive function and global cognition in older adults with MCI.
3. To compare the effects of static and dynamic balance exercises on executive function and global cognition in older adults with MCI.

6.1 Study Design

Pre-test and post-test experimental comparative study with two parallel groups.

- Group A: Static Balance Training
- Group B: Dynamic Balance Training

6.2 Study Duration

6 months

6.3 Sample Size

Total sample size: 50 participants

- Group A = 25
- Group B = 25

6.4 Sampling Method

Purposive sampling technique.

6.5 Study Population

Community-dwelling older adults above 60 years with Mild Cognitive Impairment.

6.6 Inclusion Criteria

- Age above 60 years
- Both genders
- Independent ambulation without assistive device
- Mild Cognitive Impairment based on MoCA score

6.7 Exclusion Criteria

- Neurodegenerative diseases
- Severe visual or auditory impairment
- Uncontrolled cardiovascular disease

6.6.11 Data Collection Procedure

Participants meeting eligibility criteria were screened and recruited. Baseline assessment was performed using MoCA and TMT. Participants were allocated into two groups.

Group A received static balance training while Group B received dynamic balance training for 8 weeks, 3 sessions per week, 30 minutes per session.

Post-intervention assessment was conducted after completion of training.

6.12 Statistical Analysis

Data analysis was performed using GraphPad Prism Software version 11.0.0.

Procedure

The participant is seated comfortably in a quiet environment free from distractions. Standard instructions are provided before administration of each task. The participant is asked to complete all sections of the questionnaire independently under supervision of the examiner. Scoring is done according to standard MoCA guidelines.

Procedure

The participant is presented with a sheet containing randomly distributed numbers from 1 to 25. The participant is instructed to draw lines connecting the numbers in ascending order as quickly and accurately as possible (1–2–3–4 and so on up to 25).

The examiner demonstrates the task before administration. Time taken to complete the task is recorded in seconds using a stopwatch.

8. Statistical Data Analysis and Interpretation

The collected data were tabulated and analyzed using both descriptive and inferential statistics. All the parameters were assessed using GRAPH PAD PRISM SOFTWARE 11.0.0 (84),

with α significance level of p value less than 0.05 and α 95% confidence interval set for all analysis. The Shapiro Wilk test was used to determine the normality of the data. 8.3 TMT-A Interpretation

Table 4 Comparison of TMT - A(sec) Score Between Group – A and Group - B in Pre and Post Test

Group	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	t-Test	Df	P-value
Group 1	70.92 ± 14.09	71.32 ± 14.83	0.4313	24	0.6713*
Group 2	71.92 ± 14.15	66.80 ± 14.41	6.586	24	<0.0001**

This table presents the comparison of TMT-A (Trail Making Test–A) completion time between Group A and Group B in pre-test and post-test conditions using α paired t-test.

In Group A, the mean completion time slightly increased from 70.92 seconds (pre-test) to 71.32 seconds (post-test). However, this change was not statistically significant (*t = 0.4313, df = 24, p = 0.6713; p > 0.05*), indicating that the intervention in Group A did not produce α meaningful improvement in processing speed or attention (as reflected by TMT-A performance).

Table 5 Comparison of TMT – B (sec) Between Group – A and Group - B in Pre and Post Test

Group	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	t-Test	Df	P-value
Group 1	181.24 ± 44.15	176.28 ± 45.07	1.214	24	0.2366*
Group 2	191.52 ± 38.17	184.64 ± 38.41	6.269	24	<0.0001**

This table presents the comparison of TMT-B (Trail Making Test–B) completion time between Group A and Group B in pre-test and post-test conditions using α paired t-test.

In Group A, the mean completion time decreased slightly from 181.24 seconds (pre-test) to 176.28 seconds (post-test). However, this reduction was not statistically significant (*t = 1.214, df = 24, p = 0.2366; p > 0.05*), indicating that the intervention in Group A did not produce α meaningful improvement in executive function, and cognitive flexibility.

In contrast, Group B showed α reduction in mean completion time from 191.52 seconds (pre-test) to 184.64 seconds (post-test). This change was highly statistically significant (*t = 6.269, df = 24, p < 0.0001; p ≤ 0.05*), suggesting α significant improvement in higher-order cognitive functions following the intervention.

The present study was conducted to evaluate and compare the effects of static balance exercises and dynamic balance exercises on executive function and global cognition in older adults with Mild Cognitive Impairment (MCI). A total of 50 participants were included in the study and divided into two groups: Group A received static balance training and Group B received dynamic balance training.

The findings of the present study demonstrated that both static and dynamic balance exercises produced improvements in cognitive performance among older adults with MCI. However, the dynamic balance training group showed greater improvement in executive function and global cognition when compared to the static balance training group.

Aging is associated with progressive deterioration in sensory integration, postural control, neuromuscular coordination, and cognitive processing. Executive function and balance are closely interrelated because both depend upon shared neural substrates involving the prefrontal cortex, cerebellum, basal ganglia, and vestibular pathways. In individuals with MCI, deterioration of these systems results in impaired balance, reduced attentional control, slower information processing, and increased risk of falls. Therefore, interventions that simultaneously stimulate motor and cognitive systems may produce greater neurophysiological benefits.

The present study supports this concept by demonstrating improvements in cognitive outcomes

CONCLUSION

The present study concluded that both static and dynamic balance exercises were effective in improving executive function and global cognition in older adults with Mild Cognitive Impairment.

The findings suggest that dynamic balance training provides superior cognitive-motor stimulation because it requires continuous sensory integration, anticipatory postural control, motor planning, attentional shifting, and environmental adaptation. These demands likely promote greater activation of neural pathways associated with executive functioning and global cognition.

Overall, the study rejects the null hypothesis and accepts the alternate hypothesis that there is α significant difference between static and dynamic balance exercises on executive function and global cognition in older adults with Mild Cognitive Impairment, with dynamic balance exercises showing superior effectiveness.

Summary of the Study

The present study titled "Effect of Static and Dynamic Balance Exercise on Executive Function and Global Cognition in Older Adults with Mild Cognitive Impairment" aimed to evaluate and compare the effects of static and dynamic balance exercises on cognitive performance in older adults with Mild Cognitive Impairment (MCI).

The study concluded that both static and dynamic balance exercises are beneficial in older adults with MCI, but dynamic balance exercises are more effective in improving cognitive function due to greater cognitive-motor engagement and sensory integration.

Therefore, dynamic balance exercises may be recommended as an effective physiotherapy intervention for enhancing cognitive performance, reducing fall risk, and promoting healthy aging in older adults with Mild Cognitive Impairment.

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