International Journal of Medical and Allied Health Sciences

ISSN: 2583-1879
Available at http://www.ijmahs.org/©2021 IJMAHS All Rights Reserved

Research Article

A COMPARATIVE STUDY ON THE EFFECT OF COGNITIVE INSTABILITY RESISTANCE TRAINING VERSUS INSTABILITY RESISTANCE TRAINING ON EXECUTIVE FUNCTIONS AND PHYSICAL ACTIVITY IN THE ELDERLY POPULATION

Sweety Mathur[1], R. K. Sharma[2], Chhavi Kalra[3], Ankita Sharma[4]

1. MOT (Neurology) student, Santosh College of Occupational Therapy, Ghaziabad, Uttar Pradesh, India, Pin Code- 201009
2 Dean Paramedical and Principal, Santosh College of Occupational Therapy, Ghaziabad, Uttar Pradesh, India, Pin Code- 201009
3 Assistant professor, Santosh college of Occupational therapy, Ghaziabad, Uttar Pradesh, India,Pin Code- 201009
4 Assistant professor, Santosh college of Occupational therapy, Ghaziabad, Uttar Pradesh, India, Pin Code- 201009

Article Information: Received on 19-06-2026, Accepted 30 -06- 2026, Available online 15 -07 -2026

Abstract

Background: Aging is accompanied by declines in executive function and physical capabilities, significantly increasing the risk of falls, loss of independence, and reduced quality of life in older adults. While exercise and cognitive interventions individually support healthy aging, the combined effects of cognitive instability resistance training on executive function and physical activity remain under-researched, particularly within the Indian population.

Methods: a comparative study involving a total of 48 participants were chosen through the Chit Method after screening through MOCA and 10 MWT and split into two groups. Group B received training on instability resistance, while Group A received training on cognitive instability resistance for 8 weeks, the 60-minute sessions took place on three different occasions a week. The Executive Skills Questionnaire-Revised (ESQ-R) and the International Physical Activity Questionnaire (IPAQ) were used to assess.

Results: Both groups were comparable prior to the intervention, the PRE-ESQ-R ($p = 0.256$) and PRE-IPAQ ($p = 0.177$) values were greater than 0.05, the comparison between the groups at baseline revealed no statistically significant difference. ESQ-R ($p = 0.0567$) and IPAQ ($p = 0.259$) differences were found between the groups in the post-test, indicating changes in executive function and physical activity after the intervention.

Conclusion: There was no statistically significant distinction between the CIRT and IRT interventions, even though post-intervention evaluations revealed considerable gains within both groups through lower ESQ-R scores and higher IPAQ levels.

Keywords: Cognitive instability resistance training, instability resistance training, Elderly, executive function, physical activity

1. Introduction

Population aging is a major global demographic trend characterized by progressive biological, psychological, and functional changes that increase susceptibility to chronic noncommunicable diseases and functional decline [1]. In countries like India, where the older adult population is expanding rapidly, age-related impairments significantly compromise the ability to perform activities of daily living, leading to loss of independence, heightened fall risk, and elevated mortality [2]. To mitigate these impacts, the World Health Organization emphasizes healthy aging through the maintenance of functional capacity via lifestyle modifications, regular physical activity, and disease prevention. Essential to this functional independence is an executive function- a complex cognitive domain governed by prefrontal-parietal networks that mediates goal-directed behavior, cognitive flexibility, and decision-making [3, 4]. Preserving both physical health and executive function is therefore paramount for sustaining quality of life and autonomy in the aging population [5].

*R K Sharma, Professor, and Dean Paramedical and Principal Santosh College of Occupational Therapy, Ghaziabad, Uttar Pradesh,
E mail: hod.occupationaltherapy@santosh.ac.in,
ORCID ID: 0000-0002-1780-4967
doi: https://doi.org/10.54618/IJMAHS.2026626
This is an open-access article, which permits the use and distribution of article provided that original author and source are credited

Executive function and physical capability both experience significant decline during normal aging, leading to reduced balance, slower gait, increased fall risks, and a diminished ability to perform daily tasks independently [6,7]. Furthermore, physiological changes such as reduced muscle power, impaired neuromuscular coordination, and sensory loss contribute heavily to frailty and mobility limitations in older adults [8, 9]. To counteract these age-related declines, regular physical exercise serves as a potent non-pharmacological strategy that enhances cerebral blood flow, neuroplasticity, and BDNF expression [9]. Specifically, resistance training effectively combats sarcopenia while simultaneously improving muscle strength, balance, processing speed, and executive function, making it a key intervention for preserving physical and cognitive independence [7]. Instability resistance training places heightened demands on postural control and neuromuscular coordination, offering superior enhancements in muscle activation, balance, and functional mobility compared to traditional resistance exercise [10].. Concurrently, cognitive training targeting executive function and attention promotes neural plasticity and helps preserve cognitive health in olderadults.

Integrating these modalities through cognitive-motor dual-task training simultaneously challenges both motor and cognitive networks, inducing mechanisms like increased cerebral perfusion and synaptic plasticity. Consequently, multimodal interventions yield superior improvements in executive function, gait, balance, and overall functional independence compared to single-modality approaches (Xu D et al. 2025).

Cognitive instability resistance training is an emerging therapeutic approach that integrates postural challenges with cognitive tasks to concurrently stimulate physical and neurological adaptations. However, limited evidence exists regarding its specific effects on executive function and physical activity among healthy older adults, particularly within the Indian population (Holzer KJ et al.2024). Therefore, this study aims to compare cognitive instability resistance training against single-modality instability training to establish evidence-based rehabilitation strategies that promote healthy aging and preserve functional autonomy.

1. Material And Methods:

2.1 Study design and setting

A comparative study was conducted at Santosh College of occupational therapy and Hospital, Ghaziabad; Village and post - Niwari Kalan community, Bakewar, Etawah, Residential colonies in Shastri Nagar, Ghaziabad. The institutional ethics committee of Santosh College of occupational therapy **(Ref. No.- SCOT/JULY-25/ECNEURO-06)**

2.2 Participants

Total 48 participants were tested using the Screening tools, Montreal cognitive assessment (MOCA), and 10-meter walk test (10MWT). Using Cochran's formula with a 95% confidence level and 5% margin of error, the minimum sample size was calculated to be approximately 24 participants per group. The MOCA and 10 MWT were used to screen the 48 participants who were elected based on inclusion and exclusion criteria. The chit method sampling technique was then carried out. Pre-assessments were conducted using the outcome measure executive skills questionnaire – revised (ESQ-R) and international physical activity questionnaire (IPAQ).

2.3 Intervention

Afterwards, both groups underwent an 8-week intervention. In group A, lower limb instability resistance training combined with cognitive training and group B involved only lower limb instability resistance training will be performed by subjects under the supervision of therapists. Finally, post-test assessment will be done using the same outcome measure.

2.4 Outcome measurements

Executive skills questionnaire- revised (ESQ-R):
A self-evaluation survey with twenty-five items of executive functioning abilities. Five aspects of executive functioning are evaluated by the ESQ-R: Management of Plans, Effective Time Management, organizational skills, Control of Emotions, and Control of Behavior. A Likert scale with four points, from 0 to 3. a total score between 0 and 75, where greater scores indicate more serious (typically) executive functioning problems (Strait et al., 2020).

International physical activity questionnaire (IPAQ): It is a 27-item self-explanatory physical activity test designed to be used with adult patients between the ages of 15 and 69. Physical activity duration (minutes) and frequency (days) over the previous seven days are measured in the following domains: ICF Domain – Activity. Scoring – high, moderate, and low level of physical activity (Clina JG et al.,2023).

2.5 Statistical analysis:

IBM SPSS Statistics version 29.0.1.0 was used for the statistical analysis. The baseline and post-intervention

differences between Group A and Group B were compared using an independent samples t-test. Additionally, nonparametric differences between the groups for ESQ-R and IPAQ scores were compared using the Mann–Whitney U test. The results were seen as meaningful when the p- value was below 0.05.

3.0 RESULT:

3.1 Demographic Characteristics

Total 48 participants were enrolled in the study with the mean age of Subjects in Group A was 63.42 ± 2.84 years, while in Group B it was 65.00 ± 3.88 years, signifying a comparable age distribution. In terms of gender, Group A included 10 males (41.67%) and 14 females (58.33%), whereas Group B comprised of 13 males (54.17%) and 11 females (45.83%), with 24 participants in each group. Detailed demographic characteristics are presented in Table 1.

Table 1: Demographic Statistics of Participants

Variable	Category	Group A n (%) / Mean ± SD	Group B n (%) / Mean ± SD
Age (years)	Mean ± SD	63.42 ± 2.84	65.00 ± 3.88
Gender	Male	10 (41.67%)	13 (54.17%)
	Female	14 (58.33%)	11 (45.83%)
Total		24 (100%)	24 (100%)

3.2 Baseline Comparisons

There were no statistically significant baseline differences at baseline, as the PRE-ESQ-R (p = 0.256) and PRE-IPAQ (p = 0.177) values were greater than 0.05, indicating both groups were comparable before the intervention. (Table 2)

Scale	Group A	Group B	t Value	P Value	Interp retation
PRE-ESQ-R	Pre-test ESQ-R	Pre-test ESQ-R	-2.025	0.256	No statistically significant difference
PRE-IPAQ	Pre-test IPAQ	Pre-test IPAQ	1.374	0.177	No statistically significant difference

3.3 Post-Intervention Analysis

Post-intervention analysis showed there were variances among the groups on the ESQ-R (p = 0.0567) and IPAQ (p = 0.259) post-test, indicating changes in executive function and physical activity. (Table3)

Table 3 - post data analysis of group A and B

Scale	Group A	Group B	t Value	P Value	Interp retation
POST-ESQ-R	Post-test ESQ-R	Post-test ESQ-R	-0.744	0.0567	Statistically significant difference
POST-IPAQ	Post-test IPAQ	Post-test IPAQ	1.144	0.259	Statistically significant difference

Mann–Whitney U test was used to examine the ESQ-R and IPAQ values. Before and after-test values did not differ statistically significantly across the groups, as indicated by all p-values (e.g., Pre ESQ-R p = 0.079, Post ESQ-R p = 0.448, Post IPAQ p = 0.288) being greater than 0.05. This indicates that the outcomes of executive function and physical activity were comparable between the two groups **Table 4**

4. DISCUSSION:

This study's primary goal was to evaluate and compare the impact of instability resistance training (Group A) and cognitive instability resistance training (Group B) on executive function and physical activity levels in older adults. The primary source of data for this study was collected from Santosh Medical College and Hospital in Ghaziabad.

A total of 26 people were initially recruited for Group A in this study; however, two of them were lost during follow-up, with a final of 24 participants. In a similar vein, Group B initially recruited 25 people; however, 24 remained for the final intervention after 1 participant dropped out.

Yaxin Wang et al. examines how solitary instability resistance training (IRT) and integrated instability resistance training and cognitive training (IRCT) affect older women's balance, gait, muscle strength, and cognitive abilities.

The groups' similarity before the intervention was further reinforced by baseline functional and cognitive evaluations. Participants had comparable levels of cognitive functioning at the beginning of the trial, as evidenced by the virtually equal MOCA results for both groups.

Table 4: Mann-Whitney U Test- Comparison of Group A and Group B

Tests	PRE ESQ-R scr	Pre ESQ-R Int	Post ESQ-R Scr	Post ESQ-R Int	Pre IPAQ Scr	Pre IPAQ Int	Post IPAQ Scr	Post IPAQ Int
Mann-Whitney U	203	276	251.5	288	228	239	236.5	238.5
Wilcoxon W	503	576	551.5	588	528	539	536.5	538.5
Z	-1.756	-0.288	-0.759	0	-1.24	-1.121	-1.062	-1.092
Asymp. Sig. (2-tailed)	0.079	0.773	0.448	1	0.215	0.262	0.288	0.275
a Grouping Variable: Group A=INSTABILITY RESISTANCE TRAINING, Group B= COGNITIVE INSTABILITY RESISTANCE TRAINING								

revealed similar functional mobility between the two groups. These results are significant because they demonstrate that both groups had comparable cognitive and physical capacities at the start of the trial, allowing for a fair comparison of the effects of cognitive instability resistance training versus instability resistance training.

A statistical evaluation of baseline results revealed no statistically significant changes among the two groups prior to the intervention. Specifically, p-values higher than 0.05 were obtained from baseline assessments of executive function using the pre-test Executive Skills Questionnaire–Revised (PRE-ESQ-R; t = −2.025, p = 0.256) and physical activity using the pre-test International Physical Activity Questionnaire (PRE-IPAQ; t = 1.374, p = 0.177). Prior to the implementation of any training regimens, these results clearly demonstrated that both groups were statistically equal and completely equivalent to the baseline.

Post-test evaluations showed improvements in both groups' executive function and physical activity after the intervention period. Executive function improved as ESQ-R scores dropped in both Group A (0.92 to 0.27) and Group B (1.09 to 0.29), according to the descriptive data. At the same time, both groups' IPAQ levels of physical activity improved significantly, going from 974.56 to 1712 in Group A and from 704.68 to 1346.67 in Group B. Both instability resistance training and cognitive instability resistance training were successful in improving cognitive and physical outcomes in older people, according to these post-intervention changes.

The study's null hypothesis was supported, nonetheless, as a comparison of the two intervention procedures showed no statistically significant variations in post-test results. The absence of statistical divergence implies that the shared basic elements—mechanical instability and resistance adaptation—have a similarly potent therapeutic impact on senior citizens. It's also likely that any clear synergistic benefits of the dual-task paradigm over stand-alone physical instability training require a longer intervention window or a higher level of cognitive task-loading. However, the findings clearly show that both modalities are practical, successful treatment approaches for preventing age-related cognitive and physical deterioration.

5. CONCLUSION:

The present study concluded that both instability resistance training and cognitive instability resistance training significantly improved executive function and physical activity among older adults. Participants in both intervention groups demonstrated improved executive function, as evidenced by reduced ESQ-R scores, and increased physical activity levels, as measured by the IPAQ, after the treatment. In contrast, the two groups did not differ in statistical significance, indicating that the two training approaches were equally effective. These findings suggest that instability-based resistance training, with or without an added cognitive component, may be a beneficial approach for the senior population and a successful intervention for enhancing executive function by encouraging physical activity.

6. DECLARATIONS AND ETHICAL STATEMENT

- **Acknowledgements**: The authors acknowledge all those who provided support and constructive input throughout this research.

- **Authors' Contributions**: SM conceptualized the study, drafted the protocol, carried out data collection, and wrote the initial manuscript draft. RKS supervised the project and critically revised the manuscript. PR edited the manuscript and coordinated submission. All authors read and approved the final manuscript.
- **Ethical Approval and Consent**: **Ethical Clearance:SCOT/JULY-25/ECNEURO-06.**Informed patient consent was obtained from all individual participants included in the study for both intervention participation and publication of data.

- **Financial Support Statement**: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

- **Conflict of Interest Statement:** The authors declare that they have no competing interests.
- **Data Availability Statement**: The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.
- **AI Disclosure**: Artificial intelligence tools were not used in the conceptualization, execution, data analysis, or manuscript drafting of this study.

7 References:

1. Nascimento, M. d. M., Maduro, P. A., Rios, P. M. B., Nascimento, L. d. S., Silva, C. N., Kliegel, M., & Ihle, A. (2023). The Effects of 12-Week Dual-Task Physical–Cognitive Training on Gait, Balance, Lower Extremity Muscle Strength, and Cognition in Older Adult Women: A Randomized Study. *International Journal of Environmental Research and Public Health*, *20*(8), 5498. https://doi.org/10.3390/ijerph20085498
2. Sánchez-Sánchez, J. L., de Souto Barreto, P., Antón-Rodrigo, I., Ramón-Espinoza, F., Marín-Epelde, I., Sánchez-Latorre, M., ... & Casas-Herrero, Á. (2022). Effects of a 12-week Vivifrail exercise program on intrinsic capacity among frail cognitively impaired community-dwelling older adults: secondary

analysis of a multicentre randomised clinical trial. *Age and ageing*, *51*(12), afac303. https://doi.org/10.1093/ageing/afac303

3. Claußen, L., Groß, J., & Kibele, A. (2025). Effects of metastable resistance training with strength and balance requirements compared to traditional resistance and balance training on cognitive performance in older adults: a randomized controlled trial. *BMC geriatrics*, *25*(1), 777.https://doi.org/10.1186/s12877-025-06438-y

4. Varghese, R., Fiske, A., & Holmboe, K. (2026). Neural substrates of executive function development in children under three: a mini review of recent advances. *Frontiers in Developmental Psychology*, *4*, 1752676.https://doi.org/10.3389/fdpys.2026.1752676

5. Wu, S., Ji, H., Won, J., Jo, E. A., Kim, Y. S., & Park, J. J. (2023). The effects of exergaming on executive and physical functions in older adults with dementia: randomized controlled trial. *Journal of medical Internet research*, *25*, e39993.doi: 10.2196/39993
6. Kušleikienė, S., Ziv, G., Vints, W. A., Krasinskė, E., Šarkinaite, M., Qipo, O., ... & Levin, O. (2025). Cognitive gains and cortical thickness changes after 12 weeks of resistance training in older adults with low and high risk of mild cognitive impairment: Findings from a randomized controlled trial. *Brain Research Bulletin*, *222*, 111249.10.1016/j.brainresbull.2025.111249
7. Baek, J. E., Hyeon, S. J., Kim, M., Cho, H. Y., & Hahm, S. C. (2024). Effects of dual-task resistance exercise on cognition, mood, depression, functional fitness, and activities of daily living in older adults with cognitive impairment: a single-blinded, randomized controlled trial. *BMC geriatrics*, *24*(1), 369.https://doi.org/10.1186/s12877-024-04942-1
8. Zhuang, M., Gu, Y., Wang, Z., He, X., & Chen, N. (2025). Effects of 12-week whole-body vibration training versus resistance training in older people with sarcopenia. *Scientific reports*, *15*(1), 6981.https://doi.org/10.1038/s41598-025-91644-2
9. Cheng, C. H., Hsieh, Y. W., Chang, C. C., Hsiao, F. J., Chen, L. F., & Wang, P. N. (2024). Effects of 6-month combined physical exercise and cognitive training on neuropsychological and neurophysiological function in older adults with subjective cognitive decline: a randomized controlled trial. *Journal of Alzheimer's Disease*, *100*(1), 175-192.https://doi.org/10.3233/JAD-231257
10. Pieruccini-Faria, F., Son, S., Zou, G., Almeida, Q. J., Middleton, L. E., Bray, N. W., ... & Montero-Odasso, M. (2025). Synergistic effects of exercise, cognitive training and vitamin D on gait performance and falls in mild cognitive impairment—secondary outcomes from the SYNERGIC trial. *Age and Ageing*, *54*(9), afaf242.https://doi.org/10.1093/ageing/afaf242
11. Dhankhar, A., Khobragade, P., Banerjee, J., Chopra, G., Jacob, S., Dey, A. B., ... & Hu, P. (2025). Methodology of community-based venous blood specimen collection for the harmonized diagnostic assessment of dementia for the Longitudinal Aging Study in India (LASI-DAD): Wave 2. *PloS one*, *20*(7), e0326917. https://doi.org/10.1371/journal.pone.0326917
12. Lenze, E. J., Voegtle, M., Miller, J. P., Ances, B. M., Balota, D. A., Barch, D., ... & Wetherell, J. L. (2022). Effects of mindfulness training and exercise on cognitive function in older adults: a randomized clinical trial. *Jama*, *328*(22), 2218-2229.doi:10.1001/jama.2022.21680