A Combined Balance Training Approach to Improve Balance and Reduce Fall Risk in Young-Old Individuals: An Experimental Investigation

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Abstract

***Background* and Objectives:** Falls represent a significant health risk among older adults, often resulting in injuries ranging from soft tissue trauma to fractures. Balance is a critical factor in maintaining postural stability and preventing such incidents. The present study aimed to evaluate the efficacy of a combined balance training program in improving balance and reducing fall risk in young-old adults (65–74 years).

***Methodology*:** A total of 58 participants were recruited for this experimental study. Pre- and post-intervention assessments were conducted using the Falls Efficacy Scale and the Timed Up and Go (TUG) test to quantify changes in balance and fall risk.

***Results*:** Statistical analysis revealed significant improvements in both Falls Efficacy Scale scores and TUG performance following the intervention ($p < 0.05$), indicating enhanced balance and reduced fear of falling.

***Conclusion*:** The combined balance training program demonstrated significant effectiveness in improving balance and preventing falls among young-old adults, suggesting its utility as a targeted intervention in geriatric populations.

Keywords: Fall prevention, combined balance training, young-old adults, postural stability

Introduction

Geriatrics is a specialized medical discipline focused on the prevention, diagnosis, and management of health conditions associated with aging. It addresses the multifactorial changes in physiological systems and the increased prevalence of comorbidities observed in older adults. For clinical and research purposes, the elderly population is often categorized into three groups: young-old (65–74 years), middle-old (75–84 years), and old-old (≥85 years) (1).

A fall is operationally defined as an unintentional event in which an individual descends to a lower level, such as the ground or another surface, without the influence of a major intrinsic medical event or an overwhelming external hazard. Falls are common and serious health concerns among older adults, constituting the leading cause of injury in this population (2). The incidence of falls increases with advancing age and frailty, with prevalence rates varying across populations. In India, approximately 14% of older adults experience falls, highlighting the public health significance of this issue (2). Falls can lead to severe complications, including hip fractures, increased morbidity and mortality, and substantial burdens on healthcare systems (3).

Falls also adversely affect quality of life, often leading to reduced self-confidence, fear of recurrent falls, chronic pain, and loss of independence. Consequently, older adults face an increased risk of functional impairments, including compromised balance and mobility (4). Evidence indicates that exercise interventions can significantly reduce fall risk, with structured exercise programs demonstrating up to fivefold greater efficacy in preventing recurrent falls compared to multifactorial interventions (5).

Balance is a complex motor skill that involves the precise regulation of body posture to prevent falls (2). It is fundamental to independent movement and functional capacity (6). Maintaining balance requires the coordinated interaction of stability and mobility, relying on integrated neurological and musculoskeletal functions (3). Effective postural control depends on the integration of multiple sensory systems and complex physiological mechanisms, supporting independent ambulation and task-specific functional performance (13).

The prevalence of balance impairments increases significantly with age, contributing to heightened fall risk. Evidence supports targeted balance training programs as more effective than generic exercise regimens for improving postural control and functional stability in older adults (13). However, current understanding of balance deficits and their relationship to falls remains incomplete. Literature on exercise interventions shows heterogeneity and sometimes conflicting outcomes, particularly regarding balance-specific training

and its impact on fall incidence, with notable gaps concerning female older adults (14, 15).

Achieving optimal balance is a critical indicator of functional independence and safety in daily activities. Researchers continue to investigate the factors influencing postural control, aiming to enhance mobility, reduce injury risk, and improve quality of life for older adults (15). With advancing age, physiological changes can impair balance control, increasing susceptibility to falls and contributing to healthcare and social service burdens due to associated injuries and loss of independence (2, 6, 7).

Walking has emerged as an effective, accessible, and versatile strategy for fall prevention. It can be performed without constraints related to time, location, prior experience, or supervision and is widely practiced among older adults (8). Among young-old adults, the prevalence of falls during activities of daily living is approximately 14%, further compounded by age-related declines in balance (2).

To address these challenges, Halvarsson et al. proposed a structured, multi-phase balance training program comprising Basic, Moderate, and Advanced stages. This progressive protocol not only prevents deconditioning but also enhances postural control and overall balance, providing sustained functional benefits over time (6). The program introduces increasingly complex exercises across phases, gradually enhancing difficulty to strengthen balance performance, improve functional capacity, and reduce dependency, thereby supporting greater independence in both present and future activities (6).

Materials & Methods

- **Study Design:** One-group experimental study
- **Study Setting:** Urban and surrounding areas
- **Sampling Technique:** Convenience sampling
- **Study Population:** Young-old adults (65–74 years)
- **Study Duration:** 18 months
- **Sample Size:** 58 participants
- **Intervention Duration:** 6 weeks

Data was collected and recorded in Microsoft Excel prior to statistical analysis. Descriptive statistics, including mean and standard deviation, were calculated for all measured parameters. Pre- and post-intervention scores for the Falls Efficacy Scale and Timed Up and Go (TUG) test were analysed using paired *t*-tests in SPSS software (version XX), with significance set at $p < 0.05$.

Intervention:

Participants underwent a structured balance training program over six weeks on alternate days.
Each exercise session included a two-minute rest interval between exercises.
The schedule was as follows:

- Week 1: Days 1, 3, and 5
- Week 2: Days 2, 4, and 6
- Week 3: Days 1, 3, and 5
- Week 4: Days 2, 4, and 6
- Week 5: Days 1, 3, and 5
- Week 6: Days 2, 4, and 6

This alternating schedule ensured adequate recovery while maintaining consistency in training stimulus.

Intervention Protocol

Basic Phase:

1. Walking on a foam mat
2. Navigating a "messy" environment with obstacles such as chairs and cones
3. Walking forward and returning by walking backward
4. Tandem walking

Moderate Phase:

1. Walking on a foam mat while performing a cognitive task
2. Navigating a "messy" environment while reciting or counting
3. Walking around, performing lunges on command (e.g., left foot when tapped on the left shoulder)
4. Walking forward and stepping up and down on a step platform

Advanced Phase:

1. Walking while performing complex dual tasks, such as buttoning/unbuttoning clothing, reciting/counting, and lunges on command
2. Walking forward and backward while simultaneously performing motor and cognitive tasks
3. Walking forward with step-ups/step-downs, combined with cognitive and motor tasks
4. Tandem walking integrated with both cognitive and motor challenges

Statistical Analysis

Demographic Characteristics of Study Participants (N = 58)

Table 1: Age and Gender Distribution of Participants

Variables	Sub-groups	N	%
Gender	Male	52	89.7
	Female	6	10.3
Age(Mean±SD)		69.50±2.735	

Fallsefficacyscalevaluesintermsof{Mean(SD)}atdifferenttimeinterv als using paired t test.

(Table 2)

Time interval	N	Mean	Std. Deviation	t value	Pvalue
FallsEfficacy Scale Pre	58	15.40	2.765	12.659	<0.001**

FallsEfficacy Scale Post	58	11.79	1.373		

Interpretation of Demographic Data:

The study sample comprised 58 participants, including 52 males (89.7%) and 6 females (10.3%). The mean age of the participants was 69.50 ± 2.74 years, indicating a relatively homogenous age distribution within the young-old adult group.

Timed up and go test scale values in terms of {Mean (SD)} at different time intervals using paired t test.

(Table 3)

Time interval	N	Mean	Std. Deviation	tvalue	P value
TimedUpandGoTest Pre	58	11.76	1.467	11.737	<0.001**
TimedUpandGoTest Post	58	9.76	1.559		

Interpretation

Theabovetableandgraphshowthattimedupandgotestpre–meanwas 11.76±1.467asstandarddeviation,timedupandgotestpostmean9.76±1.559 as standard deviation. P value <0.001**

Result

The demographic characteristics of the study population (N = 58) indicated a predominance of male participants (n = 52, 89.7%) compared to female

participants (n = 6, 10.3%). The mean age of the participants was 69.50 ± 2.74 years.

Falls Efficacy Scale (FES):

Pre-intervention assessment of the Falls Efficacy Scale revealed a mean score of 15.40 ± 2.77. Following the six-week balance training program, the post-intervention means significantly decreased to 11.79 ± 1.37. Paired *t*-test analysis yielded a t-value of 12.659 and a p-value < 0.001, indicating a statistically significant improvement in participants' confidence in performing daily activities without fear of falling.

Timed Up and Go (TUG) Test:

The pre-intervention mean TUG score was 11.76 ± 1.47 seconds. Post-intervention, the mean score improved to 9.76 ± 1.56 seconds, reflecting enhanced functional mobility and reduced fall risk among participants.

Discussion

Modifications to the intervention environment, including the use of both stable and unstable surfaces and the integration of upper extremity and cognitive tasks, were critical in optimizing balance among young-old adults. These strategically designed challenges enhanced postural control mechanisms, thereby contributing to fall risk reduction within this population (6). The use of variable surface conditions simulated real-world scenarios, requiring participants to develop adaptive postural responses. This approach promotes the development of versatile and resilient balance control strategies (6).

The addition of upper extremity and oral tasks further increased the complexity of the training regimen. These tasks necessitated coordinated engagement of both motor and cognitive functions, eliciting a holistic response that fostered improvements in motor coordination and cognitive processing. Together, these elements facilitated the development of adaptive and functional balance, effectively enhancing postural control (6).

A systematic, progressive increase in task difficulty served as a key mechanism for strengthening neural pathways associated with balance. Incrementally challenging activities enhanced participants' adaptive responses, illustrating how imposing higher demands on motor and cognitive systems refines postural control and improves overall balance performance (2).

The results of this study align with existing literature emphasizing the benefits of structured balance interventions. Collectively, these findings highlight the need to further refine our understanding of the mechanisms, effectiveness, and optimization of balance training. Such knowledge is essential for practitioners and therapists seeking to design evidence-based strategies to enhance balance and reduce fall risk among older adults (11).

Motor dual-task balance training, in particular, demonstrates considerable promise. Future investigations should incorporate comprehensive biomechanical, neuromuscular, and cognitive assessments to achieve a more holistic understanding of balance enhancement interventions (10). Additionally, independent studies, such as those by Tatjana Bulat et al., validate the safety and efficacy of functional balance training in improving postural control and reducing fall risk, supporting the generalizability of our findings across diverse older adult populations (7).

Conclusion

- The six-week combined balance training program significantly improved balance and reduced fall risk in young-old adults, as evidenced by improvements in the Falls Efficacy Scale and Timed Up and Go test scores.

- Accordingly, the study supports the alternative hypothesis, demonstrating that a structured combined balance training program is effective in enhancing postural control and preventing falls among young-old individuals.

Declaration by authors

*Ethical approval:*Approved

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