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Original Article

Effect of a 6-Week Balance Exercise Program on Fall Risk in Older Adults

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Abstract

Background: Falls in older adults are a leading cause of morbidity, functional decline, and reduced independence. Although balance training is widely recommended, evidence supporting the effectiveness of short-term structured programs in community-dwelling older populations remains limited.

Objective: To evaluate the effects of a 6-week supervised balance exercise program on balance performance, functional mobility, and fall-related self-efficacy in community-dwelling older adults.

Methods: In this randomized controlled trial, 80 adults aged ≥65 years were allocated to either an intervention group (n = 40) or a control group (n = 40). The intervention group received supervised balance training three times weekly for six weeks, incorporating static, dynamic, functional, and dual-task exercises, while the control group received usual care. Outcomes were assessed at baseline and post-intervention using the Berg Balance Scale (BBS), Timed Up and Go (TUG) test, and Falls Efficacy Scale–International (FES-I). Between-group differences and within-group changes were analyzed with significance set at $p < 0.05$.

Results: Baseline demographic, clinical, sensory, and fall-history characteristics were comparable between groups. After 6 weeks, the intervention group demonstrated significant improvements compared with controls in balance (BBS: +7.2 ± 3.1 vs +0.2 ± 1.0; mean difference 7.0 points, 95% CI: 6.2–8.2), functional mobility (TUG: −2.4 ± 0.9 s vs −0.1 ± 0.5 s; mean difference 2.3 s, 95% CI: −2.7 to −2.1), and fear of falling (FES-I: −8.1 ± 4.5 vs −0.2 ± 1.0; mean difference 7.9 points, 95% CI: −9.5 to −6.7) (all $p < 0.001$). No significant changes were observed in the control group. The intervention was well tolerated, with full adherence and no reported adverse events.

Conclusion: A 6-week supervised balance exercise program resulted in clinically meaningful improvements in balance, mobility, and fall-related self-efficacy in community-dwelling older adults. These findings support its role as a safe and effective short-term intervention within fall-prevention strategies, although longer-term studies are warranted to determine sustainability of benefits.

Keywords: Balance training, Falls prevention, Older adults, Functional mobility.

Introduction

Population aging is a defining demographic trend of the 21st century, with profound implications for global health systems. It is estimated that by 2050,

approximately 20% of the global population will be aged ≥60 years, reflecting increased life expectancy and declining fertility rates (United Nations, 2020; World Health Organization, 2021a). Although longevity represents a major public health achievement, it is accompanied by a higher prevalence of functional decline, multimorbidity, and disability. Among these challenges, falls are a leading cause of injury, hospitalization, and mortality in older adults, imposing a substantial burden on healthcare systems and reducing independence and quality of life (Burns & Kakara, 2018; World Health Organization, 2021b).

Falls in older adults are multifactorial and arise from the interaction of intrinsic and extrinsic factors. Age-related changes such as reduced muscle strength, impaired proprioception, delayed reaction time, and deficits in sensory integration contribute significantly to postural instability (Ambrose et al., 2013; Rubenstein, 2006). In addition to physical injuries such as fractures and soft tissue damage, falls have important psychological consequences. Fear of falling, anxiety, reduced confidence, and social isolation can lead to activity restriction and further functional decline, creating a self-perpetuating cycle of frailty and increased fall risk (Denkinger et al., 2015; Scheffer et al., 2008).

Balance is a fundamental component of functional mobility and independence in older adults. It is a complex process involving the integration of visual, vestibular, and somatosensory systems to maintain postural stability during static and dynamic activities (Horak, 2006). Age-related impairments in these systems compromise both anticipatory and reactive postural control, thereby increasing the likelihood of instability and falls (Maki & McIlroy, 2006). Given its central role in mobility and fall prevention, balance has become a key therapeutic target in geriatric rehabilitation.

To assess balance and fall risk, several standardized and validated clinical tools are widely used. The Berg Balance Scale (BBS) demonstrates high reliability and strong construct validity for assessing balance in older adults (Berg et al., 1992). The Timed Up and Go (TUG) test is a simple and reliable measure of functional mobility with strong predictive validity for fall risk (Podsiadlo & Richardson, 1991). The Falls Efficacy Scale–International (FES-I) is a well-validated instrument for assessing fear of falling and fall-related self-efficacy across different populations (Yardley et al., 2005). The combined use of these tools enables a comprehensive evaluation of both physical and psychological domains of fall risk.

Exercise-based interventions, particularly balance training, are widely recommended as an effective non-pharmacological strategy for fall prevention (Gillespie et al., 2012; Sherrington et al., 2017). Balance training programs typically incorporate static and dynamic postural tasks, functional movements, and dual-task activities designed to challenge neuromuscular control and improve postural stability (Granacher et al., 2013). Evidence suggests that such interventions can enhance balance performance, improve functional mobility, and reduce fear of falling, thereby contributing to improved independence and quality of life (Cadore et al., 2013; Howe et al., 2011).

Despite these benefits, important limitations remain in the existing literature. Many studies have focused on long-duration interventions (≥12 weeks), which may limit feasibility and adherence in real-world settings (Lesinski et al., 2015). Additionally, heterogeneity in intervention protocols and outcome measures complicates interpretation and generalization of findings. While improvements in physical outcomes are commonly reported, fewer studies have simultaneously examined psychological

outcomes such as fear of falling. Moreover, limited evidence exists regarding short-term, structured, and supervised balance programs integrating static, dynamic, functional, and dual-task components in community-dwelling older adults.

Study gap and justification

Therefore, a critical gap exists regarding the effectiveness of short-duration, multimodal balance training programs that are both clinically feasible and evidence-based. There is a need for well-designed randomized controlled trials that comprehensively evaluate both physical (balance and mobility) and psychological (fall-related self-efficacy) outcomes using validated measures such as BBS, TUG, and FES-I. Addressing this gap is essential to inform the development of efficient, scalable, and patient-centered fall-prevention strategies.

Objective, hypothesis, and clinical relevance

Accordingly, this randomized controlled trial aimed to evaluate the effects of a 6-week supervised balance exercise program on balance performance, functional mobility, and fall-related self-efficacy in community-dwelling older adults. It was hypothesized that participants receiving structured balance training would demonstrate significant improvements in BBS, TUG, and FES-I outcomes compared with those receiving usual care. From a clinical perspective, such a short-term, supervised intervention may offer a time-efficient, low-cost, and scalable strategy for fall prevention, enhancing functional independence and reducing healthcare burden among older adults.

Materials and Methods

Study Design and Participants

This study was designed as a parallel-group, randomized controlled trial conducted in accordance with established methodological standards for clinical trials. The study population consisted of community-dwelling older adults aged 65 years and above. A total of 80 participants were recruited through community centers and outpatient clinics using a convenience sampling approach. Randomized controlled trials are considered the gold standard for evaluating intervention effectiveness due to their ability to minimize bias and establish causal relationships (Hariton & Locascio, 2018).

Eligibility criteria were defined to ensure a homogeneous and clinically relevant sample. Participants were included if they were able to ambulate independently with or without an assistive device, had sufficient cognitive function to follow instructions as indicated by a Mini-Mental State Examination (MMSE) score ≥24, and had not participated in structured balance training programs within the previous six months. The MMSE is a widely validated tool for assessing cognitive status in older adults (Folstein et al., 1975). Participants were excluded if they had acute musculoskeletal injuries, uncontrolled cardiovascular conditions, severe visual impairment, or neurological disorders affecting balance, as these factors may confound balance performance and increase risk during exercise interventions (Shumway-Cook & Woollacott, 2017).

Randomization and Blinding

Participants were randomly allocated in a 1:1 ratio to either the intervention group or the control group using a computer-generated randomization sequence. Allocation concealment was ensured using sealed, opaque envelopes prepared by an independent researcher not involved in participant recruitment or assessment. Blinding of participants and therapists was not feasible due to the nature of the intervention; however, outcome assessors were blinded to group allocation to

minimize detection bias. Blinded assessment is a critical methodological component in randomized trials to enhance internal validity (Schulz et al., 2010).

Intervention Protocol

Participants in the intervention group underwent a supervised balance training program conducted three times per week for six consecutive weeks, totaling 18 sessions. Each session lasted approximately 60 minutes and consisted of three components: a 10-minute warm-up, a 40-minute balance training phase, and a 10-minute cool-down period.

The warm-up included low-intensity activities such as walking, range-of-motion exercises, and gentle stretching to prepare the musculoskeletal and cardiovascular systems for exercise. The main training phase incorporated a progressive and multimodal balance program targeting different aspects of postural control. Exercises included static balance tasks (e.g., tandem stance, single-leg stance), dynamic balance activities (e.g., weight shifting, stepping tasks), functional movements (e.g., sit-to-stand, reaching tasks), and dual-task exercises combining cognitive and motor demands. The inclusion of dual-task training is supported by evidence suggesting its effectiveness in improving balance and reducing fall risk in older adults (Woollacott & Shumway-Cook, 2002).

Exercise intensity and complexity were progressively increased based on individual performance, consistent with established principles of exercise prescription for older adults (American College of Sports Medicine, 2009). Progression strategies included reducing base of support, increasing task complexity, incorporating unstable surfaces, and adding cognitive challenges. All sessions were supervised by a trained physiotherapist to ensure safety and proper execution of exercises.

Participants in the control group received usual care and were instructed to continue their regular daily activities without engaging in structured balance training. They were not provided with any specific exercise program during the study period.

Outcome Measures

Outcome measures were assessed at baseline and after the 6-week intervention period by blinded assessors. Validated and widely used clinical tools were selected to evaluate both physical and psychological domains of fall risk.

The primary outcome measure was balance performance assessed using the Berg Balance Scale (BBS). The BBS is a 14-item scale evaluating static and dynamic balance, with scores ranging from 0 to 56, where higher scores indicate better balance. It has demonstrated excellent reliability and validity in older adult populations (Berg et al., 1992).

Secondary outcomes included functional mobility assessed using the Timed Up and Go (TUG) test and fall-related self-efficacy assessed using the Falls Efficacy Scale–International (FES-I). The TUG measures the time required to stand up from a chair, walk 3 meters, turn, return, and sit down. It is a reliable and valid measure of mobility and fall risk in older adults (Podsiadlo & Richardson, 1991). The FES-I assesses concern about falling during various daily activities, with higher scores indicating greater fear of falling. It has been validated across different populations and demonstrates strong psychometric properties (Yardley et al., 2005).

Statistical Analysis

Data were analyzed using IBM SPSS Statistics (version 22.0; IBM Corp., Armonk, NY, USA) and R statistical software. Quantitative variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as

frequencies and percentages. Normality of data distribution was assessed using the Shapiro–Wilk test.

Baseline characteristics between groups were compared using independent samples t-tests for continuous variables and chi-square tests for categorical variables. Within-group and between-group comparisons were conducted using appropriate parametric tests. Independent t-tests were used to compare post-intervention outcomes between groups, while paired t-tests were used to assess within-group changes. A p-value of <0.05 was considered statistically significant.

The statistical approach was selected based on standard analytical procedures for randomized controlled trials involving continuous outcome measures (Field, 2018). All analyses were conducted on a per-protocol basis, including only participants who completed the intervention. Significant value if p<0.05.

Results

The baseline demographic and anthropometric characteristics were comparable between the intervention and control groups. The mean age was 70.53 ± 7.66 years in the intervention group and 69.45 ± 5.75 years in the control group (p = 0.478). Mean height was 166.45 ± 10.49 cm vs 165.55 ± 10.05 cm (p = 0.696), mean weight 65.85 ± 9.57 kg vs 66.88 ± 15.12 kg (p = 0.717), and mean BMI 23.79 ± 2.71 kg/m² vs 24.41 ± 5.35 kg/m² (p = 0.515). Sex distribution (45% males, 55% females) and marital status were similar between groups (all p > 0.7). These results indicate well-matched baseline characteristics (Table 1).

Vision disorders were reported in 30% of participants in the intervention group compared with 40% in the control group, while 70% and 60% had no vision problems, respectively (χ^2 = 0.879, p = 0.348). Hearing disorders were present in 45% of participants in both groups, while 55% had no hearing impairment (χ^2 = 0, p = 1.0). Overall, sensory status was comparable between groups (Table 2).

Table 1: Baseline characteristics of participants (N=40).

Variables (Mean ±SD)	Intervention group	Control group	t-value	p-value
Height (cm)	166.45 ± 10.49	165.55 ± 10.05	0.392	0.696
Weight (kg)	65.85 ± 9.57	66.88 ± 15.12	0.364	0.717
Age (year)	70.53 ± 7.66	69.45 ± 5.75	0.713	0.478
BMI (Kg/m2)	23.79 ± 2.71	24.41 ± 5.35	0.654	0.515
Sex				
Male	18(45%)	18(45%)	x^2=0	1
Female	22(55%)	22(55%)		
Marital status				
Widowed	30(75%)	32(80%)		
Single	4(10%)	4(10%)	x^2=0.47	0.79
Divorced	6(15%)	4(10%)		

x^2: Chi-square value; p<0.05: Significant value.

Table (2): Distribution of vision and hearing disorders among the studied groups.

Disorders	Intervention group	Control group	Chi-square test value	p value
Vision disorders				
No	28(70%)	24(60%)	x^2=0.879	0.348
Yes	12(30%)	16(40%)		
Hearing disorders				
No	22(55%)	22(55%)	x^2=0	1
Yes	18(45%)	18(45%)		

P<0.05: Significant value

The distribution of comorbid diseases was generally similar between the groups. Participants without comorbidities represented 20% and 15%

in the intervention and control groups, respectively (p = 0.56). Cardiovascular disorders (30% vs 25%), musculoskeletal disorders (25% vs 20%), gastrointestinal disorders (15% vs 20%), and metabolic disorders (10% vs 15%) were observed with comparable frequencies. Neurological disorders were reported in 5% of participants in each group, while respiratory and urinary disorders were infrequent. Overall, comorbid conditions were comparable between groups. (Table 3).

Table (3): Distribution of comorbid diseases among the studied groups (N=40).

Conditions	Intervention group	Control group	Test	P value
Diseases				
None	8(20%)	6(15%)	x^2=0.346	0.56
Cardiovascular disorders	12(30%)	10(25%)	x^2=0.251	0.62
Musculoskeletal disorders	10(25%)	8(20%)	x^2=0.287	0.59
GIT disorders	6(15%)	8(20%)	x^2=0.346	0.56
Metabolic disorders (DM)	4(10%)	6(15%)	x^2=0.457	0.49
Nerves disorders	2(5%)	2(5%)	x^2=0	1
Respiratory disorders	0(0%)	2(5%)	x^2=2.051	0.15
Urinary disorders	2(5%)	0(0%)	x^2=2.051	0.15

x^2: Chi-square value; p<0.05: Significant value.

A history of falls was reported in 45% of participants in the intervention group and 40% in the control group, while 55% and 60% had no previous history of falls (χ^2 = 0.205, p = 0.65). Fall history distribution was similar between groups (Table 4).

Table (4): History of falls among the studied groups (N=40).

History of falls	Intervention group	Control group	Test	P value
No	22(55%)	24(60%)	x^2=0.205	0.65
Yes	18(45%)	16(40%)		

x^2: Chi-square value; p<0.05: Significant value.

After 6 weeks, participants in the intervention group showed marked improvements. The BBS score increased by 7.2 ± 3.1 points (95% CI: 6.2–8.2) vs 0.2 ± 1.0 (95% CI: −0.1–0.5) in the control group. The mean between-group difference was 7.0 points, which is clinically meaningful. TUG time decreased by 2.4 ± 0.9 s (95% CI: −2.7 to −2.1) in the intervention group vs 0.1 ± 0.5 s (95% CI: −0.3–0.1) in the control group, with a between-group difference of 2.3 s, reflecting improved functional mobility. FES-I score decreased by 8.1 ± 4.5 points (95% CI: −9.5 to −6.7) vs 0.2 ± 1.0 (95% CI: −0.5–0.1) in the control group, with a between-group difference of 7.9 points, indicating reduced fear of falling. All participants in the intervention group completed the program with good adherence, and no adverse events were reported. Overall, the intervention group demonstrated significant improvements in balance, mobility, and fear of falling compared with the control group. (Table 5, Figure 1).

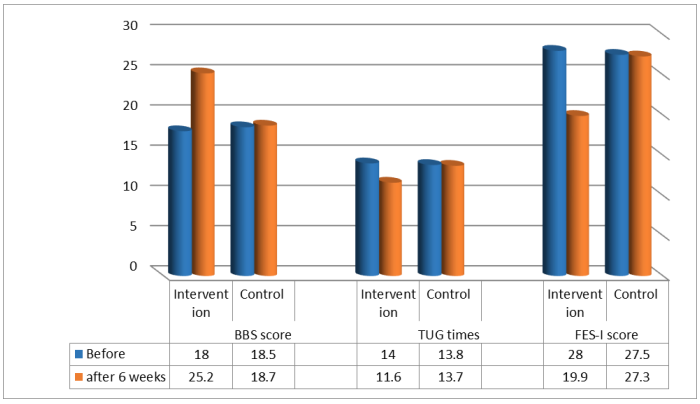

Figure 1. BBS score, FES-I score and TUG times after 6 weeks.

Table (5): BBS score, FES-I score, and TUG times after 6 weeks.

Outcome	Baseline (Mean±SD)	Posttest (Mean±SD)	Mean change ± SD	P value
BBS score				
Intervention	18.0 ± 4.0	25.2 ± 5.0	+7.2 ± 3.1	<0.001
Control	18.5 ± 4.2	18.7 ± 4.3	+0.2 ± 1.0	0.83
TUG times				
Intervention	14.0 ± 2.5	11.6 ± 2.2	−2.4 ± 0.9	<0.001
Control	13.8 ± 2.3	13.7 ± 2.4	−0.1 ± 0.5	0.85
FES-I score				
Intervention	28.0 ± 6.0	19.9 ± 5.0	−8.1 ± 4.5	<0.001
Control	27.5 ± 5.8	27.3 ± 5.9	−0.2 ± 1.0	0.88

SD: Standard deviation; p<0.05: Significant value

Discussion

The present randomized controlled trial demonstrated that a 6-week supervised balance training program significantly improved balance performance, functional mobility, and fear of falling among community-dwelling older adults. The absence of significant differences between groups at baseline across demographic, anthropometric, sensory, and clinical variables strengthens the internal validity of the findings and suggests that the observed improvements are attributable to the intervention rather than confounding factors.

The significant improvement in balance performance, as evidenced by increased Berg Balance Scale (BBS) scores, is consistent with previous literature highlighting the effectiveness of balance training in enhancing postural control in older adults. Systematic reviews and meta-analyses have consistently reported that structured balance interventions lead to meaningful improvements in both static and dynamic balance, thereby reducing fall risk (Lesinski et al., 2015; Sherrington et al., 2017). Furthermore, randomized trials have demonstrated that balance-focused programs can significantly improve BBS scores and functional stability, supporting the responsiveness of this measure to intervention (Madureira et al., 2006).

The observed reduction in Timed Up and Go (TUG) time reflects improved functional mobility and dynamic balance. The TUG test is widely recognized as a valid and reliable indicator of mobility limitations and fall risk in older adults (Podsiadlo & Richardson, 1991). Improvements in TUG performance following balance training are consistent with previous findings demonstrating that exercise interventions enhance gait performance, coordination, and neuromuscular efficiency (Granacher et al., 2013; Howe et al., 2011). These improvements may be attributed to enhanced motor control, improved muscle activation patterns, and better integration of sensory inputs.

A key finding of this study is the significant reduction in fear of falling, as measured by the Falls Efficacy Scale–International (FES-I). Fear of falling is a critical psychological factor that contributes to activity restriction, reduced confidence, and functional decline in older adults (Scheffer et al., 2008; Denkinger et al., 2015). The observed reduction in FES-I scores aligns with previous studies indicating that balance and exercise-based interventions can enhance self-efficacy and reduce fall-related anxiety (Yardley et al., 2005; Halvarsson et al., 2015). This highlights the importance of addressing both physical and psychological components of fall risk in intervention design.

The multimodal nature of the intervention, incorporating static, dynamic, functional, and dual-task exercises, likely contributed to the observed outcomes. Dual-task training has been shown to improve cognitive-motor integration and postural control, which are essential for maintaining stability during complex daily activities (Woollacott

& Shumway-Cook, 2002). Additionally, the progressive nature of the training program aligns with established exercise principles and may have facilitated neuromuscular adaptations and improved balance strategies (American College of Sports Medicine, 2009).

Importantly, the findings of this study support emerging evidence that short-term interventions can produce clinically meaningful improvements. While many previous studies have focused on longer intervention durations, recent systematic reviews suggest that shorter, well-structured programs may also be effective, particularly when supervised (Lesinski et al., 2015). This has significant clinical implications, as shorter interventions may improve adherence and feasibility in real-world settings.

Overall, the present study reinforces the role of structured balance training as an effective intervention for improving both physical and psychological determinants of fall risk in older adults. The combined improvements in balance, mobility, and self-efficacy suggest that such programs may contribute to enhanced functional independence and quality of life.

Limitations and Future Recommendations

Despite these findings, several limitations should be acknowledged. The relatively small sample size and convenience sampling approach may limit the generalizability of the results. The short duration of the intervention and absence of long-term follow-up prevent conclusions regarding the sustainability of improvements and their impact on actual fall incidence. Additionally, participant and therapist blinding was not feasible, which may have introduced performance bias, although assessor blinding was maintained. The study relied on clinical outcome measures without incorporating objective biomechanical assessments, and potential moderating effects of comorbidities and sensory impairments were not explored.

Future research should include larger, multicenter trials with longer follow-up periods to assess long-term effectiveness and fall incidence. Investigating optimal training dose and subgroup-specific responses is warranted. Incorporating objective assessment tools and exploring combined or technology-assisted interventions may further enhance clinical applicability.

Conclusion

A six-week balance exercise program significantly improved balance performance, functional mobility and reduced fear of falling in community-dwelling older adults. The control and intervention groups were similar at baseline, confirming that observed improvements were attributable to the exercise program. Participants in the intervention group illustrated elevated BBS scores, faster Timed Up and Go performance, and reduced FES-I scores, whereas insignificant changes have been found in the control group.

Author Contributions

Abdelrhman Shafiq Alsayyed contributed to the study conception and design, material preparation, data collection and analysis.

Ethical Approval and Patient Consent

This research was performed at Physiotherapy Clinic, Khobar, Suadi Arabia, Ethical Committee approval and written, informed consent was obtained from all patients, the research carried on human data in compliance with Helsinki.

Data Availability Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Conflicts of Interest

The authors declare no potential conflicts of interest in this study.

Declaration of generative AI and AI-assisted technologies

The author utilized AI tools to enhance the language quality and address any grammatical issues while preparing the manuscript. Following the use of this tool, the author carefully reviewed and edited the content as necessary and assumes full responsibility for the accuracy and integrity of the published work.

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