



The Effect of Movement-Based Interventions on Balance and Gait in Older Adults: A Systematic Review of Randomized Controlled Trials

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Authors

Fateme Soltani¹,
Ebrahim Ebrahimi^{2*},
Seyed Alihossein Nourbakhsh³

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¹ Department of Corrective Exercise & Sport Injury, Faculty of Physical Education and Sport Sciences, Allameh Tabataba'i University, Tehran, Iran

² Department of Sport Injuries and Biomechanics, Faculty of Sport Sciences and Health, University of Tehran, Tehran, Iran

³ Department of Sports Injuries and Corrective Exercises, Faculty of Sport Sciences, Shahid Bahonar University of Kerman, Kerman, Iran



* Correspondence

Department of Sport Injuries and Biomechanics, Faculty of Sport Sciences and Health, University of Tehran, Tehran, Iran.

P.O. 88351730-37

Tel : 0098 2188021527

Fax : 0098 9339708496

E-mail: ebrahimi.79@ut.ac.ir

ORCID: 0009-0004-2969-2896

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ABSTRACT

Aims: This systematic review aimed to assess the effects of movement-based interventions on balance and walking ability in older adults.

Method and Materials: This systematic review followed the PRISMA in Exercise, Rehabilitation, Sport Medicine and Sports Science guidelines and searched PubMed, Scopus, and Web of Science for peer-reviewed original articles from each database's inception through April 2026, using targeted keywords. Google Scholar was also consulted to identify any additional relevant sources. Study quality was evaluated using the PEDro scale.

Findings: From a total of 311 records, five randomized controlled trials — published between 2009 and 2025 — fulfilled the inclusion criteria. The interventions lasted between eight and sixteen weeks. Movement-based programs showed improvements in balance, reflected in better One-Leg Stance (OLS) and Berg Balance Scale (BBS) scores, as well as enhanced gait performance, as indicated by Timed Up and Go (TUG) test results and the 6-minute walk tes.

Conclusion: The findings of this systematic review suggest that movement-based interventions may be instrumental in improving balance and gait in older adults. Upcoming research should focus on large-scale, well-structured randomized controlled trials that employ standardized protocols to improve the consistency and comparability of results.

Keywords: Elderly, Balance, Gait

Introduction

The aging of the global population has become one of the most prominent demographic shifts of the 21st century. It is estimated that by 2050, the number of individuals aged 60 and above will reach approximately 2.1 billion worldwide, nearly twice the current figure ⁽¹⁾. As longevity increases, age related declines in neuromuscular function, sensory processing, and cognition increase the risk of mobility impairments in older adults ⁽²⁾. Among these, deficits in balance and gait are particularly consequential, given their strong association with falls, one of the leading causes of injury, disability, health care utilization, and mortality in this population ⁽³⁾. Fall related injuries not only lead to substantial personal and societal burdens but also undermine independence, confidence, and overall quality of life in older adults ⁽⁴⁾. Consequently, identifying

effective strategies to mitigate balance and gait impairments remains a critical priority for clinicians, researchers, and public health stakeholders ^(2, 5).

Movement-based interventions have gained considerable attention as non-pharmacological approaches for improving balance, mobility, and functional capacity in aging populations ^(6, 7). Common modalities include gait training ⁽⁸⁾, resistance and functional exercises ⁽⁹⁾, Baduanjin ^(10, 11), Taekkyon ⁽¹²⁾, Shuai Shou Gong ⁽¹³⁾, and Folklore dance ⁽¹⁴⁾. Such interventions are grounded in principles of motor learning and neuromuscular adaptation, aiming to counteract age-related deterioration in sensorimotor integration, proprioception, muscle strength, and postural responses ^(15, 16). Importantly, movement-based interventions are typically low-cost, adaptable, and safe when properly guided, rendering them accessible options for community dwelling and clinical

populations alike ⁽¹³⁾.

A growing body of evidence suggests that movement based interventions may improve balance and gait outcomes ⁽¹⁰⁻¹⁴⁾. Prior systematic reviews have documented beneficial effects on postural sway, functional mobility tests, gait speed, and fall rates across various exercise modalities ^(17, 18). However, the field remains heterogeneous, with substantial variability in intervention types, durations, intensities, participant characteristics, and outcome measures ⁽¹⁹⁾. Furthermore, many existing reviews are modality specific, focusing solely on Tai Chi, balance training, or strength training, or include studies with wide age ranges or mixed clinical conditions, reducing their applicability to healthy older adults or those at risk of age related decline ^(20, 21). As research expands, a comprehensive synthesis that integrates findings across diverse movement based modalities while applying rigorous methodological standards is needed. Interventions such as dance, which incorporate complex movement sequences and cognitive engagement, may offer superior benefits through enhanced neuroplasticity and sensorimotor integration ⁽¹⁴⁾. Yet no consensus exists on which types of movement-based interventions yield the greatest improvements ⁽¹¹⁾, or which parameters, such as dosage, intensity, and training environment, are most effective for older adults. Understanding these nuances is essential for developing targeted, evidence based clinical guidelines.

This systematic review aims to address this need by critically evaluating the current scientific literature to determine the effectiveness of movement-based interventions in improving balance and gait in older adults. By synthesizing evidence from high-quality studies, we aim to provide a comprehensive overview to inform clinical guidelines, guide intervention development, and empower older adults and their caregivers with evidence-based strategies to promote healthy aging and reduce the burden of mobility-related impairments. Specifically, this review will focus on identifying and characterizing diverse movement-based interventions and quantifying their effects on objective

measures of balance and gait. The findings are expected to offer valuable insights into which types of movement-based interventions are most effective, for whom, and under what conditions, ultimately contributing to enhanced quality of life and independence for older adults worldwide.

Method and Materials

This systematic review followed the PRISMA in Exercise, Rehabilitation, Sport Medicine and Sports Science guidelines ⁽²²⁾. PubMed, Scopus, and Web of Science were searched from their inception through April 2026, with Google Scholar consulted as a supplementary source. Search terms were selected based on Table 1 and combined using Boolean operators, with all searches conducted in English. Studies were eligible for inclusion if they involved older adult participants and examined the impact of movement-based interventions — such as Folklore dance, Taekkyon, and Baduanjin — on balance and/or gait. Only randomized clinical trials (RCTs) and original research articles published in English in peer-reviewed journals were considered. Studies were excluded if they were unrelated to movement-based interventions, were conference abstracts, review articles, or case reports, or lacked quantitative outcome data. Search results were imported into EndNote 7X, after which two independent researchers (F.S. and S.A.N.) screened titles and abstracts, with relevant studies advancing to full-text review. Any disagreements between reviewers were resolved through consensus with the supervisor (E.E.). Data on general information, study characteristics, and outcomes were then extracted from the eligible articles by the same two researchers and compiled in Table 2. Study quality was evaluated using the PEDro scale for RCTs (Table 3) ⁽²³⁾.

Findings

Figure 1 outlines the process by which studies were selected. A total of 311 articles were initially identified. Once duplicates were removed, 229 abstracts underwent screening, of which 202 were excluded, leaving 27 articles to be assessed in full. Upon thorough full-text evaluation, a further 22

articles were excluded, yielding a final set of 5 studies for inclusion in the analysis (Figure 1). A

summary of the findings from these studies is presented in Table 2.

Table 1) Search strategy used for this study

Variable	Keywords
Older Adults	(elder* OR "older adult*" OR "older people" OR "older person*" OR "older population*" OR "older individual*" OR geriatric* OR "aging population*" OR "ageing population*" OR "aged" OR "senior*" OR "senior citizen*" OR "retired" OR "retiree*" OR "later life" OR "later adulthood" OR "advanced age" OR "late adulthood" OR "60 years" OR "≥60" OR "60 years old" OR "60 and over" OR "over 60" OR "65 years" OR "≥65" OR "65 years old" OR "65 and over" OR "over 65")
Interventions	AND (baduanjin OR taekkyon OR “Shuai Shou Gong” OR “folklore dance”)
Balance/ Gait	AND (balance* OR “balance function” OR “vestibular function” OR equilibrium OR “posture control” OR gait* OR walk*)

All five included studies were published between 2009 and 2025 and employed RCT designs. Participant samples ranged from 40 to 60 older adults, with mean ages falling between 60 and 79 years. Intervention periods varied from eight to sixteen weeks. Outcomes were grouped into two categories: a) Balance, evaluated primarily through the One-Leg Stance (OLS) (11, 12) and the Berg Balance Scale (BBS) (10, 14); and b) Gait, measured using the Timed Up and Go (TUG) test (10, 12, 13) and the 6-minute walk test (14).

Based on a qualitative data synthesis, four studies encompassing 200 older adult participants examined balance outcomes. Across these studies, movement-based interventions consistently yielded positive results, with participants demonstrating

increased One-Leg Stance (OLS) duration and higher Berg Balance Scale (BBS) scores (10-12, 14). Collectively, the evidence points to a beneficial effect of movement-based interventions on balance in older adults. Regarding gait, four studies involving 216 older adult participants assessed related outcomes. Movement-based interventions were associated with improved gait performance across these studies. Yildirim et al. (2025), Kim et al. (2024), and Xiao et al. (2023) all reported favorable changes in Timed Up and Go (TUG) test scores (10, 12, 13), while Eyigor et al. (2009) demonstrated meaningful gains in the 6-minute walk test (14). Taken together, these findings indicate that movement-based interventions positively contribute to gait function in older adults.

Table 2) Demographic information from included studies

Study	Participants	Gender (M/F)	Experimental Intervention	Control Intervention	Outcome	Tool	Results
Yu et al. 2025	40 participants (EG: 20,CG: 20)	20/20	Baduanjin	Prescribed physical activities	Balance	One-leg stance	Significant difference (p<0.01)
Yildirim et al. 2025	60 participants (EG: 30, CG: 30)	25/35	Baduanjin	Physical activity recommendations are recommended in the WHO guidelines	Balance Gait	Berg balance scale Timed Up and Go	Significant difference (p<0.05) Significant difference (p<0.05)
Kim et al. 2024	60 participants (EG: 30,CG: 30)	NA	Taekkyon	Falling prevention program	Balance Gait	OLS Timed Up and Go	Significant difference (p<0.01) Significant difference (p<0.01)
Xiao et al. 2023	56 participants (EG: 28,CG: 28)	0/56	Shuai Shou Gong	Usual daily lifestyle	Gait	Timed Up and Go	Significant difference (p<0.05)
Eyigor et al. 2009	40 participants (EG: 20, CG: 20)	0/40	Folklore dance	Usual daily lifestyle	Balance Gait	Berg balance scale 6-min walk	Significant difference (p<0.05) Significant difference (p<0.05)

EG Experimental group, CG Control group, NA Not available

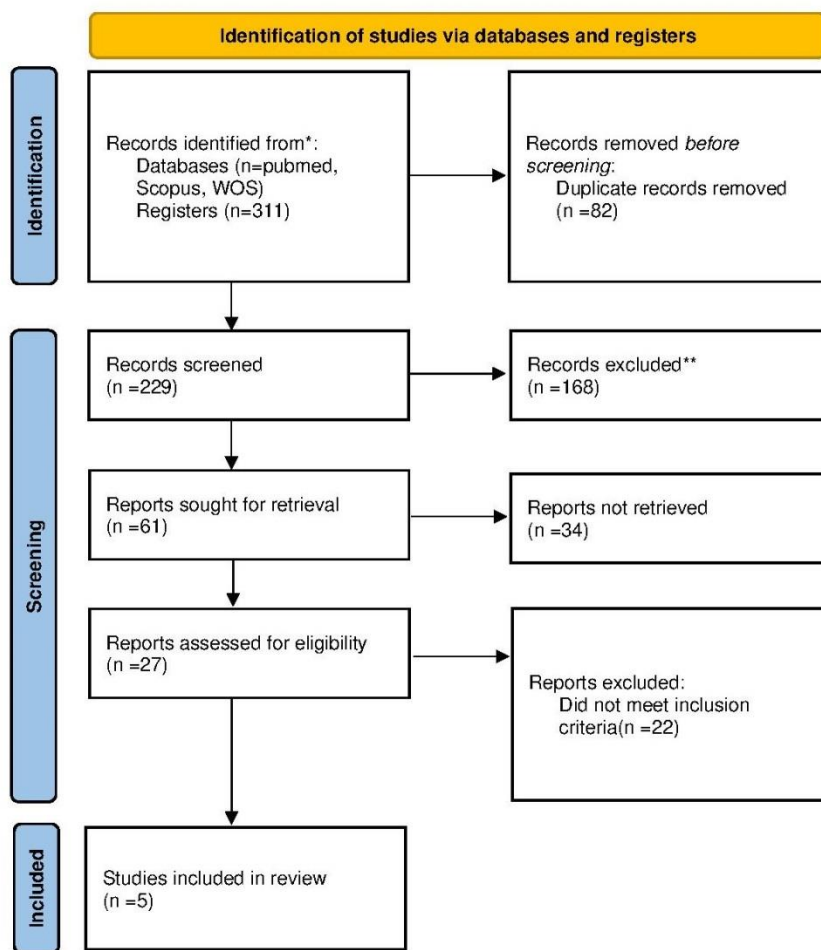


Figure 1) Flow diagram for eligible studies

The methodological quality of the included studies was evaluated using the PEDro scale, with results summarized in Table 3. Among the five studies assessed, four were considered high quality, scoring between 6 and 8 out of 10, while one study received a score of 5 and was classified as low quality (11). The top scores were achieved by Yildirim et al. (2025) and Xiao et al. (2025) (10, 13), both earning 8 points, followed by Kim et al. (2024)

with 7 points and Eyigor et al. (2009) with 6 points (12, 14). The most frequently noted limitations across studies concerned blinding procedures and allocation concealment, both of which are inherently difficult to implement in movement-based intervention research. Overall, the included studies exhibited moderate to high methodological quality, lending credibility to the synthesized findings.

Table 3) Critical appraisal results of eligible systematic reviews

Study	1	2	3	4	5	6	7	8	9	10	11	Total	Quality
Yu et al. 2025	1	1	0	1	0	0	0	0	0	1	1	5	Low
Yildirim et al. 2025	1	1	1	1	0	0	1	1	0	1	1	8	High
Kim et al. 2024	1	1	0	1	0	0	1	0	1	1	1	7	High
Xiao et al. 2023	1	1	1	1	0	0	0	1	1	1	1	8	High
Eyigor et al. 2009	1	1	0	1	0	0	1	0	0	1	1	6	High

Discussion

The primary objective of the present study This systematic review synthesizes current evidence on the effects of movement-based interventions on balance and gait in older

adults, demonstrating consistent and clinically meaningful benefits across multiple modalities, including Baduanjin, Taekkyon, Shuai Shou Gong, and Folklore dance. Despite the relatively small number of high-quality

studies (n = 5), the converging evidence supports the role of structured movement-based programs in mitigating age-related declines in postural control and functional mobility. All included studies reported significant improvements in balance and/or gait outcomes among older adults who participated in movement-based interventions. Specifically, Baduanjin demonstrated significant enhancements in One-Leg Stance (OLS) and Berg Balance Scale (BBS) scores, indicating improved static and dynamic postural stability^(10, 11). Similarly, Taekkyon and Shuai Shou Gong were associated with reductions in Timed Up and Go (TUG) test times, reflecting gains in functional mobility and dynamic balance^(12, 13). Folklore dance, incorporating rhythmical and multidirectional movement patterns⁽²⁴⁾, also yielded improvements in both balance and gait, as measured by the Berg Balance Scale (BBS) and the 6-min walking test⁽¹⁴⁾. Collectively, these findings indicate that diverse movement-based modalities, ranging from traditional martial arts to embedded dance forms, may enhance neuromuscular coordination, postural control, and gait efficiency in older adults. The consistent positive effects observed across modalities may be attributed to the common underlying mechanisms inherent in movement-based interventions⁽²⁵⁾. These interventions emphasize weight shifting, proprioceptive feedback, dynamic balance⁽²⁶⁾, and coordinated lower limb activation⁽²⁷⁾, all of which stimulate sensorimotor integration and enhance neuroplasticity⁽²⁸⁾. The cognitive engagement inherent in learning new movement sequences, particularly in complex forms such as Taekkyon or Folklore dance, may further augment cortical and subcortical adaptations⁽²⁹⁾, improving anticipatory postural adjustments and reactive balance responses⁽³⁰⁾. Moreover, movement-based interventions may influence gait by improving lower-limb strength, joint range of motion, and cardiovascular endurance^(31, 32), thereby enhancing walking speed, stride length, and functional mobility⁽³³⁾. The methodological rigor of the included studies was generally high, with four out of five studies rated as high quality on the PEDro scale, lending credibility

to the observed outcomes.

The practical implications of these findings are substantial. Falls remain a leading cause of morbidity, disability, and healthcare burden among older adults⁽³⁴⁾. Given that deficits in balance and gait are major modifiable risk factors for falls, movement-based interventions offer a feasible, low-cost, and scalable approach to fall prevention and mobility enhancement. Their adaptability enables implementation across diverse settings, from community centers and long-term care facilities to home-based programs, thereby increasing accessibility for older adults with varying functional capacities. Additionally, culturally grounded interventions, such as Folklore dance, may enhance adherence and enjoyment, thereby further supporting long-term engagement and functional gains. Despite promising evidence, several limitations remain. First, there is a need for larger, multicenter RCTs to confirm the generalizability of findings across heterogeneous populations, including older adults with comorbidities or frailty. Second, future studies should investigate dose-response relationships, including optimal frequency, intensity, and session duration for maximal improvements in balance and gait. Third, comparative effectiveness studies are warranted to determine whether certain modalities, such as cognitively integrated motor forms (e.g., complex dance sequences), offer greater benefits than simpler movement-based interventions. Fourth, most studies had relatively small sample sizes (40–60 participants). Also, blinding and allocation concealment were consistently identified as methodological challenges, reflecting the inherent difficulties in designing RCTs for movement-based interventions. Finally, long-term follow-up studies are essential to assess the durability of training effects and their impact on fall incidence, independence, and quality of life.

Conclusion

In summary, this review demonstrates that movement-based interventions are effective in improving balance and gait among older adults. These findings underscore the

potential of structured, movement-based programs as a cornerstone of preventive and rehabilitative strategies for older adults. Clinicians, public health practitioners, and caregivers should consider integrating these interventions into routine practice to promote functional independence, reduce fall risk, and support healthy aging.

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Authors' Contribution

All authors contributed to the conceptualization, methodology, project administration, resources, and formal analysis. All authors helped in the investigation. All authors contributed to data curation. All authors approved the final version of the manuscript.

Conflicts of Interest

The authors have no conflicts of interest.

Ethical Permission

Not applicable.

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