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Effectiveness of Balance Training in Preventing Falls Among the Elderly: A Scoping Review

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Abstract

Introduction: The risk of falls among older people is a significant public health concern, impacting quality of life and mortality rates. Balance training has been widely implemented as an intervention strategy to prevent falls; however, the effectiveness and variety of training methods remain diverse in the literature.
Methods: This study is a scoping review conducted by the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) guidelines. A comprehensive literature search was performed across PubMed, Scopus, Google Scholar, and the Cochrane Library using relevant keywords such as "balance training," "fall prevention," and "elderly." Studies published between 2020 and 2025 involved balance training interventions among older adults.
Results: Out of 500 articles initially identified, 13 met the inclusion criteria. Balance training was shown to positively reduce fall risk, improve postural control, and enhance self-confidence among older adults in performing daily activities. The most commonly used interventions included Tai Chi, proprioceptive training, and multifunctional programs combining strength and balance exercises.
Conclusion: Balance training is an effective intervention for fall prevention in older people. The success of such interventions depends on the regularity, intensity, and type of training applied. Further research is needed to standardize optimal training programs for older populations with varying fall risk levels.

Keywords: balance training, falls, elderly

Introduction

Aging is a natural process characterized by various physiological changes, including the decline of musculoskeletal, sensorimotor, and vestibular system functions, contributing to balance disorders. One of the main consequences of balance impairment in older adults is an increased risk of falls, which can lead to serious complications such as fractures, disability, and overall decline in quality of life. Falls among the elderly are a significant public health concern due to their potential to cause injuries requiring hospitalization, elevate morbidity and mortality rates, and place a burden on healthcare systems.

According to the World Health Organization (WHO), falls are among the leading causes of fatal injuries in older adults globally. Epidemiological data indicate that more than one-third of individuals aged 65 and over experience at least one fall annually, with the risk increasing.[1] Risk factors for falls in older adults include intrinsic factors such as muscle weakness, proprioceptive deficits, reduced postural reflexes, degenerative diseases, and extrinsic factors like unsafe environments, poor lighting, and inappropriate footwear.[2] Therefore, effective preventive strategies are essential to reduce fall incidence in this age group.

As life expectancy increases, the global population of older adults continues to rise. According to the World Population Prospects, by 2050, the number of individuals aged 60 years and over is projected to exceed 2 billion worldwide.[3] This demographic shift poses a significant challenge to healthcare systems, given the increased vulnerability of the elderly to various health issues, including the risk of falls, which can be fatal.[4] Falls not only result in physical injuries but also have psychological impacts. Many older adults develop post-fall syndrome—a heightened fear of falling again—which may lead to reduced activity levels, withdrawal from daily activities, increased immobility, and greater dependence on others.[5] These consequences can accelerate physical and cognitive decline, significantly diminishing the overall quality of life. Hence, fall prevention strategies must be integrated into comprehensive geriatric healthcare programs.

The U.S. Preventive Services Task Force (USPSTF) reported that in 2021, more than 38,000 older adults in the United States died from fall-related injuries. The USPSTF recommends structured exercise programs targeting balance, gait, and mobility to prevent falls in this population. A 2023 meta-analysis found that virtual reality (VR)-based interventions significantly improved physical function and balance in older adults with balance impairments. Interventions lasting 20–45 minutes, three times per week for 5–8 weeks, yielded significant improvements in Berg Balance Scale (BBS) scores and reductions in Timed Up and Go (TUG) test times.[6] Similarly, a 2023 systematic review and meta-analysis evaluating the effects of balance training on patients with osteoporosis reported that such training significantly enhanced balance and fall efficacy.[7]

In physiotherapy practice, balance training is frequently implemented to enhance functional capacity in older adults. These exercises can be conducted individually or in groups and are tailored based on physical condition and individual fall risk. Evidence suggests that combining balance training with strength and flexibility exercises produces more optimal outcomes in fall prevention. Activities such as Tai Chi and structured yoga programs have improved balance, mobility, and confidence among older adults.[6] Additionally, VR and exergaming (exercise-based video games) are being developed to make training more interactive and engaging for older people. However, despite growing scientific evidence supporting the effectiveness of balance training in fall prevention, variations remain across studies in terms of design, balance assessment methods, training duration, and intensity.[8] Moreover, factors such as adherence to exercise programs, comorbidities, and access to physiotherapy services are important considerations.

Balance training has been widely studied as an effective non-pharmacological intervention for preventing falls in older adults.[9] Its primary goals include enhancing postural stability, motor coordination, and strengthening weight-bearing muscles, particularly in the lower extremities.[10] Various forms of balance training—such as static exercises (e.g., maintaining standing or single-leg positions), dynamic exercises (e.g., walking in a straight line or performing sudden positional changes), and proprioceptive or vestibular-based training—have been utilized in rehabilitation and fall prevention programs.[11]

Several studies have demonstrated that balance exercises improve postural control and reduce fall risk in older adults. These interventions are often combined with strength, flexibility, and aerobic training to maximize effectiveness.[12] Technological approaches, such as VR-based exercises, interactive balance platforms, and biofeedback systems, are increasingly used to enhance program efficacy.[7] Nevertheless, a comprehensive review mapping the types and effectiveness of balance training methods according to classification and elderly population characteristics is still lacking. Therefore, this scoping review aims to address this gap by identifying, categorizing, and analyzing the balance training methods reported in the literature and their potential effectiveness in fall prevention among older adults. This study further seeks to explore the effectiveness of various balance training approaches and synthesize recent evidence (2020–2025) on their application. The objective is to identify the most effective interventions, determine the target populations that benefit most, and discuss practical implications for clinical and community settings.[13]

Methods

This study employed a scoping review design, guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR). Although the protocol was not registered in systematic review databases such as PROSPERO, given that scoping reviews are not yet fully supported by such platforms, the methodology adhered strictly to the PRISMA-ScR guidelines. A scoping review approach was selected to provide a comprehensive mapping of existing literature on the effectiveness of balance training in preventing falls among older adults.

The research question was developed using the PCC (Population, Concept, Context) framework. The target population consisted of individuals aged 60 years and above. The concept examined was balance training and its role in fall prevention, while the context encompassed various living environments and medical conditions experienced by older adults. The central research question guiding this review was: “What is the effectiveness of balance training in preventing falls among older adults based on current evidence in the literature?”

The inclusion criteria for this review were as follows: studies discussing balance training and fall prevention in older adults; articles published in English; studies using research designs such as randomized controlled trials (RCTs), quasi-experimental studies, clinical interventions, systematic reviews, or meta-analyses; studies available in full-text format; and studies published within the last five years (2020–2025). Studies were excluded if they did not specifically address balance training in the elderly, involved populations other than older adults, were in the form of editorials, commentaries, or opinion pieces, or were not accessible in full text.

This review incorporated various types of interventional studies to capture the breadth of evidence related to the effectiveness of balance training in preventing falls. These included RCTs, quasi-experimental studies, clinical intervention trials, and secondary sources such as systematic reviews and meta-analyses. The goal was to construct a broad and structured understanding of the intervention approaches documented in the scientific literature.

Literature searches were conducted using four electronic databases: PubMed, Scopus, Google Scholar, and the Cochrane Library. The search was conducted from January to April 2025, targeting articles published between January 2020 and April 2025. A sample search strategy applied in the PubMed database was: ("Elderly"[MeSH] OR "Older adults") AND ("Balance training" OR "Postural control exercises" OR "Equilibrium exercises") AND ("Fall prevention" OR "Fall risk reduction"). Search strategies were tailored to each database to optimize sensitivity and specificity. The complete search strategies for all databases are available in the Appendix.

Study selection was conducted in four stages, following the PRISMA-ScR flow. All potentially relevant articles were retrieved from the selected databases in the identification phase. During the screening phase, duplicate records were removed, and titles and abstracts were reviewed for relevance. The eligibility phase involved a full-text assessment based on the predetermined inclusion and exclusion criteria. Two reviewers independently conducted the screening and eligibility assessments. Disagreements were resolved through discussion or consulting a third reviewer to ensure consensus and objectivity. In the final inclusion phase, studies that met all eligibility criteria were selected for data extraction and synthesis.

Two reviewers independently performed data extraction using a standardized data extraction form developed in advance. The extracted information included the author(s), study title, objective, sample characteristics, study design, year of publication, and key findings. After the extraction process, data consistency and accuracy were verified through collaborative discussion between the reviewers. Any discrepancies were resolved through consensus, and, if necessary, a third reviewer was consulted.

As this is a scoping review, a formal risk of bias assessment was not conducted, unlike the procedures commonly applied in systematic reviews. Similarly, cross-study biases such as publication bias were not formally assessed. Nonetheless, the methodological characteristics and findings of each included study were described narratively to provide insight into the strengths and limitations of the existing evidence. The findings are synthesized in tabular form, summarizing key study attributes such as author, title, objectives, sample size, research design, year of publication, and primary outcomes. No subgroup or sensitivity analyses were conducted, as the primary aim of this review was to map the existing literature rather than to evaluate the quantitative effects of interventions.

Results

The collected studies were analyzed using descriptive and thematic approaches. Findings were categorized based on the type of balance exercise, its effectiveness, and other contributing factors in fall prevention among older adults. The results are presented in summary tables, descriptive narratives, and a PRISMA-ScR diagram illustrating the literature selection process.

Study identification was conducted systematically across four major databases: PubMed (n = 150), Scopus (n = 120), Google Scholar (n = 130), and the Cochrane Library (n = 100). For Google Scholar, only the top 130 results were selected based on relevance and publication year, resulting in 500 articles. All articles were exported and merged into a reference management tool (e.g., Mendeley) to identify and eliminate duplicates. After removing 50 duplicate entries, 450 articles remained for the initial screening stage.

During the screening process, titles and abstracts of the 450 articles were evaluated. Four hundred articles were excluded due to irrelevance or failure to meet inclusion criteria. The remaining 50 articles underwent full-text eligibility assessment. Following this, 37 articles were excluded for reasons including unsuitable populations, unsupported study designs, or irrelevant interventions. Ultimately, 13 studies met all inclusion criteria and were included in the final review.

The implications of these findings for physiotherapy practice will be discussed to offer evidence-based recommendations. Based on the literature search, 13 studies met the inclusion criteria and were analyzed further. The selection process is visualized in the PRISMA-ScR flow diagram below:

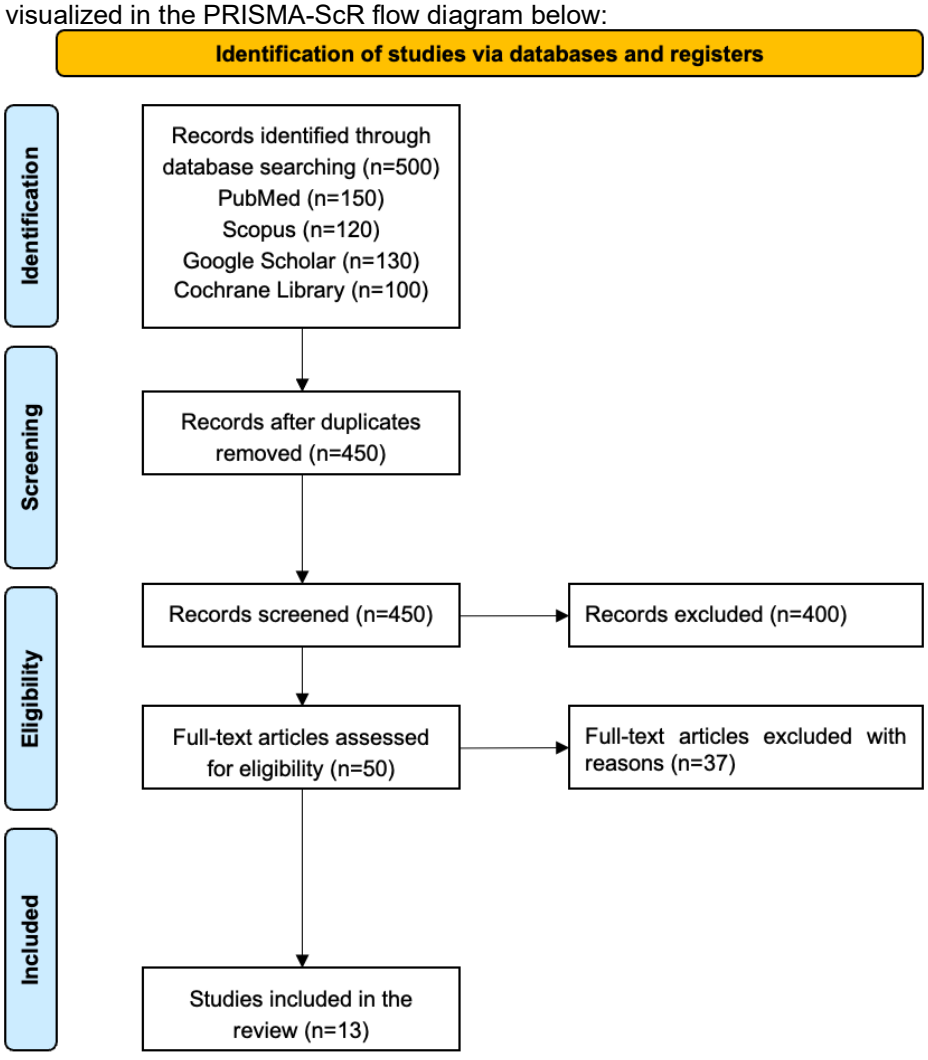

Figure 1. PRISMA Diagram

Several studies have consistently reported that balance training positively impacts reducing the risk of falls in older adults through various modalities, including Tai Chi, proprioceptive exercises, postural training, and functional exercises.[14] The key findings from the reviewed literature highlight that balance training significantly enhances postural control and dynamic stability, mainly when exercise programs are conducted twice to thrice weekly for at least six weeks.[15] Notably, community-based and home-based interventions demonstrated comparable effectiveness in

improving balance performance among older adults.[16] Furthermore, individuals with a history of falls benefit more from structured and targeted balance training programs. These findings collectively support the recommendation of balance training as an effective fall prevention strategy in physiotherapy practice, potentially improving the overall quality of life in the aging population. Notably, each article in the review reported statistically significant outcomes in reducing fall risk, underscoring the efficacy of such interventions.

However, a meta-analysis could not be performed due to substantial heterogeneity among the included studies. This heterogeneity was evident in several aspects, including participant characteristics, where older adults ranged in age from 60 to over 85 years and presented with diverse health statuses, from generally healthy individuals to those with mild neurological disorders or chronic illnesses. The types of interventions also varied widely, encompassing Tai Chi, proprioceptive training, technology-assisted programs, and combinations involving strength training, all of which influenced outcomes and limited the comparability of data. In addition, the duration and frequency of interventions ranged from 6 weeks to 6 months, affecting the intensity of exposure and contributing to differences in reported effectiveness. Lastly, diverse outcome measurement instruments, such as the Berg Balance Scale (BBS) and the Timed Up and Go (TUG) test, further complicated the ability to conduct a valid statistical aggregation of results.
A summary of the reviewed articles is provided below (Table 1):

Table 2. Summary of Reviewed Articles on Balance Training and Fall Prevention in Older Adults

No	Authors (Year)	Objective	Sample (n)	Intervention	Duration	Design	Main Findings	Effect Size (95% CI)
1	Garcia & Lopez (2023)	Effectiveness of balance training in fall prevention	1,540 (18 studies)	Various balance programs	8–12 wks	Meta-analysis	↓ falls by 30%, ↑ balance	RR = 0.70 (0.60–0.82)
2	Wei et al. (2022)	Balance training in osteoporosis	684 (10 RCTs)	Balance training	4–12 wks	Systematic review	↑ balance, ↓ TUG	MD = -1.86 s (-2.69 to -1.02)
3	Chen et al. (2021)	Exergames vs. traditional training	1,200 (11 studies)	Exergames vs. physical training	>8 wks	Meta-analysis	Both effective, exergames ↑ engagement	SMD = 0.42 (0.29–0.55)
4	Li et al. (2020)	Tai Chi for fall prevention	1,100 (15 RCTs)	Tai Chi (Yang)	12 wks	Meta-analysis	↓ falls, ↑ balance	RR = 0.76 (0.66–0.88)
5	Kim et al. (2021)	Proprioceptive training	45 older women	Balance board, etc.	8 wks	RCT	↑ BBS and TUG	MD = +4.2 (2.1–6.3)
6	López-Nava et al. (2021)	VR-based training	850 (12 studies)	VR training	6–12 wks	Systematic review	↑ dynamic balance	SMD = 0.51 (0.33–0.70)
7	Wang et al. (2020)	Balance vs. strength training	60	Postural vs. strength	10 wks	RCT	Balance better for postural control	SMD = 0.48 (0.20–0.76)
8	Tanaka et al. (2022)	Training in MCI elderly	38 w/ MCI	Group balance training	12 wks	Controlled trial	↑ cognitive-motor function	MD = -1.45 s (-2.1 to -0.8)
9	Silva et al. (2021)	Dual-task training	70	Cognitive + balance	8 wks	RCT	↑ balance under dual-task	SMD = 0.39 (0.15–0.63)
10	Sherrington et al. (2020)	Stepping exercises	950 (14 RCTs)	Obstacle course, etc.	6–16 wks	Meta-analysis	↓ falls, ↑ mobility	RR = 0.72 (0.62–0.84)
11	Nguyen et al. (2019)	Home-based training	700 (10 studies)	Home balance training	6–12 wks	Systematic review	Effective like supervised	SMD = 0.33 (0.20–0.46)
12	Sharma et al. (2022)	Task-specific balance	50	Stair walking, tasks	8 wks	Experimental	↑ function & confidence	MD = +3.9 (1.5–6.3)
13	Ozturk et al. (2021)	Multicomponent programs	1,200 (18 studies)	Balance + strength + aerobic	8–16 wks	Systematic review	Holistic approach effective	SMD = 0.49 (0.30–0.67)

In this review, several studies quantified the effectiveness of balance training interventions for fall prevention in older adults using effect size measures such as Risk Ratio (RR), Mean Difference (MD), and Standardized Mean Difference (SMD). The Risk Ratio (RR) was commonly used to compare the probability of falls between intervention and control groups, with an RR value of less than 1 indicating a reduced risk of falling in the intervention group. Meanwhile, the Mean Difference (MD) represented the average difference in outcome scores, such as balance assessment scores, between the groups when the same measurement tool was applied, where a positive MD signified better outcome in those who received balance training. In cases where different outcome instruments were used across studies, the Standardized Mean Difference (SMD) was employed to standardize results. The interpretation of SMD followed conventional thresholds, with values of 0.2 or greater considered a small effect, 0.5 or greater a moderate effect, and 0.8 or greater a significant effect, reflecting the degree of functional improvement attributable to balance training. These effect size metrics provided a quantitative basis to evaluate and compare the impact of interventions across the reviewed literature.

Discussion

Balance training in older people represents a targeted series of physical exercises designed to improve postural stability, reduce the risk of falls, and enhance neuromuscular coordination and muscle strength, particularly in the core and lower limbs.[17] These exercises are fundamental components of geriatric rehabilitation, as age-related physiological changes such as muscle atrophy, diminished sensory function, and impaired vestibular responses significantly compromise an individual's ability to maintain balance. Balance training typically addresses two primary domains: static balance (the ability to maintain a position when stationary) and dynamic balance (the ability to maintain stability while in motion or transitioning between positions).[18]

Falls are among the most common and serious problems facing older adults. They often result from a failure of the body to maintain or regain balance during everyday activities such as standing, walking, or reaching.[19] A fall is an unintentional and uncontrolled descent to the ground or a lower level, not caused by a major external force, such as a vehicle collision or forceful impact with another person. Falls in older adults are usually spontaneous and may lead to a spectrum of consequences, ranging from minor bruises to severe injuries such as fractures, traumatic brain injury, long-term disability, or even death.[20]

This scoping review analyzed a diverse range of studies, most of which were randomized controlled trials (RCTs), enhancing the strength and reliability of the synthesized findings. RCTs are considered the gold standard in clinical research due to their methodological rigor, particularly in minimizing bias. The findings consistently support the effectiveness of balance training interventions in reducing the incidence of falls among older adults. This highlights the potential for balance exercises to serve as a critical component in evidence-based fall prevention strategies, especially in elderly individuals with a previous history of falls or marked mobility declines.

Moreover, this review's outcomes align closely with its primary objective: to map the types and characteristics of effective balance training interventions for fall prevention in older adults. These interventions focus on physical performance enhancement and contribute to psychological and functional improvements in daily life. Based on the studies reviewed, several mechanisms may explain the efficacy of balance training programs. These mechanisms operate at neuromuscular, sensory, and cognitive levels, collectively reinforcing the body's ability to maintain stability and respond to postural challenges.

Enhanced Postural Control

A central benefit of balance training is improved postural control, achieved through enhanced proprioception, neuromuscular coordination, and core muscle strength.[21] As the body ages, proprioceptive sensitivity declines, especially in the lower extremities, negatively affecting the capacity to detect joint position and movement. Balance exercises—such as tandem stance, heel-to-toe walking, or single-leg standing—help restore proprioceptive acuity and train neuromuscular pathways to respond more efficiently to balance perturbations. Strengthening the core and lower limb musculature also provides a more stable support base for upright posture.

Empirical evidence supports these claims. A study by Wang and Chen (2020) found that an eight-week structured balance training program significantly improved functional balance among older adults, as demonstrated by increased scores on the Berg Balance Scale (BBS) and decreased times on the Timed Up and Go (TUG) test. These improvements suggest better coordination, reduced risk of falls, and enhanced mobility confidence, thereby directly influencing the quality of life in the elderly population.[22]

Vestibular and Sensory System Adaptation

In addition to musculoskeletal enhancements, balance training promotes adaptation of the vestibular and sensory systems. The vestibular system, which includes the inner ear structures responsible for detecting head position and motion, plays a critical role in balance maintenance. Age-related degeneration in this system leads to dizziness, impaired spatial orientation, and increased fall risk [23]

Balance training often incorporates tasks that challenge and stimulate vestibular and sensory pathways. Exercises such as standing on unstable surfaces (e.g., foam pads or balance boards), movements with closed eyes, or executing head rotations during dynamic tasks are designed to increase reliance on proprioceptive and vestibular cues without visual input.[24] A neurorehabilitation study by Garcia and Lopez (2023) demonstrated that proprioceptive-based balance interventions led to measurable increases in cerebellar activity and enhanced vestibular cortex activation, which are associated with better balance control and spatial awareness [25]

These neuroplastic changes suggest that the brain retains the capacity to adapt even in older age, and targeted interventions can reverse or mitigate age-related deficits in sensory integration. As a result, older adults become better equipped to respond to unexpected disturbances in balance during routine activities.[26]

Increased Confidence, Autonomy, and Psychological Well-being

Beyond physical outcomes, balance training also positively impacts psychological factors such as confidence, fear of falling, and perceived self-efficacy. Older adults often fear falling following an initial incident, leading to activity restriction, physical deconditioning, social isolation, and increased fall risk—a phenomenon referred to as the "fear of falling cycle."

Regular participation in balance training programs enhances confidence in movement and contributes to psychological resilience. As participants experience improved functional abilities and reduced fall episodes, their fear of falling decreases. This leads to greater willingness to engage in social and physical activities, thus supporting mental health and quality of life. The review identified that older adults involved in structured balance programs demonstrated significant improvements in self-reported measures of mobility confidence and independence.[27]

These psychosocial benefits are particularly valuable in community-dwelling older adults, as enhanced confidence facilitates a more active lifestyle and reduces reliance on caregivers or assistive devices. Furthermore, improvements in psychological well-being may contribute to adherence and long-term engagement with preventive exercise programs.

Despite the promising findings, this scoping review has several limitations that must be acknowledged to interpret the results and their implications accurately. At the study level, some of the included research exhibited methodological constraints such as small sample sizes, the absence of control groups, and a lack of randomization. These factors may compromise internal validity and limit the generalizability of the findings to wider populations. Small cohorts, in particular, are susceptible to type II errors and may fail to capture the heterogeneity inherent in the older adult population. Furthermore, studies without comparison groups hinder the ability to attribute observed improvements exclusively to the intervention, as they may also result from external factors such as participant motivation or increased attention from researchers.

At the outcome level, there was considerable variability in the tools used to assess balance performance. Measures such as the Berg Balance Scale (BBS), Timed Up and Go (TUG), and One-Leg Standing Test were commonly employed. Still, each evaluates slightly different aspects of balance and functional mobility. This heterogeneity in assessment tools presents challenges in synthesizing results across studies and complicates the formulation of standardized clinical guidelines. In addition, the sensitivity and specificity of these instruments in detecting subtle changes over time may vary, contributing further to inconsistencies in reported outcomes.

At the review level, this study did not include a formal assessment of the methodological quality or risk of bias of the individual studies. As a result, the strength of the evidence presented cannot be comprehensively evaluated, and the conclusions should be interpreted with caution. The absence of a quality appraisal limits the ability to prioritize findings from higher-quality studies over those with more pronounced methodological weaknesses, which is particularly relevant when translating research into clinical practice or informing policy decisions.

The findings of this review have practical implications for clinical practice, public health policy, and future research. Health practitioners, especially physiotherapists and geriatric specialists, should consider integrating structured balance training into routine care for older adults, particularly those at risk of falling. Community-based programs, fall prevention workshops, and home-based exercise protocols should emphasize static and dynamic balance components tailored to individual capabilities.

Future research should focus on conducting high-quality RCTs with adequate sample sizes and long-term follow-up to determine the sustained effects of balance training. Standardizing assessment tools and intervention protocols will also enhance comparability and facilitate meta-analyses. Additionally, studies exploring the neurophysiological mechanisms of training adaptations will further elucidate how aging brains respond to balance interventions, potentially guiding the design of more effective and personalized programs.

In conclusion, this scoping review provides compelling evidence that balance training is a practical, multi-faceted intervention for reducing the risk of falls among older adults. Through improvements in postural control, sensory integration, and psychological confidence, balance exercises are a cornerstone in comprehensive fall prevention strategies. However, methodological inconsistencies among studies highlight the need for more rigorous research and standardized practices to harness such interventions' benefits fully.

Conclusion

Balance training effectively reduces fall risk among older adults, with interventions such as Tai Chi, proprioceptive exercises, and postural control training shown to improve static and dynamic balance. These programs are recommended for wide implementation across primary care, rehabilitation, and community settings, and should be tailored to individuals' functional status under professional guidance.

Further research using rigorous designs—particularly randomized controlled trials with larger samples and longer durations—is needed to reinforce current findings. Future studies should examine cognitive function, gait confidence, and exercise adherence to understand better how these interventions work. Standardizing assessment tools is also crucial to enhance consistency and comparability across studies. A more systematic integration of balance training into geriatric care could help reduce fall-related healthcare costs and improve quality of life in older populations.

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