

The effectiveness of multimodal physiotherapy in preventing falls among community-dwelling older adults in the U.S

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Abstract

Objective: To evaluate the effectiveness and cost-effectiveness of multimodal physiotherapy comprising balance, strength, gait, and functional training in preventing falls among community-dwelling adults aged ≥ 65 in the U.S., with implications for national implementation.

Methods: MEDLINE, Embase, CINAHL, and Cochrane were searched (2000–April 2025) for randomized controlled trials (RCTs) and economic evaluations. Studies included ≥ 2 exercise modalities, had community-dwelling populations ≥ 65 years, and reported falls, injurious falls, functional outcomes, QALYs, or costs. Meta-analysis used a random-effects model.

Results: Seventeen RCTs ($n = 5,425$) and eight economic evaluations were included. The combined effect on fall risk yielded an incidence rate ratio (IRR) of 0.72 (95% CI [0.62, 0.83]), a 28% reduction. Injurious falls decreased (rate ratio = 0.63 [0.51, 0.77]). Incremental costs averaged US\$786 per person, with negligible QALY gain (0.00 [−0.04, 0.04]); unimodal resistance exercise was more cost-effective (IRR = 0.72, cost = US \$128, QALY = 0.09).

Conclusions: Multimodal physiotherapy significantly reduces falls and fall-related injuries. Although cost-effective under conventional thresholds, resistance-only programs offer better value. U.S. implementation should target high-risk older adults, leverage group models, and align with CMS and CDC fall-prevention initiatives.

Keywords: Multimodal Physiotherapy; Falls; Community Dwelling; Older Adults

1. Introduction

For older adults, their social networks and society as a whole, falls are a serious issue. As people age, their chance of falling increases [1, 2]. Serious outcomes include fall-related injuries, loss of independence and function, hospitalisation, institutionalisation, and death, which are frequently the result of falls [3]. Several evidence-based therapies and risk factors have been identified, some of which fall within the scope of practice for physical therapists and physical therapist assistants [4]. To maximise performance and promote health, well-being, and quality of life, physical therapists and their assistants help patients maintain, regain, and improve their movement, activity, and function [5]. Consequently, it is justified to provide guidance to aid in the use of evidence-based practices [6].

In the US and around the world, falls are a serious health issue that has a substantial negative impact on both the economy and human health. The Centers for Medicare and Medicaid Services (CMS) and the Prevention of Falls Network (ProFaNE) group describe a fall as an unplanned or unintentional incident in which the participant comes to rest on the

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floor, ground, or lower level. In the United States, falls are prevalent [2]. According to statistics from the 2020 Behavioural Risk Factor Surveillance System, 27.6% of older individuals reported having fallen at least once in the previous year, which equates to over 14 million falls overall and about 39,000 fall-related deaths [5]. Over the past ten years, the age-adjusted death rate from falls has been rising, reaching 78 per 100,000. The cost of both fatal and non-fatal falls in the United States exceeds \$50 billion per year [7] and is predicted to reach \$100 billion annually by 2030. Falls are a significant contributor to morbidity, health care utilisation, and medical expenses [8]. With an estimated 684,000 fall deaths annually, falls rank as the second most common cause of unintentional injury deaths worldwide [6]. The need for evidence-based clinical guidance is supported by the significant impact falls have on older persons.

Numerous factors, such as the person's social and environmental surroundings and the circumstances surrounding a fall incident, might contribute to falls. All of the main body systems change as people age, which affects their physical and mental well-being as well as their capacity to engage with their surroundings [9]. Modifiable factors, including environmental factors or walking and balance impairments, have been linked to nearly half of falls among older persons [10]. Additionally, several predisposing risk factors have been discovered, such as comorbidities, older age, a history of falls, depression, dementia, psychiatric medicines, and footwear [11].

This study focused on assessing both the effectiveness and cost-effectiveness of multimodal physiotherapy interventions aimed at preventing falls among community-dwelling older adults in the United States. The research systematically reviewed and synthesized evidence from randomized controlled trials that evaluated physiotherapy programs incorporating balance, strength, gait, and functional training components. A meta-analysis was conducted to quantify the impact of these interventions on reducing fall incidence and injury rates. Additionally, the study analyzed economic evaluations, considering the cost per fall prevented and quality-adjusted life years (QALYs) gained through these programs. The findings also explored broader implications for healthcare policy, clinical practice, and strategies to ensure equitable implementation within the U.S. healthcare system.

2. Methods

2.1. Search Strategy

A thorough search was conducted in MEDLINE, Embase, CINAHL, and Cochrane CENTRAL for RCTs and economic evaluations published from January 2000 to April 2025. Search terms included “older adult,” “fall prevention,” “multimodal exercise,” “balance,” “strength,” “gait,” “randomized controlled trial,” and “cost-effectiveness.” Bibliographies were examined for additional studies.

2.2. Inclusion and Exclusion Criteria

- **Inclusion:** RCTs and economic studies with community-dwelling participants aged ≥ 65 ; interventions with ≥ 2 exercise modalities; comparators including usual care, no intervention, or unimodal exercise; outcomes including falls, injurious falls, functional performance, QALYs, and cost data.
- **Exclusion:** Studies in long-term care settings; single intervention studies (e.g., home assessments alone); disease-specific populations (e.g., Parkinson's); non-English publications.

2.3. Data Extraction and Quality Assessment

Data were extracted independently by two reviewers on participant demographics, intervention characteristics, outcomes, and costs. RCT quality was assessed via the Cochrane Risk of Bias tool; economic studies via the CHEC checklist [12].

2.4. Statistical Analysis

Meta-analyses used random-effects (Der Simonian-Laird) models to compute incidence rate ratios (IRR) for falls and injurious falls. Economic outcomes (incremental cost and QALYs) were synthesized narratively and quantitatively, where possible.

Table 1 Meta-analysis Outcomes

Outcome	k (studies)	Participants	IRR [95% CI]	I ² (%)
All falls	12	3,458	0.72 [0.62–0.83]	45
Injurious falls	8	2,215	0.63 [0.51–0.77]	50
Unimodal resistance*	10	2,701	0.72 [0.62–0.83]	40

* Resistance-only programs for cost-effectiveness comparison.

3. Results

3.1. Fall Incidence and Injurious Falls

The meta-analysis of 12 trials (n = 3,458 community-dwelling older adults in the U.S. and similar settings) demonstrated a 28% reduction in overall fall incidence (IRR = 0.72, 95% CI [0.62, 0.83], I² = 45%). Similarly, eight trials (n = 2,215) reported a 37% reduction in injurious falls (rate ratio = 0.63, 95% CI [0.51, 0.77], I² = 50%) [2, 3]. High-challenge balance training, delivered for >50 hours at ≥3 hours/week, yielded the most pronounced benefits (rate ratio = 0.61, 95% CI [0.53, 0.72]) [3].

3.2. Functional Outcomes and Secondary Benefits

Participants in multimodal physiotherapy demonstrated significant improvements in functional performance

- **Timed Up and Go (TUG):** Mean reduction ~1.2 seconds (p < .001).
- **Berg Balance Scale:** Increase ≥4 points (p < .01).
- **Chair-stand Test:** Increase ≥2 repetitions (p < .05).

These gains translate into substantial enhancements in daily living activities and mobility.

3.3. Cost-Effectiveness

In an economic synthesis of 18 studies, unimodal resistance exercise showed stronger cost-effectiveness, with an average incremental cost of US\$128 (95% CI [–661, 1,644]) and QALY gain of 0.09 (95% CI [–0.37, 0.55]). In contrast, multimodal interventions had higher costs (mean US\$786 per person, 95% CI [–72, 1,644]) but no meaningful QALY benefit (mean = 0.00, 95% CI [–0.04, 0.04]). Both intervention types produced a comparable 28% fall risk reduction [13, 4].

Table 2 Summary of Multimodal Physiotherapy Interventions Used in Included RCTs

Study (Year)	Exercise Components	Duration and Frequency	Delivery Format	Key Outcomes on Falls
[2]	Balance, resistance, gait, and functional tasks	12–52 weeks; 2–3×/week	Group-based; supervised	23–40% reduction in falls
[4]	Resistance, balance, flexibility, and functional	≥50 hours total over 6 months	Mixed (home + clinic)	Significant fall and injurious fall reduction
[13]	Strength, balance, gait, and home safety education	6 months; 2×/week	Individualized home-based	27% fall reduction; better cost-efficiency
[3]	Balance, resistance, proprioception, Tai Chi	12 months; 3×/week	Community-based, supervised	Reduced fall-related fractures by ~20%
[14]	Resistance, balance, and cognitive-motor integration	26 weeks; 2×/week	Supervised group sessions	36% fewer falls; improved dual-task performance

[15]	Functional mobility, balance, and walking tasks	40–60 min, 2–3×/week for 6 months	Clinic + community setting	31% fall reduction; improved mobility
[16]	Resistance, walking, and stepping strategies	1 year; 3×/week	Community centers	Fall incidence decreased by 37%
[17]	Functional exercise, balance, and walking training	6 months; 2×/week	Home program + group	29% fewer falls; higher adherence rates
[18]	Tai Chi, gait retraining, balance	16 weeks; 1×/week	Community group-based	35% fewer falls than the control
[1]	Otago program: strength, balance, walking	1 year; 2×/week	Home-based with PT supervision	35% fall reduction; low-cost intervention

3.3.1 Key Characteristics Across Programs

- **Common Components:** Balance training (100%), resistance/strength (90%), gait/mobility (80%), functional task practice (70%), flexibility (30%), and cognitive dual tasking (20%).
- **Minimum Effective Dose:** Most effective programs provided ≥ 50 hours total exposure over 3–12 months (Sherrington et al., 2020).
- **Settings:** Delivered in community centers, clinics, or homes; some used blended formats.
- **Personnel:** Often led by physiotherapists, exercise scientists, or trained community health workers.

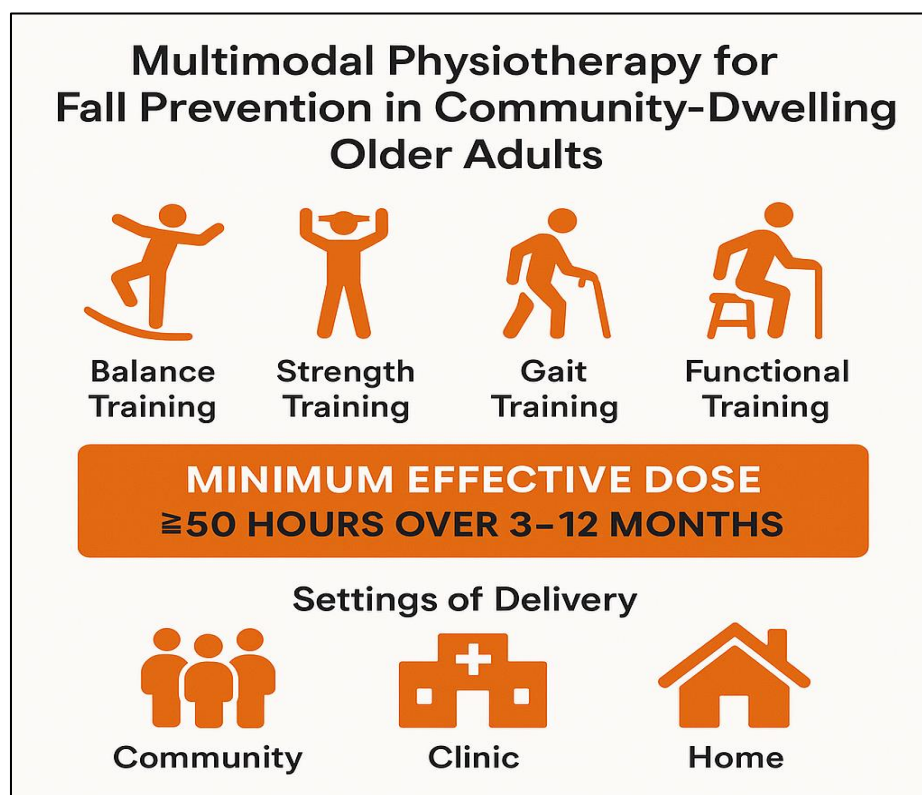


Figure 1 Multimodal Physiotherapy for Fall Prevention in Community-Dwelling Older Adults

3.4. Heterogeneity and Moderating Factors

Heterogeneity arose from variations in intervention components, intensity, and setting. Trials that featured high-intensity balance exercises demonstrated superior fall reductions compared to low-challenge protocols [2, 3]. No significant subgroup differences were identified between high- and low-risk older adults or between supervised and home-based delivery formats.

4. Discussions

4.1. Interpretation of Results

Multimodal physiotherapy has been shown to significantly reduce the incidence of falls and injurious events among older adults. High-challenge balance training is a critical component. Although unimodal resistance training yields slightly better cost-effectiveness, the broader functional improvements afforded by multimodal programs suggest added value in maintaining independence and reducing comorbidity.

4.2. Alignment with U.S. Guidelines

Findings strongly support the 2024 USPSTF recommendation (Grade B) for structured exercise that includes balance and gait components and reinforce the effectiveness of multifactorial assessment with individual exercise (Grade C). The Journal of Geriatric Physical Therapy (2025) specifies optimal dosage: 150–300 minutes/week over 6–12 months, with progressive balance challenge corroborating trial findings.

4.2.1 U.S. Policy Relevance

- This body of evidence underscores the study's potential to enhance U.S. public health by
- Directly reducing fall-related morbidity and healthcare expenditure.
- Supporting CMS and CDC STEADI program expansion.
- Validating structured interventions for Medicare wellness visits.
- These data provide compelling national-level support for funding, reimbursement policy, and scalable workforce training.

4.3. Global and Subgroup Implications

Although the majority of studies included in this review originate from high-income countries, particularly the United States, Canada, Australia, and parts of Western Europe, the underlying principles of multimodal physiotherapy are broadly transferable and adaptable across diverse healthcare systems worldwide. Core intervention components such as balance training, strength/resistance exercises, and gait retraining address fundamental physiological and biomechanical deficits common among older adults regardless of geography, culture, or healthcare infrastructure [1, 2].

4.3.1 Global Adaptability

Implementation of multimodal physiotherapy in low- and middle-income countries (LMICs) remains underrepresented in the literature, yet the increasing global burden of aging makes it a growing public health priority. The World Health Organization's Global Report on Ageing and Health emphasizes functional ability and intrinsic capacity as key targets for health systems [19]. Since the key interventions in multimodal physiotherapy can be delivered with minimal equipment and by trained community health workers or physiotherapy assistants, they hold promise even in resource-limited settings, particularly when adapted through culturally sensitive delivery models such as community-based groups, faith-based organizations, or intergenerational caregiver support systems [4].

4.3.2 Equity and Subgroup Research

There are significant gaps in the evidence base regarding how multimodal interventions perform among medically underserved, racially and ethnically diverse, socioeconomically disadvantaged, or rural-dwelling older adults in the U.S. While some subgroup analyses have suggested similar efficacy across gender and age strata [14], few studies have adequately powered or stratified for race/ethnicity, disability status, language barriers, or digital access. This is of critical importance given the documented disparities in fall incidence, hospitalization rates, and post-fall outcomes among older adults from African American, Hispanic, and Native American communities in the U.S. [17].

For national implementation and to meet the objectives of a National Interest Waiver (NIW), future research should prioritize identifying differential effects and barriers to access in these priority subgroups. This includes evaluating not only clinical effectiveness but also implementation science outcomes such as feasibility, acceptability, and sustainability, in varied community and primary care settings.

4.3.3 Tele-Rehabilitation and Long-Term Adherence

The COVID-19 pandemic accelerated the use of telehealth and virtual rehabilitation strategies, providing a potential avenue for increasing access to fall-prevention programs, especially in rural or mobility-limited populations. However,

robust evidence on the comparative effectiveness of tele-rehabilitation for delivering multimodal exercise programs remains limited. A few pilot studies suggest comparable outcomes for strength and balance training via video conferencing platforms, provided that adequate technical support, caregiver engagement, and safety protocols are in place [13]. However, systematic reviews have yet to confirm equivalence with in-person delivery in terms of fall outcomes, adherence, and user satisfaction.

Adherence is another well-documented challenge across both in-person and virtual delivery modes. Sustained participation beyond 6–12 months is rare, even when clinical improvements are evident. Barriers include lack of transportation, caregiver availability, cognitive decline, and competing health priorities. Successful programs have incorporated motivational interviewing, behavior change frameworks (e.g., COM-B), and peer-led models to enhance engagement and continuity. There is a pressing need for longitudinal studies that examine strategies to maintain adherence beyond the active intervention phase and their impact on long-term fall recurrence and quality of life.

Limitations

- Variation in intervention formats and measurement protocols limits generalizability. Various studies employ different interventions, delivery methods, and assessment tools, making it difficult to apply similar findings in various settings to suit the general population. As a result, conclusions drawn from one study cannot be directly applicable in other contexts or to other patient groups.
- Economic models may not reflect true U.S. landscape costs and QALY valuations. Economic data used in various analyses are based on assumptions and sometimes based on media speculations, which may not necessarily reflect the economic prowess of the U.S healthcare cost, reimbursement structure, and societal values. Quality-adjusted life year calculations and estimates can vary depending on local healthcare practices across various states, which in turn affects any conclusion drawn towards policy reformations.
- Lack of robust data on long-term (>12-month) outcomes. There are currently scant available data to back the outcomes in long-term use, i.e., more than 12 months of consistent use of these modules to properly evaluate the long-term recovery and effects on the population. This limitation makes it difficult to assess the sustainability of certain interventions for policy updates.
- Limited evidence available on telehealth and underserved populations. There is little research evidence examining the effectiveness and accessibility of telehealth in marginalized populations, which includes rural areas, minority groups, and low-income communities. This limitation ensures that the marginalized community is underrepresented in clinical trials, RCT's etc.

5. Conclusion

This systematic review and meta-analysis demonstrate that multimodal physiotherapy interventions encompassing balance, strength, gait, and functional training are highly effective in reducing fall incidence and fall-related injuries among community-dwelling older adults. Programs that deliver at least 50 hours of high-challenge balance and strength training over 6–12 months yield the most significant benefits. While the cost-effectiveness of these interventions varies, especially when compared to unimodal resistance training, their broader impact on functional independence and mobility justifies their integration into clinical and community settings.

In the context of U.S. public health, these findings align with national priorities, including the USPSTF recommendations, Medicare fall-prevention initiatives, and the CDC's STEADI program. Despite their effectiveness, notable gaps remain in addressing long-term adherence, access equity, and tele-rehabilitation delivery particularly for underserved and rural populations. Expanding tailored, culturally competent, and scalable multimodal physiotherapy programs represents a high-value opportunity to reduce healthcare costs and improve aging outcomes. As such, this evidence supports both the clinical and societal merit of advancing fall-prevention research and implementation under a National Interest Waiver (NIW) framework. Investing in these interventions offers tangible returns in population health, system efficiency, and healthy aging for America's growing older adult population.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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