

Effectiveness of Core Stability and Heel Raise Exercise on Balance in Older Adults: A Narrative Literature Review

Annisa Balkis¹, Fatchurohmah Ines Prabandari², Warih Anjari Dyah K³

^{1,2,3}Department of Physiotherapy, Sekolah Tinggi Ilmu Kesehatan Nasional, Sukoharjo, Indonesia

Corresponding author:

Name: Fatchurohmah Ines Prabandari

E-mail: physio.ines@stikesnas.ac.id

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Abstract

Background: Aging is associated with declines in proprioception, muscle strength, and postural control, increasing the risk of balance impairment and falls in older adults. Exercise-based physiotherapy interventions such as core stability exercise and heel raise exercise have been widely used to improve balance and functional mobility.

Objective: This literature review aimed to evaluate the effectiveness of core stability exercise and heel raise exercise in improving balance and reducing fall risk among older adults.

Methods: A literature review was conducted using articles obtained from PubMed, Scopus, ScienceDirect, and Google Scholar. The selected studies included randomized controlled trials, systematic reviews, and clinical studies published within the last ten years. The reviewed articles evaluated balance, proprioception, functional mobility, and fall risk following exercise interventions in older adults.

Results: The reviewed studies demonstrated that core stability exercise and heel raise exercise improved balance performance, ankle strength, proprioceptive control, and functional mobility. Several international studies also reported improvements in postural stability and reduced fall risk following sensorimotor and mobilization exercises. Local studies showed consistent improvements in Timed Up and Go and Berg Balance Scale outcomes after exercise interventions.

Conclusion: Core stability exercise and heel raise exercise appear effective in improving balance and reducing fall risk in older adults. These interventions may support postural control, neuromuscular activation, and functional mobility in geriatric rehabilitation programs. Further high-quality randomized controlled trials are needed to strengthen the current evidence.

Keywords

Older adults; Balance; Core stability exercise; Heel raise exercise; Physiotherapy

Introduction

Population aging has become a major global public health concern due to the increasing prevalence of functional decline, mobility limitations, and fall-related injuries among older adults.¹ Age-related physiological changes affecting the musculoskeletal, sensory, and neuromuscular systems contribute significantly to impaired balance and postural instability.² Declines in muscle strength, proprioceptive function, vestibular integration, reaction time, and postural control increase the risk of falls, loss of independence, and reduced quality of life in the elderly population.³ Falls among older adults are also associated with increased morbidity, hospitalization, disability, and mortality.⁴

Balance control is a complex physiological process involving the integration of visual, vestibular, and somatosensory systems to maintain postural stability during static and dynamic activities.⁵ Aging-related deterioration in sensory reweighting mechanisms and proprioceptive feedback has been reported to negatively affect balance performance in older individuals.⁶ In addition, sarcopenia and lower extremity muscle weakness further contribute to postural instability and increased fall risk.⁷ Previous studies have demonstrated that impaired ankle strategy, decreased trunk stability, and reduced neuromuscular coordination are closely associated with functional balance deficits in older adults.^{6,7}

Exercise-based physiotherapy interventions have been widely recommended as non-pharmacological strategies to improve balance and reduce fall risk in older adults.⁸ Among these interventions, core stability exercise has gained attention for its role in improving trunk control, postural alignment, neuromuscular activation, and dynamic stability.⁹ Core muscle activation contributes to proximal stability, which is essential for maintaining functional movement and postural control during daily activities. Several studies have reported that core stability exercise may improve balance performance and mobility outcomes in older adults.¹⁰⁻¹²

In addition to proximal stabilization, ankle-focused interventions such as heel raise exercise are also considered important in maintaining postural stability.¹³ Heel raise exercise targets the plantar flexor muscles and ankle strategy mechanisms, which play critical roles in maintaining upright posture and controlling body sway during standing and gait activities.¹⁴ Previous studies have shown that heel raise exercise may improve ankle strength, proprioceptive input, and postural balance in individuals with balance impairments.^{11,12} Sensorimotor and ankle mobilization exercises have also demonstrated beneficial effects on functional mobility and fall prevention in older populations.¹⁵⁻¹⁷

Several local Indonesian studies have also reported positive outcomes of core stability exercise, tandem walking exercise, strengthening exercise, and heel raise exercise in improving balance performance among older adults.^{10-12,18,19} However, most local studies remain limited by small sample sizes and lower levels of evidence. Furthermore, the integration of international evidence and local clinical findings regarding the effectiveness of core stability exercise and heel raise exercise in older adults remains limited.

Therefore, this narrative literature review aimed to evaluate and synthesize current evidence regarding the effectiveness of core stability exercise and heel raise exercise on balance improvement and fall risk reduction in older adults. This review is expected to provide a clearer understanding of the physiological mechanisms and clinical benefits of these exercise interventions in geriatric physiotherapy practice.

Methods

This study employed a narrative literature review design to evaluate the effectiveness of core stability exercise and heel raise exercise on balance improvement and fall risk reduction in older adults. The review was conducted by collecting and synthesizing evidence from published scientific literature relevant to physiotherapy interventions for balance disorders in the elderly population.

Literature searching was performed using several electronic databases, including PubMed, Scopus, ScienceDirect, and Google Scholar. The search process was conducted between January and March 2026. Keywords and combinations of Medical Subject Headings (MeSH) terms used in the search strategy included “older adults,” “elderly,” “balance,” “postural stability,” “fall risk,” “core stability exercise,” “heel raise exercise,” “sensorimotor exercise,” “proprioception,” and “physiotherapy.” Boolean operators (“AND” and “OR”) were applied to optimize the search process.

The inclusion criteria consisted of: (1) articles published within the last 10 years (2015–2025); (2) studies involving older adults or elderly populations; (3) studies evaluating exercise-based interventions related to balance, proprioception, postural stability, or fall prevention; (4) randomized controlled trials, systematic reviews, narrative reviews, observational studies, and relevant clinical studies; and (5) articles published in English or Indonesian. Exclusion criteria included incomplete articles, conference abstracts without full text, duplicate studies, and studies unrelated to physiotherapy or balance interventions.

The article selection process was conducted through title and abstract screening followed by full-text evaluation based on the predefined eligibility criteria. Studies considered relevant to the objectives of this review were analyzed descriptively. Information extracted from the selected articles included author, publication year, study population, intervention type, comparison, outcome measures, and main findings related to balance performance and fall risk.

The findings from the included studies were synthesized narratively to identify patterns, similarities, and differences regarding the effects of core stability exercise and heel raise exercise on balance outcomes in older adults. Due to the heterogeneity of study designs, intervention protocols, and outcome measurements, no meta-analysis was performed.

Results

The literature search identified studies investigating the effects of core stability exercise, heel raise exercise, sensorimotor exercise, strengthening exercise, and mobilization programs on balance performance and fall risk in older adults. The included studies consisted of randomized controlled trials, systematic reviews, observational studies, and clinical intervention studies published between 2015 and 2025. Overall, the reviewed evidence demonstrated positive effects of exercise-based physiotherapy interventions on balance, proprioception, functional mobility, and postural stability in elderly populations.

Several international studies reported that exercise interventions targeting trunk stability, ankle strength, proprioception, and sensorimotor control significantly improved balance outcomes in older adults. Wang et al. reported that age-related deterioration in proprioception, neuromuscular coordination, and sensory integration contributes substantially to postural instability and increased fall risk in the elderly population. Similarly, Pasma et al. demonstrated that aging affects sensory reweighting mechanisms during standing balance, resulting in impaired postural control and increased dependency on compensatory strategies.

A systematic review by Wang et al. also showed that sarcopenia and lower extremity muscle weakness were strongly associated with postural instability among older adults. Furthermore, Freire and Seixas reported that sensorimotor exercise programs improved proprioception, muscle strength, functional mobility, and fall risk outcomes in elderly individuals. These findings suggest that physiotherapy interventions focusing on neuromuscular activation and sensory integration may provide important clinical benefits for balance improvement.

Heel raise exercise demonstrated positive effects on ankle strength and postural stability. Seo and Lee found significant improvements in balance performance and ankle muscle strength following quarter heel raising exercise interventions. Similar findings were also observed in local Indonesian studies, where heel raise exercise improved Timed Up and Go (TUG) performance among older adults with balance impairment. The improvement in balance performance may be related to enhanced plantar flexor activation, ankle proprioception, and postural control during standing and gait activities.

Core stability exercise also demonstrated beneficial effects on balance performance in older adults. Local studies reported that core stability exercise improved Berg Balance Scale (BBS) scores, dynamic balance, and functional mobility outcomes. Additional improvements were observed when core stability exercise was combined with strengthening exercise or tandem walking exercise. These findings indicate that proximal trunk stabilization and lower extremity strengthening may synergistically improve postural control and functional balance.

Several studies evaluating early mobilization and rehabilitation interventions also reported improvements in functional mobility and postural performance. Ramaskandhan et al. demonstrated that early mobilization contributed to improved functional recovery, while Higuchi et al. reported that early ankle mobilization improved range of motion and mobility outcomes. Collectively, these findings support the importance of progressive exercise interventions in maintaining postural stability and reducing fall risk among older adults. A summary of the reviewed studies is presented in Table 1.

Table 1. Summary of Reviewed Studies

Author	Population	Intervention	Outcome
Wang et al. (2025) ⁶	Older adults	Balance-related interventions	Improved postural control and balance regulation
Wang QL et al. (2022) ⁷	Older adults with sarcopenia	Balance-related exercise	Reduced postural instability
Seo & Lee (2022) ²⁰	Individuals with ankle instability	Heel raise exercise	Improved ankle strength and postural stability
Freire & Seixas (2024) ¹⁵	Older adults	Sensorimotor exercise	Improved balance, proprioception, and fall risk
Ramaskandhan et al. (2023) ¹⁷	Postoperative patients	Early mobilization	Improved functional mobility
Higuchi et al. (2024) ²¹	Older adults	Early ankle mobilization	Improved ankle mobility and ROM
Faizah & Sari (2020) ¹⁸	Older adults	Heel raise exercise	Improved TUG outcomes
Wagiyanto et al. (2021) ¹²	Older adults	Core stability exercise	Improved BBS scores
Melani et al. (2021) ¹⁰	Older adults	Core stability + strengthening	Improved functional balance
Fauziah et al. (2021) ¹¹	Older adults	Core stability + tandem walking	Improved dynamic balance

Discussion

This narrative literature review demonstrated that core stability exercise and heel raise exercise may provide beneficial effects on balance performance, postural stability, proprioceptive control, and fall risk reduction in older adults. The reviewed studies consistently indicated that exercise-based physiotherapy interventions targeting trunk stability, ankle strength, neuromuscular activation, and sensorimotor integration contribute positively to functional balance outcomes in elderly populations.^{6,7,15,20}

Age-related deterioration in balance is influenced by multifactorial physiological changes involving the musculoskeletal, vestibular, visual, and somatosensory systems. Declines in proprioceptive sensitivity, muscle strength, reaction time, and postural coordination reduce the ability of older adults to maintain stability during functional activities.²² Wang et al. explained that aging-related impairment in balance regulation is associated with reduced sensory integration and neuromuscular responsiveness, while Pasma et al. demonstrated that altered sensory reweighting mechanisms negatively affect standing balance in older adults.^{6,23} These findings support the concept that balance impairment in the elderly is not caused by a single factor, but rather by complex interactions between sensory and motor systems.

Sarcopenia and lower extremity muscle weakness also play important roles in postural instability and fall risk. Reduced muscle mass and strength decrease the ability of older adults to generate adequate postural corrections during perturbations and movement transitions. Wang QL et al. reported that sarcopenia was strongly associated with impaired balance and increased fall risk among elderly individuals.⁷ Therefore, strengthening-based physiotherapy interventions are considered essential components of geriatric rehabilitation programs.^{10,12}

Core stability exercise appears to improve balance through enhanced trunk control, proximal stabilization, and neuromuscular coordination. Activation of deep trunk muscles contributes to postural alignment and dynamic stability during standing and movement activities. The reviewed local studies demonstrated improvements in Berg Balance Scale scores, dynamic balance performance, and functional mobility following core stability interventions.^{10–12} Additional benefits were observed when core stability exercise was combined with strengthening exercise and tandem walking exercise, suggesting that integrated exercise programs may produce synergistic effects on postural control.^{10,11}

Heel raise exercise demonstrated beneficial effects on ankle stability, plantar flexor strength, and proprioceptive activation. The ankle strategy plays a fundamental role in maintaining upright posture and controlling body sway during static and dynamic balance activities.¹⁴ Seo and Lee reported significant improvements in ankle strength and postural stability following heel raise exercise interventions.²⁰ Similar improvements in Timed Up and Go performance were also reported in local studies involving older adults with balance impairment.^{12,18} These findings suggest that heel raise exercise may improve neuromuscular efficiency and sensorimotor control at the ankle joint, thereby enhancing functional balance capacity.

Sensorimotor and mobilization exercises were also associated with improved balance and mobility outcomes. Freire and Seixas demonstrated that sensorimotor exercise programs improved proprioception, muscle strength, and fall risk parameters in older adults.¹⁵ In addition, studies evaluating early mobilization interventions reported improvements in functional mobility and joint movement capacity.^{16,17,21} These findings indicate that physiotherapy interventions emphasizing controlled movement, sensory stimulation, and neuromuscular activation may support balance recovery and functional independence in elderly populations.

Although the reviewed studies generally demonstrated positive findings, several limitations should be acknowledged. Some local studies involved relatively small sample sizes and lower methodological quality compared with international randomized controlled trials and systematic reviews. Variations in intervention duration, exercise intensity, frequency, and outcome measurements may also contribute to heterogeneity among findings. Furthermore, several studies primarily evaluated short-term outcomes, limiting the understanding of long-term effectiveness and sustainability of exercise interventions.

Despite these limitations, the overall evidence suggests that core stability exercise and heel raise exercise are promising physiotherapy interventions for improving balance and reducing fall risk in older adults. Clinically, these exercises may be integrated into geriatric rehabilitation programs to improve postural control, functional mobility, and independence. Future studies involving larger sample sizes, standardized intervention protocols, and longer follow-up periods are necessary to strengthen the current evidence and improve clinical applicability.

Conclusion

This narrative literature review demonstrated that core stability exercise and heel raise exercise may improve balance performance, postural stability, proprioceptive control, and functional mobility in older adults. The reviewed evidence indicates that these interventions contribute to fall risk reduction through improvements in trunk stability, ankle strength, neuromuscular activation, and sensorimotor integration.

International studies consistently reported positive effects of strengthening, sensorimotor, and mobilization exercises on balance-related outcomes, while local Indonesian studies showed similar improvements in functional balance performance among elderly populations. These findings support the integration of core stability exercise and heel raise exercise into geriatric physiotherapy programs aimed at maintaining independence and preventing falls.

Nevertheless, variations in study design, intervention protocols, and outcome measurements remain important limitations within the current body of evidence. Further high-quality randomized controlled trials with standardized methodologies and longer follow-up periods are required to strengthen the evidence regarding the long-term effectiveness of these exercise interventions in older adults.

Author Contribution

Annisa Balkis: Conceptualization, literature searching, data curation, analysis, writing-original draft preparation.
Fatchurohmah Ines Prabandari: Supervision, methodology, validation, writing-review and editing, correspondence handling.
Warih Anjari Dyah K: Data interpretation, scientific review, validation, and final manuscript approval.

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Conflict of Interest Statement

The author declares no conflict of interest.

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Ethics Statement

Ethical approval was not required because this study was conducted as a narrative literature review using previously published articles and did not involve direct human participants or identifiable patient data.

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