Falls Research – December Highlights

The Effects of Ankle and Foot Exercises on Ankle Strength, Balance, and Falls in Older People: A Systematic Review and Meta-Analysis

Liang SG, Chow JCM, Leung NM, Mo YN, Ng TMH, Woo CLC, Lam FMH. Phys Ther. 2024 Dec 6:pzae157.

DOI: 10.1093/ptj/pzae157 **PMID:** 39657220

Abstract

Objective: Ankle-foot control is essential to maintain balance and gait stability. However, there has been limited evidence on the effect of ankle-foot exercises on balance and falls in older people. This study aimed to summarize the effects of ankle-foot exercises on ankle flexibility and strength, balance, mobility, and falls in older people, and to identify determining factors for ankle-foot exercises to improve balance and mobility.

Methods: CINAHL, Embase, PubMed, and PEDro were searched to identify randomized controlled trials that studied the effects of ankle-foot exercises on ankle control, balance, and falls in older people. PEDro scale was used to evaluate the methodological quality of the studies. Meta-analyses were done for similar outcomes. The quality of evidence was rated by GRADE.

Results: Sixteen papers (n = 651) were included. Meta-analyses showed that ankle-foot exercises significantly improved ankle plantarflexion strength (SMD = 0.35, 95% CI = 0.04 to 0.65, low-quality evidence), ankle flexibility (SMD = 0.48, 95% CI = -0.01 to 0.96, low-quality evidence), and balance in an eyes-open condition (SMD = 0.41, 95% CI = 0.19 to 0.70, low-quality evidence). There was no significant change in ankle dorsiflexion strength (SMD = 0.29, 95% CI = -0.24 to 0.82, very low-quality evidence), balance under eyes-closed condition (SMD = 0.41, 95% CI = -0.1 to 0.92, very low-quality evidence), and gait speed (SMD = 0.36, 95% CI = -0.24 to 0.96, very low-quality evidence). Two studies reported insignificant findings on fear of falling, fall incidence, and risk of falls.

Conclusions: Very low to low-quality evidence showed that ankle-foot exercises effectively improve ankle plantarflexion strength, flexibility, and balance with eyes open, whereas no effect on falls was found. Improvements in balance and gait tend to be associated with improvements in ankle strength and flexibility. Toe-strengthening exercise and training 3 times per week appear to be important for improving balance.

Impact: This review suggested that ankle-foot exercises might improve balance in older people. Determining factors leading to improvement in balance and mobility were identified. It paves the ground for further research to study the effect of ankle-foot exercises on fall prevention.

Keywords: ankle and foot; balance; exercise; falls; older adults; strength.

Effectiveness of Exercise Intervention on Mobility, Postural Control, and Falls for Older Adults With Mild Cognitive Impairment: A Systematic Review and Network Meta-analysis

Zeng Z, Ho CY, Sit CH, Wong SH, Liao J, Yang Y. Arch Phys Med Rehabil. 2024 Dec 12:S0003-9993(24)01399-6.

DOI: 10.1016/j.apmr.2024.12.002 **PMID:** 39674358

Abstract

Objective: To review and synthesize the effectiveness of exercise interventions on mobility, postural control, and falls in older adults with mild cognitive impairment (MCI).

Data sources: This review was registered with PROSPERO (CRD42023453320) and adhered to the PRISMA guidelines. The PubMed, Embase, APA PsycInfo, Cochrane Library, Web of Science, CINAHL, and SPORTDiscus were searched from inception until September 2024.

Study selection: Randomized controlled trials (RCTs) examining the effectiveness of exercise interventions on mobility, postural control, and falls in older adults with MCI.

Data extraction: Data extraction included author names, publication years, participant characteristics, intervention details, outcomes, key results, and attrition rates. Data accuracy was verified by 2 reviewers, with discrepancies resolved through consultation with a third reviewer.

Data synthesis: Thirty-two RCTs met the criteria for qualitative systematic review, with 22 RCTs included in the pairwise meta-analysis and network meta-analysis. Aerobic exercise (AE) (SMD 1.07 [95% CI, 0.62-1.52]), multicomponent exercise (SMD 0.46 [95% CI, 0.18-0.74]), and simultaneous cognitive-motor training (SMD 0.56 [95% CI, 0.23-0.89]) significantly improved gait speed during single task (P<.05). AE was the most effective intervention for single-task walking performance (99.3%), whereas Exergaming was the most effective for timed Up and Go performance (100.0%) according to the surface under the cumulative ranking. Paddling exercise (SMD 0.42 [95% CI, 0.16-0.68]) effectively increased handgrip strength (P<.05). However, network meta-analyses revealed no intervention demonstrating significant effects on postural control performance (Berg Balance Scale and Functional Reach Test scores). The effect of exercise on falls remained inconclusive because of the limited number of studies.

Conclusions: AE, multicomponent exercise, and combined cognitive-motor training significantly enhance gait speed and functional performance in older adults with MCI. However, the effect of exercise on fall risk remains unclear. These findings underscore the potential of tailored exercise interventions to improve physical function in this vulnerable population.

Keywords: Balance; Elderly; Gait; Network meta-analysis; Physical function; Rehabilitation.

Falls Research – December

Unraveling the Impact of Destabilizing Shoes on Balance Control and Fall Prevention in Older Adults: A Systematic Review

Kim IJ. Ann Geriatr Med Res. 2024 Dec;28(4):377-387.

DOI: 10.4235/agmr.24.0030 **PMID:** 39748493 **PMCID:** PMC11695762

Abstract

Background: Falls pose a significant risk to older adults, often leading to severe injury and disability. One potential contributing factor to falls is footwear, particularly shoes with destabilizing features. This systematic review assessed the effects of destabilizing shoes on stability control and fall prevention in older adults, highlighting their effectiveness in balance control and fall prevention, and the detailing the specific review methodology.

Methods: We thoroughly searched relevant databases and meticulously screened the identified studies based on predetermined inclusion and exclusion criteria. We then extracted data from 30 eligible studies with various study designs and shoe types and synthesized this information to assess the impact of destabilizing shoes on balance and gait measures, fall incidence, and other relevant outcomes.

Results: While certain types of destabilizing shoes may improve specific aspects of balance and proprioception, they can also adversely affect steadiness control and potentially increase the risk of falls if not appropriately used. Therefore, the use of destabilizing shoes should be carefully considered and tailored to individual needs, with proper guidance and training to minimize fall risk.

Conclusion: The findings of this review significantly inform footwear design and selection in older adults and emphasize the need for additional research. By synthesizing the available evidence, this review highlights the potential benefits and risks associated with destabilizing shoes and suggests the need for careful evaluation of their use on a case-by-case basis. This review serves as a basis for future guidelines on the use of destabilizing shoes in older adults with the aim of developing effective fall prevention interventions.

Keywords: Balance control; Destabilizing shoes; Fall prevention; Older adults; Systematic review

Steps to Avoid Falls in the Elderly - a TECHnology Enhanced Intervention (SAFE-TECH) study: randomized controlled trial protocol for a community-based, multi-component fall prevention program

Lai WX, Koh V, Goh JW, Tan KY, Tan KZ, Pai SGS, Taylor WR, Visaria A, Singh NB, Chan AWM, Matchar DB. BMC Public Health. 2024 Dec 18;24(1):3464.

DOI: 10.1186/s12889-024-20947-2 **PMID:** 39695436 **PMCID:** PMC11656786

Abstract

Background: Falls and fall-related injuries among older adults in Singapore are a serious health problem that require early intervention. In previous research, exercise interventions have been effective in improving functional outcomes and reducing falls for a broad group of older adults. However, results from multi-domain, multi-component falls prevention programs for high fall risk older adults in the community remain equivocal. One reason for these results is that there is significant heterogeneity in falls risk factors amongst high falls risk older adults which makes tailoring multicomponent interventions complex. The objective of the trial is to evaluate the effectiveness of an enhanced version of the predecessor program, SAFE. The Steps to Avoid Falls in the Elderly-a TECHnology enhanced intervention (SAFE-TECH) is designed for older adults in the community who are at high risk of falls, with candidate selection and program tailoring based on gait variables derived from wearable sensors and various questionnaire-based features.

Methods: SAFE-TECH is a 12-month randomized controlled trial involving 400 older adults at high risk of falling, who are randomly allocated to an intervention or control group in a 1:1 ratio. Participants will be assessed at baseline, 3rd-month and 12th-month for functional status, physical performance, cognitive status, quality of life, and medical history. Monthly phone calls will assess fall status, healthcare utilization, physical activity, and exercise self-efficacy. Participants in the intervention group will undergo a tailored, multi-domain, multi-component falls prevention program. The active intervention phase will last for 12-weeks with exercises focusing on strength, balance, coordination, flexibility, and aerobic endurance; and weekly educational sessions on falls risk with personalized feedback based on participant's falls risk assessments and environmental checklist.

Discussions: SAFE-TECH seeks to evaluate enhanced existing falls prevention programs by addressing the heterogeneity of falls risk through rapid assessments and personalisation of exercise and education components while maintaining the efficiency of the group setting. Our findings will inform practical efforts to reduce falls and falls-related injuries among community-dwelling older adults.

Trial registration: ClinicalTrials.gov.

Clinical trial number: NCT06102954|| 22-10-2023.

Keywords: Falls prevention intervention; Older adults; Randomised clinical trial; Study protocols.

Dynamic changes in medication burden leading to fall and hospital readmissions in older adults: Toward a strategy for improving risk and managing costs

Rasu RS, Xavier C, Rianon N. J Manag Care Spec Pharm. 2025 Jan;31(1):96-100.

DOI: 10.18553/jmcp.2025.31.1.96 **PMID:** 39745841 **PMCID:** PMC11695846

Abstract

The majority of a health plan's performance and designated Star Rating is related to medication-related behavior, eg, medication adherence, medication review, and reconciliation, that are intricately related to adverse drug events (ADEs). Altered pharmacodynamics and pharmacokinetics owing to aging make older adults more vulnerable to ADEs like falls, fractures, hospitalizations, and mortality. Prevention of avoidable risk factors such as medication burden can help maintain quality of life. Studies of multiple populations have established drug burden index (DBI), a dose-dependent measure of anticholinergic and sedative burden, to be strongly associated with worsening vertigo, dizziness, and balance, which all predicate falls. The mean difference in DBI greater than 0.1 provides greater predictive power for adverse events, such as falls and 30-day readmission rates. Inclusion of a DBI delta metric especially on an electronic medical record has the potential to reduce fall incidence and associated health outcomes such as hospitalizations and death; this presents an opportunity to improve Centers for Medicare & Medicaid Services Star Ratings by using meaningful tools to foster engagement among informed and active Medicare beneficiaries. We believe this information is extremely relevant in real-world decision-making for health care professionals, specifically when the changes are dynamic and happen very quickly. Moreover, managed care organizations are now dedicated to eliciting a deeper understanding and mitigation of social inequalities in medication use and consequences. Among the proposed solutions includes tailoring prescription utilization management tools with DBI to decrease avoidable incidences of complications and unintended costs. Understanding the dynamic relationship between medication exposures causing ADEs and associated health care utilization and costs to third-party payments remains vital because in the United States, approximately one-third of hospital admissions in older adults occur because of ADEs. This can be achieved by emphasizing equitable therapy and tailoring quality initiatives that minimize racial disparities and avoidable costs that affect the financial burden of these patients. Importantly, this approach becomes even more critical as health care systems increasingly emphasize star ratings, which reflect the quality of care delivered to patients. By prioritizing DBI metrics in these ratings, we can ensure that care is not only clinically effective but also equitable and focused on improving patients' overall well-being. Lastly, as the future directions, the timely application of advanced technologies like artificial intelligence and machine learning in analyzing DBI metrics could enhance our ability to predict the value of DBI adjustments and their correlation with falls and other unintended ADEs. These real-world technologies can process vast amounts of data quickly and accurately, identifying patterns and potential risks that might otherwise go unnoticed.

The effect of pain on gait in older people: A systematic review and meta-analysis

Seydi M, Delbaere K, Han DU, Chan L, Ambrens M, van Schooten KS. J Pain. 2024 Dec 12:104758.

DOI: 10.1016/j.jpain.2024.104758 **PMID:** 39672448

Abstract

Multi-site pain is common in people aged 60 years and over and is associated with a high risk of falls. To prevent and treat pain-related disabilities, it is crucial to identify the mechanisms underlying these associations. There is some evidence that pain leads to changes in walking, such as slower gait speed and shorter walking distance, which impair mobility and may increase the risk of falls. This review evaluated evidence on the relationship between pain and gait characteristics in older people. A comprehensive search on PubMed and Embase included observational studies and clinical trials assessing objective measures of walking, such as gait speed, cadence, stride length, and double-limb support time, in older people with and without pain. Of the 1218 studies screened, thirteen met the inclusion criteria from the primary search. An additional study was identified through the secondary search, resulting in fourteen studies included in this systematic review and meta-analysis. None of these studies investigated the relationship between fear of pain and gait characteristics in older people. Results showed that older people with pain had slower gait speed than those without pain, with a small effect size (Hedge's g = -0.30, 95% CI = -0.41 to -0.19, $p < 0.0001$). There were no statistically significant differences in cadence, stride length, and double-limb support time. These findings suggest that pain impacts walking speed in older people, highlighting the importance of addressing this association to manage mobility deficits and fall risk. PERSPECTIVE: This systematic review and meta-analysis show that pain is associated with reduced gait speed in older people. Recognising and addressing the impact of pain on walking may be important for preventing mobility-related disorders and falls in this population.

Keywords: Ageing; Meta-analysis; Mobility limitation; Musculoskeletal pain; Walking.

Questionnaires of self-perception poorly correlate with instability elicited by walking balance perturbations

Shelton AD, Allen JL, Mercer VS, Crenshaw JR, Franz JR. PLoS One. 2024 Dec 12;19(12):e0315368.

DOI: 10.1371/journal.pone.0315368 **PMID:** 39666738 **PMCID:** PMC11637265

Abstract

Rehabilitation to prevent falls should not only directly address intrinsic and extrinsic factors, but also the neuropsychology of falls to promote safe and independent mobility in our aging population. The purpose of this study was to determine the relation between falls self-efficacy and objective responses to a series of walking balance perturbations. 29 healthy younger adults and 28 older adults completed four experimental trials, including unperturbed walking and walking while responding to three perturbations: mediolateral optical flow, treadmill-induced slips, and lateral waist-pulls; and three self-reported questionnaires: Activity-specific Balance Confidence, Falls Efficacy Scale, and the Fear of Falling Questionnaire-Revised. We quantified stabilizing responses as a change in margin of stability from unperturbed walking. Older adults generally exhibited larger instability than younger adults in response to walking balance perturbations. Only the Fear of Falls Questionnaire-Revised showed an increase in perceived falls risk for older adults. We found no significant correlations for older adults between any balance perturbation response and questionnaires of self-perception. Given the disconnect between self-perceived falls risk and responses to walking balance perturbations, rehabilitation to prevent falls while maintaining mobility and independence will likely require personalized techniques that combine neuromuscular training with approaches for neurophysiological reeducation.

Feasibility and preliminary evidence of the immediate effect on balance, functionality, and cognition in adults over 50 through postural sway-meter training

Suttanon P, Khanphed W, Saadprai S, Apibantaweesakul S. PLoS One. 2024 Dec 2;19(12):e0314357.

DOI: 10.1371/journal.pone.0314357 **PMID:** 39621709 **PMCID:** PMC11611095

Abstract

An accelerometer-based device (postural sway-meter) is increasingly used for balance assessment, training, and fall prevention. However, limited information exists regarding its immediate effect on physical and cognitive performance, especially among middle-aged and older adults. This study aims to investigate the immediate effects of a balance training program using a postural sway-meter on balance, functional, and cognitive performance in adults over 50 years. This experimental study involved 72 participants aged 50 years and over, randomly assigned to either the intervention or control group. The intervention group underwent a 30-minute balance training session using the sway-meter with sound feedback (set at 75% of the stability limits at baseline). The control group participated in a 30-minute fall prevention knowledge session. The sway-meter measured balance during quiet stance and leaning. Functional performance was assessed using the multi-dimensional reach test (MDRT). Cognitive performance was evaluated through Trail Making Tests (TMT) A & B, as well as hand/foot reaction time assessments. Between-group comparisons at post-intervention showed no significant differences in balance, functional, and cognitive performance outcomes. Within-group analysis revealed a significant decrease in maximum reaching distance in the forward direction (MDRT) ($p = 0.032$, $d = 0.31$, 95% CI [-0.15, 0.78]) and the time to complete TMT-B ($p = 0.036$, $d = 0.24$, 95% CI [-0.22, 0.71]) in the intervention group. The control group showed a significant increase in COM angle sway excursion (lateral direction) ($p = 0.011$, $d = 0.27$, 95% CI [-0.19, 0.74]) and a decrease in TMT-A time ($p = 0.031$, $d = 0.38$, 95% CI [-0.09, 0.85]). Both groups significantly reduced hand reaction time (intervention: $p = 0.036$, $d = 0.24$, 95% CI [-0.22, 0.70]; control: $p = 0.034$, $d = 0.20$, 95% CI [-0.26, 0.66]) at post-intervention assessment. The findings of this study suggest that a single 30-minute balance training session using a postural sway-meter, delivered by a physiotherapist, is not only feasible and safe for community-dwelling older adults but also has the potential to significantly improve balance and cognitive outcomes. Enhancing the training program by increasing the amount of leaning and duration could further amplify these benefits, underscoring the need for a more robust training regimen.

Factors associated with anxiety and fear of falling in older adults: A rapid systematic review of reviews

Whitmore C, Neil-Sztramko S, Grenier S, Gough A, Goodarzi Z, Weir E, Niculescu I, Suthakaran A, Adedeji I, Akram M, Mojgani J, Chan T, Flint AJ, Juola H, Reynolds K, Trenaman S, Van Amerigen M, Yeung A, Levy A, Iaboni A. PLoS One. 2024 Dec 18;19(12):e0315185.

DOI: 10.1371/journal.pone.0315185 **PMID:** 39693333 **PMCID:** PMC11654959

Abstract

Background: Anxiety disorders are prevalent amongst older adults and negatively impact their quality-of-life and health. Anxiety disorders often go undetected or are misattributed to age-related changes. The aim of this systematic review of reviews, was to synthesize existing evidence on risk factors associated with anxiety in older adults to improve opportunities for early detection and intervention.

Methods: A rapid systematic review of reviews was performed. Studies were included if they were systematic reviews, specific to older adults, reported modifiable or non-modifiable factors associated with increased or decreased frequency of anxiety, and reported on anxiety disorders or symptoms of anxiety (including fear of falling).

Results: 27 papers met criteria for inclusion. A total of 77 unique risk and protective factors across demographic, health, environmental, and psychosocial domains were identified. Recurrently identified risk factors for anxiety included female sex, health (e.g., multimorbidity, sensory impairments), physical functions (e.g., impaired balance, history of falls), psychological factors (e.g., fear of falling, depression), social isolation, and sleep disturbances, whereas good physical health and balance confidence were protective.

Conclusions: This review reinforces the multifaceted and complex nature of anxiety in older adults. The results synthesized, highlight risk factors that should prompt detection of older adults for anxiety disorders and provide valuable insight for the development of tailored detection tools that better identify older adults at risk. Future research should address methodological limitations and include more diverse populations to improve opportunities for early detection and intervention in this vulnerable population.

Mechanism-Driven Strategies for Reducing Fall Risk in the Elderly: A Multidisciplinary Review of Exercise Interventions

Zhong YJ, Meng Q, Su CH. Healthcare (Basel). 2024 Nov 29;12(23):2394.

DOI: 10.3390/healthcare12232394 **PMID:** 39685016 **PMCID:** PMC11641686

Abstract

Falls among older adults present a major public health challenge, causing significant physical, psychological, and economic consequences. Exercise interventions are a proven strategy to reduce fall risk by targeting biomechanical, physiological, and psychological factors. This review examines evidence from 155 studies published between 2004 and 2024, including systematic reviews, meta-analyses, randomized controlled trials, and cohort studies. Data were rigorously screened and extracted using predefined criteria, with studies sourced from PubMed, MEDLINE, EBSCO (EDS), and additional gray literature identified via Google Scholar. Key findings show that balance and strength training improves postural control, gait stability, and neuromuscular coordination, while resistance training mitigates sarcopenia and enhances joint mobility. Cognitive exercises enhance attention, spatial awareness, decision-making, and psychological benefits like reduced fear of falling and greater social engagement. Multidisciplinary approaches integrating physical, cognitive, and social components deliver the most significant impact. This review underscores the value of evidence-based exercise programs in promoting active aging and enhancing the quality of life for older adults.

Keywords: balance and stability; cognitive and psychological benefits; elderly exercise interventions; fall prevention; muscle strengthening.