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Physical Therapy Management of Fall Risk in Community-Dwelling Older Adults: An Evidence-Based Clinical Practice Guideline From the American Physical Therapy Association – Geriatrics

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ABSTRACT

APTA-Geriatrics, an Academy of the American Physical Therapy Association, appointed a guideline development group (GDG) to

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develop a clinical practice guideline (CPG) synthesizing the evidence for physical therapy management of fall risk in community-dwelling older adults. The GDG consisted of five physical therapists with clinical expertise in the management of fall risk in older adults and methodological expertise in evidence-based document development. The CPG includes a systematic review of existing literature, and stringent methodology developed by the American Physical Therapy Association to form the evidence-based recommendations. The CPG content, including methodology, recommendations and algorithm were externally reviewed by clinical providers and academicians with expertise in fall risk management for older adults. These recommendations are intended to assist physical therapists and physical therapist assistants who are engaged in fall risk management for community-dwelling older adults.

Key Words: fall risk, guidelines, older adults

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CLINICAL IMPLICATIONS

- Physical therapists can use the evidence-based algorithm to facilitate clinical reasoning in the management of fall risk for older adults.
- Multicomponent exercise is the most important intervention for addressing falls and fall risk in older adults.
- Multicomponent exercise must include progressive and challenging balance training exercises and may include other types of exercise.

SUMMARY OF GRADED RECOMMENDATIONS

This clinical practice guideline (CPG) provides recommendations for the management of fall risk in community-dwelling adults aged 65 and over (subsequently referred to as older adult(s)). Multifactorial management programs include screening, assessment, referral to appropriate providers, and interventions within physical therapist (PT) and physical therapist assistant (PTA) scope of practice. This guideline strongly recommends that PTs and PTAs



participate in multifactorial management programs addressing falls and fall risk for older adults. A multifactorial approach to fall risk management in older adults is supported by robust evidence (Evidence Quality/Level: I, Recommendation Strength: Strong). A multicomponent exercise program that incorporates balance training and other modes of exercise, such as resistance training or Tai Chi, is strongly recommended for reducing the risk and rate of falls (Evidence Quality/Level: I, Recommendation Strength: Strong). The guideline strongly recommends that balance training interventions be progressive and sufficiently challenging, involve limb and whole-body movements, changes in base of support, and reduced upper limb support (Evidence Quality/Level: I, Recommendation Strength: Strong). Additionally, Tai Chi is strongly recommended for older adults in particular those at lower fall risk (Evidence Quality/Level: I, Recommendation Strength: Strong). The guideline makes a strong recommendation for environmental assessments and necessary modifications for older adults at higher risk (Evidence Quality/Level: I, Recommendation Strength: Strong). Providing or prescribing resistance training ALONE to reduce fall risk and rate is not recommended, as it offers limited benefits. (Evidence Quality/Level: II, Recommendation Strength: Moderate).

This guideline also provides several weak recommendations. While reactive step (perturbation) training is a potential component of balance training, the evidence supporting this intervention is mixed (Evidence Quality/Level: II, Recommendation Strength: Weak) in comparison to strong evidence for volitional step training or balance training. Additionally, this guideline recommends a comprehensive approach that combines tailored education with individualized exercise intervention, addressing identified risk factors, home hazards, strength and balance impairments, and referral to other providers when necessary, especially for factors outside the scope of physical therapy (Evidence Quality/Level: V, Recommendation Strength: Expert Opinion). The recommendation for this comprehensive approach is predicated upon expert opinion, but each individual component is recommended based upon robust evidence. These recommendations collectively guide physical therapists in adopting evidence-based practices to manage fall risk, while also highlighting the limitations and areas requiring further research.

INTRODUCTION

Overview

Falls among older adults are a major problem for individuals, their social networks, and society. The risk of falls increases with age. Falls often result in serious consequences including fall-related injuries, loss of function and independence, hospitalization, institutionalization, and death. Multiple risk factors and evidence-based interventions have been identified, some of which fall within the scope of physical therapist and physical therapist

assistant practice. Physical therapists and physical therapist assistants enable patients to maintain, restore, and improve movement, activity, and function to optimize performance and enhance health, well-being, and quality of life. Therefore, the development of guidance documents to support the implementation of evidence-based approaches is warranted.

Burden

Falls are a major health concern in the United States and globally that results in significant economic and health burden. A fall is defined by The Prevention of Falls Network (ProFaNE) group and the Center for Medicare and Medicaid Services (CMS) as an unexpected or unintentional event in which the participants come to rest on the ground, floor or lower level.^{1,2} Falls are common in the United States, where data from the 2020 Behavioral Risk Factor Surveillance System demonstrated 27.6% of older adults reporting one fall in the past year (more than 14 million total falls) resulting in almost 39 000 fall-related deaths.³ The age-adjusted death rate due to a fall was 78 per 100 000, and has been increasing over the last 10 years.³ Falls contribute to substantial morbidity, health care utilization, and medical expenditures, with the cost of fatal and non-fatal falls exceeding \$50 billion per year in the United States,⁴ and the cost of falls is expected to reach \$100 billion annually by 2030.⁵ Worldwide, falls are the second leading cause of unintentional injury deaths, with an estimated 684 000 fall deaths per year.⁶ The substantial impact falls have upon older adults supports the need for evidence-based clinical guidance.

Etiology and Risk Factors

Falls result from multiple causes including the individual's environmental and social context and the situation surrounding a fall event. Aging adults experience changes in all major bodily systems that impact physical health,⁷ mental health,⁸ and their ability to interact with their environment.⁹ Almost half of falls in older adults have been attributed to modifiable factors such as environmental factors or impairments in balance and walking.¹⁰ Certain predisposing risk factors have also been identified including older age, a previous fall, depression, dementia, comorbidities, psychotropic medications, and footwear.¹¹

Goals and Rationale

Several evidence-based documents have been published addressing the physical therapy management of falls and screening for fall risk in older adults.¹²⁻¹⁶ In prior work, this guideline development group (GDG) conducted a systematic review (SR) of existing CPGs and published a guidance statement with recommendations for physical therapist screening, examination, and interventions for fall risk management.¹² In 2022, the World Falls Guideline Task Force published a World Guideline for Falls management which provides recommendations

for screening, assessment, and management of falls.¹⁶ These documents lacked specificity to comprehensively guide physical therapy management of falls and fall risk in older adults. The present CPG fills this gap by conducting a review of the primary literature on physical therapist fall risk management, with particular attention to dosage (ie, sets, repetitions, load), modes of delivery (type of exercise), and the influence of physical function on levels of fall risk. This CPG provides recommendations (see Table 1 for summary of recommendations), a decision algorithm to facilitate implementation of the recommendations (Figure 1), discusses limitations in the literature, gaps in evidence, areas that require future research, and potential benefits and risks to implementing each recommendation when information was available.

Intended Users

This CPG is intended to be used by physical therapists, and physical therapist assistants under the supervision of physical therapists, for the management of falls and fall risk in community-dwelling older adults. Given the multifactorial nature of falls, a variety of health care providers will benefit from the recommendations provided in this CPG including geriatricians, primary care physicians,

physiatrists, neurologists, orthopedists, nurse practitioners, physician assistants, nurses, occupational therapists, speech-language pathologists, and other health care professionals who routinely care for older adults. This document may also inform health care decision-makers, health care providers, and consumers.

Patient Population

This CPG addresses the management of falls and fall risk in community-dwelling older adults. It is not intended to address the management of falls and fall risk in older adults who are institutionalized. Those who are institutionalized may be at a greater risk of falls but require care specific to the acute condition, nursing home facility, or change in cognition, to name a few examples. This CPG specifically defines community-dwelling older adults as 65 or over who do not have major health conditions that prevent them from interacting in their environment without substantial physical, cognitive or social support. Clinicians should use their clinical judgment for whether these recommendations apply to their patients that fall outside these inclusion criteria. For older adults with condition-specific impairments and activity limitations (eg, people

Table 1. Summary of Recommendations

Recommendation	Level of Evidence	Strength of Recommendation
Physical therapists should participate in multifactorial ^a management programs addressing falls and fall risk for older adults.	I	Strong
Physical therapists must provide or prescribe multicomponent ^b exercise to older adults to reduce risk and rate of falls and it must include balance training and may include other exercise modes.	I	Strong
Physical therapists must prescribe exercise programs to older adults to be performed at least 150 minutes to 3 hours per week, lasting from 6 to 12 months, and must include progressive and sufficiently challenging balance training.	I	Strong
Physical therapists must provide or prescribe balance training to older adults that is progressive and sufficiently challenging as evidenced by movement of the limbs and whole body in multiple directions, changing the base of support, and reducing upper limb support either alone or as part of a multicomponent program to reduce the risk and rate of falls.	I	Strong
Balance training must include volitional step training and/or gait adaptability training.	I	Strong
Balance training may also include reactive step (perturbation) training.	II	Weak
Physical therapists should NOT provide or prescribe resistance training ALONE to older adults if the purpose is to reduce the risk and/or rate of falls.	II	Moderate
Physical therapists should prescribe Tai Chi for older adults to reduce the risk and rate of falls.	I	Strong
Physical therapists should NOT provide education ALONE to older adults to reduce the risk and/or rate of falls.	I	Strong
Physical therapists should provide tailored education combined with individualized exercise intervention to older adults. The tailored education should include specific actions to address identified risk factors, including home hazards and strength and balance impairments, and should also include referral to appropriate providers for risk factors outside of PT scope of practice.	V	Expert opinion
Physical therapists should provide environmental assessment and recommend modifications to older adults at high risk of falls.	I	Strong

^aMultifactorial management includes screening, assessment, referral to appropriate provider, and interventions within physical therapist scope of practice.

^bMulticomponent exercise refers to exercise that includes more than one category of exercise according to the PROFANE¹ taxonomy (balance and functional, flexibility, resistance training, 3-D).

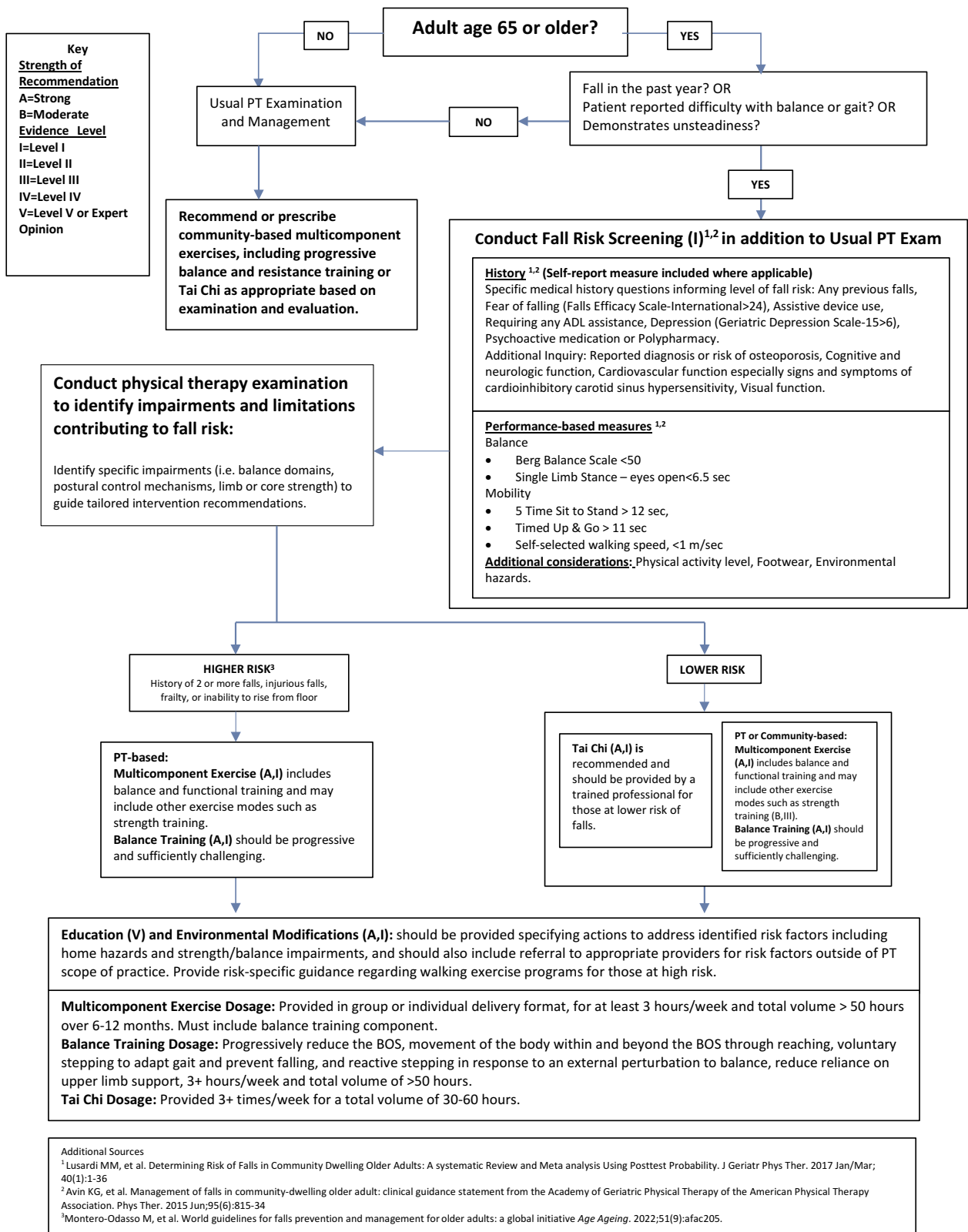


Figure 1. Algorithm for physical therapy falls risk management.

with Parkinson's disease or severe cardiac pathology), clinicians should refer to existing evidence-based documents for these populations. Customization of the

recommendations with respect to application and dosage would be warranted in persons with multiple co-morbidities.

Statement of Intent

This document is intended to guide primarily physical therapists and physical therapist assistants in the management of fall risk in older adults. Secondarily, this CPG may provide guidance to older adults, family members, educators, researchers, policymakers, and payers. It is not intended to be construed or to serve as a legal standard of care or as an insurance benefit determination document. As rehabilitation knowledge expands, CPGs are promoted as syntheses of current research and provisional proposals of recommended actions under specific conditions. Standards of care are determined based on all clinical data available for an individual patient/client and are subject to change as knowledge and technology advance, patterns of care evolve, and patient/family values are integrated. This CPG is a summary of practice recommendations that are supported by current published literature that has been reviewed by expert practitioners and other interested parties. These parameters of practice should be considered guidelines only, not mandates. Adherence to them will not ensure a successful outcome for every patient, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results.

This CPG includes interventions provided in group settings and in individual one on one clinical settings. Some older adults can exercise without supervision in group settings, while others may need one-on-one intervention to safely exercise. Individualized exercise prescription should be driven by a targeted PT examination and evaluation of the movement system to identify impairments that contribute to the risk identified with performance based and self-report measures. Recommendations for specific examination tests and measures to support individualized exercise prescription are outside the scope of this CPG.

The ultimate decision regarding a particular clinical procedure or treatment plan must be made using the clinical data presented by the patient/client/family, the diagnostic and treatment options available, the patient's values, preferences, expectations, support, and resources, and the clinician's scope of practice and expertise. The CPG suggests that significant departures from accepted guidelines should be documented in patient records at the time the relevant clinical decisions are made.

METHODS

The American Physical Therapy Association-Geriatrics (APTA-Geriatrics) is an Academy of the American Physical Therapy Association that serves physical therapists, physical therapist assistants, and students who work with older adults. The APTA-Geriatrics appointed the members to the GDG to develop and disseminate an evidence-based document on the management of falls. The GDG developed the current CPG using a multi-pronged approach by incorporating published results from the Geri-Edge Task Force SR¹³ and the previously

published guidance statement¹² to inform recommendations on screening and examination. Intervention recommendations were formed from a comprehensive review of the literature performed by the GDG on physical therapist interventions.

The GDG collaborated with a research librarian with expertise in SR processes to develop the search strategies. The search strategies and results are provided in Supplemental Digital Content, Appendices I (<http://links.lww.com/JGPT/A267>) and II. The inclusion criteria were:

- publication time frame: Studies published between 2005 and 2022 were included.
- design: SRs and meta-analyses were included.
- population: Studies of community-dwelling older adults with a mean age greater than or equal to 65 years or older were included. Studies that included individuals with mild cognitive impairment were included.
- interventions: Studies of interventions within the scope of PT practice including exercise, mobility training, balance training, education, environmental modification, and footwear were included. All comparators were included, because a priori we intended to determine the influence of physical function on intervention effectiveness.
- outcomes: Studies that reported falls as number, rate, or risk, whether injurious or not, regardless of whether medical attention was required were included. **Rate ratio** refers to the relative difference in the fall rate (number of falls) between the intervention and comparator groups. **Risk ratio** refers to the relative difference in the fall risk (number of fallers) between the intervention and comparator groups.

Exclusion criteria were:

- Studies focused on individuals with specific conditions, such as hip fracture, osteoporosis, Parkinson's disease, and dementia including moderate and severe cognitive impairment were excluded.

Article Screening, Review, and Critical Appraisal Process

Title and abstract screening and full-text eligibility reviews were conducted by two independent GDG members using the pre-specified inclusion and exclusion criteria described above. Discrepancies were discussed by the two reviewers, and if consensus was not reached, a third reviewer was enlisted. Two members of the GDG independently assigned each included study a level of evidence based upon study design and critically appraised the included SRs using the AMSTAR 2¹⁷ instrument. Based on this critical appraisal, an AMSTAR 2 quality score was provided for each article as either High, Acceptable, Low, or Unacceptable. Scoring discrepancies were discussed between the two reviewers and if consensus could not be reached, a third reviewer

was enlisted. Studies with a final rating of high quality remained at the initial evidence level (eg, level I); those rated as acceptable were downgraded one level (eg, to level II), and those rated low were downgraded two levels (eg, level III). Articles that were rated unacceptable were excluded.

A data extraction form was developed and piloted by the team prior to use. Supplemental Digital Content, Appendix III (available at: <http://links.lww.com/JGPT/A268>) includes a description of the data extracted and definitions of rate and risk ratios. Data was extracted by two members of the GDG in the first two rounds. In the final literature search update, a research assistant conducted the data extraction, which was checked for accuracy by one GDG member.

Recommendation Development

The GDG considered the body of evidence and additional domains^{18,19} to guide development of the recommendations. The domains were: strength of evidence, magnitude of effect, benefits, risks, harms, costs, value judgments, role of patient preferences, exclusions, and differences of opinion. Operational definitions of the strength of recommendations based on the level of evidence and magnitude of effect are provided in Table 2. In addition, the GDG adjusted the strength of recommendation up or down based on the benefit-harm ratio, value judgments, and role of patient preferences. The role of these considerations was described in the Rationale for each recommendation.

External Review by Constituents

Clinical providers and academicians with expertise in fall risk management for older adults and CPG methodology were invited by the GDG to review the draft guideline and provide comments. A survey was used to elicit feedback on key aspects, and open comment was invited. The guideline was posted for comment for two weeks on the APTA-Geriatrics website, and invitations were disseminated to the physical therapy community through the Balance and Falls Special Interest Group of the Academy of Geriatric Physical Therapy. The final recommendations and manuscript were also reviewed by three older adult laypersons. All comments were addressed by the GDG and revisions and responses were documented.

Conflict of Interest

Conflict of interest statements were provided by each member of the GDG to the APTA-Geriatrics at the initiation of the project, and no changes to declarations were required throughout the guideline development process.

RESULTS

The search strategies are provided in Supplemental Digital Content, Appendix I (available at: <http://links.lww.com/JGPT/A267>). The initial search was conducted in 2015, with updates in 2018 and 2022. Therefore, the final search results included studies from 2005 through 2022. In total 1549 articles were identified and 55 were included. See Figure 2 and Supplemental Digital Content, Appendix II

Table 2. Levels of Evidence and Strength of Recommendations¹⁷

Level of Evidence	Types of Studies: Intervention/Prevention	Notes
I. Evidence obtained from high-quality systematic reviews, diagnostic studies, prospective studies, or randomized controlled trials (RCTs)	Systematic review of high-quality RCTs	High-quality RCT >80% follow-up, blinding, appropriate randomization procedures
II. Evidence obtained from lesser-quality studies or RCTs (eg, weaker diagnostic criteria, and reference standards, improper randomization, no blinding, less than 80% follow-up)	Systematic review of high-quality cohort studies, lower quality SRs/RCTs	High-quality or dramatic effect cohort study includes >80% follow-up
III. Case-controlled studies or retrospective studies	Systematic review of case-controlled studies	
IV. Case Series	Case series.	NA
V. Expert Opinion	Expert Opinion	Insufficient Evidence
Strength of Recommendation	Operational Definitions Based on Magnitude of Effect and Certainty ^a	
Strong	A high level of certainty of moderate to substantial benefit, harm, or cost, or a moderate level of certainty for substantial benefit, harm, or cost (based on a preponderance of Level I or II evidence with at least one level I study)	
Moderate	A high level of certainty of slight to moderate benefit, harm, or cost, or a moderate level of certainty for a moderate level of benefit, harm, or cost (based on a preponderance of Level II evidence, or a single high-quality RCT)	
Weak	A moderate level of certainty of slight benefit, harm, or cost, or a weak level of certainty for moderate to substantial benefit, harm, or cost (based on Level II through V evidence)	

^aThe GDG adjusted the strength of recommendation based on the benefit-harm ratio, value judgments, and role of preferences of older adults, as appropriate.

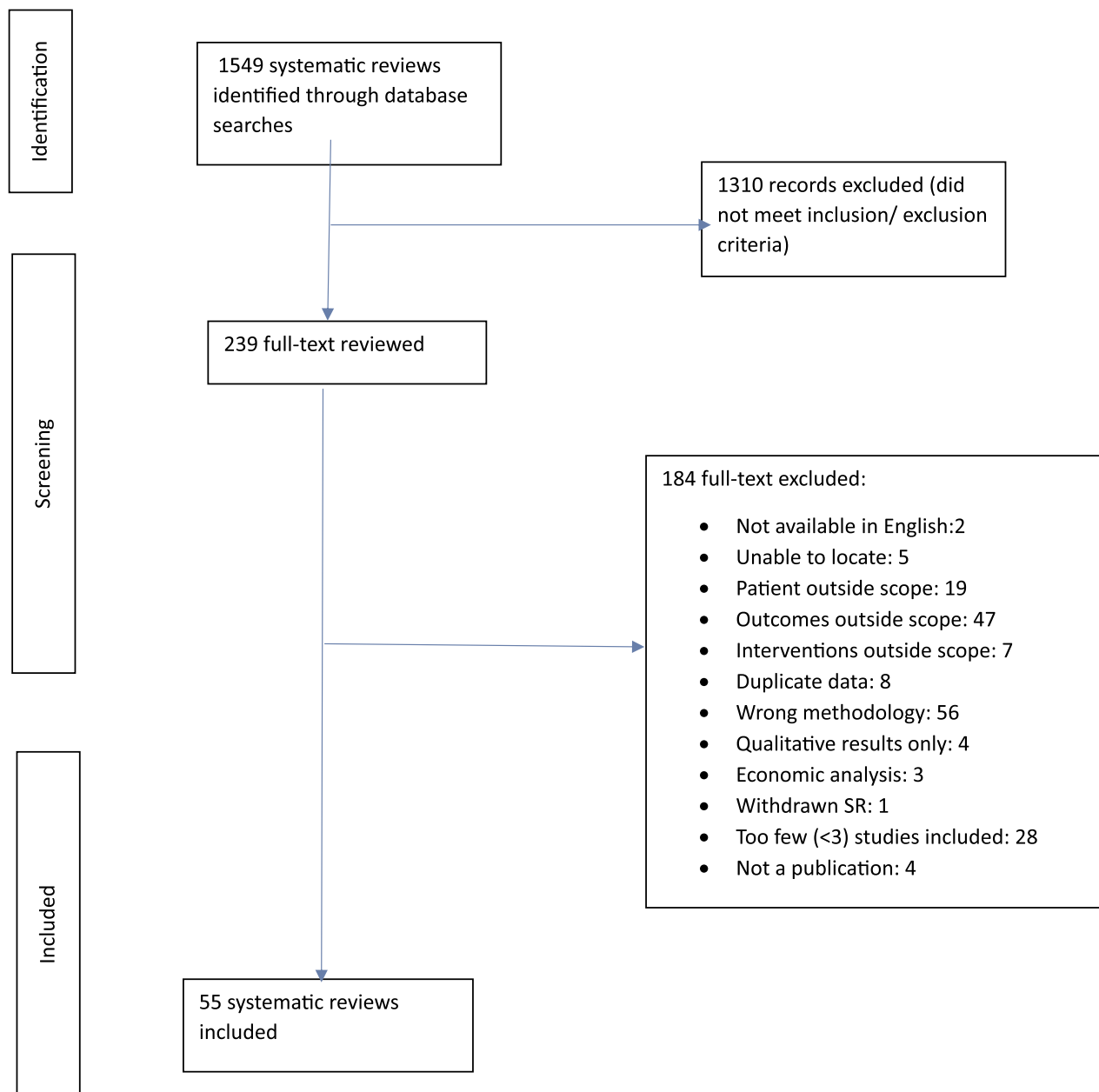


Figure 2. PRISMA diagrams for all three searches combined.

(available at: <http://links.lww.com/JGPT/A271>) for the PRISMA diagram. The included studies and their quality ratings are found in Supplemental Digital Content, Appendix IV (available at: <http://links.lww.com/JGPT/A269>) and the list of excluded studies is found in Supplemental Digital Content, Appendix V (available at: <http://links.lww.com/JGPT/A270>). Five invited experts in falls prevention, falls research, and/or synthesis document methodology reviewed the draft guideline. From the call for public comment, 23 individuals opened the document, eight completed the scoring, and five provided specific feedback.

This CPG reviews the evidence related to both multifactorial management programs and multifactorial

physical therapy fall risk management interventions. In multifactorial management programs, the physical therapist's role may include some or all the following: screening, assessment, referral to appropriate providers and providing interventions within the physical therapist scope of practice. In the absence of a multifactorial management program in the physical therapist's practice setting, the role of the physical therapist includes all of the following: screening, assessment, referral and providing interventions within the physical therapist's scope of practice.¹² Fall risk management studies of interventions that addressed multiple fall risk factors by providers from any discipline, within and outside of physical therapist

scope of practice, were included. This guideline addresses multifactorial management programs first, and then reviews each category of intervention within the physical therapy scope of practice

The results of individual systematic reviews are summarized in the accompanying tables, and the risk ratio, rate ratio, and 95% confidence intervals are provided. **Risk ratio** refers to the proportion in the **number of people falling** in the intervention group compared to a comparison group, and the **rate ratio** refers to the proportion in the **number of fall events** in the intervention group compared to a comparison group. For both measures, a number less than one indicates a decreased risk and greater than 1 indicates an increased risk. The 95% confidence interval indicates the statistical significance of estimated risk or rate ratio. If the 95% confidence interval contains the value of 1.0, then the estimate of the risk ratio or rate ratio indicates no statistically significant difference between the control group and the intervention group.

Screening

Physical therapists' management of falls is predicated on their ability to identify fall risk and movement dysfunction as part of a multifactorial evaluation process to guide treatment choice. In 2017, through the Geriatrics Evidence Database to Guide Effectiveness Initiative (GeriEDGE) task force, Lusardi et al published a systematic review of history questions, self-report measures, and performance-based measures for assessing fall risk of community-dwelling older adults.¹³ This CPG developed a screening process using these results¹³ and the previous guidance statement recommendations.¹² The screening process includes medical

history questions, self-report measures, and performance-based functional measures as part of a multifactorial falls screening¹³ (see Table 3). The GDG did not systematically review the evidence for screening for falls risk, thus we indicate the level of evidence for screening, but do not provide specific recommendations for falls risk screening.

The medical history questions, self-report measures, and performance-based measures with the highest post-test probability of identifying falls risk align with the Center for Disease Control (CDC) "Stopping Elderly Accidents, Death, and Injuries" (STEADI) processes²⁰ and recent guidelines on the management of falls.¹⁵ The details are provided in the Falls Management Algorithm (Figure 1).

Screening may include self-report measures of falls self-efficacy and depression. Self-efficacy for the maintenance of balance should be screened using the Falls Efficacy Scale-International,²¹ with scores greater than 24 indicating increased fall risk.¹³ Depression is associated with impaired mobility and increased falls incidence, and therefore screening for depression using the Geriatric Depression Scale-15²² (cut-off score >6)¹³ can be used to identify fall risk.

Tests and measures that encompass body functions and structures, activity and participation, and environmental and personal factors should be performed during the examination. Based upon positive predictive values associated with fall risk established by the GeriEDGE SR we recommend the Timed Up and Go (TUG),²³ 5 times sit-to-stand test,²⁴ single limb stance with eyes open,²⁵ the Berg Balance Scale (BBS)²⁶ and self-selected gait speed.²⁷ Scores greater than 11 seconds for the TUG and/or greater than 12 seconds on the 5 times sit-to-stand test indicate risk for falls.¹³ If the older adult is unable to maintain a single limb stance with eyes open greater than 6.5 seconds, fall risk is increased.¹³ A score of less than 50 on the BBS or a Self-selected walking speed less than 1.0 m/s indicate risk for falling.¹³

An intention of this CPG is to provide recommendations while considering the older adult's level of fall risk. Determining the level of fall risk is part of the screening component of physical therapy management of older adults. Providing recommendations for fall risk classification is challenging due to inconsistent definitions in the literature, and variability in fall risk cut-off scores. As reinforced by Lusardi et al,¹³ the clinician can merge the findings of several tests to more accurately portray an older adult's risk of falls. The Sherrington 2019 SR²⁸ included studies that categorized higher risk as 1 or more falls and often some additional impairment on balance or mobility tests. The recent World CPG¹⁶ categorized high fall risk as those who had an injurious fall, 2 or more falls, a frailty diagnosis, inability to get up from the floor, or a loss of consciousness/suspected syncope. The GDG considers pre-fall loss of consciousness and syncope to be separate issues and out of the scope of this CPG. The GDG values a quantitative approach to assessing fall risk using change in post-test probability of validated questions, tests, and measures. We suggest that

Table 3. Medical History and Measures with Highest Post-test Probability for Falls Risk¹³

Category	Measure	Risk threshold
Medical history questions	Any previous falls	Yes
	Psychoactive medication	Yes
	Requiring ADL equipment	Yes
	Self-reported fear of falling	Yes
	AD for ambulation	Yes
Self-report measures	Geriatric Depression Scale – 15	>6 points
	Falls Efficacy Scale – International	>24 points
Performance-based measures	Berg balance scale	<50 points
	Timed up and go Test	>11 sec
	Single leg stance – eyes open	<6.5 sec
	Five time sit-to-stand test	>12 sec
	Self-selected walking speed	<1.0 m/sec

^aAdapted from Lusardi MM, Fritz S, Middleton A, et al. Determining risk of falls in community dwelling older adults: a systematic review and meta-analysis using posttest probability. *J Geriatr Phys Ther.* 2017;40(1):1-36. doi: 10.1519/JPT.0000000000000099.

those who have a history of multiple or injurious falls, frailty, and/or are identified as having balance impairment by evidence-based tests, as suggested by Lusardi et al,¹³ should be classified as high risk.

Examination

After the screening process determines the level of fall risk, physical therapy management of people at risk for falls requires a thorough examination to identify movement related impairments and activity limitations. The examination leads to a movement system diagnosis that enables the development of a tailored intervention for falls management. Utilization of tests and measures with the best post-test probability for fall risk¹³ allows for the identification of who is at high risk of falls, but does not identify impairments in subdomains of balance, or other specific impairments (ie, in strength, balance, or cognition) that can guide what intervention is most appropriate for individuals. A recent study of the BESTest and MiniBESTest may support the relevance of these tests in this population.²⁹ Magnani et al²⁹ suggested age-standardized cut-off points for the BESTest and the Mini-BESTest. These tests may be particularly relevant to this population as they allow characterization of balance during standing and walking across multiple subdomains,²⁹ and may better inform the evaluation and treatment planning process. Clinicians should refer to other evidence-based guidelines to assist with identification and classification of movement system impairments and limitations.³⁰⁻³² A systematic review of examination strategies was outside the scope of this CPG.

MULTIFACTORIAL MANAGEMENT PROGRAMS

Multifactorial management programs include screening, assessment, referral to appropriate provider, and interventions within physical therapist scope of practice.¹² Studies of fall prevention intervention programs that addressed multiple fall risk factors by providers from any discipline within and outside of PT practice in which a physical therapy provider might be involved were included. According to the ProFaNE Taxonomy, “multifactorial interventions are those interventions in which two or more sub-domains of intervention can be given to participants, and the interventions are linked to each individual’s risk profile, such that not all participants in a program receive the same combination of sub-domains.”¹

Recommendation

Physical Therapists should participate in multifactorial management programs addressing falls and fall risk for older adults. (Evidence Quality/Level: I, Rec. Strength: Strong)

Participation may include:

- screening for fall risk factors, including depression and fear of falling, within the context of multifactorial management, and referral to the appropriate provider for identified risk factors
- examination of:
 - mobility
 - balance
 - gait
 - activities of daily living
 - physical activity
 - lower extremity strength
 - environmental hazards
 - footwear
- determined by level of fall risk, prescribing and implementing interventions within the scope of physical therapist practice for management of falls and fall risk including:
 - balance training
 - strength training
 - gait training
 - functional training
 - education
 - environmental modification

Rationale

Evidence for the effectiveness of multifactorial interventions comes from eight high-quality SRs,³³⁻⁴⁰ and nine acceptable quality SRs.⁴¹⁻⁴⁹ Details and estimates of rate and risk reduction can be found in Table 4. Healthy older adults and older adults at high risk of falls receive beneficial effects from multifactorial interventions; greater effects were seen when exercise, environmental or more active interventions were utilized. Greater reductions in fall rate and fall risk were found in those considered high risk. In addition, reductions in fall rate were larger than fall risk. Overall, the evidence supports a small-to-moderate benefit of multifactorial interventions that poses minimal to no harm. The GDG acknowledges the need to incorporate patient preferences in decision-making for intervention selection, and potentially additional benefits that extend beyond successful fall prevention (ie, reduced fall-related injuries, fractures, mobility limitations, and improved independence, and/or life expectancy).

Evidence Synthesis

The early literature indicated limited evidence for the effect of multifactorial interventions and lacked precision of the effect estimate for fall risk.⁴³ With additional studies in 2010, the United States Preventive Services Task Force (USPSTF)³³ reported a 25% reduction in fall risk, and concluded that there was evidence that multifactorial interventions reduced falls among those at high risk. The USPSTF recommendations were updated in 2018⁵⁰ and 2024,⁵¹ and affirmed that multifactorial interventions should be selectively offered to older adults based on clinicians’ findings and patients’ values and preferences. Additional SRs built evidence for an approximately 25% reduction of fall rate, and, in some cases, for fall risk.^{34,38} Larger reductions in fall rate (35-36%) were demonstrated for interventions that included exercise, or environmental

Table 4. Estimate of Risk and Rate Reduction for Multifactorial Studies of Fall Prevention Interventions

Study	Rate ratio (95% CI)	Risk ratio (95% CI)
Campbell 2007 ⁴¹	0.78 (0.68-0.89)	NR
Caristia 2021 ⁴⁸	0.63 (0.41-0.98)	0.77 (0.65-0.90)
^a Cheng 2018 ⁴⁶	NR	OR: 0.64 (0.53-0.77)
Choi 2012 ⁴⁵	NR	0.86 (0.74-0.99)
Costello 2008 ⁴²	NR	NR
Dautzenberg ³⁹	0.87 (0.80-0.95)	0.95 (0.89-1.01)
^a Gates 2008 ³⁸	NR	0.91 (0.82-1.02)
	Higher fall risk: 0.77 (0.66-0.90)	Higher fall risk: 0.94 (0.85-1.03)
	Lower fall risk: 0.57 (0.23-1.38)	Lower fall risk: 0.92 (0.76-1.11)
	Active exercise included: 0.74 (0.61-0.89)	Active exercise included: 0.87 (0.76-0.98)
	Referral or information only: 0.82 (0.71-0.95)	Referral or information only: 1.02 (0.93-1.12)
^a Gillespie 2012 ³⁴	0.76 (0.67-0.86)	NR
^a Giurgis-Blake 2018 ³⁵	0.79 (0.68-0.91)	0.95 (0.89-1.01)
Petridou 2009 ⁴⁴	NR	0.90 (0.82-1.00)
^a Michael 2010 ³³	NR	0.75 (0.58-0.99)
Hopewell 2020 ³⁷	0.79 (0.70-0.88)	0.95 (0.90-1.00)
^a Lee 2020 ³⁸	0.68 (0.58-0.81)	OR: 0.83 (0.72-0.95)
	Higher risk: 0.66 (0.52-0.84)	Higher risk: 0.84 (0.69-1.01)
	“Healthy”: 0.72 (0.58-0.89)	“Healthy”: 0.77 (0.62-0.95)
	Exercise included: 0.66 (0.54-0.80)	Exercise included: 0.79 (0.66-0.95)
	EAM included: 0.65 (0.54-0.79)	EAM included: 0.80 (0.68-0.95)
	Active components only: 0.64 (0.51-0.80)	Active components only: 0.73 (0.60-0.89)

Abbreviations: EAM, environmental assessment and modification, NR, not reported; OR, odds ratio.
^aHigh-quality SR/meta-analysis.

modifications,³⁸ or included a more active component (26-36%), as compared to components consisting of education, referrals or information provision.^{38,43} Other SRs reported results that were consistent with Lee et al³⁸ including that there was substantial heterogeneity among studies.^{39,40,48} Loureiro et al,⁴⁹ in an acceptable quality SR, reported that only multifactorial interventions that included exercise with falls risk home assessment and exercise with health education showed a significant reduction in fall rate. Loureiro et al⁴⁹ also reported that when multifactorial interventions included exercise, utilization of group exercise resulted in reduction in fall rate, while individual exercise programs did not have a significant effect on fall rate.

High-risk versus low-risk participants

Subgroup analyses from Gates et al⁴³ revealed that multifactorial interventions are effective for reducing fall rate by 23% for people at higher risk of falls but no effect was found in studies that did not select for people at higher risk of falls. Meta-analysis from Caristia et al⁴⁸ showed that multifactorial interventions lasting less than 12 months were effective in reducing falls, while those lasting more than 12 months

were not. Cheng et al⁴⁶ conducted a network meta-analysis (NMA) of the comparative effectiveness of interventions and found multifactorial intervention compared to usual care had the greatest efficacy (36% reduced odds) relative to several other intervention comparisons including exercise, referral, and education. However, Cheng's definition of multifactorial intervention resulted in inclusion of multi-component exercise interventions that likely caused overestimation of the effect.

EXERCISE

Physical activity can be defined as any bodily movement produced by skeletal muscles that results in energy expenditure.⁵² Exercise is a type of physical activity featuring bodily movement that is planned, structured and repetitive and is performed with the intention of improving or maintaining physical fitness.⁵² In this CPG, we focus on exercise as opposed to physical activity, as defined above. In 2018, the USPSTF released a final statement recommending exercise to prevent falls in older adults based on adequate evidence,⁵⁰ and reissued the recommendation in 2024.⁵¹ This has been supported

by several other falls-related guidelines and guidance statements.^{11,53,54}

Many high-quality SRs categorize studies using the ProFaNE taxonomy.¹ The ProFaNE taxonomy considers the broad category of exercise by its method of delivery and includes strength/resistance training, flexibility, general physical activity, and endurance. ProFaNE also includes a gait, balance, and functional training category and a category called 3D training. 3D training includes Tai Chi, Qi Gong, and dance.¹ This CPG adopts these categories of exercise.

Systematic reviews included in this CPG calculate risk and rate ratios by combining studies that include single component exercise programs, multicomponent exercise programs, or a mix of multi-component and single component exercise. The evidence from these three categories of SRs is addressed separately. Recommendations and descriptions of the evidence for mixed exercise (single- and multi-component) and multicomponent exercise are provided first, followed by recommendations for each individual exercise mode.

Recommendation

Physical therapists must provide or prescribe multicomponent exercise to older adults to reduce risk and rate for falls and it must include balance training and may include other exercise modes. (Evidence Quality/Level: I, Rec. Strength: Strong)

Rationale

For older adults at lower risk for falls, physical therapists must ensure participation in a multicomponent exercise regimen that includes balance exercise to manage fall risk. For older adults with identified impairments in strength and balance, physical therapists must provide tailored, progressive exercise to address these deficits. This strong recommendation is based on Level 1 evidence from 14 high or moderate quality SRs of multicomponent exercise programs,^{13,14,28,34,44,45,55-57,59-63} 10 additional high or moderate quality SRs of mixed single and multi-component exercise programs,^{13,14,28,36,39,46,55-57,61} and 4 lower quality SRs that did not include meta-analysis.⁶⁴⁻⁶⁷ Details and estimates of rate and risk reduction can be found in Table 5 for mixed multicomponent and single component studies, and Table 6 for multicomponent studies.

Multicomponent exercise interventions provided by a health professional and by a trained instructor who is not a health professional are effective in reducing falls rate.²⁸ The GDG valued having a health professional trained in exercise prescription to monitor and progress multicomponent exercise programs. The GDG judged this to be particularly important in populations with movement dysfunction or health conditions that may impact the ability to exercise. Older adults with lower fall risk who are safe to exercise alone may benefit equally from a physical therapist delivering a tailored intervention and a group delivered intervention, while those who are at

Table 5. Estimates of Risk and Rate Reduction for Mixed Single- and Multi-component Exercise Programs

Study	Population	Rate ratio (95% CI)	Risk ratio (95% CI)	Comments
Cheng, 2018 ⁴⁶	Community-dwelling older adults	NR	0.67 (0.52-0.84)	Network MA
^a Dautzenberg, 2021 ³⁹	Community-dwelling older adults	0.90 (0.86-0.95)	0.92 (0.88-0.97)	Network MA, limited to studies that included falls as primary outcome
El Khoury, 2013 ⁵⁵	Community-dwelling older adults	0.63 (0.51-0.77)	NR	All injurious falls
Finnegan, 2019 ⁵⁶	Community-dwelling older adults	0.79 (0.71-0.88)	0.83 (0.76-0.92)	SRs included only studies with longer than 12 month follow-up
^a Guirguis-Blake, 2018 ³⁵	Community-dwelling older adults	0.87 (0.75-1.00)	0.89 (0.81-0.97)	
^a Hamed, 2018 ⁵⁷	Healthy older adults	0.68 (0.58-0.80)	0.78 (0.68-0.89)	SRs included only studies with longer than 6 month follow-up
Sherrington, 2011 ¹⁴	Not specified	0.84 (0.77-0.91)	NR	
Sherrington, 2017 ⁵⁴	Not specified	0.79 (0.73-0.85)	NR	
^a Sherrington, 2019 ²⁸	Not specified	0.77 (0.71-0.83)	0.85 (0.81-0.89)	
^a Sherrington, 2020 ¹⁵	Not specified	0.77 (0.73-0.83)	NR	No difference based on whether participants are >75 or <75, high risk vs not high risk, HP delivered vs not HP delivered, and group vs individual
Wong, 2020 ⁵⁸	Community-dwelling older adults	0.71 (0.62-0.82)	NR	Only included studies in which both falls and fractures were reported.

Abbreviation: NR, not reported.
^aHigh-quality SR/meta-analysis.

Table 6. Estimates of Risk and Rate Reduction for Multi-component Exercise Programs

Study	Population	Rate ratio (95% CI)	Risk ratio (95% CI)	Comments
Caristia, 2021 ⁴⁸	Apparently healthy older adults not diagnosed as frail	0.69 (0.52-0.89)	NR	SR included all RCTs in Cochrane reviews
Finnegan, 2019 ⁵⁶	Community-dwelling older adults	0.82 (0.74-0.91)	0.91 (0.85-0.96)	SRs included only studies with longer than 12 month follow-up
		GBFT, RT, Flex, 3D 0.65 (0.43-0.99) (3 studies)	Too few studies	
		GBFT, RT, Flex 0.76 (0.62-0.93) (3 studies)	GBFT, RT, Flex 0.87 (0.79-0.95) (3 studies)	
^a Garcia-Hermoso, 2020 ⁶⁸	Community-dwelling older adults with a few cohorts of institutionalized older adults	NR	0.89 (0.83-0.96)	SR only included studies of interventions lasting longer than 12 months
^a Gillespie, 2012 ³⁴	Community-dwelling older adults	Group	Group	
		0.71 (0.63-0.82)	0.85 (0.76-0.96)	
		Individual	Individual	
		0.68 (0.58-0.80)	0.78 (0.64-0.94)	
		Selected for high risk	Selected for high risk	
		0.70 (0.58-0.85)	0.87 (0.78-0.97)	
		Not selected for high risk	Not selected for high risk	
		0.72 (0.58-0.90)	0.85 (0.68-1.06)	
Hill, 2015 ⁶¹	Community-dwelling older adults including those recently d/c from hospital	NR	0.93 (0.72-1.21)	Home-based individualized exercise program
	Community-dwelling older adults excluding those recently d/c from hospital	NR	0.84 (0.72-0.99)	
^a Lee, 2020 ³⁸	Community-dwelling older adults	0.66 (0.54-0.80)	0.79 (0.66-0.95)	Multicomponent exercise as part of multifactorial intervention
Liu, 2017 ⁶⁰	Community-dwelling older adults at risk of reduced physical capacity	0.63 (0.49-0.80)	NR	
^a Papalia, 2020 ⁶²	Not specified	0.64 (0.49-0.83)	0.88 (0.79-0.98)	
Petridou, 2009 ⁴⁴	Community-dwelling older adults with high risk of falls	NR	0.45 (0.29-0.71)	
^a Sherrington, 2019 ²⁸	Community-dwelling older adults	0.66 (0.50-0.88)	0.78 (0.64-0.96)	
		Selected for high risk	Selected for high risk	
		0.77 (0.63-0.94)	0.84 (0.71-1.00)	
		Not selected for high risk	Not selected for high risk	
		0.54 (0.29-0.99)	0.71 (0.41-1.19)	
		Delivered by HP	Delivered by HP	
		0.65 (0.43-0.99)	0.81 (0.65-1.02)	
		Not delivered by HP	Not delivered by HP	
		0.66 (0.44-0.99)	0.70 (0.45-0.91)	
		Group program:	Group program	
		0.64 (0.46-0.89)	0.77 (0.60-1.00)	
		Too few studies	Individualized program	
			0.86 (0.72-1.03)	

(continues)

Table 6. Estimates of Risk and Rate Reduction for Multi-component Exercise Programs (Continued)

Study	Population	Rate ratio (95% CI)	Risk ratio (95% CI)	Comments
^a Sherrington, 2020 ¹⁵	Community-dwelling older adults	0.72 (0.56-0.93)	NR	Update of Sherrington 2019
Teng, 2020 ⁶³	Community-dwelling older adults with identified risk factors for falls	NR	0.86 (0.68-1.08)	Combined group + home-based
Thomas, 2010 ⁵⁹	Community-dwelling older adults	NR	0.86 (0.56-0.79)	OTAGO program
Abbreviations: Flex, flexibility exercises; GBFT, Gait, balance and functional training; NR, not reported; RT, resistance training; 3D, three dimensional exercises (ie, dance, Tai Chi). ^a High-quality SR/meta-analysis.				

higher risk may show significantly more benefit from exercise administered by a physical therapist. The literature does not permit a direct comparison based on level of risk or safety in exercising without assistance.

Multicomponent exercise programs were deemed safe, with a large majority of studies reporting no adverse events from participation.^{28,35} Overall, RCTs reported few adverse effects after a multicomponent intervention which included falls during exercise, pain during exercise, muscle soreness, muscle strain, low back pain, and abnormal heart rhythm. A recent SR with meta-analysis by Garcia-Hermoso⁶⁸ examined safety in RCTs that included long-term exercise interventions and reported no difference between exercise and control groups in the proportion that dropped out due to health issues or mortality.

Evidence Synthesis

Mixed single- and multi-component exercise evidence

Systematic reviews of mixed single- and multi-component exercise which estimate the reduction in both fall rate and risk include one high quality³⁹ and one acceptable quality network meta-analysis (NMA).⁴⁶ The high-quality study found an 8% reduction in fall risk and a 10% reduction in fall rate, while the acceptable quality study found a 33% reduction in fall risk. It is not clear if the discrepancy in fall risk is due to quality or that the high-quality study was limited to studies with falls as a primary outcome.

Systematic reviews with meta-analyses which estimate the reduction in fall rate and risk included four high quality^{14,28,35,55} and five acceptable quality^{13,54-56,58} studies. The nine meta-analyses^{13,14,28,35,54-58} showed a reduction in fall rate (13% to 32%), and fall risk (11% to 22%). Two of these meta-analyses had unique inclusion criteria and fall outcomes.^{55,58} El Khoury et al⁵⁵ included only injurious falls and found a 37% reduction in fall rate. Wong⁵⁸ only included studies with fall and fracture rates and found a 29% reduction in falls and a 46% reduction in fractures.

Multicomponent exercise evidence

Multicomponent exercise to reduce fall rate and fall risk is supported by 14 meta-analyses.^{13,14,28,34,38,44,48,54,56,59-63}

Multicomponent exercise resulted in a reduction in fall rate (21-28%) and risk (22-27%).^{14,28,34} Caristia et al⁴⁸ only included studies that enrolled participants who were not considered frail and found a higher (31%) reduction in fall rate. In another high-quality SR with meta-analysis, Lee et al³⁸ examined studies that included multicomponent exercise as part of a multifactorial program and found a 34% reduction in falls rate and 21% reduction in fall risk. Thus SRs with different methodologies and inclusion criteria show similar rate and risk reductions, supporting this strong recommendation.

Recent SRs by Papalia et al,⁶² Wong et al,⁵⁸ and Hamed et al⁵⁷ performed meta-analyses in which most of the studies were included in previous SRs. The results of the analyses were consistent with other SRs and most of the RCTs included multicomponent exercise but these analyses did not break down the types of exercise as we do in this CPG.^{58,62} Hamed et al⁵⁷ included only RCTs with longer follow-up periods, and found a slightly higher reduction in fall rate (32%) and risk (22%), suggesting that the positive benefit of exercise programs can be long-lasting.

Many SRs examining multicomponent programs include studies in which the Otago exercise program was the intervention. The Otago exercise program is a home-based exercise program that includes balance exercises, resistance training, and a walking program.⁵⁹ One moderate quality SR with meta-analysis⁵⁹ compared the Otago exercise program to no treatment control or social visits and found a 14% reduction in fall risk. One SR without meta-analysis examined the effectiveness of functional exercise like the Lifestyle Integrated Functional Exercise (LIFE) program and found 31% reduction in fall rates in two studies.⁶⁷

Group vs. individual

More studies of multicomponent exercise involved group rather than individual interventions.^{28,34} Individual interventions are delivered in one-on-one clinical settings, and individualized exercise is tailored to the specific problems identified by a physical therapy examination. Although reported inconsistently in the literature, group exercise is presumed to be not tailored to the individual, while

individual exercise may or may not be individualized or tailored to specific individuals. We found no direct comparisons between group and individual exercise in the same population, however several SRs included separate sub-analyses of group programs and individual programs.

Gillespie et al,³⁴ found no difference between group or individual delivery of multicomponent exercise for fall rate (29% vs 32% reduction) or risk (15% vs 22% reduction) as evidenced by overlapping confidence intervals. In a more recent high-quality SR, Sherrington et al¹⁴ found no difference between group and individual exercise programs for fall rate, with 26% risk reduction in group settings and 19% risk reduction in individual settings. In another moderate quality SR with meta-analysis investigating group plus home-based exercise programs in people with identified risk factors for falls, Teng et al⁶³ found no reduction in fall risk. Therefore, we are unable to make a recommendation about group vs individual exercise, thus the patient preference, availability and cost may guide the decision about the best delivery mode to reduce falls.

Delivery personnel

In two high-quality SRs, Sherrington compared multicomponent interventions that were delivered by health care professionals versus non-health care professionals, and found no difference in fall rate or fall risk between delivery by health care professionals and by non-health care professionals.^{14,28} One low-quality SR without meta-analysis⁶⁶ found that most physical therapist-led group exercise programs reduced fall rates, but not more than individualized physical therapy programs. These results should be interpreted with caution as it is unclear if the samples in these studies were similar enough to make a direct comparison or were generalizable to a wider population. For example, older adults who participate in a community-based program delivered by a non-health care professional might have less frailty or more ability to exercise independently than those who participate in programs delivered by a physical therapist or other health care professional.

High-risk vs low-risk older adults

The evidence on the effect of multicomponent exercise on older adults identified as being at a higher risk vs lower risk of falling does not allow for separate recommendations. Gillespie et al³⁴ found a similar reduction in fall rate in studies that selected for people at high risk of falls and in studies that did not (30% vs 28% rate reduction). Sherrington et al¹⁴ also reported no differences between studies that recruited older adults selected for high risk and those that did not (24% vs 22% rate reduction, respectively). In contrast, in one moderate-quality SR that examined home-based individualized exercise programs, there was no effect on fall risk when including studies of people who were recently discharged from the

hospital, but a 16% risk reduction when those studies were excluded.⁶¹ Because this moderate quality study is focused on home therapy alone, the GDG does not believe that this study provides enough evidence of a differential effect between people at higher and lower risk.

Two SRs with meta-analysis^{44,60} found large reductions in the fall rate and risk when including only studies that recruited individuals with health conditions that might impact falls. Liu et al,⁶⁰ in a moderate quality review that included only people with reduced physical capacity, found a 37% reduction in fall rate, and Petridou et al⁴⁴ found an even larger 55% reduction in the fall risk when examining studies that included only people with a history of falls. Thus, we are unable to make separate recommendations about high-risk individuals vs the general population and recommend that physical therapists use clinical judgment based on individual patient examination of the movement system, patient safety, and patient preferences.

Recommendation: Dosage, Intensity, and Components

Physical therapists must prescribe exercise programs to older adults to be performed at least 150 minutes to 3 hours per week, lasting from 6 to 12 months, and must include progressive and sufficiently challenging balance training. (Evidence Quality/Level: I, Strength: Strong)

Rationale

Multicomponent exercise programs that include more than 150 minutes of exercise weekly are most effective in reducing fall rates⁴⁸ and programs of 6 to 12 months duration are most effective in reducing fall rate and risk.⁶⁰ Evidence from one meta-analysis⁶¹ examining the most effective combination of exercises in studies with longer follow-up times indicated that the most effective combination reduced risk by 35%, and included all categories of exercise combined, including gait, balance, and functional training, resistance training, flexibility exercises, and 3D training such as Tai Chi or dance.

Evidence Synthesis

Duration, intensity, and components of mixed single- and multi-component exercise programs

In three separate SRs, Sherrington et al^{13,14,54} investigated the intensity, duration, and components of mixed single- and multi-component exercise interventions and found that the highest rate reductions were found with programs that included high intensity/high challenge balance training, did not include walking programs, had doses greater than 50 hours, and had frequencies greater than 3 hours per week. Differences in fall risk and rate reduction according to duration, intensity, or exercise components are summarized in Table 7. The most recent high-quality SR¹⁴ showed a 50% reduction in falls in programs that included more than 3 hours per week and balance and functional training.

Table 7. Components, Doses, or Intensity in Single and Multi-component Exercise Programs

Study	Component or quality	Rate ratio (95% CI)
Sherrington, 2011 ¹⁴	Includes mod-high challenge balance	0.78 (0.70-0.86)
	Includes high challenge balance	0.75 (0.66-0.85)
	Dose >50 hours	0.77 (0.68-0.87)
	Includes walking	0.90 (0.78-1.00)
	High risk population	0.90 (0.80-1.00)
	Includes balance, no walking, >50 hours	0.62 (0.54-0.73)
	Includes balance, walking, >50 hours	0.79 (0.70-0.89)
Sherrington, 2017 ⁵⁴	Includes mod-high intensity strength training	0.97 (0.82-1.15)
	Includes high intensity strength training	1.23 (0.96-1.57)
	Includes mod-high intensity balance training	0.85 (0.71-1.00)
	Includes high intensity balance training	0.85 (0.73-1.00)
	Includes >2 hours/week	0.98 (0.83-1.16)
	Includes >3 hours/week	0.77 (0.65-0.91)
	Includes >3 hours per week and high intensity balance training	0.61 (0.53-0.72)
	Includes walking	1.01 (0.86-1.20)
^a Sherrington, 2020 ¹⁵	Includes >3 hours/week	0.83 (0.60-1.15)
	Includes balance/functional training	0.76 (0.69-0.83)
	Includes >3 hours/week and balance functional training	0.50 (0.45-0.76)

Abbreviation: NR, not reported.
^aHigh-quality SR/meta-analysis.

Duration, intensity and components of multicomponent exercise programs

Evidence from a moderate quality SR with meta-analysis by Caristia et al⁴⁸ demonstrated that exercise programs at an intensity of more than 150 minutes weekly decreased falls by 47% in contrast to a 12% decrease in fall rate in studies that had intensities less than 150 minutes weekly. Another SR with meta-analysis⁵⁶ provides level I evidence of higher reductions in risk (36%) and rate (33%) in studies lasting between 6 and 12 months than studies less than 12 months or more than 12 months. Estimates of risk and rate ratios by intensity and duration of

intervention from SRs of multicomponent interventions are found in Table 8.

Long term outcomes

Estimates of risk and rate reductions in studies that include longer follow-up times can be found in Table 9. Two SRs, Finnegan et al⁵⁶ and Hamed et al,⁵⁷ were limited to studies that had follow-up times longer than 12 and 6 months, respectively. Finnegan et al⁵⁶ reported a 21% reduction in rate and a 17% reduction in risk, while Hamed et al⁵⁷ found a 32% reduction in rate and 22% reduction in risk. Finnegan et al⁵⁶ also investigated

Table 8. Intensity and Duration of Intervention in Multicomponent Exercise Interventions

Study	Rate ratio (95% CI)	Risk ratio (95% CI)	Comments
Caristia, 2021 ⁴⁸	>150 minutes weekly	NR	SR included all RCTs in Cochrane reviews
	0.53 (0.36-0.77)		
	<150 minutes weekly	NR	
	0.88 (0.62-1.25)		
Finnegan, 2019 ⁵⁶	>12 months	>12 months	SRs included only studies with longer than 12-month follow-up
	0.88 (0.82-0.94)	0.91 (0.85-0.98)	
	6-12 months	6-12 months	
	0.67 (0.56-0.80)	0.64 (0.48-0.85)	
	<12 months	<12 months	
	0.79 (0.72-0.87)	0.89 (0.77-1.03)	

Abbreviation: NR, not reported.

Table 9. Risk and Rate Reduction for Studies that Include Longer Follow-up Times

Study	Rate ratio (95% CI)	Risk ratio (95% CI)	Comments
Finnegan, 2019 ⁵⁶	>24 months	>24 months	SR included all RCTs in Cochrane reviews
	0.80 (0.60-1.06)	0.79 (0.61-1.03)	
	12-24 months	12-24 months	
	0.79 (0.70-0.88)	0.83 (0.75-0.93)	

studies that had follow-up times greater than 24 months and found a 20% reduction in fall rate and 21% reduction in fall risk. These higher rates in studies with longer follow-up times suggest that the positive impact of exercise programs may extend for many months after completion of the interventions.

BALANCE TRAINING

Balance training is included in the Gait, Balance, Functional Training delivery mode of exercise in the ProFaNE taxonomy.¹ Systematic reviews categorized balance training using different terminology: by the ProFaNE category, by balance training generally, or by several explicit methods such as volitional or reactive step training, or gait adaptability training. While the ProFaNE definition of balance is compatible with those used in physical therapy, this CPG considers a conceptual framework that includes steady state (controlling the location of the body's center of mass within the area defined by the base of support under predictable, quasi-static conditions),³⁰ anticipatory (generating postural adjustments prior to or during voluntary movement to counter an upcoming postural disturbance or realigning the body's center of mass),³⁰ and reactive (responding to sensory input that signals a need for a response to ensure successful maintenance of postural control.)³⁰ postural control strategies as a foundation to examine balance dysfunction and to target balance exercises accordingly.³⁰ Therefore, balance training, such as volitional and reactive step training, when individualized to the patient, will specifically target impaired postural control processes.

Recommendation

Physical therapists must provide or prescribe balance training to older adults that is progressive and sufficiently challenging as evidenced by movement of the limbs and whole body in multiple directions, changing the base of support, and reducing upper limb support either alone or as part of a multicomponent program to reduce the risk and rate of falls (Evidence quality/level: I, Recommendation strength: strong).

Balance training must include volitional step training and/or gait adaptability training (Evidence quality/level: I, Recommendation strength: Strong).

Balance training may also include reactive step (perturbation) training (Evidence quality/level II, Recommendation strength: Weak).

Rationale

The recommendation is based on six high-quality SRs with meta-analyses^{14,28,34,69-71} and three acceptable quality SRs.^{56,72,73} The strength of this recommendation is based on the preponderance of benefit via consistent reductions in fall rate and risk across multiple high-quality SRs with balance as an element of a multicomponent exercise program, and moderate to large benefit when provided alone.

Evidence for the benefit of balance training to reduce fall rates and risk is supported by many SRs and guidance statements. Gillespie et al³⁴ demonstrated a 28% reduction in fall rate and 19% reduction in fall risk. Similar rate and risk reductions have been confirmed for balance training by Sherrington et al²⁹ with 24% and 13% reductions, respectively. Estimates of risk and rate reduction from gait, balance and functional training programs can be found in Table 10. Earlier expert recommendations advocated for a progressive and challenging nature to balance training.¹⁴ This means that task and environmental manipulations must be employed throughout the training program. For example, upper limb support should be reduced over time. The base of support should be reduced to provide challenges to balance when standing or walking. Finally, limb and body movements should occur under voluntary and reactive conditions.

Recent studies have provided additional clarity on the nature and form of training required to produce benefit.⁶⁹⁻⁷¹ The progressive and challenging nature of balance training remains critical for fall rate and risk reductions. For example, movements requiring changes to the base of support should include voluntary stepping that is self-directed or verbally or visually cued and executed in multiple directions (eg, forward, backward, laterally). Most studies examining volitional step training provide stepping targets under varied cognitive conditions, square-stepping, and/or exergaming step training. Movements that require changes to the base of support can also be reactive in nature. Reactive step training refers to individualized interventions which include external perturbations while standing still or walking overground, on a treadmill, or in a virtual environment, and usually occurring in a clinical environment. Some studies examining reactive step training provide perturbations through complex technology which adds cost and staff training time. Both volitional and reactive step training produce reductions in fall risk and rate.^{69,70}

The risk of either form of step training includes patient falls during the training session. This can be avoided by using a full body harness system and/or individualized guarding or supervision. When precautions are taken, there is a preponderance of benefit with these approaches. However, given mixed findings due to generally lower

Table 10. Estimates of Risk and Rate Reduction for Programs that Include, Gait, Balance, and Functional Training

Study	Rate ratio (95% CI)	Risk ratio (95% CI)	Comments
Dennett, 2015 ⁷²	NR	0.19 (–0.45–0.83) (note that this is a SMD, not a risk ratio)	Clinical technology for balance training vs traditional balance training.
Finnegan, 2019 ⁵⁶	0.45 (0.28–0.74)	0.66 (0.33–1.12)	Long term follow-up
^a Gillespie, 2012 ³⁴	0.72 (0.55–0.94)	0.81 (0.62–1.07)	Group exercise only
Mansfield, 2015 ⁷³	0.54 (0.34–0.85)	0.71 (0.52–0.96)	Perturbation training, some studies with people with Parkinson's disease
^a Norgaard, 2021 ⁷¹	0.58 (0.43–0.79)	0.57 (0.40–0.80)	Gait adaptability (volitional) training
^a Okubo, 2017 ⁶⁹	0.48 (0.36–0.65)	0.51 (0.38–0.68)	Step training
	0.43 (0.27–0.68)	0.48 (0.36–0.65)	Volitional step training
	0.42 (0.28–0.64)	0.60 (0.40–0.90)	Reactive step (perturbation) training
^a Papadimitriou, 2017 ⁷⁰	NR	0.89 (0.70–1.12)	Perturbation training
^a Sherrington, 2019 ²⁸	0.76 (0.70–0.81)	0.87 (0.82–0.91)	Gait, balance and functional training
	Not selected for high risk	Not selected for high risk	
	0.80 (0.72–0.90)	0.88 (0.80–0.97)	
	Selected for high risk	Selected for high risk	
	0.72 (0.65–0.80)	0.86 (0.81–0.91)	
	HP delivered	HP delivered	
	0.67 (0.58–0.76)	0.82 (0.75–0.90)	
	Non-HP delivered	Non-HP delivered	
	0.82 (0.76–0.88)	0.89 (0.84–0.94)	
	Group	Group	
	0.73 (0.65–0.82)	0.87 (0.80–0.95)	
	Individual	Individual	
	0.77 (0.70–0.85)	0.87 (0.82–0.92)	
^a Sherrington, 2020 ¹⁵	0.76 (0.70–0.82)	NR	Update of Sherrington, 2019

Abbreviation: NR, not reported.
^aHigh-quality SR/meta-analysis.

quality of evidence for perturbation training, and the uncertainty of type of perturbation (belt, walkway, treadmill) on community falls compared to laboratory

falls,^{71,74} further research is warranted to examine perturbation training within the clinical setting using relatively less-expensive equipment to determine if the form of perturbation training has a differential effect on fall risk and rate. Furthermore, it is uncertain currently who benefits the most and if reactive step training employing external perturbations is superior to multicomponent exercise or volitional step training.

Similar to step training, gait adaptability training provides opportunities for employing proactive and reactive postural control strategies during ambulation. Norgaard et al⁷¹ defined gait adaptability training as making quick and appropriate modifications to walking in response to environmental challenges such as avoiding or accommodating obstacles or stepping to specific targets. This can be done during overground walking or in a virtual environment. Similar risks exist during gait adaptability training compared to step training in standing. The benefits of gait adaptability training include reductions in fall risk and rate. It is unclear currently if gait adaptability training alone is superior to multicomponent exercise.

Step and gait adaptability training should be individualized, challenging, and progressive. To be individualized, the physical therapist should address the impact of the underlying determinants of postural control. For example, if fear is a factor, then progression should be incremental using improved balance confidence as a guide to increase challenges to balance. If use of sensory information is a factor, then conducting step training under varied and altered sensory conditions is warranted. Challenges to balance during step training occur through modifying the task or environmental configuration and context. Commonly manipulated task and environmental conditions during step training include sensory conditions such as reducing or eliminating vision, support surface compliance, and the use of concurrent cognitive and/or focal motor tasks. Direction of perturbation (anterior/posterior, lateral) should be considered along with task context (standing, walking) and individualized to the patient's needs.

Given the ecological validity and potential carryover to real world settings, the GDG placed high value on incorporating gait adaptability training as part of a multicomponent exercise program. We also placed value on step training (volitional and reactive) as it requires a change in the patient's base of support through engaging proactive (volitional) or reactive (through external perturbation) postural control mechanisms.

Evidence Synthesis

Norgaard et al⁷¹ evaluated 11 studies in an SR with meta-analysis and found gait adaptability training resulted in a 42% reduction in fall rate with moderate certainty. They also found the proportion of fall-related fractures and fall risk was reduced by 81% and 43%, respectively, however, with low or very low certainty because the analysis was based on only two studies and a small

number of fall events. The type of gait adaptability training interventions included stepping during virtual reality exercise games, treadmill walking with virtual reality, volitional, multi-targeted, and square stepping training, obstacle course navigation, and multitask and interactive cognitive-motor stepping games. Therefore, as defined, gait adaptability training shares many features of volitional step training with the added application of navigating open, challenging environments.

Dennett and Taylor⁷² compared exergaming interventions to traditional interventions in an SR with meta-analysis. Only one analysis on fall risk using three studies comparing exergaming with a balance focus against traditional balance training applied to this CPG. Results were determined to be non-significant, and two of the studies were very low quality.

Okubo et al conducted a meta-analysis⁶⁹ with low risk of bias including seven studies of volitional and reactive step training in older persons not selected for the level of fall risk. Overall, step training reduced the rate of falls by 52% and the risk for falls by 49%. Three studies were used to examine the effects of volitional step training on risk and rate of falls. Volitional step training reduced the risk of falls by 58% and the rate of falls by 57%. Four studies were used to examine the effects of reactive step training on fall risk and rate. Reactive step training reduced fall risk by 40% and fall rate by 48%.

Papadimitriou et al⁷⁰ conducted a meta-analysis of studies examining the effects of perturbation training in community-dwelling older persons at increased risk for falling. When perturbation training was added to standard physical therapy and compared to a multimodal exercise program including strengthening, flexibility, and dynamic balance exercises (one study, 64 older adults), the intervention had an uncertain effect on fall risk. When perturbation training as a stand-alone intervention was compared to a single slip perturbation, volitional step training, no training, or flexibility and relaxation exercises, perturbation training showed an uncertain effect on fall risk. Studies in this meta-analysis were determined to be low-quality and exhibiting a high risk of bias.⁷⁰

Mansfield et al⁷³ conducted an SR with meta-analysis of eight studies that included some form of perturbation training with results favoring the intervention. However, three studies included people with Parkinson's disease. Therefore, we were unable to use the meta-analysis results in this CPG. Of note, Papadimitriou et al⁷⁰ reactive step training analysis included 3 of the 4 studies included in Mansfield.⁷³

Some SRs did not provide details on the nature and form of balance training, as compared to SRs that were explicitly descriptive or were described as step training or gait adaptability training. For example, Sherrington 2019²⁸ and 2020¹⁴ categorized balance training within the ProFaNE definition of gait, balance, and functional training.¹ When the broad category of balance and functional exercise was considered, Sherrington et al^{14,28}

found fall risk was reduced by 13% and fall rate was reduced by 24%.

Group vs individual

In one high-quality SR, Sherrington et al²⁸ analyzed balance and functional training delivered in group and individual settings. Results were nearly identical for either delivery method, with 27% falls rate reduction with group exercise compared to 23% falls rate reduction with individual exercise. Both group and individual exercise showed a 13% reduction in fall risk. The GDG found no direct comparison between group and individual exercise in the literature.

Delivery personnel

In one high-quality SR, Sherrington²⁸ analyzed balance and functional training delivered by health care professionals and non-health care professionals. There was a slightly greater effect on fall risk and rate when balance training was delivered by health care professionals (18% vs 11% fall risk reduction and 33 vs 18% fall rate reduction).

High-risk vs low-risk subjects

The evidence about the effect of general balance and functional training on older adults identified as being at a higher risk of falling is inconclusive with a similar reduction in fall risk (12% reduction when not selected for higher risk vs 14% fall risk reduction when selected for higher risk) and a slightly higher fall rate reduction when selected for higher risk (28 vs 20%).²⁸

RESISTANCE TRAINING

This section includes studies that provided resistance exercise as a sole intervention for fall risk reduction. Resistance exercise includes all components of muscle power and strength training, contracting the muscles against resistance to overload the body sufficiently to bring about a training effect. This may include increasing external force by changing a position (ie, gravity-based functional resistance exercises) or using an external resistance.¹ The evidence to support resistance exercise comes from SRs and meta-analyses that report the effect on fall risk and/or fall rate.

Recommendation

Physical therapists should NOT provide or prescribe resistance training ALONE to older adults if the purpose is to reduce the risk and/or rate of falls. (Evidence quality/level: II, Recommendation strength: Moderate)

Rationale

For all older adults, regardless of fall risk factors, there is insufficient evidence to support lower extremity resistance training as the sole mode of exercise intervention to reduce fall risk. Because there is strong evidence for the

Table 11. Estimates of Risk and Rate Ratios for Programs that Include Resistance Training

Study	Rate ratio (95% CI)	Risk ratio (95% CI)	Comments
Caristia, 2021 ⁴⁸	0.60 (0.37-0.99)	NR	Community dwelling without comorbidity or frailty
Claudino, 2021 ⁷⁶	NR	1.00 (0.77-1.3)	Included both community-dwelling and institutionalized and with and without comorbidity and frailty
^a Manas, 2021 ⁷⁵	0.99 (0.68-1.45)	0.83 (0.48-1.44)	Unsupervised home-based Resistance training
^a Sherrington, 2019 ²⁸	1.14 (0.67-1.97)	0.81 (0.57-1.15)	
^a Sherrington, 2020 ¹⁵	1.14 (0.67-1.97)	NR	Update of Sherrington, 2019
Abbreviation: NR, not reported. ^a High-quality SR/meta-analysis.			

effectiveness of balance training to reduce fall risk, providing resistance training ALONE is not sufficient. For people with identified impairments, it is the standard of practice to provide tailored, progressive resistance exercises to address these deficits within a multicomponent plan.

Resistance exercise ALONE was not recommended due to the uncertainty of its effect on fall rate and risk. The studies that we reviewed had several limitations such as small sample sizes, no study stratified by their sample by risk of falls, and moderate-to-high risk of bias was present. The overwhelming majority of studies reported minimal adverse events from resistance training performed as part of a multicomponent exercise program, such as falls during exercise, pain during exercise, muscle soreness, muscle strain, low back pain, and abnormal heart rhythm.

Evidence Synthesis

Overall, the rate ratios are of low clinically meaningful value with insignificant confidence intervals. Estimates of risk and rate ratios are found in Table 11. Meta-analysis of acceptable or higher quality that found resistance training alone reported >1.0 fall rate ratio in two studies,^{14,28} no change in rate ratio in a study,⁷⁵ and reduced rate ratio in one study.⁴⁸ Fall risk ratio had similar findings with three of three studies reporting a ratio between 0.81 and 1.00 with insignificant confidence intervals.^{28,75,76} In one SR without meta-analysis,⁷⁷ resistance training was viewed favorably concerning fall risk reduction when applied conventionally or as part of ADLs and when compared to usual care or relaxation training.

Resistance training protocols employed differing doses and formats. Individual studies from the meta-analyses were further explored to identify specific characteristics for frequency, intensity, time, and types. Resistance exercise was often group-based, performed for 50-minute sessions, two-to-three times per week for 25 to 52 weeks.⁷⁸⁻⁸⁰ None of the studies demonstrated a decrease in fall rate or risk. The lack of change supports the recommendation that resistance training should not be performed in isolation, but as a component of a patient management plan as recommended in the multicomponent recommendation section.

The safety of resistance training was further demonstrated in a recent meta-analysis of RCTs of long-term exercise interventions that found no difference between exercise and control groups in dropout due to health issues or mortality.⁶⁸

Limitations in study design and reporting limit the ability to fully elucidate the importance of resistance training for falls. No studies were stratified by risk of falls, bias risk was consistently moderate-to-high, studies were limited by relatively small sample sizes, and resistance exercise was not commonly separated from multicomponent exercise protocols. Multicomponent protocols found no effect on fall rate when either moderate or high-intensity resistance training was included.⁵⁴ Multimodal exercise that included resistance training was analyzed in a recent meta-analysis of RCT and found no effect on fall rate or fall risk.⁷⁶

The multicomponent or multimodal design of RCTs and subsequent meta-analyses limits the ability to distinguish the impact of resistance training alone. A systematic investigation with meta-analysis of the effectiveness of resistance training as a single modality or part of a multimodal program in reducing fall rate or fall risk would support recommendations in this area. Furthermore, the effectiveness of unsupervised home-based resistance training programs in reducing falls has not been confirmed by existing SRs.⁷⁵

TAI CHI

In this CPG, Tai Chi refers to any form of Chinese martial art consisting of a series of slow, low-impact, bodily movements. One form, Yang-style, includes 24 different forms that incorporate multidirectional weight shifting, awareness of body alignment, and multisegmental movement coordination. Tai Chi is often included as a 3D exercise in the ProFaNE taxonomy.¹ The evidence comes from SRs and meta-analyses that report the effect of Tai Chi on fall risk and fall rate.

Recommendation

Physical therapists should prescribe Tai Chi for older adults to reduce the risk and rate of falls. (Evidence Quality/Level: I, Rec. Strength: Strong)

Rationale

Six high-quality^{14,28,34,81-83} and two acceptable quality^{48,84} SRs with meta-analysis demonstrated that Tai Chi reduces fall rate and fall risk for older adults at risk of falling. No serious adverse events were reported in any SR, therefore, there is a preponderance of beneficial effects compared to negative outcomes, risks or harms.

Tai Chi is most often delivered in a group setting and by trained instructors such as a Tai Chi practitioner. Physical therapists can provide Tai Chi if they are trained instructors.

We placed a high value on the group exercise nature of Tai Chi. Most included studies used a version of Yang-style Tai Chi. One SR determined Yang style may have a greater effect on fall risk and rate than Sun style.⁸¹ However, the analysis for Sun style was based on only three studies and this analysis may be influenced by publication bias. Therefore, we did not provide a recommendation on the style of Tai Chi to be used.

While there are benefits for older adults participating in community-based Tai Chi intervention programs, availability, and cost of programming along with patient preference related to the type of exercise should be considered. Older persons may inquire about and physical therapists should inform older adults of intervention options if there are Tai Chi programs in their geographic vicinity.

The GDG placed value on Tai Chi as an effective intervention for reducing fall rate and fall risk in older adults, in particular, the GDG valued Tai Chi as an intervention for those at lower risk of falling. Due to evidence variability, the GDG intentionally refrained from prescribing specific dosing and Tai Chi style recommendations. Patient preferences were recognized as crucial, considering factors such as program availability and cost.

Evidence Synthesis

Tai Chi resulted in a 29% to 48% reduction in fall rate and a 20% to 43% reduction in fall risk. Risk and rate ratios varied according to the type of Tai Chi, fall risk status of the participants, time of follow-up, and type of control group. Estimates of fall risk and rate reduction for studies that included Tai Chi or dance are found in Table 12.

Higher vs lower risk of falls

There is an abundance of evidence that the magnitude of effect is greater for persons designated as lower risk of falling, nevertheless, persons at higher risk may benefit from Tai Chi. The definitions of higher and lower risk of falling varied among SRs and no standard definition could be ascertained from the evidence.

Tai Chi is an effective intervention strategy for reducing rates of falls and fall risk in older persons living in the community who are high functioning or have a lower fall risk. In studies in which participants were not stratified or

selected according to risk level, fall rate reductions ranged from 19% to 49%. Similarly, fall risk reductions ranged from 20% to 42%. Specifically, Sherrington et al¹⁴ demonstrated a 19% rate reduction and Gillespie et al³⁴ reported a 41% rate reduction while Logghe et al⁸⁴ reported a 49% average reduction in fall rate.

The overall reduction in falls from Tai Chi is less in those who were considered at high risk for falling. Huang et al⁸¹ found a 10% reduction in fall risk and 17% fall rate reduction when individuals were selected for higher risk. This is compared to a 38% and 22% reduction in fall risk and rate, respectively, for persons at lower fall risk. Lomas-Vega et al⁸² included higher-risk older adults and included all studies from a previous meta-analysis of Tai Chi³⁴ and demonstrated a 43% reduction in falls over the short time (less than 12 months) and a 13% reduction in fall rate over the long-term (greater than or equal to 12 months).⁸² The included RCTs did not report any serious adverse events with Tai Chi practice. No effect of Tai Chi on time to first fall was found. For persons at higher risk of falling, the magnitude of the effect is greater when also participating in multicomponent exercise than for Tai Chi alone (refer to multicomponent exercise in Table 6). Therefore, we recommend that multicomponent exercise be the first choice of treatment over Tai Chi alone when persons are at high risk of falling.

Finally, the combined insights from multiple SRs without meta-analysis investigating Tai Chi's effectiveness in fall prevention among older adults reveal a nuanced landscape. Reviews by Low et al⁸⁵ and Liu et al⁸⁶ showed mixed results, with some studies and analyses showing a reduction in fall risk and rate, while others failing to demonstrate risk reduction. For example, one intervention trial showed risk reduction in the whole group and the pre-frail older adults, but an increased risk in those who were classified as frail.⁸⁷ The SR by Liu et al,⁸⁶ also showed fall rates decreasing in some but not all studies reviewed, and that fear of falling was more consistently reduced than falls rate.⁸⁶ Gregory and Watson⁸⁸ and Leung et al⁸⁹ highlighted Tai Chi's positive impact on healthy older individuals but not frail older participants. Harling et al⁹⁰ indicated limited evidence for fall reduction, especially in non-high-risk groups. Overall, this evidence is influenced by factors like study quality and participant characteristics.

Duration and intensity of Tai Chi

Evidence on the effects of duration and intensity for Tai Chi is emerging. Estimates of rate and risk reduction according to intensity and duration of Tai Chi interventions is summarized in Table 13. Interventions ranged from 1 to 3 or more times per week, typically performed for 60 minutes for 5 to 12 months. Huang et al⁸¹ analyzed the impact of dosage and frequency on fall risk and rate, reporting that 30 to 60 total hours of Tai Chi produced the greatest

Table 12. Estimates of Rate and Risk Reduction in Studies that Included 3D exercise-Tai Chi and Dance

Study	Rate ratio (95% CI)	Risk ratio (95% CI)	Comments
Caristia, 2021 ⁴⁸	0.51 (0.32-0.80)	NR	3D exercise (includes Tai Chi)
^a Gillespie, 2012 ³⁴	0.72 (0.52-1.00)	0.71 (0.57-0.87)	Tai Chi
	Selected for high risk of falls	Selected for high risk of falls	
	0.95 (0.62-1.46)	0.85 (0.71-1.01)	
	Not selected for high risk of falls	Not selected for high risk of falls	
	0.59 (0.45-0.76)	0.58 (0.46-0.74)	
^a Huang 2017 ⁸¹	0.69 (0.60-0.80)	0.80 (0.72-0.88)	
	Yang type	Yang type	
	0.54 (0.42-0.70)	0.61 (0.46-0.80)	
	Sun type	Sun type	
	0.91 (0.75-1.11)	0.88 (0.80-0.98)	
	High risk	High risk	Unclear how low and high risk was defined
	0.90 (0.75-1.07)	0.83 (0.70-0.98)	
	Low risk	Low risk	
	0.62 (0.50-0.76)	0.78 (0.68-0.88)	
Logghe, 2010 ⁸⁴	Exercise control	Exercise control	Larger effect in community as compared to congregate living facilities, and larger effects with higher doses
	0.51 (0.38-0.68)	NR	
	Non-exercise control	Non-exercise control	
	0.79 (0.60-1.03)	NR	
^a Lomas-Vega, 2017 ⁸²	Short-term follow-up (<12 months)	Short-term follow-up (<12 months)	Tai Chi
	NR	0.57 (0.48-0.70)	
	Long-term follow-up (≥12 months)	Long-term follow-up (≥12 months)	
	NR	0.87 (0.77-0.99)	
^a Mattle, 2020 ⁸⁴	0.69 (0.53-0.89)	0.63 (0.49-0.80)	Tai Chi (six studies) and Dance (2 studies) together Participants were community-dwelling, no comorbidity, high risk of falls
^a Sherrington, 2019 ²⁵	0.81 (0.67-0.99)	0.80 (0.70-0.91)	
^a Sherrington, 2020 ¹⁰	0.81 (0.67-0.99)	NR	
Abbreviation: NR, not reported.			
^a High-quality SR/meta-analysis.			

benefit with a 42% reduction in fall rate and 19% reduction in fall risk. This was greater than the reductions observed for less than 30 hours of Tai Chi (rate reduction 16%; risk reduction 15%) and comparable to >60 hours of Tai Chi (rate and risk reductions of 36% and 20% respectively >60 hours). Tai Chi provided three times per week or greater produced larger fall rate and risk reductions than Tai Chi provided one or two times per week.

EDUCATION

Education refers to providing tailored information about an individual's fall risk and specific actions or activities to decrease risk.

Recommendations

Physical therapists should NOT provide education ALONE to older adults to reduce the risk and/or rate of falls. (Evidence Quality/Level: I, Rec. Strength: Strong)

Physical Therapists should provide tailored education combined with individualized exercise intervention to older adults. The tailored education should include specific actions to address identified risk factors, including home hazards and strength and balance impairments, and should also include referral to appropriate providers for risk factors outside of PT scope of practice. (Evidence Quality/Level: V, Rec. Strength: Expert Opinion)

Table 13. Estimates of Rate and Risk Reduction Related to Intensity and Duration of Tai Chi Interventions

		Rate ratio (95% CI)	Risk ratio (95% CI)
^a Huang, 2017 ⁸¹	Dose	Dose <30 hours	Dose <30 hours
		0.84 (0.64-1.07)	0.85 (0.73-0.99)
		Dose 30-60 hours	Dose 30-60 hours
		0.58 (0.35-0.94)	0.81 (0.65-1.00)
		Dose >60 hours	Dose >60 hours
		0.64 (0.49-0.84)	0.80 (0.67-0.94)
	Frequency	1 time/week	1 time/week
		0.95 (0.84-1.07)	0.84 (0.63-1.13)
		2 times/week	2 times/week
		0.83 (0.76-0.92)	0.73 (0.57-0.95)
		3 times/week	3 times/week
		0.62 (0.71-0.95)	0.48 (0.36-0.64)
		>3 times/week	>3 times/week
		0.36 (0.13-0.98)	0.38 (0.18-0.65)
Abbreviation: NR, not reported.			
^a High-quality SR/meta-analysis.			

Rationale

Evidence from one high-quality SR³⁴ and one NMA⁴⁶ indicates that education alone does not reduce the fall rate or risk. Benefits of tailored education in addition to exercise intervention may include increased knowledge and adherence to exercise and fall risk reduction management plans. Educational materials should consider the learning style and literacy of the patient or client. Although individualized patient education is presumed to be the standard of care for all older adults, it must not be used as the sole intervention.

Evidence Synthesis

Estimates of risk and rate reduction in studies including educational intervention are summarized in Table 14.

Table 14. Estimates of Risk and Rate Reduction in Studies Including Educational Intervention

Study	Rate ratio (95% CI)	Risk ratio (95% CI)	Comments
Cheng 2018 ⁴⁶	NR	Education: 0.81 (0.61-1.03)	NMA – reported as odds ratio
^a Dautzenberg 2021 ³⁹	1.01 (0.95-1.08)	0.94 (0.89-1.01)	NMA
	NR	People over 75:	
		0.96 (0.78-1.17)	
	NR	People with multimorbidity:	
		0.80 (0.39-1.63)	
^a Gillespie 2012 ³⁴	Too few studies	0.88 (0.75-1.03)	
Abbreviations: NMA, network meta-analysis; NR, not reported. ^a High-quality SR/meta-analysis.			

A high-quality SR with meta-analysis³⁴ and a moderate quality NMA⁴⁶ of fall prevention interventions in older people living in the community found no significant fall risk or rate reduction for education when provided as the sole intervention. However, in multiple SRs of multifactorial interventions, education was included as a part of effective interventions.^{37-40,48,49,91}

One NMA⁴⁶ analyzed fall rate and risk for quality improvement interventions which included both patient education and provider level interventions and also found no rate or risk reduction in trials that included these types of interventions.

ENVIRONMENTAL ASSESSMENT AND MODIFICATIONS**Recommendation**

Physical therapists should provide environmental assessment and recommend modifications to older adults at high risk of falls. (Evidence quality/level: I, Rec. strength: Strong)

Rationale

This strong recommendation is based on Level I evidence from two NMAs^{39,46} and three SRs with meta-analysis.^{34,38,92} Risk reductions (number of fallers) range from 12% to 24%, and one meta-analysis³⁴ also reported a 19% reduction in the rate of falls. The falls risk and rate reduction is greater in populations selected to be at high risk for falls,^{34,88} and are not effective in those populations who are not selected for high risk of falls.^{34,88} Inclusion of environmental assessment and modifications in multifactorial programs results in a larger reduction in the number of falls and fallers as compared to multifactorial programs that do not include environmental assessment.

Evidence Synthesis

Estimates of risk and rate reduction in studies that included environmental assessment and modification are summarized in Table 15. One high-quality SR³⁴ examining the effect of an environmental modification intervention versus a control found a significant 19% reduction in fall rate and 12% reduction in fall risk. Two acceptable quality NMAs also informed this recommendation. Cheng et al⁴⁶ found a 27% reduction in fall risk, in contrast to the findings of Dautzenberg et al³⁹ who found no risk reduction with environmental modifications.

High risk vs low risk subjects

The risk and rate reduction were greater in studies selecting for higher risk of falling, as defined by history of falls or other specific risk factors for falling. In a moderate quality SR, Clemson found a 21% reduction in fall risk, and that was increased to 39% reduction when only considering studies that selected for higher risk of

Table 15. Estimates of Risk and Rate Reduction in Studies that Included Environmental Assessment and Modification (EAM)

Study	Rate ratio (95% CI)	Risk ratio (95% CI)	Comments	
Cheng, 2018 ⁴⁶	NR	0.73 (0.57-0.94)	NMA	
Clemson, 2008 ⁹²	NR	All studies: 0.79 (0.65-0.97)		
		Selected for high risk: 0.61 (0.47- 0.79)		
^a Dautzenberg, 2021 ³⁹	0.94 (95% CI: 0.85-1.03)	1.01 (0.92-1.11)	NMA	
	NR	>75 years: 0.85 (0.72-1.00)		
	NR	People with multimorbidity:		
		0.76 (0.32-1.85)		
^a Gillespie, 2012 ³⁴	0.81 (95% CI: 0.68-0.97)	0.88 (0.80-0.96)	Cochrane review	
	Selected for high risk:	Selected for high risk:		
	0.52 (95% CI: 0.50-0.77)	0.85 (0.75-0.97)		
	Not selected for high risk:	Not selected for high risk:		
	0.94 (95% CI: 0.84-1.05)	0.90 (0.80-1.00)		
^a Lee, 2020 ³⁸	Included EAM:	Included EAM:	Environmental assessment modification as part of multifactorial	
	0.65 (95% CI: 0.54-0.79)	0.80 (0.68-0.95)		
	Did not include EAM:	Did not include EAM:		
	0.82 (95% CI: 0.55-1.21)	0.96 (0.81-1.14)		
Abbreviation: NR, not reported. ^a High-quality SR/meta-analysis				

falling.⁹² Another large high-quality SR found that in studies where individuals were not selected for high risk there was no risk or rate reduction with environmental assessment and modification, but studies that selected for high risk subjects had a 48% reduction in falls and a 15% reduction in fall risk.³⁴ Similarly, Dautzenberg et al³⁹ found no effect for environmental modification in reducing fall risk in the general community-dwelling population, but found a 15% risk reduction in people over 75 years of age.

Environmental assessment and modification as part of multifactorial intervention

Finally, Lee et al³⁸ (2020) conducted a high-quality SR with meta-analysis and found that multifactorial interventions that did not incorporate environmental assessment and modification had no effect on fall risk or fall rate. Multifactorial interventions that included environmental

assessment and reduced fall rates by 35% and fall risk by 20%.

Dissemination Plans

The primary purpose of the CPG is to provide guidance for physical therapy management of falls and fall risk based on a comprehensive review and synthesis of the best-available evidence. Publication of this CPG will be announced via press release by APTA-Geriatrics, and disseminated via online resources, social media, pocket guides, and continuing education courses at professional conferences. The knowledge translation task force of APTA-Geriatrics will facilitate the creation of additional implementation tools during the three years following the publication of this CPG.

Revision Plan

This CPG will be subject to an evidence surveillance process periodically within the first five years. Criteria for revision, reaffirmation, or withdrawal include changes in evidence on the benefit and harms of any of the interventions in this CPG, changes in available interventions, and current practice patterns including validity of existing screening and assessment procedures and tests for fall prediction.^{20,93} APTA-Geriatrics leadership will determine a revision coordinator to assist in this process.

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This CPG is dedicated to the memory of Dr. Christine McDonough. Her passion for the profession and her attention to truth and detail in providing evidence to guide physical therapist practice inspired us throughout the completion of this work.

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