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The Role of Training and Physical Exercise in Reducing the Risk of Falls in Older Adults—A Narrative Review

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Abstract

Background. Falls among older adults constitute a significant public health problem because they are associated with reduced independence, impaired functional capacity, and an increased risk of subsequent health problems.

Aim. The aim of this study was to discuss the role of training and physical exercise in reducing the risk of falls among older adults and to identify the forms of activity with the greatest practical relevance.

Material and methods. This study is a literature review incorporating elements of narrative synthesis. Publications available in PubMed and Google Scholar, from 2015–2026, were analysed, including systematic reviews, meta-analyses, randomised clinical trials, and intervention studies concerning exercise used in fall prevention.

Results. The most consistent evidence indicates beneficial effects of regular, progressive, and individually tailored programmes combining balance, functional, and strengthening exercises. Such interventions improve static and dynamic balance, lower-limb muscle strength, functional mobility, postural control, gait, and fall-prevention self-efficacy. Tai Chi, the Otago programme, and selected multicomponent programmes are of particular relevance in preventive practice, whereas Pilates, exergames, vibration training, and mHealth solutions primarily improve selected intermediate risk factors.

Conclusions. Physical exercise should constitute an important component of fall prevention among older adults. When interpreting the findings, improvements in risk factors should be distinguished from a direct reduction in fall incidence. Programmes should be safe, systematic, and adapted to the participant's level of physical function.

Key words: older adults; falls; fall prevention; physical exercise; balance training; strength training

1. Introduction

Falls among older adults are an important public health problem because they are associated with impaired physical function, reduced independence, and an increased risk of further functional decline. Advancing age is accompanied by deterioration in balance, muscle strength,

coordination, and mobility, all of which are directly associated with fall risk.^{1,2} Therefore, fall prevention among older adults should focus not only on reducing environmental hazards but also on improving physical function through appropriately selected exercise. Available systematic reviews and meta-analyses indicate that physical exercise is one of the best-documented methods of reducing fall risk in older adults.²⁻⁴ A review of randomised clinical trials involving community-dwelling older adults showed that exercise interventions may reduce the rate of falls, with the greatest importance attributed to balance and functional exercises, Tai Chi, and multicomponent programmes.³ Similar conclusions were presented in a review prepared to inform World Health Organization guidelines, which confirmed the effectiveness of physical activity as a stand-alone intervention for preventing falls in adults aged 65 years and older.⁴

Balance exercises are of particular importance in fall prevention because they affect postural control, gait stability, and the ability to maintain balance during activities of daily living.^{1,2} A meta-analysis examining the effects of physical exercise on balance and fall prevention demonstrated improvements in static and dynamic balance, together with reductions in the number of falls and the number of individuals experiencing a fall in the exercise groups.¹ These findings indicate that exercises targeting balance and postural control should constitute an important component of preventive programmes for older adults.

The studies analysed also emphasise the role of multicomponent programmes, which combine different types of exercise, most commonly balance training, functional exercise, and elements of strength training.^{2,4-6} This approach appears justified because fall risk is multifactorial and depends on the interaction among muscle strength, balance, gait performance, mobility, and confidence in movement.^{1,6} The authors of the reviewed studies indicate that combining balance, coordination, and resistance exercises may improve physical fitness related to fall risk and enhance fall-prevention self-efficacy.⁶

Tai Chi represents a distinct group of interventions examined in the literature. Researchers indicate that Tai Chi may reduce fall risk and improve balance in older adults.^{4,7} The beneficial effects of this form of activity may result from slow, controlled weight shifting, training of postural stability, and motor coordination.⁷ Tai Chi is therefore frequently identified as a potential form of exercise for older adults, particularly when the aim of the programme is to improve balance and postural control.

The role of strength training in fall prevention should be presented with caution. Reduced lower-limb muscle strength is one of the factors associated with poorer mobility and a higher

risk of falling; therefore, resistance exercise may be an important component of preventive programmes.^{2,8} However, a study examining strength training as a stand-alone intervention did not demonstrate its superiority over other forms of exercise in reducing the number of falls, and the authors highlighted the limited and heterogeneous evidence base.⁸ Consequently, strength training should primarily be considered as part of a broader programme that also includes balance and functional exercises and tasks designed to improve mobility.^{2,8,9}

Despite consistent conclusions regarding the overall effectiveness of physical exercise, study findings differ in terms of intervention type, duration, frequency, intensity, mode of delivery, and participant characteristics.^{3,5,10} This variability indicates the need for cautious interpretation and for further determination of which programme components are most important for specific groups of older adults. Current evidence nevertheless suggests that the greatest practical relevance is associated with regular, progressive programmes targeting balance, mobility, and functional capacity, supplemented with strength exercises when required.^{2,4,9}

The aim of this review is to discuss the role of training and physical exercise in reducing fall risk among older adults on the basis of current literature. Particular attention is given to balance exercises, multicomponent programmes, Tai Chi, and strength training as components of interventions used in fall prevention.

2. Research materials and methods

This study is a narrative review incorporating elements of narrative synthesis. The aim of the review was to analyse current scientific evidence concerning the role of training and physical exercise in reducing fall risk among older adults, with particular emphasis on the effects of exercise interventions on fall rate, fall risk, static and dynamic balance, lower-limb muscle strength, functional mobility, fear of falling, and fall-prevention self-efficacy.

The source material comprised scientific publications concerning physical activity, balance training, strength training, multicomponent interventions, and selected exercise programmes used to prevent falls among older adults. Priority was given to systematic reviews, meta-analyses, and randomised clinical trials evaluating the effectiveness of physical exercise in older populations, mainly among individuals living at home or functioning independently in the community. The analysis also included studies of specific forms of intervention, such as Tai Chi, Pilates, the Otago Exercise Programme, Lifestyle-integrated Functional Exercise, whole-

body vibration training, exergame-based training, telerehabilitation, home-based programmes, and interventions supported by mobile technologies and activity-monitoring devices.

The literature was selected purposively from publications available in PubMed and Google Scholar. The search covered studies published between 2015 and 2026. The search was conducted using the following English-language keywords and their combinations: “older adults”, “elderly”, “falls”, “fall prevention”, “fall risk”, “exercise”, “physical activity”, “balance training”, “strength training”, “resistance training”, “multicomponent exercise”, “Tai Chi”, “Pilates”, “Otago Exercise Program”, “telerehabilitation”, “exergames”, “whole-body vibration”, “fear of falling”, and “fall efficacy”.

The inclusion criteria were as follows: publications concerning older adults, usually aged 60 or 65 years and above; studies evaluating physical exercise as the principal or a substantial component of the intervention; studies analysing the effects of interventions on falls, fall risk, or fall-related functional factors; full-text publications in English; and systematic reviews, meta-analyses, randomised clinical trials, and intervention studies relevant to the topic of the review. Publications not concerning older adults, studies focusing exclusively on pharmacological, surgical, or environmental interventions without a physical-exercise component, reports without available full text, and articles in which falls or functional parameters associated with fall risk were not assessed as outcomes were excluded.

Because of the considerable heterogeneity of the analysed publications, including differences in study populations, intervention types, programme duration, measurement instruments, and endpoints, no original meta-analysis was conducted. The findings were presented as a narrative synthesis, with the material organised by intervention type: balance and functional exercises, strength training, multicomponent programmes, Tai Chi, Pilates, the Otago Exercise Programme, LiFE, vibration training, exergames, and home-based, remote, and mobile-technology-supported interventions. The interpretation of findings also considered the methodological quality of the primary studies and reviews, including randomisation, sample size, the method of fall reporting, length of follow-up, risk of bias, and the transferability of findings to fall-prevention practice among older adults.

As this study is a review based on the analysis of previously published data, approval from a bioethics committee and the acquisition of participants’ informed consent were not required.

2.3.2. AI.

AI was utilized for two specific purposes in this research. Text analysis of clinical reasoning narratives to identify linguistic patterns associated with specific logical fallacies. Assistance in refining the academic English language of the manuscript, ensuring clarity, consistency, and adherence to scientific writing standards. **AI** were used for additional linguistic refinement of the research manuscript, ensuring proper English grammar, style, and clarity in the presentation of results. It is important to emphasize that all AI tools were used strictly as assistive instruments under human supervision. The final interpretation of results, classification of errors, and conclusions were determined by human experts in clinical medicine and formal logic. The AI tools served primarily to enhance efficiency in data processing, pattern recognition, and linguistic refinement, rather than replacing human judgment in the analytical process.

3. Research results

The analysis of the included studies indicates that physical exercise may play an important role in reducing fall risk among older adults; however, the strength of the evidence depends on the type of intervention and the outcome assessed. Some studies analysed the actual number or rate of falls, whereas others primarily evaluated intermediate risk factors, such as balance, functional mobility, fear of falling, postural control, or gait variability.^{11–20}

In a randomised clinical trial involving community-dwelling older adults who had previously experienced a fall, a home-based strength and balance exercise programme delivered by a physiotherapist was associated with a lower rate of subsequent falls than standard geriatric care. During follow-up, 236 falls were recorded in the intervention group and 366 in the standard-care group. The fall rate was lower in the exercise group, indicating that supervised home-based training may be an effective component of secondary fall prevention in older adults with a history of falling.¹¹

Positive findings were also reported in studies of the Pilates method, although these studies most often assessed balance and functional-performance parameters rather than the number of falls directly. In a randomised trial comparing a Pilates programme with a general physical-activity programme, both forms of exercise improved the assessed parameters; however, the Pilates group achieved more favourable outcomes in balance measured using the Berg Balance Scale and posturographic analysis. These findings suggest that training focused on postural control, trunk stabilisation, and coordination may beneficially affect fall-related risk factors.¹²

Similar conclusions were presented in a systematic review and meta-analysis of Pilates in healthy older adults. The authors indicated that Pilates may improve selected fall-risk factors, including functional mobility, balance, postural stability, gait, and fear of falling. It should be noted, however, that the available studies did not always assess the actual number of falls. The findings therefore primarily concern modification of risk factors rather than unequivocal confirmation of a reduction in fall incidence.¹³

Tai Chi and Tai Ji Quan exercises constituted an important group of interventions. In a randomised clinical trial involving older adults, a 10-week Tai Chi programme performed three times per week reduced fear of falling and improved fall-risk scores measured using functional scales. A reduction in fear of falling was observed after 4 weeks, whereas improvements in fall-risk indicators were observed after 8 and 10 weeks of the intervention. These findings indicate that Tai Chi may influence both the physical and psychological dimensions of fall prevention.¹⁴ An 8-week Tai Chi Chuan programme conducted twice weekly likewise improved balance and reduced fear of falling among community-dwelling older adults. After the intervention, the exercise group achieved better Timed Up and Go and Tinetti scale scores than the control group, together with lower FES-I scores, indicating less concern about falling. However, the study did not directly demonstrate a reduction in the number of falls; therefore, its findings should be interpreted as evidence of improvement in risk factors rather than proof of reduced fall incidence.¹⁵

The strongest evidence concerning Tai Ji Quan derives from a randomised clinical trial involving older adults at high risk of falling. The Tai Ji Quan: Moving for Better Balance programme was more effective than stretching exercises and a standard multimodal exercise programme in reducing the number of falls. Compared with the stretching group, the number of falls was 58% lower, and compared with the multimodal-exercise group, it was 31% lower. These findings suggest that interventions targeting balance control, weight shifting, postural stability, and motor coordination may be particularly effective in older adults at increased risk of falling.¹⁶

A study examining the effects of discontinuing regular Tai Chi exercise assessed postural control in older women after 16 weeks of training and after a subsequent 8-week period without training. Tai Chi improved the ability to maintain balance during single-leg stance, and some of the benefits were retained during the detraining period. However, the study did not assess the number of falls; its relevance therefore mainly concerns the effect of Tai Chi on postural control as an intermediate fall-risk factor.¹⁷

Tai Chi may also affect gait parameters under dual-task conditions. In a study comprising a cross-sectional analysis and a randomised component, individuals with Tai Chi experience demonstrated lower step-time variability while walking with a concurrent cognitive task than individuals without experience of this form of exercise. In the randomised component, only a modest improvement in gait variability was observed after Tai Chi training, with no significant between-group differences. These findings are promising but should be interpreted cautiously because of the small sample size and the indirect nature of the assessed parameters.¹⁸

Observational data likewise indicate a favourable functional profile among older adults who practise Tai Chi. In a study comparing Tai Chi practitioners and non-practitioners, the practising group achieved better results in functional-fitness tests and lower fall-risk scores. Owing to the observational design, however, it cannot be concluded that Tai Chi directly caused these differences. The findings may nevertheless support the hypothesis that regular participation in this type of activity facilitates the maintenance of functional capacity relevant to fall prevention.¹⁹

Beneficial effects were also demonstrated for a modified Otago programme. In a multicentre randomised trial involving older adults with a history of falls, a 6-month Otago programme delivered under physiotherapist supervision and supported by a video recording improved balance, functional performance, and lower-limb strength and reduced fear of falling. The intervention group also demonstrated a greater reduction in the number of falls than the control group, and some effects were maintained at 12-month follow-up. At the same time, the authors found no significant improvement in adherence to the exercise programme, indicating that the effectiveness of such interventions may be constrained by long-term adherence.²⁰

In summary, the strongest evidence for reducing the rate or number of falls relates to physiotherapist-delivered home-based strength and balance training, the Tai Ji Quan: Moving for Better Balance programme, and the modified Otago programme.^{11,16,20} Pilates, Tai Chi Chuan, and other forms of Tai Chi primarily showed beneficial effects on fall-risk factors, including balance, mobility, postural control, gait variability, and fear of falling.^{12–15,17–19} Thus, physical exercise is an important component of fall prevention among older adults; however, interpretation of the findings requires a distinction between an actual reduction in the number of falls and improvement in intermediate parameters.^{11–20}

The second group of analysed studies included Otago programmes, lifestyle-integrated functional exercise, whole-body vibration training, and exercise using active video games. Most studies assessed intermediate factors rather than the number of falls itself, including balance,

fear of falling, functional performance, lower-limb strength, gait, or quality of life. Consequently, the findings in this section should primarily be interpreted as evidence of the effects of exercise on factors associated with fall risk, rather than invariably as direct evidence of reduced fall incidence.^{21–30}

In a study comparing the Otago programme with gaze-stability exercises, participants were allocated to two groups: the Otago Exercise Programme and Gaze Stability Exercise. The interventions lasted 8 weeks and were performed three times per week; trunk-muscle strengthening exercises were also used in both groups. The findings demonstrated significant improvements in both groups in balance assessed using the Berg Balance Scale and in fear of falling assessed using the FES-I. Improvement was greater in the Otago group: the BBS score increased from 40.4 to 48.0 points, whereas the FES-I score decreased from 39.47 to 32.73 points. The study did not report the number of actual falls during follow-up; therefore, its findings should be interpreted in relation to improved balance and reduced fear of falling rather than a direct reduction in fall incidence.²¹

The Otago programme was also evaluated in a telerehabilitation study. The study included 45 individuals aged 65–78 years with a history of falls, who were assigned to a remotely delivered Otago group, a directly supervised Otago group, or a control group. The intervention lasted 8 weeks, with 45-minute sessions three times per week. Both exercise groups improved in most assessed parameters, including TUG, the 30-second chair-stand test, FES, quality of life, and the Tinetti test. Between-group comparisons demonstrated significant differences, among others, for the 30-second chair-stand test, FES, and the Tinetti test, whereas no significant between-group difference was found for change in TUG. The study did not prospectively measure the number of falls after the intervention and therefore provides evidence of improvement in selected fall-risk factors rather than evidence of a reduction in the number of falls.²²

The LiFE-is-LiFE study compared an individually delivered home-based LiFE programme with its group-based version, gLiFE, in adults aged 70 years and older at risk of falling. This was a non-inferiority trial, and its primary finding did not unequivocally confirm that the group-based version was non-inferior to the individual version with respect to the fall rate adjusted for physical-activity level. The number of falls decreased from baseline in both groups, but the reduction was greater in the individual LiFE group than in the gLiFE group. At the same time, the group-based version was associated with a larger increase in daily step count and lower intervention costs. The findings indicate that exercise incorporated into daily activities may

support physical activity and functional capacity, but they do not unequivocally confirm equivalent effectiveness of the group-based programme in reducing falls.²³

A modified LiFE programme was also assessed in a pilot study conducted in retirement communities. The study had a single-arm design without a control group and was completed by 16 participants. After 26 weeks, improvements were observed in lower-limb strength and balance, assessed using measures including the 30-second chair-stand test, Functional Reach Test, and Timed Up and Go. The authors emphasised, however, that the study design did not permit confirmation of a reduction in fall risk. The study should therefore be regarded as preliminary evidence of feasibility and of a potential effect on functional capacity rather than confirmation of fall-prevention effectiveness.²⁴

Whole-body vibration training was evaluated in a pilot randomised study involving community-dwelling older adults.²⁵ The intervention lasted 8 weeks and comprised three sessions per week. The primary endpoint was a fall induced by an experimental treadmill slip rather than solely spontaneous falls in daily life. Immediately after the programme, the proportion of participants who fell following the slip was lower in the training group than in the control group. The authors also reported improvement in the assessed fall-risk factors and a possible reduction in the number of falls during follow-up, while emphasising the pilot nature of the study. The findings should therefore be regarded as promising but in need of confirmation in larger samples.²⁵

A larger study of 10-week whole-body vibration training with 12 months of follow-up did not confirm the effectiveness of this method in preventing falls. The study included 130 older adults at risk of falling, assigned to either a vibration-training group or a low-intensity wellness-exercise group. A total of 156 falls were recorded during follow-up, and the fall rate was not lower in the vibration-training group. The fall-rate ratio was 1.50, favouring the wellness group over the WBV group, and was not statistically significant. Vibration training was nevertheless well tolerated and was associated with more favourable lower-limb performance outcomes at the end of follow-up, including SPPB and chair-stand performance. This study indicates that vibration training may support physical function but did not demonstrate a reduction in falls.²⁶

In another pilot study, whole-body vibration training was evaluated in middle-aged and older adults, with a focus on balance control and sit-to-stand performance. After 8 weeks of training, improvements were found in selected limits-of-stability and weight-shifting parameters, particularly in the group receiving individually tailored vibration settings. The study did not assess the number of falls. Its findings can therefore be related only to improved postural control

and functional capacity, which may be associated with fall risk but do not constitute confirmation of reduced fall incidence.²⁷

In women aged 60 years and older at increased risk of falling, 12 weeks of whole-body vibration training improved selected intrinsic fall-risk factors. The intervention group demonstrated more favourable changes in the Timed Up and Go, 6-minute walk test, and 30-second chair-stand test. No significant reduction was found in fear of falling assessed using the FES-I, nor was there a change in interleukin-6 concentration. The study did not report the number of falls as an intervention outcome; therefore, its relevance concerns improved functional performance rather than direct fall prevention.²⁸

Exercise using active video games was assessed in a randomised study of a home-based exergame programme among community-dwelling older adults.²⁹ After 8 weeks, the intervention group improved in physical-function tests, including single-leg stance, the Berg Balance Scale, Functional Reach Test, Timed Up and Go, and the five-times sit-to-stand test. Improvements were also reported in fall-prevention self-efficacy, depressive symptoms, and selected quality-of-life domains. However, the study did not directly demonstrate a reduction in the number of falls; its findings should therefore be interpreted as improvements in functional capacity, functional confidence, and psychological well-being.²⁹

A study using the Ring Fit Adventure game evaluated older adults attending rural long-term care facilities. The primary aim was to assess the programme's effects on frailty and sarcopenia rather than on the number of falls. The intervention improved muscle mass, muscle strength, and functional performance, together with selected physical-function, mood, and cognitive outcomes. These findings may be indirectly relevant to fall prevention because muscle weakness, sarcopenia, and impaired functional capacity are associated with susceptibility to falls. The study should not, however, be presented as evidence of reduced fall incidence because this was not its primary endpoint.³⁰

In summary, the second group of analysed studies most often demonstrated improvement in fall-risk factors and less frequently a direct reduction in the number of falls.^{21–30} The Otago programme improved balance, fear of falling, and functional performance, including when delivered through telerehabilitation.^{21,22} LiFE programmes indicated the possibility of improving activity and functional capacity, but findings regarding fall reduction were inconclusive or constrained by the study design.^{23,24} Vibration training produced mixed findings: a pilot study reduced the risk of falling after an experimental slip, whereas a larger study with one year of follow-up did not confirm a reduction in falls.^{25,26} Exergame programmes

improved physical function, self-efficacy, mood, or sarcopenia-related parameters but did not provide direct evidence of a reduction in the number of falls.^{29,30}

The third group of studies comprised interventions using digital technologies, such as exergames, game-supported stepping training, an online exercise programme, activity monitors, and an mHealth application. Findings in this group require particularly cautious interpretation because only some studies assessed the actual number or rate of falls. The remaining studies mainly analysed intermediate indicators, such as balance, fear of falling, physical performance, step count, or stepping-task performance.^{31–35}

A multicentre cluster-randomised clinical trial evaluated a 12-week exergame programme based on strength and balance exercises in adults aged 55 years and older living in assisted-living or sheltered-housing facilities in the United Kingdom. The intervention was delivered three times per week with support from physiotherapists or trained assistants. The primary endpoint was balance assessed using the Berg Balance Scale, whereas falls were a secondary outcome. After completion of the programme, the intervention group achieved a significantly greater improvement in balance than the control group. Reductions in fear of falling and pain were also reported. During the study, a fall was reported by 20% of participants in the exergame group and 24% of those in the control group, and the analysis of fall rates favoured the intervention. These findings therefore indicate that a supervised exergame programme based on strength and balance exercise may improve balance and selected fall-related outcomes among older adults in assisted-living settings.³¹

In a randomised study of stepping training with a cognitive-motor component, participants in the intervention group performed standard strength and balance exercises together with additional stepping-exergame training, whereas the control group performed strength and balance exercises only. The programme lasted 10 weeks and was followed by a 10-week period without training. The findings demonstrated improved stepping reaction time or game performance in 7 of 10 levels and an improved overall stepping-exergame score in the intervention group compared with the control group. Some effects were maintained during post-programme follow-up. However, the study did not assess whether training reduced the actual number of falls. The authors stated that further research is needed to evaluate the effect of this intervention on fall incidence.³²

A study of an online exercise programme primarily assessed fear of falling among older adults participating in either an online or an in-person programme. It was not a study designed to confirm programme effectiveness in reducing the number of falls. The study included 85

participants, of whom 44 participated online and 41 in person. After the programme, no significant change in fear of falling was found in either group. Falls were reported by 20.5% of participants in the online group and 9.8% in the in-person group, but the difference was not statistically significant. These findings do not support the conclusion that the online programme reduced fear of falling or the number of falls.³³

A 2025 randomised trial evaluated the combination of an activity monitor with a home-based multicomponent exercise programme in older adults with a history of falls. The intervention group was compared with a group using an activity monitor alone. After 12 weeks, the group combining the monitor with exercise improved in fear-of-falling and physical-performance outcomes, including the SPPB, Timed Up and Go, and 2-Minute Step Test.³⁴ The activity-monitor-only group also improved in some parameters, including FES-I and TUG. However, no significant between-group differences were found in the assessed outcomes. The study therefore provides no evidence that adding a home-based exercise programme to an activity monitor was more effective than use of the activity monitor alone. The effectiveness of the intervention in prospectively reducing the number of falls was also not assessed.³⁴

The BeSt Age cluster-randomised trial evaluated a tablet-based mHealth application supporting exercise among nursing-home residents. The study included 229 residents from 19 German nursing homes. The intervention lasted 12 weeks and comprised two staff-led training sessions per week using the application. The primary outcomes were fall incidence and fall risk assessed using the Berg Balance Scale and Timed Up and Go, whereas fear of falling was a secondary outcome. The intervention group achieved a greater improvement in Berg Balance Scale score than the control group. However, no significant between-group changes were found in TUG, fear of falling, or fall incidence. Thus, the BeSt Age application improved balance as one functional indicator of fall risk but did not reduce the number of falls in this study.³⁵

In summary, in the third group of analysed studies, digital technologies most often improved selected intermediate indicators and did not consistently reduce fall incidence directly.^{31–35} The most favourable fall-related findings were obtained in the study of strength- and balance-based exergames in assisted-living facilities.³¹ Stepping-exergame training improved stepping-task performance but did not assess the number of falls.³² The online exercise programme did not significantly reduce fear of falling.³³ An activity monitor combined with home-based exercise demonstrated no advantage over an activity monitor alone.³⁴ The BeSt Age application improved the Berg Balance Scale score but did not significantly reduce fall incidence, fear of falling, or TUG performance.³⁵ Digital technologies should therefore be described in this

section primarily as tools for improving selected functional parameters rather than as unequivocally established methods of reducing falls.^{31–35}

4. Discussion

The literature analysis indicates that physical exercise may play an important role in reducing fall risk among older adults, particularly among community-dwelling or home-dwelling populations.^{1–5,9} Conclusions drawn from systematic reviews, meta-analyses, and randomised trials suggest that interventions targeting balance, muscle strength, functional performance, mobility, and gait control are of greatest importance.^{1,2,4,5,7–10} At the same time, the available evidence should not be interpreted as demonstrating that every form of physical activity reduces fall risk to the same extent. Intervention effectiveness is likely to depend on the type of exercise, mode of delivery, regularity, level of difficulty, and degree of adaptation to the capabilities of the older person.^{2–5}

Falls among older adults are complex and multifactorial events. They may be associated with reduced muscle strength, impaired balance, gait disturbances, limited mobility, fear of falling, and reduced overall functional capacity.^{1,2,4,7} Preventive programmes should therefore target more than one risk factor. The analysed publications particularly frequently emphasised the importance of balance, strength, and functional exercises, as well as multicomponent programmes.^{1–5,9,10} This approach appears justified because a single form of training may improve one selected performance parameter without necessarily translating into a meaningful reduction in fall risk during daily functioning.

Balance training is considered particularly important in fall prevention. This is because maintaining a stable posture is essential during most activities of daily living, including walking, standing up, turning, reaching for objects, and negotiating uneven surfaces. Systematic reviews indicate that balance exercise is an important component of effective fall-prevention programmes.^{1,2,4,9} This does not mean, however, that it should be used in isolation. Combining balance exercise with strengthening, functional, and mobility-enhancing exercises appears more justified.^{5,7,9,10} Such an approach more closely reflects the actual movement demands faced by older adults.

Strength training is another important component of interventions. Muscle weakness, particularly in the lower limbs, may impair the ability to rise from a chair, walk, stabilise the body, and recover balance in unexpected situations. Reviews of strength training and exercise in older adults indicate that muscle strengthening may help reduce fall-related risk factors.^{5,6,8,9}

These findings should nevertheless be interpreted cautiously. An improvement in muscle strength alone does not necessarily imply a proportional reduction in the number of falls, particularly when it is not accompanied by improvements in balance, coordination, and gait function.^{2,6,8,9} Strength training should therefore be regarded as an important, but not the sole, component of prevention.

An important conclusion from the analysed publications is the advantage of multicomponent interventions over programmes limited to a single form of activity.^{2,4,5,9,10} Programmes combining strength, balance, and functional exercises with components designed to improve gait may better address the diverse needs of older adults. This approach is particularly important for individuals with several coexisting risk factors, for example those with a history of falling, limited physical function, or reduced confidence during mobility.^{11,20-22} From a practical perspective, a programme should be adapted to the participant's baseline level and progressively modified as functional capacity improves.

Home-based programmes constitute a separate group of interventions. They are particularly important for older adults who have difficulty participating regularly in group classes or facility-based rehabilitation. A study of a home-based exercise programme in high-risk older adults with a previous fall indicates that this mode of intervention may be useful in reducing subsequent falls.¹¹ Home-based interventions may also be more accessible organisationally and economically, although their effectiveness depends on regular participation, adherence to recommendations, and appropriate instruction. Safety monitoring is particularly important in this group because individuals with a history of falling or at high fall risk may require closer supervision during the initial stage of the programme.

The Otago programme occupies an important place among interventions designed for fall prevention. The analysed studies described both programme modifications and its use in telerehabilitation.²⁰⁻²² Such approaches are important because they allow elements of rehabilitation and prevention to be transferred into the home environment. Programmes based on strength, balance, and functional exercises may be particularly useful for individuals who require regular training but cannot always attend in-person appointments at healthcare facilities.²⁰⁻²² Telerehabilitation should not, however, be regarded as a universal solution for all patients. Its use requires an assessment of safety, technological capacity, level of independence, and the older person's ability to perform the exercises in accordance with instructions.

Lifestyle-integrated programmes such as LiFE also warrant attention. Their premise is to incorporate balance and strength exercises into daily activities rather than restrict training to

separate exercise sessions. This approach may be relevant to the long-term maintenance of activity because exercise becomes part of the daily routine. Among older adults who are reluctant to participate in formal training sessions, programmes integrated into activities of daily living may be more acceptable.^{23,24} It should be emphasised, however, that some studies of modified programmes of this type are pilot studies; their findings should therefore be regarded as promising but requiring further confirmation.²⁴

A substantial proportion of the analysed literature concerns Tai Chi. Findings from systematic reviews, meta-analyses, and randomised trials suggest that Tai Chi may beneficially affect balance, fear of falling, and selected functional-performance parameters in older adults. Tai Chi is based on slow, controlled movements and changes in body position and may therefore be useful for training stability and postural control.^{7,14–16} Studies also indicate the possibility of improving selected gait and dual-task parameters, which may be relevant to functioning in everyday situations requiring simultaneous movement and attention.¹⁸ It should not be overlooked, however, that maintaining these effects probably requires continued training. A study of the consequences of discontinuing regular Tai Chi exercise indicates that interruption of the activity may be associated with a reduction in previously obtained benefits in postural control.¹⁷

Comparison of Tai Chi with other forms of intervention requires caution. A study evaluating a therapeutic Tai Ji Quan intervention against multimodal exercise suggests that different programme types may be effective, but their effects may depend on participant characteristics and the nature of the intervention.¹⁶ The choice of exercise should therefore be adapted to the needs and preferences of the older person. Tai Chi may be appropriate for some individuals, whereas Otago training, a multicomponent programme, functional exercise, or a home-based intervention may be more suitable for others. It is important that the programme can be performed regularly and is safe and acceptable to the participant.

Pilates is another form of activity analysed in relation to reducing fall-risk factors. Available studies suggest that Pilates may improve selected parameters related to balance and functional performance in older adults. A potential advantage is the controlled nature of the exercises and the possibility of adapting their level of difficulty to the participant's capabilities. At the same time, the number of studies examining Pilates in fall prevention is smaller than that concerning Tai Chi, multicomponent programmes, or conventional balance-and-strength interventions.^{12,13} Pilates may therefore be considered a complementary or alternative form of exercise, but the

available evidence does not justify regarding it as one of the best-documented methods of fall prevention.

In recent years, technology-based interventions have been examined increasingly often. These include whole-body vibration training, exergames, online programmes, mobile applications, and activity-monitoring devices.^{25–35} Vibration training may affect selected physical-performance and balance parameters; however, study findings should be interpreted cautiously because some studies are pilot investigations or involve limited participant groups. Furthermore, the studies differ in training protocols, intervention duration, and assessed endpoints.^{25–28} Whole-body vibration training may therefore be regarded as a potentially useful adjunct, but not as a primary and unequivocally established method of fall prevention.

Exergames, defined as exercises performed using games and interactive technologies, represent a promising direction in preventive practice. Studies of home-based programmes, game-based training, and motor-cognitive interventions indicate the potential to improve physical function, balance, stepping performance, self-efficacy, and quality of life. Such interventions may make exercise more engaging and support motivation, particularly among individuals who have difficulty maintaining a traditional training programme. At the same time, the effectiveness of exergames in directly reducing the number of falls requires cautious interpretation because not all studies assess actual fall incidence as the primary endpoint.^{29–32} In many cases, the outcomes are intermediate factors, such as physical function, balance, functional capacity, or gait parameters.

Online programmes and mHealth solutions may increase access to exercise for older adults, particularly when direct contact with a therapist is difficult. Interventions of this type may affect fear of falling, physical activity, functional performance, or parameters associated with fall risk.^{33–35} At the same time, they require appropriate adaptation to user capabilities. Older adults may differ in their level of physical function, experience with technology, ability to concentrate, and capacity to exercise safely without direct supervision. Digital solutions should therefore be designed with ease of use, clear instructions, the possibility of monitoring progress, and minimisation of the risk of incorrect exercise performance in mind.

Fear of falling is also an important aspect of the discussion. It is not merely a consequence of previous falls; it may itself contribute to activity restriction, functional decline, and reduced quality of life. In the analysed publications, fear of falling appears as an important outcome in the evaluation of intervention effectiveness.^{6,14,15,21,33–35} Physical exercise may affect not only objective performance parameters but also a sense of safety during mobility. This is important

because an older person who fears falling may avoid activity, which may in turn lead to further muscle weakness and deterioration in balance. Preventive programmes should therefore address both physical and psychological dimensions.

Attention should also be paid to the distinction between reducing fall-risk factors and actually reducing the number of falls. Some studies assess balance, strength, functional performance, fear of falling, or gait parameters, whereas not all studies analyse fall incidence as the primary outcome.^{2,6,7,12,19–24,26–28,34} Improvement in these parameters is clinically relevant but does not always automatically imply a reduction in the number of falls. When interpreting the findings, studies that directly assess the occurrence of falls should therefore be distinguished from those focusing on intermediate risk indicators.

An important limitation of the available literature is the heterogeneity of the studied populations and interventions. The studies include community-dwelling adults, individuals with a history of falls, high-risk participants, residents of care facilities, and individuals participating in different forms of activity.^{1,5,10,14,24,25,29,32} These differences impede direct comparison of findings. A programme that is effective in relatively fit older adults living independently may not have the same effectiveness in individuals with greater disability, frailty, or a higher burden of comorbidity. Study findings should therefore be considered in relation to the specific population in which a given intervention was evaluated.

A further limitation is the variability in programme duration, exercise frequency, mode of supervision, and methods of outcome assessment.^{1,3,4,30,32} In exercise studies, complete blinding of participants and intervention providers is also difficult, which may affect risk-of-bias assessment.¹ In addition, some fall data may be based on self-report, with the possibility of underestimation or recall bias. Randomised studies and systematic reviews that account for methodological quality are therefore particularly valuable.^{1,2,4,30,31,33,35}

In clinical practice, it is important that fall-prevention programmes are not selected arbitrarily. Older adults differ in physical function, movement experience, comorbidities, motivation, access to care, and home conditions. Assessment of fall risk and functional capacity is therefore advisable before a programme is initiated. For individuals at lower risk, group exercise, Tai Chi, Pilates, lifestyle-integrated programmes, or exergames may be considered.^{6–10,17,18,23–26,31} For individuals with a history of falling, at higher risk, or with substantial fear of falling, supervised, home-based, or telerehabilitation programmes such as Otago, or interventions targeting balance and strength, may be more important.^{5,14–16,33–35}

Adherence is also important from an implementation perspective. Even a well-designed programme may fail to produce the expected effects if it is not performed regularly. The analysed studies address various approaches to improving exercise accessibility and acceptability, including home-based programmes, telerehabilitation, LiFE, exergames, online solutions, and mHealth.^{5,14–18,23–29} Effective fall prevention can therefore be assumed to require not only selection of the appropriate type of exercise but also the creation of conditions that support long-term participation. Programme simplicity, safety, the ability to monitor progress, and adaptation to the older person's preferences may be particularly important.

It should be emphasised that physical exercise should not be considered solely as a rehabilitative intervention after a fall. It may also have a preventive role in individuals who have not yet fallen but exhibit risk factors such as impaired balance, muscle weakness, or reduced functional capacity.^{1,2,4–6,8–10} Early implementation of appropriately selected activity may be important for maintaining independence and physical function in later life. At the same time, interventions for individuals who have already fallen should be planned with particular caution because this group may require closer supervision, graded progression, and consideration of fear of another fall.^{6,11,33}

In summary, the available literature indicates that physical exercise is an important component of fall-risk reduction among older adults, but its effectiveness depends on programme type, structure, and individual tailoring.^{1–6,8–10} Interventions including balance training, muscle-strength training, gait-function training, and functional exercise appear most justified.^{1,4,5,7–9} Tai Chi, the Otago programme, LiFE, Pilates, exergames, vibration training, and mHealth solutions may provide different forms of support for prevention, although the extent to which their effectiveness is documented varies. The greatest caution is required when interpreting pilot and short-term studies and studies that primarily assess intermediate risk factors rather than actual fall incidence.^{24–30,32–35}

Further research should focus on determining the optimal exercise dose, the durability of effects after programme completion, effectiveness among individuals with different levels of risk, and the practical implementation of interventions in home, community, and institutional settings. Different forms of exercise should also be compared not only in terms of effectiveness but also with respect to safety, accessibility, cost, acceptability, and the feasibility of long-term maintenance. From a practical perspective, the most valuable programmes are those that combine evidence-based balance and strength components with high feasibility in the daily lives of older adults.^{2,4,9,10,23}

5. Conclusions

The available literature indicates that physical exercise may play an important role in reducing fall risk among older adults, particularly by improving balance, muscle strength, functional performance, postural control, and confidence in performing activities of daily living.^{1,3–5,10} Findings from systematic reviews and meta-analyses suggest that the greatest practical relevance is associated with interventions targeting factors directly related to falls, such as balance impairment, lower-limb weakness, gait deterioration, and limited functional capacity.^{1,2,4,9,10}

On the basis of the analysed sources, exercise programmes should be regular, planned, and adapted to the capabilities of the older person.^{2–4} The importance of balance, functional, and strengthening exercises is particularly frequently emphasised.^{1,4,6,8–10} Increasing general physical activity alone may be beneficial to health; however, targeted exercises incorporating balance, strength, gait control, and functional-performance components appear to be of greater importance in fall prevention.^{2,4,6,9}

Balance training is an important component of fall prevention. Study findings indicate that exercises improving postural stability may beneficially affect parameters associated with fall risk, particularly among older adults living at home or remaining independently ambulatory.^{1,2,9} Balance training should be complemented by strength training, primarily targeting the lower-limb muscles, because reduced muscle strength is one of the factors increasing the risk of loss of balance and loss of independence.^{6,8,9} Combining both forms of activity in multicomponent programmes appears most justified.^{2,4,5,9,10}

The analysed publications also indicate the potential usefulness of selected training methods. Tai Chi and Tai Ji Quan have been studied as forms of activity targeting balance, postural control, gait, and fear of falling. The findings suggest that they may constitute valuable components of fall prevention, particularly for older adults who can safely perform exercises in a standing position. At the same time, some studies assessed intermediate parameters, such as balance, postural control, gait variability, or fear of falling, rather than fall incidence itself.^{7,14–19}

The Otago programme is an example of a home-based intervention based primarily on balance and strengthening exercises. The analysed studies evaluated both conventional and modified versions of the programme, including versions delivered through telerehabilitation. These approaches may be of practical importance for older adults with limited access to in-person

classes or who require exercises that can be performed at home. It should be emphasised, however, that the effectiveness of such programmes depends on regular participation, safe exercise performance, and appropriate supervision or instruction.^{20–22}

The literature also describes other forms of activity, including Pilates, lifestyle-integrated exercise, whole-body vibration training, exergames, online programmes, mHealth interventions, and activity-monitoring devices.^{12,13,23–35} These approaches may improve selected fall-related parameters, such as balance, physical performance, lower-limb function, fear of falling, quality of life, or physical activity.^{12,13,23–30,32–35} Their findings should nevertheless be interpreted cautiously because some studies involved small samples, had pilot designs, or assessed mainly intermediate indicators rather than the actual number of falls.^{24–28,30,32–35}

An important limitation of the analysed evidence is the heterogeneity of interventions, their duration and intensity, modes of supervision, participant characteristics, and outcome measures.^{2–5} This makes it difficult to identify a single best exercise programme for all older adults. In practice, management must therefore be individualised. Exercise programmes should take into account age, functional level, previous falls, comorbidities, fear of falling, cognitive capacity, housing conditions, and participant preferences.^{2,3,11}

In summary, physical exercise is an important component of fall prevention among older adults. Programmes combining balance, functional, and strengthening exercises, performed regularly and adapted to the participant's level of physical function, are the most justified.^{1,2,4,6,8–10} Tai Chi, Tai Ji Quan, the Otago programme, Pilates, LiFE, vibration training, and digital solutions may complement preventive practice; however, their selection should depend on the older person's needs, capabilities, and safety.^{7,12–35} Further research should focus on determining the optimal exercise dose, intervention duration, durability of achieved effects, and effectiveness of individual programmes in different groups of older adults.^{2–5,9}

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