Exercise for preventing falls in older people living in the community: an abridged Cochrane systematic Review

Sherrington, Cathie; Fairhall, Nicola; Wallbank, Geraldine; Tiedemann, Anne; Michaleff, Zoe A; Howard, Kirsten; Clemson, Lindy; Hopewell, Sally; Lamb, Sarah

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Complete List of Authors:	Sherrington, Cathie; University of Sydney - Camperdown and Darlington Campus, Institute for Musculoskeletal Health Fairhall, Nicola; University of Sydney - Camperdown and Darlington Campus, Institute for Musculoskeletal Health Wallbank, Geraldine; University of Sydney - Camperdown and Darlington Campus, Institute for Musculoskeletal Health Tiedemann, Anne; The University of Sydney, Musculoskeletal Health Sydney, School of Public Health Michaleff, Zoe; University of Sydney - Camperdown and Darlington Campus, Institute for Musculoskeletal Health Howard, Kirsten; The University of Sydney, School of Public Health Clemson, Lindy; The University of Sydney, Faculty of Health Sciences Hopewell, Sally; University of Oxford, Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences Lamb, Sarah; University of Oxford, NDORMS
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Exercise for preventing falls in older people living in the community: a Cochrane systematic review

Sherrington C[1], Fairhall NJ[1], Wallbank GK[1], Tiedemann A[1], Michaleff ZA[1], Howard K[2], Clemson L[2], Hopewell S[3], Lamb SE[3].

[1]Institute for Musculoskeletal Health, School of Public Health, Faculty of Medicine and Health, The University of Sydney, Sydney, Australia.
[2]School of Public Health, The University of Sydney, Sydney, Australia.
[3]Faculty of Health Sciences, The University of Sydney, Lidcombe, Australia.
[4]Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences (NDORMS), University of Oxford, Oxford, UK

Objectives

To assess the effects of exercise interventions for preventing falls in older people living in the community.

Selection criteria

We included randomised controlled trials evaluating the effects of any form of exercise as a single intervention on falls in people aged 60+ years living in the community.

Results

Exercise reduces the rate of falls by 23% (rate ratio (RaR) 0.77, 95% confidence interval (CI) 0.71 to 0.83; 12,981 participants, 59 studies; high-certainty evidence). Subgroup analyses showed no evidence of a difference in effect on falls on the basis of risk of falling as a trial inclusion criterion, participant age 75 years+ or group versus individual exercise but revealed a larger effect of exercise in trials where interventions were delivered by a health professional (usually a physiotherapist).

Different forms of exercise had different impacts on falls. Compared with control, balance and functional exercises reduce the rate of falls by 24% (RaR 0.76, 95% CI 0.70 to 0.81; 7920 participants, 39 studies; high-certainty evidence). Multiple types of exercise (commonly

balance and functional exercises plus resistance exercises) probably reduce the rate of falls by 34% (RaR 0.66, 95% CI 0.50 to 0.88; 1374 participants, 11 studies; moderate-certainty evidence). Tai Chi may reduce the rate of falls by 19% (RaR 0.81, 95% CI 0.67 to 0.99; 2655 participants, 7 studies; low-certainty evidence). We are uncertain of the effects of programmes that are primarily involve resistance training, dance or walking.

Conclusions and implications

Given the certainty of evidence, effective programmes should now be implemented.

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Introduction

At least one-third of community-dwelling people over 65 years of age fall each year (Campbell 1990; Tinetti 1988), and the rate of fall-related injuries increases with age (Peel 2002). Falls can have serious consequences, such as fractures and head injuries (Peel 2002).

Falls are associated with reduced quality of life (Stenhagen 2014), and can have psychological consequences: fear of falling and loss of confidence that can result in self-restricted activity levels leading to a reduction in physical function and social interactions (Yardley 2002). Paradoxically, this restriction of activities may increase the risk of further falls by contributing to deterioration in physical abilities.

A previous Cochrane Review found exercise as a single intervention, prevents falls (Gillespie 2012), and to be the most commonly tested single fall prevention intervention. Economic evaluations accompanying randomised trials have found exercise to be a cost effective fall-prevention strategy (Davis 2010). Exercise interventions have been found to be effective when delivered in a group-based setting or on an individual basis. The optimal features of successful fall prevention exercise programmes are not yet clear, but programmes that are multicomponent (e.g. target both strength and balance; Gillespie 2012), and programmes that include balance training appear to be particularly effective (Sherrington 2017).

An update of the effects of exercise interventions on falls is warranted given the number of new trials published, the increasing number of older people living in the community and the major long-term consequences associated with falls and fall-related injuries to both the individual and to society. Different exercise programmes may have different effects on falls and so careful analysis of the impact of different programmes is crucial to optimise the prescription of exercise interventions and inform public health promotion initiatives for healthy ageing.

This systematic review of randomised controlled trials aimed to assess the effects of exercise interventions for preventing falls in older people living in the community when compared to control. The present report focuses on the review's primary outcome, rate of falls. Please refer to the full Cochrane review (Sherrington et al, 2019) for reports of other outcomes as well as more detailed methods, descriptions of included studies and forest plots.

Methods

Protocol

The protocol for this review was published (ref)

Eligibility criteria

We included randomised controlled trials (RCTs), either individual or cluster randomised, evaluating the effects of exercise interventions on falls or fall-related fractures in older people living in the community. We included trials if they specified an inclusion criterion of 60 years of age or over. Trials that included younger participants were included if the mean age minus one standard deviation was more than 60 years. We included trials where the majority of participants were living in the community, either at home or in places of residence that, on the whole, do not provide residential health-related care or rehabilitative services; for example, retirement villages, or sheltered housing. We excluded studies that only included participants affected by particular clinical conditions that increase the risk of falls, such as stroke, Parkinson's disease, multiple sclerosis, dementia, hip fracture and severe visual impairment. Several of these topic areas are covered by other Cochrane Reviews (Canning 2015; Verheyden 2013). We acknowledge that some individuals with these (and other) health conditions may be included in studies of the general community; these we included. This review included all exercise interventions tested in trials that measured falls in older people. The intention was to include trials where exercise was a single intervention as opposed to a component of a broader intervention. We included trials where an additional low-contact intervention (e.g. information on fall prevention) was given to one or both groups if we judged that the main purpose of the study was to investigate the role of exercise.

Information sources and search

Our search extended the searches performed up to February 2012 in Gillespie 2012. We searched: the Cochrane Bone, Joint and Muscle Trauma Group Specialised Register (February 2012 to 2 May 2018); the Cochrane Central Register of Controlled Trials. (CENTRAL) (Cochrane Register of StudiesOnline) (2012 Issue 2 to 2018 Issue 5);MEDLINE (including Epub Ahead of Print, In-Process & Other Non-Indexed Citations and MEDLINE Daily) (January 2012 to 30 April 2018); Embase (March 2012 to 2018 Week 18); the Cumulative Index to Nursing and Allied Health Literature (CINAHL) (February

2012 to 2 May 2018); and the Physiotherapy EvidenceDatabase (PEDro) (2012 to 2May 2018), using tailored search strategies. We did not apply any language restrictions. In MEDLINE, we combined subject-specific search terms with the sensitivity- and precision-maximising version of the Cochrane Highly Sensitive Search Strategy for identifying randomised trials (Lefebvre 2011).The search strategies for CENTRAL, MEDLINE, Embase, CINAHL and PEDro are shown in Appendix 2 of Sherrington et al 2019, ref). We also searched the World Health Organisation International Clinical Trials Registry Platform (WHO ICTRP) and ClinicalTrials.gov for ongoing and recently completed trials (May 2018) (see Appendix 2 of Sherrington et al 2019, ref). We checked reference lists of other systematic reviews as well as contacting researchers in the field to assist in the identification of ongoing and recently completed trials.

Study selection

Pairs of review authors (CS, AT, NJF, ZAM) screened the title, abstract and descriptors of identified studies for possible inclusion. From the full text, two review authors (CS, AT, NJF, ZAM) independently assessed potentially eligible trials for inclusion and resolved any disagreement through discussion. We contacted authors for additional information as necessary.

Data collection process

Pairs of review authors (CS, AT, NJF, ZAM, GW) independently extracted data using a pretested data extraction form (based on the one used in Gillespie 2012). We extracted data from both newly included trials and those included in Gillespie 2012. For the latter trials, however, we primarily extracted information and data for additional outcomes that were not collected previously for Gillespie 2012. Disagreement was resolved by consensus or third party adjudication. Review authors were not blinded to authors and sources. Review authors did not assess their own trials.

Data items

Full details of data extracted are shown in Sherrington 2019. The present publication focuses on the primary outcome, the rate of falls. We grouped similar exercise interventions using the fall prevention classification system (taxonomy) developed by the Prevention of Falls Network Europe (ProFaNE) (Lamb 2011). For simplicity the ProFaNE category gait, balance, co-ordination or functional task training was referred to as balance and functional exercises. Full details are shown in Appendix 1 of Sherrington et 2019 (ref)

Risk of bias and certainty of evidence

Pairs of two review authors (CS, AT, NJF, ZAM, GW) independently assessed risk of bias using Cochrane's Risk of bias tool as described in the Cochrane Handbook (ref). We constructed and visually inspected funnel plots. We used the GRADE approach to assess the quality of evidence (Schünemann 2017). Using GRADEpro GDT (GRADEPro GDT 2015), we assessed the certainty of the evidence as 'high', 'moderate', 'low' or 'very low' depending on the presence and extent of five factors: risk of bias; inconsistency of effect; indirectness; imprecision; and publication bias. We prepared 'Summary of finding' tables. We used standardised qualitative statements to describe the different combinations of effect size and the certainty of evidence (Cochrane Norway 2017).

Synthesis of results

We reported the treatment effects for rate of falls as rate ratios (RaRs) with 95% confidence intervals (CIs). We assessed heterogeneity of treatment effects by visual inspection of forest plots and by using the Chi^2 test (with a significance level at $P < 0.10$) and the I^2 statistic. For our primary comparison, we pooled data from all relevant trials without stratification.

We undertook subgroup analyses to compare the effect of exercise on falls in trials that did and did not use an increased risk of falls as an inclusion criterion and in trials with predominantly older populations (defined by inclusion criteria 75 years or above, lower range limit more than 75 years, or mean age minus one standard deviation more than 75 years) compared with those with predominantly younger populations. We also assessed the impact of individual versus group-based exercise, exercise delivered by people with different qualifications (e.g. health professionals versus trained fitness leaders) and the different ProFaNE exercise intervention categories. We used the test for subgroup differences available in Review Manager 2014 to determine whether there was evidence for a difference in treatment effect between subgroups. We carried out 10 sensitivity analyses to explore the stability of the results.

Results

Study selection

Figure 1 (Sherrington 2019) shows the flow of records. In brief, after downloading 8007 potentially eligible new records and 359 studies from previous reviews, the final round of study selection (based on 235 reports) resulted in the inclusion of 108 studies (194 reports), the exclusion of 21 studies (23 reports) and identification of 16 ongoing studies.

Study characteristics

The 108 included studies were all randomised controlled trials (RCTs) and involved 23,407 participants. The majority of trials were individually randomised and nine were cluster randomised. The median number of participants randomised per trial was 134 (interquartile range (IQR) 65 to 262). The included trials were carried out in 25 countries, the most common being Australia (19 trials), USA (18 trials), Japan (11 trials) and the UK (7 trials). Overall, 77% of included participants were women. All participants were women in 28 trials and men in one trial. The average of average participant ages in the included trials was 76 years. Sixty included studies (56%) specified a history of falling or evidence of one or more risk factors for falling in their inclusion criteria. Seventy-two trials (67%) excluded participants with cognitive impairment, either defined as an exclusion criterion or implied by the stated requirement to be able to give informed consent.

Risk of bias within studies

We judged the risk of bias in generation of the allocation sequence as low in 67% (n = 72/108) of trials, unclear in 33% (n = 36/108) and high in zero trials. We assessed the methods of concealment of the allocation prior to group assignment as low risk of bias in 35% (n = 38/108), unclear in 60% (n = 65/108) and high in the remaining 5% (5/108) of trials. In the majority of studies (90%, n = 97/108) it was not possible to blind the personnel and participants to group allocation. As the likelihood of awareness of group allocation introducing performance bias was not clear, we assessed the risk of bias for nonblinding as unclear for these trials. We judged the impact of performance bias as low in 5% (n = 5/108) of trials, unclear in 89% (97/108) of trials and high in 6% (6/108) of trials. We judged the risk of detection bias in relation to the methods of ascertainment of the rate of falls to be low in 40% (n = 43/108), high in 21% (n = 23/108) and unclear in 39% (n = 42/108) of the included trials. We judged the risk of bias due to incomplete outcome data to be low in 53%

(n = 57/108), unclear in 20% (n = 22/108) and high in the remaining 27% of trials (n = 29/108). We assessed the risk of bias due to selective reporting of falls outcomes as low in 12% (n = 13/108) of studies, unclear in 40% (n= 43/108) and high in 48% (52/108). We assessed 58% of included studies (n = 63/108) as being at low risk of bias in the recall of falls (i.e. falls were recorded concurrently using recommended methods of monthly diaries or postcards). We judged the risk of bias to be high in 27% of trials (n = 29/108), in that ascertainment of falling episodes was by participant recall, at intervals during the study or at its conclusion. In 15% of trials (n = 16/108) the risk of bias was unclear, as retrospective recall was for a short period only, or details of ascertainment were not described.

Overall effects of exercise (all types)

Exercise (all types) reduces the rate of falls by 23% compared with control (rate ratio (RaR) 0.77, 95% confidence interval (CI) 0.71 to 0.83; 12,981 participants, 59 studies, I^2 = 55%; high-certainty evidence).

Subgroup analysis by falls risk at baseline, found there was probably little or no difference in the effect of exercise (all types) on the rate of falls in trials where all participants were at an increased risk of falling (RaR 0.80, 95% CI 0.72 to 0.88; 6858 participants, 30 studies, I^2 = 56%) compared with trials that did not use increased risk of falling as an entry criterion (RaR 0.74, 95% CI 0.65 to 0.84; 6123 participants, 29 studies, I^2 = 53%); test for subgroup differences: Chi^2 = 0.90, df = 1, P = 0.34, I^2 = 0%.

Subgroup analysis by participant age found there was probably little or no difference in the effect of exercise (all types) on the rate of falls in trials where participants were aged 75 years or older (RaR 0.83, 95% CI 0.72 to 0.97; 3376 participants, 13 studies, I^2 = 54%) compared with trials where participants were aged less than 75 years (RaR 0.75, 95%CI 0.69 to 0.82; 9605 participants, 46 studies, I^2 = 55%); test for subgroup differences: Chi^2 = 1.36, df = 1, P = 0.24, I^2 = 27%.

Subgroup analyses found a larger effect of exercise (all types) in trials where interventions were delivered by a health professional (usually a physiotherapist, RaR 0.69, 95% CI 0.61 to 0.79; 4511 participants, 25 studies, I^2 = 47%) than in trials where the interventions were delivered by trained instructors who were not health professionals (RaR 0.82, 95%CI 0.75 to

0.90; 8470 participants, 34 studies, $I^2 = 57\%$); test for subgroup differences: $Chi^2 = 4.44$, df = 1, P = 0.04, $I^2 = 78\%$. Notably, both approaches resulted in reductions in the rate of falls.

Subgroup analyses found there may be no difference in the effect of exercise (all types) on the rate of falls where interventions were delivered in a group setting (RaR 0.76, 95%CI 0.69 to 0.85; 8163 participants, 40 studies, $I^2 = 62\%$) compared with trials where interventions were delivered individually (RaR 0.79, 95%CI 0.71 to 0.88; 4818 participants, 21 studies, $I^2= 35\%$); test for subgroup differences: $Chi^2 = 0.21$, df = 1, P = 0.65, IÇ = 0%.

Subgroup analysis by exercise type showed a variation in the effects of the different types of exercise on rate of falls, the visual impression being confirmed by the statistically significant test for subgroup differences: $Chi^2 = 17.18$, df = 5, P = 0.004, $I^2 = 70.9\%$.

Effects of different types of exercise

Exercise interventions that were classified as being primarily balance and functional reduce the rate of falls by 24% compared with control (RaR 0.76, 95% CI 0.70 to 0.81; 7920 participants, 39 studies, $I^2 = 29\%$, high-certainty evidence).

Exercise interventions that include multiple categories of the ProFaNE taxonomy (most commonly balance and functional exercises plus resistance exercises) probably reduce the rate of falls by 34% compared with controls (RaR 0.66, 95% CI 0.50 to 0.88; 1374 participants, 11 studies; $I^2 = 65\%$; moderate-certainty evidence). Sensitivity analyses revealed little difference in the results when we pooled only trials that include the most common two components (balance and functional exercises plus resistance exercises) (RaR 0.69, 95%CI 0.48 to 0.97; 1084 participants, 8 studies; $I^2 = 72\%$).

Exercise interventions that were classified as 3D (Tai Chi or similar) may reduce the rate of falls by 19% compared with control (RaR 0.81, 95% CI 0.67 to 0.99; 2655 participants, 7 studies, $I^2= 74\%$; low-certainty evidence).

We are uncertain whether exercises, classified as being primarily 3D (dance) using the ProFaNE taxonomy, reduce the rate of falls compared with control (RaR 1.34, 95% CI 0.98 to 1.83; 522 participants, 1 study; very low-certainty evidence).

We are uncertain whether interventions, classified as being primarily walking programmes using the ProFaNE taxonomy, reduce the rate of falls compared with control (RaR 1.14, 95% CI 0.66 to 1.97; 441 participants, 2 studies; $I^2 = 67\%$; very low-certainty evidence).

Heterogeneity and risk of bias across studies

This review's analyses display minimal to substantial heterogeneity with $P < 0.05$ for the Chi^2 test and I^2 values up to 74%. This variability was not explained by our subgroup analyses. We consider this likely to represent between-study differences in the exact nature of programmes (e.g. dose, intensity, adherence) and target populations, which requires ongoing investigation. Given the overall positive impact of the programmes and the stability of results, we do not consider this to preclude the meta-analyses we have undertaken. The funnel plots in did show some asymmetry but did not consider the asymmetry sufficient to downgrade the level of evidence.

Sensitivity analysis, GRADE assessment

The nine sensitivity analyses (based on age of included participants, risk of bias, cluster trials, fixed-effect analyses, and categorisation of interventions) made little difference to the results of the primary pooled analysis (full details shown in Appendix 18, Sherrington et al 2019 ref). This indicates the robustness of the review's primary findings and methods. In undertaking the GRADE assessment we downgraded the certainty of evidence based on sensitivity analysis (removal of trials with one or more items at high risk of bias) for the following comparisons of resistance exercises, Tai Chi and walking programme versus control.

Discussion

There is high-certainty evidence from 59 randomised controlled trials that exercise reduces the rate of falls in older adults living in the general community. Subgroup analyses did not reveal differences in effect according to whether trials were selected for high risk of falling or not but the absolute numbers of falls prevented will be greater in the higher risk populations. Subgroup analyses did not reveal differences in effect on falls according to whether trials included younger and older populations based on a 75 year cut-off. There was, however, a greater reduction on the rate of falls from exercises (all types) in trials where interventions were delivered by a health professional than in trials where trained instructors who were not health professionals delivered the interventions; however, both approaches reduced the rate of falls. Subgroup analyses did not reveal differences in effect on falls according to whether interventions were delivered in a group setting or delivered individually. When sub-grouped by exercise type there were significant subgroup differences for rate of falls, a finding that endorsed our prespecified intention to report separate analyses by primary exercise type. Exercise programmes that reduce falls primarily involve balance and functional exercises, while programmes that probably reduce falls include multiple exercise categories (typically balance and functional exercises plus resistance exercises). Tai Chi may also prevent falls but we are uncertain of the effect of resistance exercise (without balance and functional exercises), dance, or walking on the rate of falls.

Despite our thorough search strategy, we acknowledge the possibility that some relevant trials may have been missed, especially if they were published in languages other than English. Two review authors independently classified the exercise interventions using the ProFaNE guidelines (Lamb 2011), including assigning intervention categories to primary or secondary status. We recognise there is some subjectivity in this classification system, particularly for those interventions containing more than one category of exercise. Sensitivity analyses that tested the effects of re-categorising primary balance and functional exercise trials with a secondary component of strength training indicated that this did not importantly affect the results.

Our review adds to the existing body of evidence and supports the findings of Gillespie 2012, whereby multiple component group-based exercise was found to reduce the rate of falls. We extended the findings of Gillespie 2012 by recoding intervention programmes, in an attempt to identify a primary exercise component for each included study and reserving the 'multiple component' category for trials in which the intervention programme had an equal focus on each of the multiple components. As a result, more studies in our review are classified as balance and functional exercises and fewer as multiple component programmes. The present review also adds to our previous non-Cochrane review (Sherrington 2017), that used different methodology (multivariable meta-regression) yet reached similar conclusions about the importance of the inclusion of exercises that safely challenge balance in fall prevention exercise programmes. Other recent analyses have reached similar findings, including a large network meta-analysis (Tricco 2017).

Further work is needed to understand the relative impact of different exercise programmes. Such studies will need to be very large to be adequately powered to detect effects between interventions. Large studies are also needed to establish the impact of fall prevention interventions on fall-related fractures and falls requiring medical attention, as such falls are particularly costly to health systems and impactful for individuals. When developing priority topics for future research, the current evidence base should be considered in conjunction with the areas studied in the ongoing trials. Individual participant data meta-analysis could contribute further to the investigation of differential effects of exercise in people of different ages and baseline fall risks, as these are individual-level rather than trial-level characteristics. We recommend researchers follow the Prevention of Falls Network Europe (ProFaNE) guidelines for the conduct of falls trials (Lamb 2005). Further research is required to establish the effectiveness of fall prevention programmes in emerging economies, where the burden of falls is increasing more rapidly than in high-income countries due to rapidly ageing populations (WHO 2015). There is an urgent need to investigate strategies to enhance implementation of effective exercise-based fall prevention interventions into routine care of older people by healthcare professionals and community organisations. As it is possible that interventions designed to increase physical activity could increase falls due to increased exposure to risk, we suggest that those undertaking trials of physical activity interventions in older people consider monitoring falls. Future studies should use the consensus definition of a fall developed for trials in community-dwelling populations by ProFaNE (Lamb 2005), consistent methods of falls ascertainment, and consistent measurement of adverse events in both groups throughout the trial period. Future research should use the ProFaNE descriptors to categorise interventions (Lamb 2011), but should be clear how this was operationalised.

The importance of exercise in fall prevention suggests that greater attention be given to the widespread implementation of a life course approach to healthy ageing, i.e. lifelong exercise to maximise physical functioning in older age, as suggested by the World Health Organization (WHO 2015). Although trial follow-up ranged from 3 to 18 months in the main comparison, there are likely to be longer-term benefits of introducing fall prevention exercise habits in people in the general community. Notably too, the duration of most of the exercise programmes was 12 weeks or over and nearly one-third lasted a year or more. These findings highlight the importance of ongoing exercise.

In conclusion, this review provides high-certainty evidence that well-designed exercise programmes reduce the rate of falls amongst older people living in the community. Greater provision and implementation of these programmes is an urgent challenge for the global sport and exercise medicine community and broader health and social support systems.

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References

Suggest use the references from the above text only and refer the reader to Sherrington et al 2019 for other references.

Figures

Figure 1. Flow of studies (Figure 1 from Sherrington et al 2019).

Figure 2. Funnel plot (Figure 4 from Sherrington et al 2019)

Table 1. Summary of findings table made up of the fall rate row from the main Summary of Findings table in Sherrington et al 2019 and the rate of falls rows from the additional Summary of Findings table in Sherrington et al 2019.

Cathie Sherrington

Digitally signed by Cathie Sherrington
DN: cn=Cathie Sherrington, o, ou, email=cathie.sherrington@sydney.edu.au, c=AU
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