A meta-analysis of exercise programmes for preventing falls in older people
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CRD summary
This review assessed the effectiveness of exercise programmes in preventing falls and improving balance and muscle strength in older people. The authors concluded that there is an overall, marginally significant, benefit of exercise, but further studies are recommended. The limited search and lack of a quality assessment of the included studies make it difficult to assess the reliability of the results.

Authors' objectives
To assess the effectiveness of exercise programmes in preventing falls and improving balance and muscle strength in older people.

Searching
MEDLINE and CINAHL were searched from inception to 2003; the search terms were reported. The authors also checked the reference lists of retrieved articles and review articles. Studies published in English after 1990 were included in the review.

Study selection
Study designs of evaluations included in the review
Quasi-experimental and randomised controlled prospective intervention trials were eligible for inclusion.

Specific interventions included in the review
Studies that evaluated exercise programme(s) of any duration, frequency and intensity were eligible for inclusion. Studies that used multi-factorial interventions (behavioural modification, education or removal of environmental hazards) in all treatment groups were included, whereas those that only used multi-factorial interventions in the intervention group were excluded. The types of exercise programme in the primary studies included strength balance, aerobic strength balance, stretching, endurance strength, strength walking, physiotherapy and mobility balance. Where stated, interventions differed between studies with respect to the duration of the exercise programmes (range: 30 days to 1 year), the frequency of the programmes (range: 1 to 3 times per week), and the total exercise time (range: 90 to 270 minutes per week).

Participants included in the review
Studies of older people were eligible for inclusion. Studies of patients with osteoporosis were not eligible for inclusion. The mean age of the participants ranged from 71 to 84 years. The proportion of participants that had fallen in the previous year ranged from 22 to 86%. Eighty-four per cent of the included participants were female. The majority of studies included community-residing older people; others included patients from the rehabilitation ward of a geriatric hospital or geriatric out-patients who had completed ward rehabilitation following hospitalisation.

Outcomes assessed in the review
Studies that reported fall frequency in addition to balance and/or muscle strength were eligible for inclusion. Studies that reported the total number of falls or rate of falls, but did not report the numbers of participants who had fallen and not fallen in each group, were excluded. A fall was defined as an event that resulted in a person coming to rest unintentionally on the ground or some other lower level, not as the result of a major intrinsic event (e.g. stroke or syncope) or an overwhelming hazard. All included studies but one used this definition; the other study defined a fall as an accidental collapse to the ground that ultimately resulted in the completion of an accident report form by the nursing staff. The included studies assessed ankle and knee strength.

How were decisions on the relevance of primary studies made?
The authors did not state how the papers were selected for the review, or how many reviewers performed the selection.
Assessment of study quality  
The authors stated that validity was assessed, but did not state what criteria were used.  
The authors stated that two reviewers independently evaluated the validity of the studies.

Data extraction  
Two reviewers independently extracted the data. The reviewers calculated the fall rate in the intervention and control groups using data on the numbers of participants who had and had not fallen in each group. They then calculated the difference in fall rate by subtracting the fall rate of the exercise group from the fall rate of the control group. The odds ratio (OR), risk difference and relative risk were also calculated, along with their 95% confidence interval (CI) or standard error (SE).

The standardised net increase in balance and muscle strength was calculated as the mean difference (exercise minus control) of the change (post-measurement minus pre-measurement) divided by the standard deviation. The associated 95% CI or SE was also presented.

Methods of synthesis  
How were the studies combined?  
The differences in fall rate, relative risks, ORs and increase in balance and muscle strength were pooled, but the authors did not report the methods used to pool the data.

How were differences between studies investigated?  
Statistical heterogeneity was assessed using the Q statistic and differences between the studies were described in the text. The authors assessed whether there was an association between post-intervention fall risk and compliance rate, and also between post-intervention fall rate and baseline fall rate. The meta-analyses were repeated after excluding one study in which muscle strength decreased markedly in the control group resulting in a large effect size.

Results of the review  
Eight trials (n=843) were included in the review: 6 randomised controlled trials (RCTs) and 2 quasi-experimental studies in which the treatment centre, rather than the patient, was randomly assigned.

Five trials assessed compliance with the exercise programme. The proportion of patients who adhered to the entire programme ranged from 42 to 93% (4 trials), while the proportion of sessions that the participants attended ranged from 73 to 95% (4 trials).

Exercise had a marginally significant effect on fall rate, reducing it by 6.2% (95% CI: 0, 12.7, P=0.06) with no evidence of significant heterogeneity (Q=6.11, P=0.53). The pooled OR was not statistically significant (0.79, 95% CI: 0.59, 1.05, P=0.10).

There was a statistically significant improvement in balance after exercise therapy (7 studies: effect size 0.32, 95% CI: 0.17, 0.47, P<0.0001). However, there was evidence of statistically significant heterogeneity between the studies (P<0.0001).

There were statistically significant improvements in ankle muscle strength (effect size 0.42, 95% CI: 0.25, 0.59, P<0.0001) and knee muscle strength (effect size 1.11, 95% CI: 0.90, 1.32, P<0.0001) after exercise therapy. However, there was evidence of statistically significant heterogeneity between the studies (P<0.001 for both).

There was no significant association between post-intervention fall risk and compliance rate, or between post-intervention fall rate and baseline fall rate.

Authors' conclusions
There is an overall, marginally significant, benefit of exercise in preventing falls and improving balance and muscle strength in older people. The authors made recommendations for future research.

**CRD commentary**

The review question was clear in terms of the study designs, participants, interventions and outcomes of interest. The authors searched two relevant electronic databases for studies. However, they only included studies published in English and made no attempts to identify unpublished studies, thereby increasing the potential for publication and language biases. Two reviewers undertook the data extraction and validity assessment processes, but the authors did not state how any disagreements were resolved. The authors did not state how studies were selected for the review, thus the potential for reviewer bias and error cannot be assessed. Whilst the authors stated that the validity of the studies was assessed, the criteria used and the results of the assessment were not reported. Although appropriate measures of effect were calculated and heterogeneity was assessed, the authors did not report the methods used to pool the data.

The authors’ conclusions appear to be supported by the review findings. However, given that other relevant studies might have been missed and details of the validity assessment were lacking, the reliability of the included studies, and thus the review, cannot be assured.

**Implications of the review for practice and research**

**Practice:** The authors did not state any implications for practice.

**Research:** The authors stated that as additional studies are published, a meta-analysis should be carried out in the future. They recommended that, in future, researchers should provide detailed descriptions of exercise programmes, participants' health and functional conditions, medications and activity levels in order to examine fall reduction after adjusting for activity level and individual characteristics related to fall risk.

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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.