Effective exercise for the prevention of falls: a systematic review and meta-analysis

CRD summary
This review concluded that exercise could reduce falls in older people. Greater relative effects were seen in programmes including exercises that challenged balance, that used a higher dose of exercise and that did not include a walking programme. However, these conclusions may not be reliable, given the possible inappropriate pooling of trials and optimistic interpretation of meta-regression analyses.

Authors' objectives
To determine the effects of exercise on prevention of falls in older people, and to evaluate the effects of trial characteristics or components of exercise programmes on the reduction of falls.

Searching
MEDLINE, EMBASE and CINHAL, PubMed, PEDRO, SafetyLit and the Prevention of Falls Network Europe were searched in May 2007. Search terms from a relevant Cochrane review were used and the reference list of this and other reviews were checked for additional references. The updated search results of the trial search co-ordinator of the Cochrane Bone, Joint and Muscle Trauma Group were also examined. Published studies were included.

Study selection
Randomised, controlled trials (RCTs) of older people in which exercise was the primary intervention, and that reported the number of falls, the number of people who fell or the rate of falls, were eligible for inclusion. Trials in which non-exercise interventions were a major component (more than 25% of time), or trials in which the control group received exercise, were excluded.

Most of the included trials were conducted in older people living in the general community and only included participants that could be defined as being at greater risk of falls. Most of the exercise programmes evaluated were supervised (with less than 10 participants per instructor) and the intensity or type of exercise was tailored to the individual.

Studies were selected independently by two reviewers and differences resolved by discussion.

Assessment of study quality
Methodological quality was assessed in terms of allocation concealment and intention-to-treat analysis.

The number of reviewers that assessed study quality was not reported.

Data extraction
Incidence rate ratios (from negative binomial regression models), person-time analyses, and hazard ratios (from proportional hazards models that allowed for multiple falls) were extracted where possible from each trial. Where these were not available, total number of falls or number of falls per person, and exposure times (person-years of follow-up using actual follow-up times and number of participants providing data, where reported) were extracted to calculate incidence rate ratios. Three trials only reported the incidence proportions of fallers and two trials only reported hazard ratios for time to first fall; these were used as an estimate of the incidence rate ratios. Where possible unadjusted falls rates and longer follow-up times were used.

Data were extracted by two reviewers and disagreements resolved by discussion.

Methods of synthesis
Incidence rate ratios (IRRs) were pooled in a random-effects meta-analysis. Statistical heterogeneity was calculated.
using $I^2$ and Q statistics, and investigated using a random-effects meta-regression. Publication bias was assessed using Egger's test and a funnel plot. Sensitivity analyses were also conducted to examine the effect of excluding trials for which only risk ratios (RR) and hazard ratios (HRs) were available and excluding cluster randomised trials.

**Results of the review**

Forty-four RCTs (including 49 estimates of the effects of exercise) were included in the meta-analysis (n=9,603 participants). Four trials were cluster randomised. Sixteen trials reported allocation concealment. Twenty-two trials reported intention-to-treat analysis.

**Effects of exercise on fall rates:** Exercise was associated with a decrease in fall rates compared with control (IRR 0.83, 95% CI: 0.75 to 0.91) and this was associated with statistically significant heterogeneity ($I^2$ 62%, Q 125.5, p<0.001). Sensitivity analyses showed similar results. There was no evidence of publication bias.

**Trial-level determinants of effects of exercise:** The programme characteristics that explained most variability in the effects of exercise on fall rates were the total dose of exercise (22%, dichotomised as up to 50 hours over the trial period) and the presence of highly challenging balance training within the exercise programme (19%). The presence of either of these features was associated with a statistically significant decrease in fall rates: for dose, ratio of rate ratios 0.80 (95% CI: 0.65 to 0.99); for balance training, ratio of rate ratios 0.76 (95% CI: 0.62 to 0.93). There was a significantly greater effect of exercise in trials in which the control group had an average fall rate of two or more per person-year, ratio of rate ratios 1.36 (95% CI: 1.05 to 1.77). A meta-regression found that the greatest effects of exercise on falls were obtained from programmes that challenged balance to a high extent, included a higher total dose of exercise and did not include a walking programme (RR 0.58, 95% CI: 0.48 to 0.69), and each variable was independently and significantly associated with the effect of exercise on falls (p<0.05).

**Authors' conclusions**

Exercise could reduce falls in older people. Greater relative effects were seen in programmes that included exercises that challenged balance, used a higher dose of exercise and did not include a walking programme.

**CRD commentary**

The review question was supported by inclusion criteria for participants, intervention, outcomes and study design. As unpublished studies were not sought, publication bias was possible, but this was assessed and no publication bias was found. The authors did not report whether language restrictions were applied to the searches, so language bias was a possibility. A limited validity assessment was performed and less than half the included trials reported allocation concealment, and only half reported intention-to-treat analysis, indicating that overall quality was possibly low. Some aspects, such as blinding and method of randomisation, were not examined. Study selection and data extraction were performed in duplicate, reducing possible bias and error, but it was not reported whether similar steps were taken for validity assessment. Significant statistical heterogeneity was present, so pooling of the trials may not have been appropriate, indicating that the overall finding, that exercise was associated with a decrease in falls, may not be reliable. Meta-regression did not prove causality, so the conclusions regarding relative effects of exercise components may have been over-stated. As there was possible inappropriate pooling of trials and optimistic interpretation of meta-regression results, the authors' conclusions may not be reliable.

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

**Practice:** The authors stated that service providers can use the findings of this review to design and implement exercise programmes for preventing falls.

**Research:** The authors did not state any implications for research.

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Record Status
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.