A meta-analysis of fall prevention programs for the elderly: how effective are they?

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Authors' objectives
To assess the effects of fall prevention programmes on the proportion of falls in the elderly.

Searching
MEDLINE (from 1966 to 1999) and CINAHL (from 1982 to 1999) were searched using combinations of the keywords 'aged or elderly', 'falls', 'fall prevention', 'accidental falls', 'interventions', 'intervention studies', 'experimental studies' and 'results'. The searches were restricted to articles published in the English language. Citation searches of the Social Sciences Citation Index and the Science Citation Index were then undertaken using eleven of the abstracts that had variables of interest. The authors also checked the references of articles that were identified for inclusion.

Study selection
Study designs of evaluations included in the review
Controlled studies were eligible for inclusion. Randomised controlled trials (RCTs) and quasi-experimental studies were included.

Specific interventions included in the review
Studies that assessed a fall prevention intervention were eligible for inclusion in the review. The specific interventions included were exercise-focused interventions (3 studies), a combination of exercise intervention and some other form of risk modification (5 studies), interdisciplinary comprehensive risk assessment with recommendations made for specific interventions based upon the assessment (3 studies), and community education related to fall prevention with environmental modification made by the participant (1 study).

Participants included in the review
Studies of participants aged 60 years or older were eligible for inclusion. The studies included a large proportion of women (overall 79.5%). The mean age of the participants was 76.5 years. Of the total population studied, 2,938 were living in the community (8 studies), 597 were in long-term care (2 studies), 160 were in residential care with varying levels of support (1 study) and 379 were in a hospital (1 study).

Outcomes assessed in the review
Studies which gave sufficient information to determine the rate of the difference in falls as the outcome measure, and which reported the number of participants in the study groups, were eligible for inclusion. The primary outcome of interest was the difference in the proportion of falls between the treatment and control groups.

How were decisions on the relevance of primary studies made?
Two reviewers independently assessed the studies for inclusion, and any disagreements were resolved through consensus with a third reviewer.

Assessment of study quality
The authors assessed the validity of the primary studies using a modified version of the 'Research Quality Scoring Method' described by Sackett and Haynes (see Other Publications of Related Interest no.1). Study design, the clarity of the outcome construct definition (i.e. falls), the outcome measure (subjective or objective), and the length of assessment were all assessed. One reviewer undertook the validity assessment, with two further reviewers then applying the quality rating scale to four randomly selected studies. The intra-class correlation coefficient (ICC) among the three raters was 0.905 (95% confidence interval, CI: 0.80, 0.96) with an average measure ICC of 0.97 (95% CI: 0.92, 0.99). When the primary rater was paired with each of the other two raters, the ICCs 1.0 and 0.86.
Data extraction
The data were extracted by one reviewer, while another reviewer extracted the data for three randomly selected articles in order to assess the inter-rater reliability. Coder agreement was initially 91%. The coders then reviewed those items for which there was a lack of agreement and consensus was reached. The following data were extracted: study details, setting, country, time to outcome measure, study design, type of fall prevention intervention, the number of participants in the study sample, the proportion of falls for the treatment and control groups, and the study quality. The effect size (d) was calculated for each of the individual studies using the difference between population proportions formula (see Other Publications of Related Interest no.2). Specifically, the effect size was calculated by subtracting the proportion of falls for the experimental group from that for the control group, so that a positive effect size favoured the experimental group.

Methods of synthesis
How were the studies combined?
An overall mean weighted effect size (MWES) and 95% CI were calculated for the 12 studies, weighting for study variance. To explore the effectiveness of the three major types of interventions combined in the meta-analysis, a MWES was calculated for the studies using an exercise intervention alone, those using an exercise and risk factor modification intervention, and those using an interdisciplinary comprehensive risk assessment (CRA) approach. Study setting (i.e. community-based and institutional) was then examined, again using the MWES. Finally, because the studies differed in the time point at which the outcome was measured, the studies were grouped based on time (12 months versus 4 months or less). Publication bias was assessed through calculation of the 'fail-safe n' (see Other Publications of Related Interest no.2) and through examination of a funnel plot (see Other Publications of Related Interest no.3).

How were differences between studies investigated?
The variability of the effect sizes was examined for the complete set of studies and within subsets of studies, using the Q statistic. When the test for heterogeneity of variance in the effect sizes of the 12 studies was found to be significant (p=0.10), partitioning of the variance was performed. A sensitivity analysis was then performed, based on the study quality rating.

Results of the review
A total of 12 studies (n=4,074) were included: 7 RCTs (n=2,743) and 5 quasi-experimental studies (n=1,331).

The overall MWES for the 12 studies was 0.0779 (Z=5.03; p<0.001; 95% CI: 0.0475, 0.1083). Therefore, across the 12 studies, the results indicated the intervention was effective in reducing the proportion of falls incurred.

Subgroup analysis by intervention: the MWES was 0.022 (Z=0.5303; p<0.05; 95% CI: -0.0593, 0.1033) for the exercise intervention studies, 0.0687 (Z=3.41; p<0.01; 95% CI: 0.0292, 0.108) for the exercise and risk factor modification studies, indicating a significant effect size for this combined intervention, and 0.1231 (Z=3.97; p<0.001; 95% CI: 0.0623, 0.1839) for the CRA studies. The results indicated that the results of the exercise interventions were not statistically significant. However, the MWES for the exercise combined with risk factor modification studies, and the CRA approach were statistically significant.

Setting: the MWES was 0.0972 (Z=5.37; p<0.001; 95% CI: 0.0617, 0.1327) for the community-based studies and 0.0237 (Z=0.7822; p=0.22; 95% CI: -0.0357, 0.0831) for the institution-based studies. The results indicated that community-based interventions demonstrated a significant effect on the proportion of falls whereas institution-based interventions did not.

Time of outcome assessment: the MWES was 0.0905 (Z=5.43; p<0.001; 95% CI: 0.058, 0.123) for the 12-month group and -0.0972 (Z= -0.005; p=0.50; 95% CI: -0.081, 0.081) for the 4-month or less group (this result or CI is clearly mis-reported, as the result is not within the CI range).. The results indicated that studies which measured the proportion of falls at 12 months demonstrated significant effects, whereas those that measured them at 4 months or less did not.

Sensitivity analysis: 9 of the 12 studies scoring between 4 and 6 on the quality rating scale were assigned a high-
quality rating while the remaining 3 studies were assigned a low-quality rating. The MWES for the high-quality studies was 0.0812 (Z=4.86; p<0.001; 95% CI: 0.0485, 0.1139), while the MWES for the low-quality studies was 0.0593 (Z= 1.55; p=0.07) (95% CI: -0.0193, 0.1379). The results indicated that interventions in the high-quality studies demonstrated a significant reduction in the proportion of falls whereas the low-quality studies did not.

Publication bias: a fail-safe N of 56 was computed for the standardized Z of the 12 studies. The funnel plot of sample size versus effect size indicated no asymmetry in the distribution of the points. The characteristics of the plot indicated that publication bias was unlikely to have been a problem in the meta-analysis.

Authors' conclusions
The results of the meta-analysis indicated a 4% decrease in the rate of falls for individuals who were in the treatment groups receiving various fall prevention interventions. Additional intervention studies with the goal of preventing falls need to be conducted in the elderly.

CRD commentary
The authors addressed a well-defined review question in terms of the types of interventions, study design, participants and outcome measures that were to be assessed in the review. The literature search was adequate, although only studies published in the English language were searched for. This means that both unpublished studies and those published in other languages could have been missed. Two reviewers independently assessed the studies for inclusion, thus minimising any bias in the selection process. However, only one reviewer systematically undertook the validity assessment, and although the authors reported a strong correlation between the reviewers' assessments for the four studies that were also assessed by a further two reviewers, bias may have been introduced into the validity assessment process. Adequate details on the characteristics of the included studies were provided by the reviewers; these allow the reader to assess whether the results and conclusions are consistent with the primary studies included. The statistical analysis was appropriate, and heterogeneity between the results of the different studies was adequately explored.

Overall, whilst some bias may have been introduced into the review process, this a reasonable review. The authors' results and conclusions appear to be consistent with the evidence base reviewed.

Implications of the review for practice and research
Practice: The authors did not state any implications for practice.

Research: The authors state that additional studies are needed to enhance the effectiveness of fall prevention programmes. Consistently including the rate difference of falls as an outcome measure will permit additional meta-analyses to be conducted and promote the development of knowledge in this area.

Bibliographic details

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Other publications of related interest

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