Strategies to prevent falls and fractures in hospitals and care homes and effect of cognitive impairment: systematic review and meta-analysis


CRD summary
The review evaluated strategies to prevent falls or fractures in care home residents and hospital inpatients and investigated the effect of dementia and cognitive impairment. The authors concluded that there was positive evidence for multifaceted interventions in hospitals and hip protectors in care homes, but insufficient evidence for other interventions. The conclusions appear reliable but the review question may be too wide for clinical practice.

Authors’ objectives
To evaluate the evidence for strategies to prevent falls or fractures in care home residents and hospital inpatients and to investigate the effect of dementia and cognitive impairment.

Searching
MEDLINE, CINAHL, EMBASE, PsycINFO, the Cochrane Database of Systematic Reviews and the Cochrane CENTRAL Register were searched from inception to September 2004 for guidelines. In addition, references of guidelines and systematic or expert reviews were screened and the authors of the included studies were contacted for unpublished and ongoing trials. The search strategy was provided on the University of Reading, Institute of Health Sciences website (accessed 23/04/2007; http://www.reading.ac.uk/ihs/bmj_falls.htm).

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs), case-control studies and observational cohort studies were eligible for inclusion.

Specific interventions included in the review
Studies of interventions in hospitals or care homes, including interventions whose primary purpose was not fall prevention, were eligible for inclusion in the review. The studies were categorised as multifaceted and single interventions. The components of multifaceted interventions were varied and included risk assessment, risk factor assessment, care planning, medical or diagnostic approaches, changes in the physical environment, education programmes, medication review, hip protectors, removal of physical restrictions, and exercise. Single interventions included hip protectors in care homes, removal of physical restraints, fall alarm devices, exercise, changes in the physical environment, calcium and vitamin D supplements, and medication review.

Participants included in the review
Studies of patients in hospitals or care homes were eligible for inclusion. The participants in the included studies were mainly elderly people. The mean age ranged from 76 to 87 years, where reported.

Outcomes assessed in the review
Studies that reported the number or rate of falls or fractures or people who fell (fallers), and which reported data in such a way that the log rate ratios or log relative risks and variances could be calculated, were eligible for inclusion. The review addressed the outcomes of reported falls per person-year, fractures per 1,000 person-years and the percentage of people falling.

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. [A: Four pairs of assessors selected papers for the review.]
Assessment of study quality
Two reviewers independently assessed the papers using a published checklist (Downs and Black, 1998) covering a wide range of validity issues; a third reviewer arbitrated if necessary. A statistician scored statistical items on the checklist independently.

Data extraction
Two reviewers independently extracted the data and a third arbitrated if necessary; two statisticians abstracted the quantitative outcome data. The log rate ratio for falls and fractures and the log relative risk of falling were calculated, together with the variance, where possible. Where RCTs did not report adjustments for clustering, an intra-cluster correlation of 0.1 for falls, 0.071 for fractures and 0.026 for fallers was used.

Methods of synthesis
How were the studies combined?
Fixed-effect and random-effects meta-analyses were performed to derive pooled effects and 95% confidence intervals (CIs) for the outcome measures of falls, fallers and fractures.

How were differences between studies investigated?
Statistical heterogeneity was assessed by calculating the I-squared statistic; because of the presence of heterogeneity, only the results of the random-effects analyses were presented. Forest plots showed the studies ordered by quality score. The authors discussed nine areas separately: multifaceted interventions in hospitals; multi-faceted interventions in care homes; hip protectors in care homes; removal of physical restraints; fall alarm devices; exercise; changes or differences in the physical environment; calcium and vitamin D in care homes; and medication review. Meta-regression analyses (restricted maximum likelihood method) were performed, including the investigation of dementia as an effect modifier, adjustments for the type of intervention, and the identification of associations with the type or quality of studies. Sensitivity analyses were carried out on the adjustments used for clustered RCT data.

Results of the review
Forty-three studies (n>9,378, exact number unclear) were included in the review, of which 28 were RCTs (n>8,035, exact number unclear). Sixteen studies were individually randomised RCTs, twelve were cluster randomised RCTs, nine were prospective (historical control studies), two were retrospective observational cohort studies, two were prospective cohort studies, one was a case-control study, and one was a quasi-experimental with a multiple interrupted time series study.

The quality scores ranged from 2 to 25 (possible scores: 0 to 27).

Multifaceted interventions in hospitals showed a rate ratio for falls of 0.82 (95% CI: 0.68, 0.997; based on 12 studies); there was evidence of statistical heterogeneity (I-squared 80%). The effects of the interventions were not statistically significant for other outcomes or in care home settings.

Hip protectors in care homes showed a positive effect on fractures of 0.67 (95% CI: 0.46, 0.98; 9 studies; I-squared 39%), but no significant effects on falls; the number of fallers was not assessed.

Other single interventions (removal of physical restraints in either setting, fall alarm devices in either setting, exercise in care homes, calcium or vitamin D in care homes, changes in the physical environment in either setting, and medication review in hospital) were either unsuitable for meta-analysis or showed no significant effect on falls, fallers or fractures.

There was no significant association between the effect size and the prevalence of dementia or cognitive impairment (falls, p=0.72; fallers, p=0.87; fractures, p=0.18).

Authors' conclusions
While there is some evidence that multifaceted interventions in hospitals reduce the number of falls and that the use of
hip protectors in care homes prevents hip fractures, there is insufficient evidence for the effectiveness of other single interventions in hospitals or care homes or for multifaceted interventions in care homes.

**CRD commentary**
The review addressed a complex research topic. No inclusion criteria for eligible interventions were specified. The search encompassed several databases and covered the identification of unpublished material, thereby reducing the risk of publication bias. Steps to reduce errors and bias were taken throughout the review process. The methodological quality of the included studies was assessed in detail and incorporated into some analyses, although this was based on a summary quality score which can be problematic.

The analyses were sophisticated and made adjustments for statistical shortcomings in the primary studies. However, the pooling of studies so different in design, patient samples, setting and treatment is controversial, especially in the presence of considerable statistical heterogeneity. The interventions and comparator treatments in the included studies varied greatly and were not described in detail; even when stratified for the nine categories, it was not clear whether the pooled results were clinically meaningful or immediately translatable into practice (each category and the multifaceted interventions per se still covered a wide field and a variety of different approaches). The same was true for the studies that showed no significant pooled effect; the authors also indicated that some individual studies showed substantial positive effects. Overall, the conclusions appear reliable but the review question and categories may be too wide to be immediately translated into clinical practice.

**Implications of the review for practice and research**
Practice: The authors stated that, apart from the structured multifaceted interventions in hospitals and the use of hip protectors in care homes, there is currently no evidence to support widespread implementation of prevention interventions. It is possible that health care providers are currently incurring important opportunity and financial costs by using injury prevention strategies of uncertain value.

Research: The authors stated that while replication of studies using a structured multifaceted intervention is not high priority, a closer investigation of specific components and studies with sufficient power to draw definitive conclusions about the effects of multifaceted interventions and hip protectors on fracture rates are warranted. Furthermore, they stated that RCTs may not be suitable to answer many pragmatic questions in clinical practice, and an approach of realistic evaluation considering factors such as context, case-mix, adherence, quality of intervention and process may be valuable. Finally, the authors identified the following gaps in the evidence: interventions specifically for those with cognitive impairment or dementia; the reproducibility of interventions within and between different types of service setting; the cost-effectiveness of interventions; and the effect of a range of single interventions such as medication review, use of alarms, or changes or differences in the physical environment.

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