

Effectiveness of hip protectors for preventing hip fractures in elderly people: systematic review

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Abstract

Objectives To present the updated results of systematic review of the current evidence for the effectiveness of hip protectors from reports of completed randomised trials, and to explore the evolution of that evidence.

Design Systematic review with meta-analysis.

Data sources Cochrane Bone, Joint, and Muscle Trauma Group trials register (January 2005), Cochrane central register of controlled trials (Cochrane Library Issue 1, 2005), Medline (1966 to January 2005), Embase (1988 to January 2005), and CINAHL (1982 to December 2004). Other databases and reference lists of relevant articles were searched and some trialists were contacted.

Review methods Randomised or quasirandomised controlled trials reporting the incidence of hip fractures, pelvic fractures, and other fractures in elderly people offered hip protectors compared with a control group that was not.

Results Outcomes for fracture were available from 14 randomised and quasirandomised trials. Pooling of data from 11 trials carried out in nursing or residential care settings, including six cluster randomised studies, showed evidence of a marginally statistically significant reduction in incidence of hip fracture (relative risk 0.77, 95% confidence interval 0.62 to 0.97). Pooling of data from three individually randomised trials of 5135 community dwelling participants showed no reduction in hip fracture incidence with provision of hip protectors (1.16, 0.85 to 1.59). No evidence was found of any significant effect of hip protectors on incidence of pelvic or other fractures. No important adverse effects of hip protectors were reported, but compliance, particularly in the long term, was poor.

Conclusions On the basis of early reports of randomised trials, hip protectors were advocated. Accumulating evidence indicates that hip protectors are an ineffective intervention for those living at home and that their effectiveness in an institutional setting is uncertain.

Introduction

Hip fracture is the commonest reason for admission of elderly people to an acute orthopaedic ward and is generally the result of a fall. Hip protectors consist of

padding worn around the hip to reduce the impact of a fall.

We previously published a systematic review of randomised trials that investigated the effectiveness of hip protectors.¹ Five trials totalling 1681 elderly participants at risk of hip fracture were included in that review. We concluded that hip protectors seemed to reduce the risk of a hip fracture after a fall in elderly residents of nursing homes. A large cluster randomised study was subsequently published that seemed to strengthen the evidence for the effectiveness of hip protectors.² In the five years since the publication of the first review, the inclusion of further studies in updates has led us to revise our original conclusions. We report on the most recent update of the systematic review³ and discuss some lessons learnt from the accumulation of evidence since the mid-1990s.

Methods

We carried out a systematic review of the current evidence for the effectiveness of hip protectors on the basis of reports of completed randomised and quasirandomised trials. The null hypothesis was that hip protectors have no effect on the incidence of hip fracture in elderly people. We included randomised or quasirandomised trials that compared the incidence of hip, pelvic, and other fractures in elderly people of either sex allocated to the provision of hip protectors or not. The search strategy is on bmj.com.

Two reviewers independently extracted data for each study on the incidence of hip fractures over the study period, incidence of pelvic fractures (pubic ramus and other pelvic) and other fractures, compliance, and reported adverse events from wearing hip protectors. Two reviewers independently assessed each trial for methodological quality. We assessed eight aspects of methodology (see bmj.com).

For each study we calculated the relative risk with 95 per cent confidence limits for the incidence of fractures (hip, pelvic, and other). We used generic inverse variance to pool data from individually randomised

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BMJ 2006;332:571-3



Details of the included studies and references w1-w15 are on bmj.com



This is the abridged version of an article that was posted on bmj.com on 2 March 2006: <http://bmj.com/cgi/doi/10.1136/bmj.38753.375324.7C>

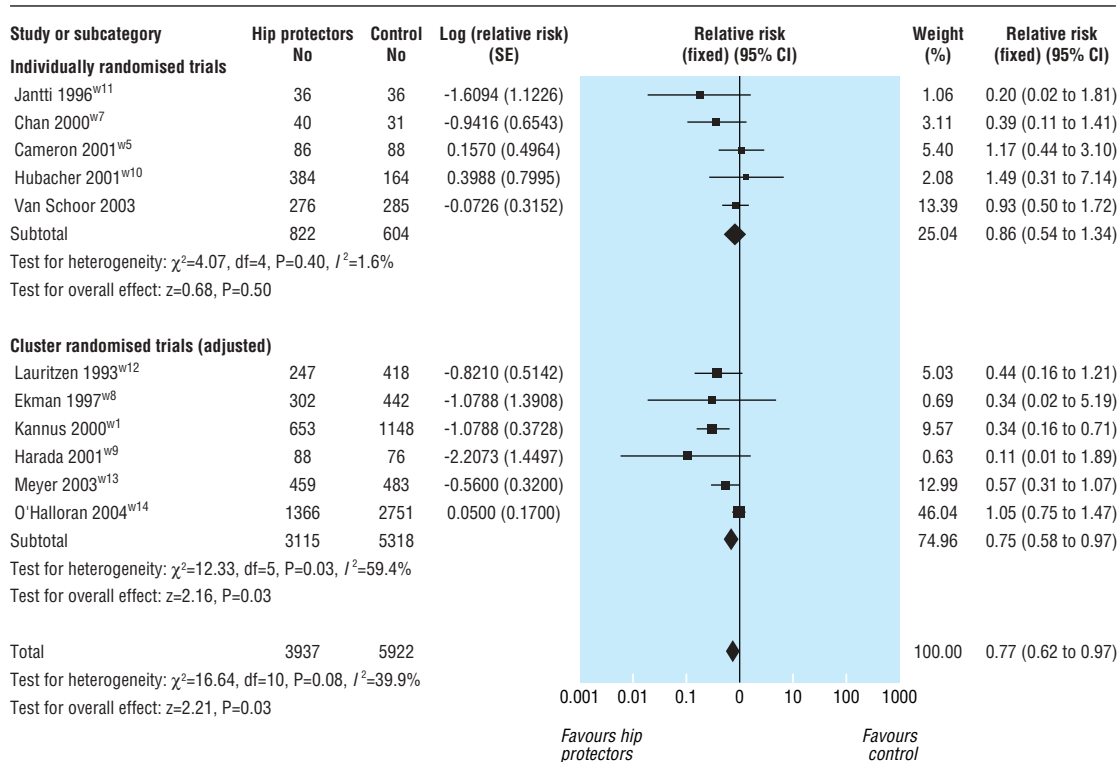


Fig 1 Incidence of hip fractures in elderly participants provided with hip protectors or not in an institutional setting

studies, and from cluster randomised studies for which the intracluster correlation coefficient was known or could be calculated.⁴ A standard χ^2 test in conjunction with the I^2 statistic was used to test heterogeneity between trials.⁵ We explored evidence of statistical heterogeneity using sensitivity analysis with and without outlying studies.

Results

We identified 28 primary studies and one systematic review for possible inclusion in our study.⁶ Fourteen studies were excluded (see *bmj.com*), leaving 14 randomised and quasirandomised trials for analysis in the updated review.^{w1 w3-w15} The mean age of participants in the included studies ranged from 78 to 86 years. Most were women. Eleven studies recruited mainly or exclusively residents in institutional care,^{w1 w5 w7-w15} and three recruited people mainly or exclusively living in the community.^{w3 w4 w6} Quality scores ranged from 4 to 9

out of a possible 10. (See *bmj.com* for characteristics of included studies.) Detailed results of the methodology assessment are listed in the updated Cochrane review.³

Figure 1 shows the incidence of hip fractures in studies carried out in institutions. The pooled data showed evidence of a statistically significant reduction in incidence of hip fractures in the groups allocated hip protectors (relative risk 0.77, 95% confidence interval 0.62 to 0.97). This reduction is of marginal significance, with wide confidence intervals, and is sensitive to the inclusion or removal from the analysis of two large cluster randomised studies that contributed to heterogeneity in the overall analysis ($I^2=39.9\%$).⁷

The significant reduction in hip fracture was not apparent on pooling only the individually randomised studies (0.86, 0.54 to 1.34). This subgroup showed no evidence of significant heterogeneity ($I^2=1.6\%$). Within the cluster randomised subgroup, however, there was significant statistical heterogeneity ($I^2=59.4\%$). This heterogeneity was explored by sensitivity analyses. It was accounted for by the different outcomes of two large studies,^{w1 w14} the 95% confidence intervals of which did not overlap. Testing for interaction showed that the results from Kannus et al^{w1} were significantly different from the remainder of the cluster randomised trials ($P=0.03$), as were the results from O'Halloran et al ($P=0.001$).^{w14} Removal of the Kannus et al data from the analysis means there is no significant evidence of effectiveness, whereas if O'Halloran et al was removed from the analysis the significant evidence of effectiveness remained.

Figure 2 shows the relative risks and 95% confidence intervals from the three individually randomised studies that recruited elderly people living in the community. These studies found no significant

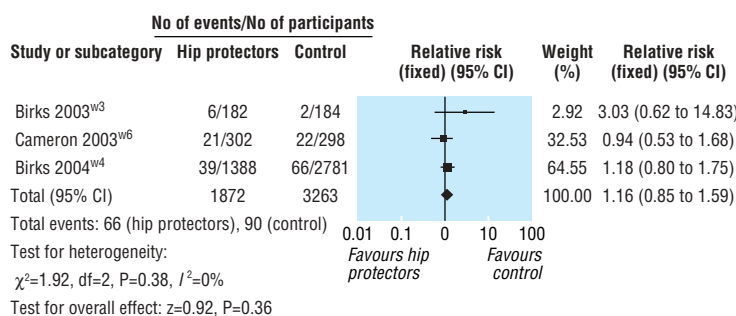


Fig 2 Incidence of hip fractures in elderly participants provided with hip protectors or not in the community

reduction in the occurrence of hip fractures between groups (1.16, 0.85 to 1.59).

Most studies recorded the incidence of fractures of the pelvis, including the pubic rami. No evidence was found that hip protectors reduced the incidence of pelvic fracture. Seven individually randomised studies identified 21 pelvic fractures among 2654 participants allocated to hip protectors compared with 28 among 3836 controls (0.96, 0.54 to 1.69). Hip protectors had no effect on the incidence of other fall related fractures (0.85, 0.70 to 1.05). Problems with compliance were reported in all included studies.

Discussion

The bulk of evidence from the initial cluster randomised trials up to 2001 on hip fractures in elderly people living in institutional care suggested that hip protectors significantly reduced the incidence of hip fracture, and their use has been adopted in such settings. This significant protective effect has not been confirmed by data from individually randomised studies. The results of the two more recent large cluster randomised studies^{w1 w14} showed significant heterogeneity. Design issues in these two studies may have contributed to heterogeneity.

Selection bias is a risk in cluster randomised trials that recruit participants over time, as admission to a particular nursing home or ward may not have been a random event. Differences between groups of participants in rates of falls and fractures might be confounded through systematic differences in other aspects of care between nursing homes or wards.

Reports of the effectiveness of hip protectors may have been misleading owing to publication bias or flaws in the design, conduct, and reporting of the early cluster randomised studies. Four of the six included cluster randomised studies that dominated the earlier literature (including our first Cochrane review) were influential in encouraging the wider introduction of hip protectors. In the primary reports of these four studies, analysis was by individual without allowing for the effect of clustering.^{w1 w8 w9 w12} Two more recent cluster randomised studies reported appropriate analyses.^{w13 w14} In our initial review we were able only to provide exploratory analyses of cluster randomised trials; it has now been possible with additional information from the trialists to carry out appropriate statistical analysis for clustering.

Our Cochrane review gives details of the heterogeneity among the populations studied in respect of their baseline risk of fracture. Many of the trials included in this review targeted people at particularly high risk of hip fracture. In practice, the use of hip protectors seems to have varied between trials and within trials. A systematic review reported that acceptance ranged from 37% to 72% (median 68%) and compliance varied between 20% and 92% (median 56%).⁸ Non-compliance presents both practical challenges in the healthcare setting and problems in analysis and interpretation of data. The hip protectors may be difficult to fit and be uncomfortable.^{w2 w10} Older people may find them unattractive, and even those with a previous hip fracture may not use them.^{w7} Also, hip protectors may cause skin irritation.

Since the previous update of our Cochrane review, another systematic review on this topic has been

What is already known on this topic

Hip protectors have been advocated to prevent hip fractures in elderly people

What this study adds

Early randomised trials on elderly institutionalised people suggested that hip fracture incidence was reduced in those using hip protectors

Subsequent randomised studies found hip protectors to be ineffective for those living at home and questioned their effectiveness in institutionalised people

Compliance with wearing hip protectors is poor

published.⁶ These investigators agreed with our earlier analyses and conclusions on the ineffectiveness of hip protectors in community dwelling people. Although their inclusion criteria were stricter than ours, they concluded that hip protectors were effective in older people in an institutional setting. However, their review included Van Schoor et al^{w15} in the community dwelling analysis. Of 561 residents in that study, 38 lived in apartment houses for elderly people, 247 in homes for elderly people, and 276 in nursing homes (N M Van Schoor, personal communication, 2005). Admission to homes or nursing homes was based on the need for extra care. We therefore feel justified in including that trial in the analysis of institutional settings.

The studies included in this review concerned several designs of hip protector. It is not possible to be sure that the different hip protectors used were of equal effectiveness for preventing fractures. In addition, compliance may vary between hip protectors, and standard definitions for adherence have been proposed.⁹ Trials in progress are examining both effectiveness of hip protectors in a range of institutional and community settings and ways of improving acceptance and adherence. Their results may help resolve the current uncertainty.

Contributors: See bmj.com.

Funding: None.

Competing interests: None declared.

Ethical approval: Not required.

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(Accepted 10 January 2006)

doi 10.1136/bmj.38753.375324.7C