SYSTEMATIC REVIEWS

Older people’s recruitment, sustained participation, and adherence to falls prevention interventions in institutional settings: a supplement to the Cochrane systematic review

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Abstract

Background: randomised controlled trials (RCTs) of falls prevention conducted in institutional settings have recently been systematically reviewed.
Objective: to supplement this review by analysing older people’s participation in the trials and engagement with the interventions.
Design: review of the 41 RCTs included in the Cochrane systematic review of falls prevention interventions.
Setting: hospitals and nursing care facilities.
Participants: adults aged/mean age of 65+.
Methods: calculated aggregate data on recruitment (inclusion into the trial), attrition at 12-month follow-up (loss of participants from the trial), adherence (to intervention protocol), and whether adherence moderated the effect of interventions on trial outcomes.
Results: the median inclusion rate was 48.5% (38.9–84.5%). At 12 months the median attrition rate was 10.4% (3.9–12.3%, n = 10) or with the inclusion of mortality 16.2% (9.5–17.1%, n = 11). Adherence was high for exercise that was individually targeted (e.g. 89% physical therapy) and group based (72–88%) and for medication interventions (68–88%). For multifactorial interventions, adherence ranged from 11% for attending 60+/88 of exercise classes to 93% for use/repairs of aids. Adherence as a moderator of treatment effectiveness was tested in nursing care facilities (n = 6) and positively identified in three studies for medication and multifactorial interventions.
Conclusions: using median rates for recruitment (50%), attrition (15%) and adherence (80%), by 12 months, it is estimated that on average only a third of nursing care facility residents are likely to be adhering to falls prevention interventions.

Keywords: patient adherence, falls, accidental, intervention studies, patient participation, review, systematic

Introduction

Falls in later life are highly prevalent and associated with an increased risk of mortality and morbidity [1, 2]. Approximately half of residents of long-term care will fall annually with incidence rates of 0.6–3.6 falls per bed [3, 4], and for hospital inpatients, the incidence rate is 2.2–17.1 falls per 1000 patient days [5]. Falls are costly for the economy, particularly those that result in hip fracture [6]. The prevalence of hip fractures in care homes is estimated at 50.8/1000 person-years in women and 32.7/1000 in men [7] and their occurrence...
associated with an increased mortality risk for at least 6 months [8].

Randomised controlled trials (RCTs) to prevent falls have been systematically reviewed by the Cochrane Collaboration and recently separated into reviews of trials in the community and those in institutions [9, 10]. The results of trials in institutional settings were largely negative, though multifactorial and supervised exercise interventions were effective in hospital settings and vitamin D supplementation was effective in residential settings [10].

A limitation of the Cochrane systematic reviews was that they did not consider the role of older people’s participation in the trials and engagement with the interventions. Participation and engagement are pertinent issues for the development of trials and implementation of interventions in policy and practice [11–13]. We conducted a supplementary review of the Cochrane systematic reviews on falls prevention interventions, and report here our review relating to institutional settings with specific reference to: (i) estimations of older people’s recruitment and retention in falls prevention RCTs; (ii) estimations of older people’s adherence to interventions prescribed within the RCTs; and (iii) determine whether older people’s adherence moderates the effect of interventions on trial outcomes.

Method

Search strategy and selection criteria

The primary outcome of the Cochrane review was the rate of falls and the number of participants sustaining at least one fall (number of fallers) [10]. RCTs and quasi-randomised trials were included, and hospital inpatients/residents of nursing care facilities were aged 65+ or a mean age of 65+. Studies were identified from electronic searches including the Cochrane Bone, Joint and Muscle Trauma Group Specialised Register, the Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE and CINAHL. The existing review included any intervention to reduce falls whether compared with usual care, a placebo, or a variation of the intervention. Our focus was on single interventions to provide aggregate data for each type of intervention as trials using more than one intervention simultaneously are limited in that it is unknown what part(s) of the intervention package are effective [14, 15]. Therefore, we excluded one trial that employed more than one intervention simultaneously (multiple intervention) [16]. We did however include a separate analysis of multifactorial interventions (based on individual falls risk assessment) as a quarter of the trials reviewed used this design.

Each paper used for the Cochrane review [10] was included that comprised both full papers and conference abstracts. Identical to the Cochrane review, for single interventions we followed the classification developed by the Prevention of Falls Network Europe [for full list see 9, 17]:

- Exercise. Supervised and un-supervised exercise programmes such as walking, aerobics and strength and balance training.
- Medication. Vitamin D supplementation with or without calcium.
- Environmental/assistive technology. Home adaptations and the provision of aids for personal care, protection, personal mobility, communication and information.
- Interventions to increase knowledge. Education in falls and their prevention including nurse-led classes.
- Psychological. Cognitive behavioural therapy to reduce fear of falling.

Outcome measures

Our outcomes were recruitment, attrition, adherence, and whether adherence was a moderator for the effect of interventions on primary outcomes. For recruitment, data for the total sampling frame (of both those approached and not approached) for inclusion in the trials would be required to generalise to all older people. In absence of these data, we measured the inclusion rate—i.e. the proportion of participants invited to participate who enrolled into the study—and distinguished between those who refused, did not respond or who were willing but excluded (volunteered but did not meet the study inclusion criteria).

For attrition, we measured the duration of study follow-up and number of participants lost at final follow-up due to mortality or other reasons. We then analysed attrition rates for only the studies that reported sample retention at 12 months so that duration of follow-up was held constant. Twelve months was considered long enough for patterns in attrition to emerge, and studies that collected data beyond this point (e.g. final follow-up at 24 months) that provided data at 12 months were included in this analysis. As 12 months is much longer than an inpatient’s stay at hospital and for interventions that have one-off/lasting effects, this timeframe is used to inform interventions based at nursing care facilities that require continued activity.

For adherence to interventions that require continued action, we recorded any data that indicated participants’ degree of engagement with the intervention, e.g. for exercise interventions this could be the number of classes attended. Papers that reported adherence rates were then searched for data that indicated a moderator analysis had been performed. We recorded any data that tested whether the level of participants’ adherence had an influence on trial outcomes.

Procedure

Data were stored and analysed using Excel 2003 and SPSS 16.0. A research assistant input the data for recruitment and attrition categorised by intervention type. The first author then checked the accuracy of all the data and input the data for adherence and moderator analyses. For each
intervention type, we performed descriptive statistics on the outcome measures by generating percentages for each paper and then calculating the average percentage. Medians and ranges/interquartile ranges are reported as the distributions of the data for the measures of interest were substantially skewed. Meta-analysis was inappropriate as we calculated descriptive values rather than aggregate values from existing descriptive statistics.

Results

Forty papers published between 1990 and 2008 were reviewed. One study conducted a $2 \times 2$ trial [18] that comprised both exercise and floor covering and so was included—identical to the Cochrane review—as two separate single interventions on exercise and environmental/assistive technology. Therefore, 41 interventions were reviewed that were categorised into one of the following intervention types: exercise ($n = 15$), multifactorial ($n = 12$), medication ($n = 8$), environmental/assistive technology ($n = 3$), interventions to increase knowledge ($n = 2$) and psychological ($n = 1$).

Recruitment

Rates of recruitment into trials are presented in Table 1. We excluded a study from our analysis of recruitment because it collected data on patients through hospital records and did not reflect inclusion into a trial [19]. Studies varied in the number of older people invited (127–1061, median = 658, $n = 25$) and subsequent rates of participation (38.9–84.5%, median = 48.5%, $n = 25$). The study with the lowest inclusion rate reported inviting 5106 older people and included 308 (6.0%) [20]. Of those who did not take up the intervention, the median refusal rate was 5.6% (2.4–15.6%, $n = 17$) and the median rate of those willing to take part but excluded was 42.3% (27.4–60.2%, $n = 15$). The study with the highest refusal rate reported 367 (35.3%) of the 1040 invited to take part refused [21], and the study with the highest rate of those excluded by the researchers reported 276 (53.6%) of 515 screened were not included [22]. Only one study reported data on the proportion of older people who did not respond to a study invitation, which is probably because staff recruit participants face to face. The study reported a non-response rate of 38.9% [23].

### Attrition

Rates of attrition to interventions at 12 months are presented in Table 2. The median 12-month attrition rate was 16.2% (9.5–17.1%, $n = 11$), and the study with the highest attrition rate reported losing 201 (32.6%) of the 617 participants who completed baseline measures [24]. Median attrition due to mortality was 13% (4.8–17.7%, $n = 8$), and the adjusted median (for mortality) reduced to 10.4% (3.9–12.3%, $n = 10$). Studies with the highest attrition rates at 12 months reported 80 of 308 (26%) lost due to mortality [20] and 143 of 682 (21%) lost for reasons other than mortality [25].

### Adherence

No adherence data were reported for the following 20 interventions because they were delivered by a member of research/health-care staff to ensure full adherence: exercise [26–29], medication, whether as vitamin D and/or calcium supplementation [30–32] or medication review [33, 34], environmental/assistive technology [18, 35, 36], interventions to increase knowledge [37, 38], psychological [39] and multifactorial interventions [19, 21, 24, 40, 41]. Twenty-one studies that included data on adherence were categorised as exercise ($n = 11$), medication ($n = 3$) and multifactorial...

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### Table 1. Recruitment rates to fall prevention interventions in institutional settings ($n = 40$)

<table>
<thead>
<tr>
<th>Recruitment</th>
<th>Intervention</th>
<th>Exercise$^a$</th>
<th>Medication$^b$</th>
<th>Psychological$^c$</th>
<th>Interventions to increase knowledge$^d$</th>
<th>Environmental/assistive technology$^e$</th>
<th>Multifactorial$^f$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>IR</td>
<td>Median</td>
<td>IR</td>
<td>Median</td>
<td>IR</td>
<td>Median</td>
</tr>
<tr>
<td>Invited into study ($n$)</td>
<td>487.00</td>
<td>975.50</td>
<td>639.00</td>
<td>1637.00</td>
<td>127.00</td>
<td>–</td>
<td>1061.00</td>
</tr>
<tr>
<td>Included in the study ($n$)</td>
<td>54.00</td>
<td>166.00</td>
<td>407.50</td>
<td>562.50</td>
<td>71.00</td>
<td>–</td>
<td>3563.00</td>
</tr>
<tr>
<td>% included in the study</td>
<td>38.9</td>
<td>40.9</td>
<td>39.8</td>
<td>71.7</td>
<td>55.9</td>
<td>–</td>
<td>84.5</td>
</tr>
<tr>
<td>% refused participation</td>
<td>15.8</td>
<td>15.3</td>
<td>5.6</td>
<td>13.1</td>
<td>2.4</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>% excluded</td>
<td>60.2</td>
<td>58.4</td>
<td>42.3</td>
<td>57.6</td>
<td>39.4</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

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$^a$ for the column from top to bottom = 5, 15, 5, 4, 4.
$^b$ for the column from top to bottom = 7, 8, 7, 4, 5.
$^c$ for the column from top to bottom = 1, 1, 1, 1, 1.
$^d$ for the column from top to bottom = 0, 0, 0, 0, 0.
$^e$ for the column from top to bottom = 1, 3, 1, 1, 1.
$^f$ for the column from top to bottom = 10, 11, 10, 7, 4.
interventions (n = 7) (detailed notes on these studies are available in Supplementary data in Age and Ageing online, Appendix 1 on the journal website http://www.ageing.oxfordjournals.org/).

Individually targeted exercise interventions achieved high adherence rates among those requiring physical therapy (89%) [42] and those with dementia [43], though adherence dropped by 12-months post-intervention [23]. For group-based exercise interventions, median attendance was 82.2% (72–88%), and dropped by 18–24 months [44]. A study using two separate exercise interventions achieved significantly better adherence rates to resistance/endurance training (M = 55.8%, SD = 29.4) than Tai Chi (M = 24.2%, SD = 30.8%) [44]. Medication interventions achieved adherence from 68 to 88% of participants.

Multifactorial interventions reported varying levels of adherence, with one study reporting an overall adherence rate of 63% [45]. Some components may receive high adherence, e.g. for financial benefits (93% adherence to supply/repairs of aids [46], whereas rates for environmental modifications and revising medications was 57.5 and 47.5%, respectively. Other interventions may receive high adherence among a proportion of participants such as wearing hip protectors (67.5%), but others refuse to wear them all the time, resulting in a low adherence rate across resident days in the trial (27.9%) [47]. For exercise interventions within multifactorial trials, 84% carried out self-managed exercise two to three times a week [46], whereas the proportion of class sessions attended was between 59 [48] and 81% [49], and low at 11% for attending ≥60 out of 88 classes [47].

**Adherence as a moderator**

Moderator analyses were reported in six studies in nursing care facilities under the categories of exercise (n = 3), medication (n = 1) and multifactorial interventions (n = 2).

**Exercise**

Those that had achieved their individual goal (187/330, 57%) did not improve in function post-intervention more so than those that did not achieve their goal [25]. No significant difference was found in fall rate between those with greater/poorer attendance to high-intensity functional exercise sessions compared with adherence to control group sessions of sedentary activity (23+/29 sessions attended = greater adherence) [50]. Similarly, no significant difference was found in fall-rate between those that did or did not adhere to either a resistance/endurance or Tai Chi exercise programme, but non-adherers had increased in time required to stand from sitting and number of medications consumed [44].

**Medication**

One study reported a subanalysis with residents with >50% adherence to vitamin D supplements and found a moderate reduction in falls (incidence rate ratio = 0.63; hazard ratio = 0.67), reduced risk of falls compared with a placebo group (odds ratio = 0.70), and reduction in fractures and a protective effect for time to first fall (0.80) [51].

**Multifactorial interventions**

A study investigated the impact of adherence at 3 months —split into tertiles—on outcome measures at 12 months [45], and found that a higher proportion of safety recommendations adhered to was associated with a lower rate of recurrent fallers (top adherence group versus control group = 46% reduction) and a lower rate of injurious falls. Another study found that no hip fractures occurred while hip protectors were worn, but several (figure not specified) hip fractures occurred in the subgroup with suboptimal staff support in use of the hip protectors, mainly with dressing and use of the toilet [47].

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**Table 2. Attrition rates at 12 months to fall prevention interventions in institutional settings (n = 11)**

<table>
<thead>
<tr>
<th>Attrition</th>
<th>Exercise</th>
<th>Medication</th>
<th>Interventions to increase knowledge</th>
<th>Multifactorial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>IR</td>
<td>Median</td>
<td>Median</td>
</tr>
<tr>
<td>n at baseline</td>
<td>355.00</td>
<td>—</td>
<td>604.00</td>
<td></td>
</tr>
<tr>
<td>n at follow-up</td>
<td>250.00</td>
<td>—</td>
<td>496.00</td>
<td>6229.00</td>
</tr>
<tr>
<td>% retained at follow-up</td>
<td>82.9</td>
<td>—</td>
<td>82.9</td>
<td>90.5</td>
</tr>
<tr>
<td>% died by follow-up</td>
<td>4.8</td>
<td>13.0</td>
<td>4.8</td>
<td></td>
</tr>
<tr>
<td>% lost at follow-up other than mortality</td>
<td>12.3</td>
<td>11.2</td>
<td>9.5</td>
<td></td>
</tr>
</tbody>
</table>

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IR, interquartile range; ‘–’ is used when a calculation is inappropriate as less than one study provided data for this cell; ‘—’ is used when the interquartile range could not be calculated as only two to three studies provided data for this cell.

a n for the column from top to bottom = 6, 6, 6, 5, 5.

b n for the column from top to bottom = 6, 2, 2, 1, 2.

c n for the column from top to bottom = 1, 1, 1, 1.

d n for the column from top to bottom = 2, 2, 2, 1, 2.

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18 months post-intervention, 84% attended (M = 55.8%, SD = 29.4) Tai Chi exercise intervention [44].
Discussion

We conducted a supplementary review to a previous systematic review of RCTs to prevent falls in older people who were hospital inpatients or residents of nursing care facilities [10]. We analysed data on recruitment, attrition, adherence and the potential for adherence to moderate the effect of interventions on trial outcomes.

Our review suggested that on average half of older people approached in institutions are likely to participate in falls prevention interventions. Although the rate of non-response was only provided in one study, data from 32 studies suggested that older people are more likely to be willing but excluded than refuse to participate. On average, researchers should plan for an attrition rate of 10% by 12 months or 16% to include mortality, and further losses if the trial is for a longer duration. Adherence rates were high for exercise that was individually targeted and group based and for medication interventions. For multifactorial interventions, overall adherence averaged at two-thirds in one study and varied from 11 to 93% for specific intervention components across studies.

For moderator analyses—in nursing care facilities only—exercise interventions have yet to demonstrate a moderation effect for adherence, though their effectiveness in these settings is uncertain [10]. A moderation effect was found for a medication study and two multifactorial studies, and Vitamin D supplementation has been found to be effective in nursing care facilities where multifactorial interventions could also be effective [10]. For hip protectors within multifactorial trials, a moderation effect was found in one study, though a separate Cochrane review of single-factorial RCTs has cast doubt on their effectiveness [52], which has been consolidated in a recent study [53]. From the previous Cochrane review on hip protectors, data can be synthesised for the rates of refusal (19–79%, median = 31.5%), recruitment (34–49%, median = 37%), adherence (34–57%, median = 48%) and regular use at final follow-up (20–70%, median = 36%) [52, p. 8]. The two multifactorial studies from our review that included hip protectors had a higher acceptance rate (72%) but lower adherence rate (27.9%).

Implications for policy/practice

Our figures from RCTs suggest that if a single intervention is implemented and targeted at 1,000 nursing care facility residents, has a recruitment rate of 50%, dropout rate of 15% by 12 months, and 80% adherence rate during the intervention, the proportion of residents who would be adhering to the intervention would be 340, i.e. only a third at 12 months. Thus, falls prevention interventions may be effective but only with a self-motivated subgroup, and effort is required to enhance older people's participation and adherence. For older people in these fall prevention studies, the motivation of staff members will be crucial in many situations because the study participants have significant cognitive impairment.

Limitations

The studies reviewed had two limitations that in turn limited our review. First, because the primary question of the RCTs concerned whether the intervention prevented falls, data on participation and adherence were secondary. Therefore, data for our outcomes were only reported in 25/40 studies for recruitment, 11/41 for attrition, 21/41 for adherence and 6/41 for moderator analyses.

Second, there was a lack of uniformity in how data were reported for our review outcomes. Information was often not provided for the rate of refusals (17/40), non-responses (1/40) and those willing to take part but excluded (15/40), and adherence was reported with either a proportion of overall participation, average rate, or rates within bands (e.g. 50–75%). Uniformity in presenting data would facilitate pooling of results, and we suggest future studies report the average adherence rate in values and percentages.

As our review only included RCTs, it was limited further in two ways. First, other study designs (e.g. pre- and post-) that could provide valid data were not included. However, we chose to review the trials included in the Cochrane review because it brought two strengths: (i) We were able to include all the relevant RCTs in this area that had already been systematically searched and categorised by intervention type; and (ii) RCTs are considered the gold standard in trial design and so the studies reviewed would be less likely to suffer methodological limitations [54, 55].

Second, data from trials do not necessarily translate to interventions delivered in routine care. It is likely that RCTs will have lower recruitment rates than routine care because they entail the undesirable features of assignment to a non-treatment control group and repeated assessments, and some may object to participating in research. It is also likely that RCTs will have higher adherence rates than routine care because suitable participants are often selected on entry to the trial.

Future research

Further research could investigate how to increase participation in and engagement with falls prevention trials. From our review, in accordance with intervention types that had the lowest rates for participation, particular attention is to be paid to increasing recruitment to exercise, medication and environmental modification interventions; decreasing attrition to exercise and medication interventions and increasing adherence to multifactorial interventions. For multifactorial interventions, asking participants to make more than one change to their lifestyle simultaneously may attract lower adherence rates, and further research could explore what number or combinations of interventions become too disruptive and lead to low adherence rates. Further research could also explore differences in adherence rates within intervention types, for example, to explore why a study had poorer adherence to Tai Chi than resistance/ endurance training [44]. We also found no study that
Adherence to falls interventions in institutions

tested whether adherence moderated the effect of the intervention on trial outcomes in hospital settings.

Conclusion

By 12 months of implementation, it is possible that only a third of nursing care facility residents are adhering to falls prevention interventions. We hope our review stimulates discussion among researchers and practitioners on how to increase participation in and engagement with interventions so that older people in institutions can maximise their opportunity to benefit from falls prevention activities.

Key points

• Falls prevention interventions rely on the active participation of older people.
• On average, 49% of inpatients/residents approached are recruited and by 12 months 16% of residents are lost.
• Adherence varied for exercise (24–89%), medication (68–88%) and multifactorial (11–93%) interventions.
• On average, by 12 months, only a third of nursing care facility residents are likely to be adhering to interventions.
• Attention should be paid to increasing participation in and engagement with effective falls prevention interventions.

Acknowledgements

We thank Sandeep Kaur (research assistant) for entering data from the reviewed papers on rates of recruitment and attrition and the full citation details, Dr Yinghui Zhou for statistical advice, and Ian Cameron, Frances Healey and Terry Haines for their helpful comments on an earlier draft of this paper.

Conflict of interest

None declared.

Funding

This work was supported by a grant awarded to Dr Samuel Nyman to employ Sandeep Kaur using the University of Reading’s Undergraduate Research Opportunity Programme.

Author’s contributions

S.N. involved in the study concept and design, acquisition of papers for review, recruitment and supervision of research assistant, quality check of data input by research assistant, input data on adherence and effect on trial outcomes, analysis and interpretation and preparation of manuscript (first draft). C.V. involved in the preparation of manuscript (revised the manuscript with additional information and interpretation).

Sponsor’s role

The sponsor played no role in the design, conduct or reporting of the review presented in this paper. The opinions expressed in this paper are of the authors and may not represent those of the University of Reading.

Supplementary data

Supplementary data mentioned in the text is available to subscribers in Age and Ageing online.

References

The long list of references supporting this review has meant that only the most important are listed here and are represented by bold type throughout the text. The full list of references is available on the journal website http://www.ageing.oxfordjournals.org/ as Appendix 2.

10. Cameron ID, Murray GR, Gillespie LD et al. Interventions for preventing falls in older people in nursing care facilities...
A systematic review of comprehensive geriatric assessment to improve outcomes for frail older people being rapidly discharged from acute hospital: ‘interface geriatrics’

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Abstract

Background: many frail older people who attend acute hospital settings and who are discharged home within short periods (up to 72 h) have poor outcomes. This review assessed the role of comprehensive geriatric assessment (CGA) for such people.

Methods: standard bibliographic databases were searched for high-quality randomised controlled trials (RCTs) of CGA in this setting. When appropriate, intervention effects were presented as rate ratios with 95% confidence intervals.

Results: five trials of sufficient quality were included. There was no clear evidence of benefit for CGA interventions in this population in terms of mortality [RR 0.92 (95% CI 0.55–1.52)] or readmissions [RR 0.95 (95% CI 0.83–1.08)] or for subsequent institutionalisation, functional ability, quality-of-life or cognition.