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Systematic Review

The Efficacy of Fall Hazards Identification on Fall Outcomes: A Systematic Review With Meta-analysis

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KEYWORDS
Environmental hazard;
Falls;
Rehabilitation

Abstract *Objective:* To investigate the efficacy of fall hazards identification programs when compared to no intervention or other fall prevention programs on number of falls, falls incidence, and identifying fall hazards in community-dwelling adults.
Data Sources: CINAHL, PubMed, EMBASE, Scopus, and PsychINFO were used to identify articles.
Study Selection: Studies were selected to compare fall hazards identification programs to a control group. Studies were eligible if they were randomized controlled trials and enrolled adults older than 50 years with the incidence rate of falls as an outcome.
Data Extraction: Study or authors, year, sample characteristics, intervention or comparison groups, number of falls, and number of hazards identified in the intervention and control groups, and follow-up were extracted. The risk of bias assessment was performed using the Cochrane Risk of Bias tool. Quality was evaluated with Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach per outcome.

List of abbreviations: 95% CI, 95% confidence interval; GRADE, Grading of Recommendations Assessment, Development and Evaluation; IRR, incidence rate ratio; RCT, randomized controlled trial.

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Data Synthesis: A total of 8 studies (N=8) and 5177 participants were included. There was a high risk of bias across the studies mostly due to improper blinding of personnel of the outcome assessor. Pooled estimate effects from 5 studies assessing the incidence rate of falls from 3019 individuals indicated no difference between fall hazards identification programs and control (incidence rate ratio=0.98; 95% confidence interval, 0.87-1.10).
Conclusions: The current study suggests that there may be a benefit for fall hazards programs in reducing incident falls. However, because of a moderate GRADE rating, more large-scale studies with a higher number of falls events and more consistent control groups are required to determine the true effect.

In North America, an older adult is admitted to the emergency room because of a fall-related injury every 13 seconds and dies from a fall every 20 minutes.[1] According to the World Health Organization report on global burden of disease, fall-related injuries are the third leading cause of years lived with a disability.[1]Approximately 1 in 4 community-dwelling adults older than 65 years will experience a fall and approximately half of these individuals will experience a second fall within the year.[2,3] One in 10 falls lead to serious injuries including fractures,[4] resulting in a large economic burden for the health care system,[5] and a reduction in the confidence of the performance of daily activities.

Although there are many known factors that contribute to falls in older adults, the most modifiable risk factors for community-dwelling older adults include the use of drugs and polypharmacy, environmental hazards, poor vision, and reduced lower extremity balance and strength. These risks contribute to an impaired ability to perform daily activities.[6-9]

One strategy to reduce the number of falls in older adults is to identify modifiable environmental risk factors by using home hazards assessment checklists. Robust evidence from a meta-analysis demonstrated that a home safety intervention could reduce falls by 39% among at-risk seniors.[10] In a traditional home safety assessment, a therapist scans the home using a fall-hazard checklist to identify potential hazards.[10-13] Therapist home visits to identify and remediate hazards within the home may be considered a criterion standard method for the prevention of secondary falls and fractures, but may not always be feasible due to cost or availability of professionals.[14] Other strategies to reduce falls in the home are through falls hazards identification programs. An operational definition of a fall hazards program is a program that identifies any environmental agent that results in the person coming to rest on the floor, ground or a lower level. These programs may involve using a self-directed checklist, or are administered by an allied health professional to help identify potential falls hazards. Conversely, a guideline for the prevention of falls in older adults suggested that home modification alone was not sufficient for reducing falls,[15] and a multifactorial intervention may be the best strategy.[16] It is not clear whether these home modifications addressed identification of home hazards, or just to reduce falls. Therefore, this systematic review will address both the number of falls and fall hazard identification to evaluate the efficacy of fall hazard programs. The purpose of this article was to investigate the efficacy of fall hazards identification programs when compared to no intervention or other fall prevention programs on number of falls, falls incidence, and identifying fall hazards, in community-dwelling adults.

Methods

We used the guidelines from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses and Cochrane collaboration guidelines for this systematic review and meta-analysis.[17]

Eligibility criteria

Studies were included in this review if the following criteria were met: (1) design: randomized controlled trial (RCT), gray literature was permitted; (2) participants: adults older than 50; (3) intervention: fall hazards identification program, either therapist led or self-directed; (4) comparison: no intervention, or alternative fall prevention program; (5) outcomes: number of falls, incidence of falls, number of recurrent falls, fall hazard identification.

Studies that had no full text available were excluded from this systematic review. This review has been registered on PROSPERO: CRD42019133515.

Information sources

A systematic electronic search of the literature was performed in June 2019 in CINAHL, PubMed, EMBASE, Scopus, and PsychINFO with no date restrictions. The following key words and MeSH terms were used to identify potentially relevant studies: "falls," "falls hazards," "environmental hazards," "adults," "older adults," "randomized controlled trials," "RCT." In addition, we conducted a manual search of the reference lists of the included studies to identify any potential studies missed in the electronic search. The complete search strategy is summarized in appendix 1.

Study selection

The selection of individual studies involved 2 independent reviewers (2 authors) who performed the systematic

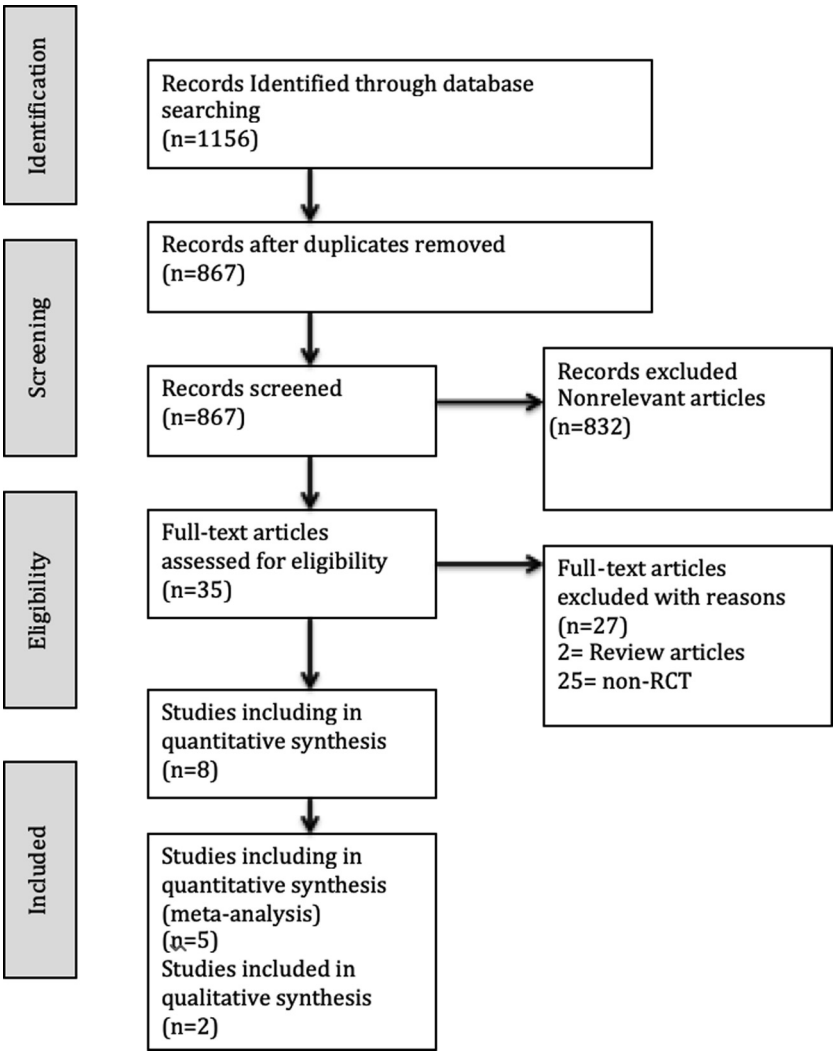

Fig 1 Flow diagram of the selection of studies.

electronic search of the databases. The 2 reviewers identified potentially relevant articles, removed duplicates, and then screened titles and abstracts. Any study marked as include or uncertain was assessed in the full text review and the eligibility criteria were applied.

Data collection process

Two independent researchers (2 authors) extracted the data from the eligible included studies, and 1 researcher (1 author) cross-checked the extracted data. Data extraction included study or authors, year, sample characteristics, intervention or comparison groups, number of falls, and number of hazards identified in the intervention and control groups, and follow-up.[2]

Assessment of risk of bias in individual studies

Two independent review authors assessed the included RCTs for risk of bias and 1 researcher cross-checked the risk of bias assessment. The risk of bias assessment was performed using the Cochrane risk of bias tool.[18] The Cochrane risk of bias tool is based on 7 items: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other bias.[18] The adequacy of each of the 7 risk of bias domains was rated as *low*, *unclear*, or *high* risk according to criteria provided in the Cochrane Handbook for Systematic Reviews of Interventions.[18] We summarized the assessment of risk of bias per study as Low risk of bias (if low risk of bias was judged for all the 7 domains), as Unclear risk of bias (if unclear risk of bias was judged for 1 or more of the 7 domains), and as High risk of bias (if high risk of bias was judged for 1 or more of the 7 domains).[18]

Quality of outcomes

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) guidelines for systematic reviews were used to evaluate the quality of outcomes (fall incidence risk ratio). The GRADE approach includes assessing risk of bias for study limitations, consistency, publication bias, imprecision, and indirectness[19-24] for the

Table 1 Study descriptors

Author	Year	Country	Study Design	Intervention Group Mean Age ± SD (y)	Control Group Mean Age ± SD (y)	N (men)	Primary Outcome	Program Length	Follow-up	Dropout (n)	Adherence (%)
Cumming et al[28]	1999	Australia	RCT	76.4±7.1	77.2±7.4	530 (227)	Number of falls	1 visit	12 mo	25	73
La Grow et al[29]	2006	New Zealand	RCT	Not applicable	Not applicable	391 (not applicable)	Number of falls	1 visit	6 mo	59	90
Kamei et al[30]	2015	Japan	RCT	75.7±6.7	75.8±6.4	130 (20)	Overall and indoor fall reduction	4 wk, 120 min each session, 4 sessions	3 and 12 mo	20	83
Stevens et al[31]	2001	Australia	RCT	76	76	1737 (829)	Number of falls	1 visit	12 mo	264	74
Stevens et al[32]	2001	Australia	RCT	Not applicable	Not applicable	570	Home hazards	1 visit	11 mo	43	Not clear
Tan et al[33]	2018	Malaysia and Australia	RCT	74.5±6.8	76.1±7.5	268 (87)	Falls during 12 mo	1 visit	12 mo	22	Not clear
de Vries et al[34]	2010	Netherlands	RCT	79.0±7.7	80.6±7.0	217 (64)	Not clear	2 home visits	3, 6, 12 mo	25	55
Duff[35]	2010	United States	RCT	74.6	74	96 (11)	Compliance in the hazard remediation recommendations	10 wk	10 wk	Not clear	50

body of included literature. The rating of the quality of individual RCTs per outcome across trials was carried out to indicate the degree of our certainty (high, moderate, low, or very low) at the total effect estimates.[19-24]

Synthesis of the results

Our primary outcome, number of recurrent falls, was a count outcome. It follows a Poisson distribution, and therefore we used the appropriate meta-analytical approach, an inverse-variance method, by applying a fixed effect and random effects to estimate the pooled incidence rate ratio (IRR). Three different methods (Cochran's Q, Higgins and Thompson's I^2, τ^2) were used to calculate statistical heterogeneity of the pooled IRR estimates. Based on Higgins et al,[25,26] statistical heterogeneity was classified as low ($I^2=25\%$), moderate ($I^2=50\%$), or substantial ($I^2=75\%$). Forest plots with 95% confidence intervals (CIs) were used to illustrate the IRR estimates, and publication bias was assessed with funnel plots. All the data analysis was conducted with R (version 3.6.1)[a] and the *meta* package.[27]

Subgroup analysis and exploring heterogeneity

In the presence of statistical heterogeneity in the meta-analysis, we planned to investigate it quantitatively with metaregression (*a priori*) by considering the following study characteristics: allocation concealment, sequence generation (low, high, or unclear risk of bias), and year of publication. Selecting studies with similar interventions and controls reduced clinical heterogeneity.

Results

Study selection

Initially, our search generated 1156 articles. After removal of duplicates and title and abstract screening, 35 articles remained for full-text review. Of these, 8 of the studies met the eligibility criteria. The study selection flow chart is presented in fig 1.

Study characteristics

The 8 eligible RCTs were conducted between 1999 and 2018 and included 1543 participants. The study size ranged from 67 to 570 participants. All trials were conducted on adults older than 50 years. A summary description of the included RCTs is displayed in table 1.

Interventions and comparators

The studies included in this review were fall hazards identification programs. Most of the programs involved having a professional visit the house of the participant and identify potential fall hazards. However, 2 studies[29,33] also included an exercise intervention with the home hazard identification program, and another study included additional fall prevention interventions such as measuring blood pressure,

Table 2 Intervention characteristics

Author	Year	Main Inclusion Criteria	Main Exclusion Criteria	Intervention Details	Comparator Details	What the Study Reported	Risk of Bias
Cumming et al[31]	1999	Age 65 or older living in the community	Cognitive impairment, or unable to speak English	An occupational therapist assessed the home for hazards and provided the participant with home modifications.	Received usual care postfall incident. Did not receive a home visit by an occupational therapist.	Home visits by an occupational therapist can reduce falls.	Low risk
de Vries et al[32]	2010	Living independently or in an assisted living facility that had experienced a fall	Inability to sign the consent or cognitive impairment, having a fall due to occupational or traffic, and acute disease	Multidisciplinary intervention consisting of several therapies and recommendations, home training to improve balance and strength.	Usual care, treating the consequences of the fall.	During the 1-y follow-up, 55 intervention participants (51.9%) and 62 control participants (55.9%) fell at least once. Intention-to-treat analysis showed no significant treatment effect on the time to first fall (HR=0.96, 95% CI, 0.67-1.37), or time to second fall (HR=1.13; 95% CI, 0.71-1.80).	Low risk
Duff[33]	2010	Community-dwelling ambulatory elderly individuals	Younger than 65 y or older than 90 y, illiterate or cognitively impaired	Self-administered home hazard identification, done at baseline and 24-48 h after baseline, a professional assessment was completed, and follow-up after 10 wk.	Nonexpert self-assessment performed by the participant.	Great variation in the proportion of recommendations implemented across the 3 assessment groups ranging from 0% to 100%. The proportion of implemented was consistently lower for recommendations on fixed structural domains than nonfixed domains.	High risk
La Grow et al[29]	2006	Older than 75, had a low distance visual acuity, and lived in the community	Not clear	An occupational therapist assessed the home for hazards and provided the participant with home modifications.	Exercise intervention of the Otago Exercise program modified for those with severe visual acuity loss, with vitamin D supplementation.	A reduction in falls of elderly people with severe vision loss was not restricted to falls associated with an environmental hazard.	Low risk
Kamei et al[30]	2015	Older adults older than age 65, living in their	Low cognitive function or inability to exercise	About 5-15 min of physical and mental	The control group was given a short talk on	The HHMP group achieved a 10.9%	Unclear risk

(*continued on next page*)

Table 2 (*continued*)

Author	Year	Main Inclusion Criteria	Main Exclusion Criteria	Intervention Details	Comparator Details	What the Study Reported	Risk of Bias
		own residence, and cleared by their physician to exercise		assessment interviews; blood pressure check; 30 min of education regarding fall risk factors, food and nutrition, foot self-care; 60 min of exercise for strength coordination and balance; a residential safety self-assessment checklist.	health and aging by a physician researcher.	reduction in overall falls than the control group (HR=0.591; 95% CI, 0.305-1.147). Falls occurring in the home at 52 weeks were reduced by 11.7% in the HHMP group (HR=0.397; 95% CI, 0.151-1.045).	
Stevens et al[34]	2001	Able to read and speak English, could make home modifications	Had not previously made home modifications	A nurse provided home modifications through a home hazard assessment, installation of safety devices, and an educational strategy to empower seniors to remove or modify home hazards.	No home hazard assessment and no intervention.	Home hazard assessment and modifications are insufficiently potent or targeted to reduce the incidence of falls in healthy older people.	High risk
Stevens et al[35]	2001	People aged 70 y and older living in the community	Not clear	A trained registered nurse provided home hazard assessment, provided advice on home modification, and helped install safety devices.	The control group received the home visit but no specific advice on home modifications.	Removal of hazards is the optimum solution; existing structural hazards cannot be readily removed and must be modified. The effectiveness of safety devices to reduce the fall risk associated with these hazards as not been ascertained.	Low risk
Tan et al[28]	2018	Community-dwelling individuals aged 65 y and older with a history of $\geq$2 falls, or 1 injurious fall over the last 12 months	Clinically diagnosed dementia or inability to stand	Participants were engaged in a modified Otago exercise programme, visual intervention, home environmental modification, medication review, and cardiovascular intervention.	Conventional treatment and health advice.	No reduction of fall recurrence, rate of fall, or time to first fall were observed over a 12-month follow-up.	Unclear risk

Abbreviations: HHMP, home hazard modification program; HR, hazard ratio.

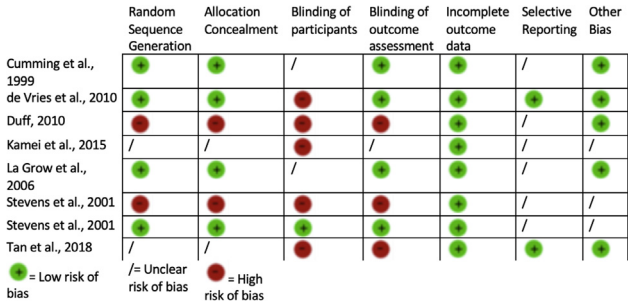

Fig 2 Risk of bias summary: review authors' judgments about each risk of bias item for each included study.

ensuring adequate nutrition, as well as an exercise intervention.[30] The comparator groups consisted of usual care after a fall,[28,33,34] self-directed fall hazard assessment,[35] a short discussion with a physician around falls,[30] or no intervention at all.[31,32] See table 2 for further intervention and comparator descriptions.

Excluded studies

Of the 35 studies that were deemed relevant for full-text review, 27 articles were excluded for the following reasons: (i) ineligible study design (n=24)[13,14,36-55] and (ii) ineligible intervention: RCT (n=3).[11,56,57]

Risk of bias

The risk of bias assessment of the individual studies is presented in fig 2. Selection bias was rated as low risk in 4 studies,[28,29,32,34] unclear risk in 2 studies,[30,33] and high risk in 2 studies,[32,35] which was the same for allocation concealment. Performance bias, specifically blinding of participants, was rated as low risk in 1 study,[32] unclear risk in 2 studies,[28,29] and high risk in 5 studies,[30,31,33-35] and blinding of personnel was rated as low risk in 2 studies,[28,32] unclear bias in 1 study,[29] and high risk in 5 studies.[30,31,33-35] Detection bias was rated as low risk in 4 studies,[28,29,32,34] unclear bias in 1 study,[30] and high risk of bias in 3 studies.[31,33,35] Attrition bias was rated low risk of bias in all the studies. Selective reporting bias was unclear in all but 2 studies,[33,34] and other sources of bias were rated as low risk in all but 3 studies where it was rated as unclear risk.[30-32]

Participants

Data from a total of 5177 adults enrolled in a falls hazard identification program were included in this systematic review. The average age across all participants was 76, and most of the participants (76%) were women (see table 1).

Outcomes

The main outcome was to reduce the number of falls.[28,29,32,33] One study specified reducing the number of falls both indoors and outdoors.[30] Two studies wanted to reduce the number of home hazards after the intervention.[31,35] For 1 study, the primary outcome was unclear[34] (see table 1).

Timeframe

Five of the studies followed the participants for 1 year. One study followed the participants for 11 months, 1 study for 6 months, and 1 study for 10 weeks. However, the actual program length was often only 1 visit, which was seen in 5 of the studies. One study provided 2 visits; 1 study engaged the participants for the full 10 weeks, and 1 study provided a program, which included 4 sessions (see table 1).

Meta-analysis of the incidence of falls

Five studies were included in the meta-analysis (tables 3 and 4). Figure 3 shows the rates of falls between the fall identification programs and usual care during the follow-up of 12 months. The total estimate of IRR with a fixed-effect model or with a random-effects model produced similar results (IRR 0.98; 95% CI, 0.87-1.10), which were not statistically significant indicating no benefit. Heterogeneity was absent from the meta-analysis with all the heterogeneity statistics confirming this ($\tau^2=0\%$; $\chi^2=0\%$ and $I^2=0\%$). The funnel plot, with all of the studies hovering around the 1.0 IRR, indicates no evidence of publication bias (fig 4).

Qualitative synthesis of home hazard identification

Two of the studies reported on using fall hazard programs to reduce the number of fall hazards in the home. The study by Duff[35] had 3 groups, 1 self-administered the home hazard identification, the second had a health care professional administer the hazard identification, and the third group did it both independently and with a health care professional. The first group identified 237 home hazards and 56% of those were implemented; the second group identified 590 home hazards and 45% of those were implemented, the final group identified 871 hazards and 51% were implemented.[35] The study by Stevens et al[32] noted that the intervention group took more care to reduce the number of home hazards for all of the hazards assessed.[32] For example, 78% of the intervention group installed grab rails, whereas only 6.7% of the control group did; and 78% of the intervention group improved poor lighting, compared to 70% of the control group.[32]

Discussion

This systematic review and meta-analysis found no benefit for fall hazards programs on falls incidence rate or number of falls, but suggests a potential benefit in identifying fall hazards in community-dwelling adults older than 50 years. Our meta-analysis showed no statistical difference in falls incidence rate between participants in falls hazards identification interventions and participants who received a control intervention, which included usual care, education intervention, or no intervention. Although there was no statistical significance, the greater number of fall hazards identified in the intervention groups suggests a potential improvement in clinical significance. The quality of included studies was low to moderate and was usually downgraded because of high risk of bias and imprecision.

Table 3 GRADE evidence profile: fall hazards identification program versus control

Quality Assessment						Summary of Findings			
Outcome (No. of studies; design)	Limitations	Inconsistency	Indirectness	Imprecision	Publication Bias	Fall Hazards	Control	IRR (95% CI)	Quality
No. of falls compiled (5 RCTs)	No serious limitations	No serious inconsistency	Serious indirectness	No serious imprecisions	Unlikely	520/1203	702/1816	Fixed-effect model: 0.98 (0.87-1.10) Random-effects model: 0.98 (0.87-1.10)	⊕⊕⊕⊖ Moderate

The CIs excluded a clinically important benefit, because the IRR ranged from about 6% in favor of the intervention to about 6% in favor of the control.

This meta-analysis provides a unique insight into the benefits of fall hazards programs. Fall hazards programs are a common component of falls prevention programs for older adults. Often, an older adult is accompanied by an occupational therapist that will audit their home or environment to identify potential fall hazards.[28,29,37,42,45,49,52] It is becoming increasingly popular to provide older adults with a home checklist to facilitate independent identification of fall hazards.[34,43,46,57] However, the current meta-analysis suggests that there may be no effect, or similar effect of reducing the number of falls through a fall hazard assessment alone, and 2 studies suggested that there may be a benefit in better identifying fall hazards.[32,35] When looking at the pooled estimate for number of falls, all of the included studies show a similar null effect. Further, the CIs of the pooled estimate suggest that checklists are unlikely to reduce the number of falls. Fall hazards identification program may be better than usual care, as seen in the Stevens et al[32] study, because the overall effect favors the intervention group. However, more work needs to be done to determine whether the participant can do fall hazards identification independently, or whether a therapist facilitated visit is more beneficial.[35]

Another potential reason for the lack of improvement in the number of falls after a fall hazard intervention is the inherent lack of understanding of what a fall is for older adults. A study by Zecevic et al[58] explored the idea that people at risk of falling are not clear on what is categorized as a fall. Although a fall has been defined as "an event which results in a person coming to rest inadvertently on the ground or floor or other lower level,"[59] it is not always explicitly explained and may be considered as tacit knowledge without a clear understanding of potential classifications of other falls.[60] The clear understanding of a fall is further complicated by the fact that the terms "slips, trips and falls" have been used interchangeably,[60] which would contribute to the lack of findings in the current study, suggesting more people are "falling" than is reported. Further, data on falls are subject to recall bias, with some participants not recalling that a fall occurred, therefore decreasing the effect of the fall hazards identification program.

Although it is recognized that fall hazard identification and identification of environmental factors contributing to falls are a modifiable risk factors to reduce the incidence of falls,[6] understanding the cause of falls may be a better approach to fully understand the interventions required to reduce falls in community-dwelling adults.[61] An interesting study by Zecevic et al[61] suggested approaching falls research similar to that of industrial accidents, where there is a need to establish what happened, why it happened, and how to prevent similar events from reoccurring. As it relates to fall hazards identification, it seems plausible for an occupational or physical therapist to assist a high falls risk person by identifying what happened, why it happened, and how to prevent it from happening. Ideally, it is important to first learn how to modify their actions to prevent future falls from occurring. This is particularly relevant for the current study, because fall hazards were

Table 4 Summary of findings. Fall hazards identification program versus control in adults

Population: adults
Intervention: fall hazards identification program
Comparison: control
Outcome: falls

Study	IRR (95% CI)	No. of Participants	Quality of the Evidence (GRADE)
Overall effect	Fixed-effect model: 0.98 (0.87-1.10) Random-effects model 0.98 (0.87-1.10)	4109	⊕⊕⊕⊖ Moderate*

NOTE. GRADE quality of evidence:
High quality: We are very confident that the true effect lies close to that of the estimate of the effect.
Moderate quality: We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low quality: Our confidence in the effect estimate is limited. The true effect may be substantially different from the estimate of the effect.
Very low quality: We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect.
* We downgraded by 1 level due to indirectness.

reduced and there was compliance with the fall hazards program, but there was no reduction in the number of falls. A clear understanding of the cause of falls will better identify fall prevention targets. That being said, a fall incident can in fact, just be a random accident—with no increased likelihood of happening again in the future. So, expecting a change in incidence, no matter how *good we are* at education or identifying risk, is likely not an easy thing to measure.

Finally, the studies included in this systematic review suggest that fall prevention is multifactorial and may require a combined approach of identifying fall hazards,[15,16] exercise to improve strength and balance, and addressing other potential modifiable risk factors.[29] It may be that a fall hazard identification program is not enough to reduce the number of falls, and it is necessary to pair with other falls prevention programs such as strength training and balance training.[62]

The lack of effect reported in this study may be due to limitations of the primary studies. First, to identify a fall event, a large sample size is required. Only 1 study had a sample size over 1000,[31] and 2 studies had sample sizes less than 200.[30,35] Depending on how rare the event is, the sample sizes may not have been sufficient to capture a fall. A wearable monitor may provide better objective information on whether a fall occurred. The follow-up time may not have been adequate to capture a fall. Most of the studies were 1 year in length, but none of the studies was greater than 1 year. It may take more time to integrate a fall prevention program and maybe take even more time to see a fall event.

Study limitations

Overall, this study demonstrated both strengths and limitations. The strength of this study is attributed to using a meta-analysis to indicate the magnitude of the effects. We assessed the risk of bias to provide insight into the quality of the studies evaluated, and this review was systematically performed to reduce the risk of bias from the research team. Although we aimed to do a thorough search, there is a possibility some articles may have not been included. Following our inclusion criteria resulted in the exclusions of articles that did not have a full text; therefore, there may be more literature available. Furthermore, our results indicated a high risk of bias in the current studies. Therefore, the individual studies included should be interpreted with caution until more studies are conducted to further contribute to the effect of fall hazard intervention to reduce falls and increase the identification of hazards. One of the studies in the meta-analysis was a self-directed falls identification, which may prove differences compared to the other studies using non-falls checklist-related control groups. Further, the studies did not report on whether the participants had a previous fall, or if the falls were injurious in nature. Also, none of the studies reported their findings according to the CDC's STEADI algorithm to address fall specific questions. Finally, the lack of specific reporting of

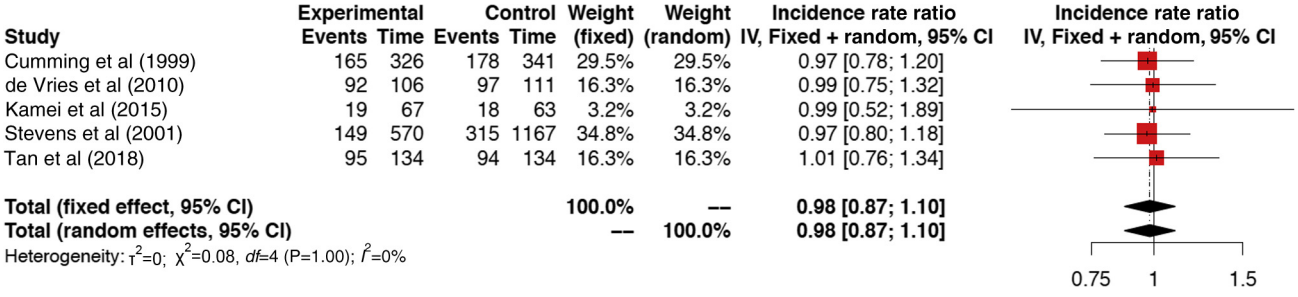

Fig 3 Meta-analysis of studies comparing the incidence of falls between the intervention and control groups.

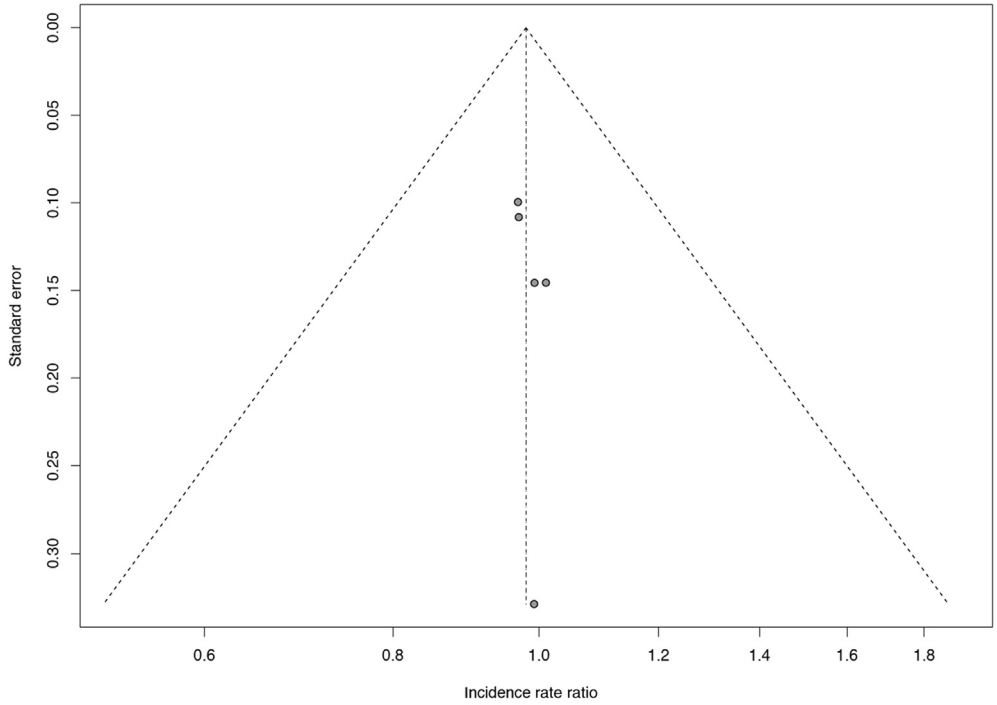

Fig 4 Funnel plot of studies comparing the incidence of falls between the intervention and control groups.

the interventions, made the comparisons challenging. Although statistical heterogeneity was absent, there is potentially a possibility of undetected clinical heterogeneity among the tested interventions. Although we believe that reducing falls is multifactorial, it would be beneficial if future studies focused on which falls risk factor or combination of fall risk factors contribute to falling.

Conclusions

The current study suggests that there may be a benefit for fall hazards programs to identify fall hazards but not to reduce falls. No important benefit was seen in reduction of recurrent falls through falls hazards identification interventions and participants who received a control intervention, which included usual care, education intervention, or no intervention. Future studies may benefit from longitudinal follow-ups with explicit action plans for care that are consumer or older adult driven and accepted will likely be worthwhile.

Supplier

a. R, version 3.6.1; The R Foundation for Statistical Computing.

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Appendix 1

Keywords

1. Fall hazard
2. "Fall hazard*"
3. "Fall prevention"
4. "fall risk*"
5. "slip*" or "trip*" or "faint*"
6. "older adult*"
7. 2 and 6
8. "community setting"
9. 2 and 8
10. "environmental fall hazard*"
11. "fall risk injur*"
12. "dwelling hazard*"
13. "falls history"
14. "medications"
15. 2 and 14
16. "sensory loss"
17. 2 and 16
18. "balance loss"
19. "unsteadiness"
20. "slip* surface*"
21. "trip* surface*"
22. "house hazard*"
23. "home hazard*"
24. "community fall hazard*"
25. "dwelling hazard*"
26. "walking hazard*"
27. "standing hazard*"
28. "housework risk*"
29. "housework hazard*"
30. "household hazard*"

31. "fall* safety"
32. "home modification*"
33. 2 and 32
34. "vision loss"
35. 2 and 34
36. "footwear hazard*"
37. "cognitive status"
38. 2 and 37
39. "nutrition"
40. 2 and 39
41. "unsafe task*"
42. 8 and 41
43. "balance assessment"
44. "gait loss"
45. 2 and 44

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