BMJ Uncertainties Article

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Title: Uncertainties: Should environmental assessment and modification to prevent falls be offered to all community dwelling, older people?

Accidental falls affect around 30% of people over the age of 65 and 50% of those over 80.(1) Falls are one of the leading causes of injury induced morbidity and mortality in people over 75. After a fall, nearly 25% of older people are concerned about further falls and some restrict activity, resulting in physical deconditioning, increased risk of future falls, institutionalisation and reduced quality of life. (2) The health and social care costs of falls are escalating with increasing longevity. (3, 4)

Box 1: Risk factors for falls in community dwelling older people

- Age (≥ 65)
- History of falls in the past year
- Use of mobility device, such as a walking aid
- Requiring assistance for any activities of daily living (ADL)
- Use of psychoactive medications
- Fear of falling

We categorise falls risk as:
High falls risk: Aged ≥ 65 years, have a history of falls and possess one or more of the above remaining risk factors for falls
Moderate risk of falls: Aged ≥ 65 years and possess one of the above additional risk factors
Low falls risk: Possess only one falls risk factor

Box 1 lists the six most potent falls risk factors in community dwelling older people (people who live in the community as opposed to residential care). (5) Falls prevention interventions address risk factors and are more effective if they are individualised and target people at high falls risk.(5-7)

Environmental hazards, such as trailing cables and poor lighting, have been attributed as causal risk factors in 30-50% of falls in observational studies.(1, 7) Thus, environmental assessment and modification (EAM) to prevent falls is intuitively sensible. Indeed, national and international guidelines recommend interventions to reduce environmental hazards for older people at risk of falling.(8-11) Australian,(10) American,(9) and British(8, 9) guidelines recommend including EAM as an effective component of multifactorial interventions, although recent American guidelines conclude that the net benefit of multifactorial interventions in falls prevention is small.(12) Other guidelines recommend that EAM is routinely provided by occupational therapists for older people at risk of falling or who are admitted to hospital following a fall.(8, 11)

The theoretical approach underpinning EAM posits that the person, environment and task being performed continually interact in ways that enhance or diminish a person's task performance and that environmental hazards are dynamic entities which occur through an interaction between these three elements (13). Robustly designed observational studies have shown that the mere presence of a hazard is not associated with falling. (14) This supports the relevance of context, environment, use of environment, and a person's capacity as key features of EAM to reduce fall risk. Occupational Therapy practice aims to enhance, restore or create a balance between these elements. In choosing environmental solutions, individuals tend to design their environments appropriately with respect to their ability.(15) Thus, active engagement of older people in environmental interventions is key, along with the need for interventions to encompass functional assessment, rather than checklist style hazard removal, provided by health care workers with an

understanding of the complexities of the relationship between the individual, the environment and the task.

Box 2: Categories of falls risk factors

Falls risk can be categorised as:

- Intrinsic (personal risk factors);
- Extrinsic (environmental risk factors / environmental hazards), and;
- Behavioural (activity related risk factors)

Within each of these categories, falls risk can be sub-divided into:

- Modifiable risk factors (e.g. muscle weakness, lack of a stair rail, alcohol consumption), and;
- Non-modifiable risk markers (e.g. age and gender)

Falls prevention interventions address risk factors, but both risk factors and risk markers are useful determinants of future falls risk.

Box 2 outlines categories of falls risk factors for community dwelling older people.(16) EAM appears to be more effective if all three categories of falls risk are considered during the assessment.(11, 16)

A range of health care workers provide environmental interventions, such as: health care support workers (HCSWs) without a professional qualification (home care, nursing assistants); other professionals (nurses, physiotherapists); and, occupational therapists (OTs) who specialise in EAM. The intensity of EAM ranges from hazard screening checklists, administered without the older person necessarily being present, to high intensity intervention comprising a comprehensive functional assessment of the older person in their home environment. Thus, health care workers can be classified by their level of expertise and environmental interventions by their intensity (Box 3). It remains uncertain, however, whether EAM reduces falls in high risk older people and who can most effectively provide it.

Box 3: Types of environmental intervention to reduce falls risk

- Assessment and modification of the environment and tasks performed, including raising awareness of falls risks and joint problem solving with the older person to identify acceptable solutions;
- Home modifications to improve task performance, independence and/or safety (e.g. modifying a shower to improve access), and;
- Assistive technology to maintain or improve independence (e.g. provision of mobility aids, grab rails and personal alarms).

What is the evidence of uncertainty?

Box 4: Search strategy

We searched the Cochrane Database of Systematic Reviews,
MEDLINE, EMBASE and CINAHL (Cumulative Index to Nursing and Allied Health Literature) for studies published from 2010 to 2017. We applied English language and peer reviewed journal restrictions. We used the following terms for the literature search:
Accidental falls; fall*; frail elderly; aged; older*; elder*; senio*; home N5 (assessment or intervention or design or hazard or modification or safety); home N3 hazard N3 reduction N3 visi*; equipment; adaptatio*; assistive technology; enviro* N5 (assessment or design or hazard or modification or safety or risk); "facility design and construction".

We found four systematic reviews specific to EAM, including a Cochrane Review, eight randomised controlled trials and four clinical guidelines isolating the clinical effectiveness of EAM.

The evidence underpinning EAM is equivocal. This evidence has been synthesised in systematic reviews with meta-analyses, some of which suggest that in high risk populations, high intensity OT led EAM may reduce falls, but further, robust evidence is required to confirm this.(6, 17-19) Limitations of the studies summarised

in the systematic reviews include: Intervention delivered to low risk populations; variation in health care background of the person delivering the intervention; variation in the intensity of the intervention being evaluated, with some studies incorporating a checklist / screen as opposed to a functional environmental assessment; and, methodological weakness and small sample sizes in some studies (see Appendix 1 for a summary of the systematic review findings).

Eight randomised controlled trials (RCTs), which isolate the effectiveness of EAM, have been summarised in the systematic reviews along with other multifactorial studies. Of these, five studies showed a statistically significant reduction in falls in high risk participants through high intensity, OT led EAM.(4, 20-23) The remaining three trials found no effect on falls when low intensity interventions, were provided by other professionals(24) or trained support workers to both high and low risk populations.(25, 26) (see Appendix 2 for a summary of RCTs which isolate the effects of EAM).

Risk, professional background and intervention intensity

Specialism in environmental assessment and participant risk profile are likely to be important factors which determine the clinical effectiveness of the intervention. In a three-armed trial (n=238), Pighills et al (2011) found that in high risk populations, high intensity intervention provided by trained health care support workers (HCSWs) did not statistically significantly reduce falls compared to controls, but showed a trend in that direction, whereas high intensity intervention provided by OTs showed a significant and clinically important reduction in falls. (22) In an early evaluation of the effectiveness of EAM, Cummings et al (1999) (n=530) found that high intensity OT led intervention did not statistically significantly reduce falls in low risk populations, but it did in high risk populations. This concurs with other research indicating that falls prevention interventions have less effect when delivered by health workers other than OTs or to low risk populations.(6)

Is ongoing research likely to provide relevant evidence?

We searched the CDSR, the WHO ICTRP, ClinicalTrials.gov and the ANZCTR for research protocols. We found two ongoing studies: a small study (15 participants) in Chicago, USA investigating an OT led fall prevention intervention aiming to reduce fear of falling and the Occupational Therapy Intervention Study (OTIS). The OTIS is a large trial, currently being conducted by the authors of this paper. It aims to detect whether OT led EAM, delivered to people at high risk of falls, is effective in reducing falls.(27) To date 1333 older people have been randomised to high intensity EAM or control. The trial is in the follow-up phase, in which fall events are being recorded over the period of one year. Follow-up is scheduled to be completed in late 2019. This trial will add to the evidence base on whether OT led EAM delivered to people at high risk of falls is clinically effective. The question of whether trained HCSWs and other professionals can deliver EAM will not be answered by the OTIS trial and still needs to be addressed.

Box 5: Recommendations for future research

Large trials in community dwelling older people ≥65 at high risk of falls to evaluate whether:

- OT led EAM is clinically effective compared to controls, to resolve the uncertainty
- High intensity EAM is as clinically effective in reducing falls if delivered by OTs, compared to other trained professionals
- HCSWs, who specialise in falls prevention and have been trained to a skill level in EAM similar to that of OTs, are as clinically effective as OTs in reducing falls through EAM
- Intensive follow-up to implement recommendations, immediately post OT led EAM, produces a greater reduction in falls than no follow-up or a single follow-up visit. A nested project to identify the most effective level of follow-up would enable resources to be deployed more efficiently.

Qualitative studies to understand what OTs consider in their clinical reasoning when carrying out EAM. This would help determine what the important elements are and inform future staff training.

What should we do in the light of the uncertainty?

In spite of practice guidelines recommending that older people at high risk of falls receive OT led EAM,(8, 11) evidence of variation in OT clinical practice suggests collective uncertainty.(28) Recent qualitative and implementation research examining current OT practice revealed that EAM for falls prevention has not been adopted in routine practice.(28, 29) Reasons for this could include a perceived lack of robust evidence, limited awareness of clinical guidelines and access to the evidence, complexity of the intervention and a perceived lack of practitioner skill and time to carry out the assessment.(28)

Given the lack of robust evidence, and considering the cost and resource implications of occupational therapists intervening with people in all risk categories, we recommend that OT led EAM is only offered to older people at high risk of falls,(6, 11, 17) including those who are aged ≥65, have a history of falls and possess one or more additional risk factors.(5) On referral, doctors should explain that the OT will support the patient to identify hazards in the home and those activities which might increase the risk of falling, and jointly problem solve solutions.(17)

Boxes:

Box 6: What you need to know

- Based on current evidence, OT led EAM should be offered to frail older people at high risk of falls
- EAM should address falls risk using a comprehensive, validated assessment and involve functional assessment of the individual in their home environment, a joint problem-solving approach and follow-up as required, to support the older person to implement mutually agreed action items
- There is a lack of evidence to indicate whether OT led EAM is clinically effective for people at moderate risk of falling

Box 7: In summary the evidence outlined tells us that:

In high falls risk populations:

- High intensity OT led EAM statistically significantly reduces falls

- High intensity trained support worker led EAM does not statistically significantly reduce falls, but shows a trend in that direction

In low falls risk populations:

- High intensity OT led EAM does not significantly reduce falls
- Low intensity EAM led by either other professionals or trained support workers does not significantly reduce falls

Box 8: Education into practice

- How would you assess whether an older person is at high risk of falls?
- Out of all frail older patients that you treated in the last year, following a fall, how many received a validated environmental assessment which involved a functional assessment of the individual in their home environment and follow-up as required?
- What would you include in a comprehensive environmental assessment, who would provide it and which patients would you offer it to?

Box 9: How patients were involved in the production of this article

A consumer from the OTIS Consumer Reference Group reviewed the manuscript and provided feedback.

As a result of their input, the article was changed in the following ways:

- Clarified the term 'community dwelling'
- Specified that only some, not all, of those who are fearful of falling subsequently restrict their activity
- Provided more information on the factors that are causing the escalation in the cost of falls

Box 10: What patients need to know

- If you are 65 or over, live in the community and either: have had a fall in the past year; take psychoactive medications; need assistance with any activities of daily living; are concerned about falling; or, use a mobility aid, your risk of falls in the future is higher. It is likely that environmental assessment and

modification, provided by an occupational therapist, would reduce your risk of future falls

- With your consent, the OT would visit your home to: assess and recommend modifications to the environment and tasks that you perform; reduce falls hazards and improve your independence and/or safety; and, consider whether any assistive technology would help to maintain or improve your independence
- After the assessment you would be asked to identify what you think puts you at risk of falling and jointly problem solve and agree on solutions with the OT

Tables:

Summary of Randomised Controlled Trial evidence: See Appendix 1

Summary of Systematic Review evidence: See Appendix 2

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Appendix 1

Systematic reviews summarising environmental interventions

Systematic review	Research aim/question	Size/population	Environmental intervention	Outcome	Quality of evidence assessment	Clinical implications	Uncertainty
Chang et al (2004)	To assess the relative effectiveness of interventions to prevent falls in older adults to either a usual care group or control group	5 trials (participant numbers not specified)	Environmental modification	ARR for falling once during 6 to 18m follow up 0.90 (0.77 to 1.05) AIR for monthly rate of falling 0.85 (0.65 to 1.11)	Jadad score used to assess quality of evidence. Assigned scores not specified	Environmental modification deemed not to be effective in reducing falls	Pooled estimates not statistically significant
Clemson et al (2008)	To determine the efficacy of environmental interventions in reducing falls in community dwelling older people	6 trials: 3298 participants 4 trials 570 participants	Environmental interventions: adaptations and modifications; changing individual behaviours; and management of the environment	Relative Risk 0.79 (0.65 to 0.97) Participants at high risk Relative Risk 0.61 (0.47 to 0.79)	Criteria based on those used in the Cochrane Review. All trials met 60% of the quality criteria	Environmental interventions that are comprehensive, focused, and incorporate an environmental-fit perspective with adequate follow-up can significantly reduce falls	The 4 trials with high risk populations were relatively small
Gillespie et al (2012)	To assess the effects of interventions designed to reduce the incidence of falls in older people living in the community	6 trials; 4208 participants 7 trials; 4051 participants	Home safety assessment and modification, including: aids and home adaptations	Reduced rate of falls (RaR 0.81, 95% CI 0.68 to 0.97) Reduced risk of falling (RR 0.88, 95% CI 0.80 to 0.96)	Bias assessed using criteria in the Cochrane Review handbook	Home safety interventions reduce the rate and risk of falls. More effective in high risk groups and when delivered by an OT	
Tricco et al (2017)	What types of fall-prevention programs may be effective for reducing	Numbers combined with	Environmental assessment and modification (EAM)	Reduced risk of injurious falls, OR 0.30 (0.13 to 0.70)	Cochrane Effective Practice and	Environmental interventions were effective in reducing	EAM in isolation was not

Systematic review	Research aim/question	Size/population	Environmental intervention	Outcome	Quality of evidence assessment	Clinical implications	Uncertainty
	injurious falls in older people?	exercise and vision studies – unable to isolate		when combined EAM with exercise and vision assessment and treatment Reduced risk of falls. OR 0.53 (95% CI 0.29 to 0.97) when combined EAM with exercise, education and hip protectors	Organisation of Care Group's risk of bias tool	injurious falls when combined with exercise and vision assessment and treatment and effective in reducing the risk of falls when combined with exercise, education and hip protectors.	significantly associated with a reduction in injurious falls and falls risk

Key: AIR – Adjusted incidence rate; ARR – Adjusted risk ratio; EAM – Environmental assessment and modification; OT - Occupational Therapist; RaR – Rate ratio; RR – Risk ratio

Appendix 2

Summary of trials evaluating environmental interventions in isolation

Study	Size	Intervention	Control	Ax Used	Inclusion Criteria	Outcome	Quality of Evidence Score (un-met criterion number) *	Uncertainty
Cumming et al 1999 RCT	N=530	EAM – OT led	Usual care	WeHSA Standard, valid and reliable. Criterion referenced	≥ 65 Community dwelling No falls Hx	No significant effect on falls reduction overall RR=0.81 (95%CI 0.66-1.00) Sub group analyses Falls Hx RR=0.64 (95%CI 0.50-0.83) No falls Hx RR=1.03 (95%CI 0.74-1.41)	10/10	Sample size too small Only a subset of 206 participants were high risk
Stevens et al 2001 Cluster RCT	N=1737	EAM – Nurse led	No intervention control	Home hazard Ax (type not specified)	≥ 70 Cognitively intact Not modified environment	No significant effect on falls reduction RR=1.02 (95% CI 0.83-1.27)	7/10 (1,2,7)	Participants low risk Not statistically significant Checklist not Ax
Day et al 2002 RCT factorial design	N=1090	1. Exercise 2. EAM – SW led 3. Vision 4. Control 5. Exercise + EAM 6. Exercise + vision 7. EAM + vision	No intervention control	Walk through checklist	≥ 70 Community dwelling Could walk 10-20 metres without rest	No significant effect on falls reduction for EAM in isolation RR=0.92 (95%CI 0.78-1.08) 14% reduction for all 3 interventions combined. RR=0.67 (0.51-0.88)	8/10 (5,6)	Participants low risk Not statistically significant Checklist not Ax Factorial study so only 136 received EAM in isolation
Niklaus & Bach 2003	N=360	Geriatric assessment –	Geriatric Ax & usual care	Standard home	Mean 81.2 SD 6.4 In patients	Significant effect on falls reduction IRR=0.69 (95%CI 0.51-0.97)	10/10	Sample size too small Checklist not Ax

Study	Size	Intervention	Control	Ax Used	Inclusion Criteria	Outcome	Quality of Evidence Score (un-met criterion number) *	Uncertainty
RCT		Nurse / physio led & EAM – OT led		safety checklist	Community dwelling Chronic conditions or functional decline			
Campbell et al 2005 RCT	N=391	Factorial design: EAM – OT led Exercise EAM & exercise	Social visits	Modified WeHSA. Standard valid and reliable. Criterion referenced	≥ 75 with low vision, community dwelling, admitted to hospital with functional decline	Significant effect on falls reduction RR=0.59 (95%CI 0.42-0.83) Incremental cost per fall prevented $NZ650	10/10	Factorial study so only 100 received EAM in isolation
Lin et al 2007 RCT	N=150	3 arm design: EAM – SW led Exercise	Education via pamphlets and social visits	Home hazard Ax (type not specified)	≥ 65 Community dwelling Medical attention for fall in previous 4 weeks	Fall incident rate per 1000 PY: EAM 1.1 Exercise 1.6 Education 2.4 Not statistically significant	6/10 (1,2,8,10)	Sample size too small 3 arm study so only 50 received EAM 4 month falls follow-up Not statistically significant Checklist not Ax
Pighills et al 2011 RCT	N=238	3 arm design: EAM – OT led EAM – SW led	Usual care	WeHSA Standard, valid and reliable. Criterion referenced	≥ 70 Community dwelling Falls Hx	Significant effect on falls reduction in OT group: IRR= 0.54 (95% CI 0.36–0.83, P=0.005) Non-significant reduction in falls in SW group IRR= 0.78 (95% CI 0.51–1.21, P=0.34)	10/10	Pilot study Primary outcome fear of falling 3 arm study so only 87 received OT led EAM

Study	Size	Intervention	Control	Ax Used	Inclusion Criteria	Outcome	Quality of Evidence Score (un-met criterion number) *	Uncertainty
Chu et al 2017	N=204	EAM – OT led	Well-wishing visit from RA	WeHSA Standard, valid and reliable. Criterion referenced	≥ 65 Community dwelling Visiting ED for fall	Significant difference in falls (P=0.02), fallers (P=0.03) and time to first fall (log rank test 5.052, P=0.02) at 6m in favour of the OT group Non-significant reduction in falls at 1 year in OT group	9/10 (2)	Sample size too small Statistically significant difference at 6m not sustained at 12m. Possibly underpowered to detect a difference at 12 months due to attrition and low rate of falls in both groups

Key:

EAM – Environmental assessment and modification
WeHSA – Westmead Home Safety Assessment
OT – Occupational Therapist
SW – Support Worker
RA – Research Assistant
Ax – Assessment
Hx – History
IRR – Incident rate ratio
PY – Person Years

Quality of Evidence Questions (scored 0/1): * Clemson 2008 rating criteria

1. Randomisation generated by random sequence
2. Allocation concealment
3. Clearly defined inclusion and exclusion criteria
4. Clearly defined outcome measures
5. Treatment and control group compatibility on entry
6. Potential for contamination bias
7. Blinding of outcome assessors
8. Intention to treat analysis
9. Reliable measures to ascertain falls and other outcome measures
10. Clinically appropriate duration of surveillance