

### *Fall prevention in older persons*

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The population of South Africa is ageing. In 2000 there were about 600 000 people aged 75 years and older; in 2025 there will be 1.5 million and in 2050 the number will have climbed to 2.6 million.<sup>[1]</sup> It is people in the 75+ age group who tend to suffer the most from falls. Falls are one of the five so-called 'geriatric giants', along with dementia, poor mobility, incontinence and polypharmacy.<sup>[2]</sup> Studies in Europe, North America and Australia showed that about 30% of people aged 65 years and older and living in the community fall at least once a year.<sup>[3]</sup> Fall frequency is even higher among older people living in residential aged care facilities.<sup>[3]</sup> About 5% of falls lead to fractures, but even falls without obvious injury can lead to loss of confidence and eventual institutionalisation.<sup>[4]</sup>

The frequency of falls in South Africa is unknown. Classic studies by Solomon in the 1960s showed that hip fracture rates in black South Africans in Johannesburg were many times lower than in whites in European studies, with a total of only 78 hip fractures identified in black South Africans over the 7-year period 1957 - 1963.<sup>[6]</sup> It has generally been thought that the low hip fracture rate was due to higher bone mineral density among blacks compared with whites, but the low fracture rate could also be explained, at least in part, by a lower fall rate. Low fall rates, not stronger bones, seem to explain the relatively low hip fracture rate in China compared with Europe and North America.<sup>[6]</sup>

Studies conducted in the 1980s identified the main risk factors for falls: impaired balance, weak muscles, poor vision, psychotropic medications, inadequate footwear and environmental hazards.<sup>[9]</sup> Medical conditions, including stroke and Parkinson's disease, which lead to poor balance and muscle weakness are important causes of falls. Dementia and delirium are also associated with increased risk of falls.<sup>[3]</sup>

Building on the risk factor evidence base, interventions for fall prevention began to be evaluated in randomised trials in the early 1990s. In 1994, Yale's Mary Tinetti and colleagues published a seminal article in the *New England Journal of Medicine* which showed conclusively that many falls could be prevented by a multidisciplinary team approach.<sup>[7]</sup> Since then, more than 200 fall-prevention randomised trials have been published. This article reviews the evidence accumulated across these studies,

with emphasis on the findings of 2 Cochrane Collaboration Reviews published in 2012.<sup>[8,9]</sup> The article considers fall prevention in 3 different settings: the community, hospitals and residential aged care facilities (often called nursing homes).

**Falls in the community**

There have been more than 150 randomised trials evaluating interventions to prevent falls among older people living in the community. The Cochrane Review identified 3 groups of interventions which statistically significantly reduced the risk of falls: multifactorial interventions, exercise programmes and home modifications (Table 1).<sup>[8]</sup>

Multifactorial interventions start with a comprehensive assessment of risk factors for falls, with subsequent management of identified risk factors. The assessment is typically done by a multidisciplinary team that includes a physician (often a geriatrician), a physiotherapist and an occupational therapist. Management may include withdrawal of unnecessary psychotropic medications, an exercise programme to improve balance and strength, and home modifications. Early studies of multifactorial interventions, such as those by Tinetti *et al.* in the US and Close *et al.* in the UK,<sup>[7,10]</sup> showed that they could reduce falls risk by 30 - 40%. More recent studies, however, have tended to find less of an effect. One explanation for reduced effectiveness is that control subjects in recent studies have had better access to falls prevention programmes that are becoming more available in the community. Another explanation is that some recent studies have

not had strong links between assessment and treatment: an intervention will only work if identified falls risk factors are treated appropriately.

Exercise programmes have been studied more than any other fall-prevention intervention. The Cochrane Review reported that various types of exercise programmes reduced the risk of falls by about 30%.<sup>[8]</sup> Sherrington *et al.* conducted a systematic review, including meta-regression, to try to identify the characteristics of exercise programmes that were most effective for fall prevention.<sup>[11]</sup> The review found that the most effective programmes were those that had a focus on improving balance, rather than muscle strength. This fits well with several studies that have shown that Tai Chi can prevent falls.<sup>[8]</sup> Sherrington *et al.* also found that walking does not prevent falls and may even increase fall risk.<sup>[11]</sup>

Some older people are unwilling to join a formal exercise programme. Clemson *et al.* in Australia have recently demonstrated that incorporation of exercise into daily life can reduce fall risk.<sup>[12]</sup> Examples of exercises include standing on one leg while washing the dishes and placing the washing basket on the ground, rather than in a trolley, and squatting down and then up to take clothes from the basket to the clothesline.

Several studies have investigated home modifications for fall prevention.<sup>[8]</sup> Home modifications seem to be effective if assessment for home hazards and subsequent modifications are supervised by an occu-

**Table 1. Results of randomised trials of falls prevention interventions for older people living in the community**

Intervention	Relative risk (95% confidence interval)
Multifactorial interventions	0.76 (0.67 - 0.86)
Exercise programmes	
Group exercise programmes	0.71 (0.63 - 0.82)
Home-based exercises	0.68 (0.58 - 0.80)
Tai chi	0.72 (0.52 - 1.00)
Home modifications	0.81 (0.68 - 0.97)
Vitamin D supplements	
Low vitamin D levels	0.57 (0.37 - 0.89)
Normal vitamin levels	1.02 (0.93 - 1.13)

Source: Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. Cochrane Collaboration, 2012.<sup>[8]</sup>

pational therapist. Simply giving older people a home safety check-list and expecting them to arrange their own modifications does not prevent falls.

An elegant randomised trial by Campbell *et al.* in New Zealand showed that withdrawal of psychotropic medications has a dramatic impact on falls risk, with a 60% relative risk reduction.<sup>[13]</sup>

Interventions to improve vision have had mixed results.<sup>[8]</sup> First eye cataract surgery has been shown to be effective for fall prevention (and fracture prevention). On the other hand, improving refraction with new glasses was found to increase fall risk, at least in the first few months during accommodation. Building on the observation that use of bifocal lenses was associated with increased risk of falls, Haran *et al.* conducted a randomised trial of users of bifocals in which half the subjects were switched to two pairs of single-lens glasses, one for distance and one for reading.<sup>[14]</sup> They found that this strategy reduced fall risk among older people who spend considerable amounts of time outdoors, but not among those who remain indoors.

Vitamin D supplements are effective for people living in the community who have low vitamin D levels, but not for people with normal levels.<sup>[8]</sup> This implies that vitamin D levels should be measured before prescribing vitamin D supplements.

While there is now good evidence about effective fall-prevention interventions for most older people living in the community, one group has been excluded from most trials: people with dementia. The only trial to restrict its study population to those with dementia found no effect of the type of multifactorial intervention that has worked for cognitively intact people.<sup>[15]</sup> This is an area where more research is needed.

### Falls in hospital

Up to 20% of older people admitted to hospital, fall during their hospital stay.<sup>[9]</sup> These falls are distressing for patients, their families and hospital staff. Unfortunately, the best way to prevent these falls remains unclear.

The Cochrane Review included 17 randomised trials evaluating fall-prevention interventions in hospitals.<sup>[9]</sup> Most of these studies lacked the statistical power needed to detect an effect. Three large studies have

investigated multifactorial interventions, with conflicting results.<sup>[9]</sup> The studies by Haines *et al.* and Healey *et al.* found a reduction in falls risk,<sup>[16,17]</sup> while the study by Cumming *et al.* did not.<sup>[18]</sup> One explanation may be the differing average lengths of stay in these studies. Cumming *et al.*'s Australian study mainly involved patients in acute care wards with an average length of stay of 7 days. In contrast, Haines *et al.* studied patients in Australian rehabilitation wards, with an average length of stay of about 30 days. The average length of stay in Healey *et al.*'s study in the UK was 20 days. Some interventions, such as exercise programmes to improve balance and strength, take several weeks to be effective and so patients in hospital for just a few days will not benefit.

To be effective, fall prevention in hospital probably requires major re-design of the layout of wards and changes in the way wards are managed. Patients at high risk of falls should probably be observable at all times from the nursing station. Fall injuries might be prevented by using very low beds. All staff need to make fall prevention a priority, which requires education and strong leadership. Interventions such as these take time and money and are difficult to evaluate in a randomised trial.

Many falls by older people in hospital are related to dementia and delirium. Fall-prevention interventions that target these conditions need to be developed and evaluated.

### Falls in residential aged care facilities

The Cochrane Review identified 43 randomised trials of fall-prevention interventions for older people living in aged care facilities (often called nursing homes).<sup>[9]</sup> The studies were mainly concerned with multifactorial interventions, exercise programmes alone or vitamin D supplements.

The best evidence is for vitamin D supplements, which are effective.<sup>[9]</sup> This reflects the fact that most people in residential aged care facilities are vitamin D deficient. If resources for testing vitamin D levels are limited, then it would seem reasonable to recommend vitamin D supplements for all residents of aged care facilities.

The evidence for multifactorial interventions in aged care facilities is inconsistent; never-

theless, the Cochrane Review concludes that such interventions are probably effective.<sup>[10]</sup> One of the negative trials came from Kerse *et al.* in New Zealand.<sup>[19]</sup> They employed a falls prevention officer in each intervention facility and found that this might have actually increased the risk of falls. While this might seem paradoxical, it may be that the existence of a designated fall-prevention staff member meant that other staff no longer felt responsible for fall prevention, with a net reduction in fall-prevention activities in intervention facilities.

The role of exercise programmes for falls prevention in aged care facilities remains unclear. The Cochrane review found some evidence that exercise programmes might reduce falls among more robust older people but might increase falls among more frail older people.<sup>[9]</sup>

### Conclusions

Over the past 20 years there have been impressive advances in knowledge about how to prevent falls. It is no longer acceptable to consider falls an inevitable part of ageing about which nothing can be done. It is now established that many falls among older people living in the community can be prevented. Effective interventions include: multifactorial interventions, exercise programmes designed to improve

balance, home modifications supervised by an occupational therapist, withdrawal of psychotropic medications, cataract surgery and vitamin D supplements for people who are vitamin D deficient. In residential aged care facilities, vitamin D supplements are definitely effective and multifactorial interventions probably are. There is less certainty about what is effective in the hospital setting and this is clearly an area where much more research is needed.

### References

1. United States Census Bureau International Programs. International Database. <http://www.census.gov/population/international/data/idb/informationGateway.php> (accessed 28 May 2013).
2. Isaacs B. *The Challenge of Geriatric Medicine*. Oxford, UK: Oxford University Press, 1992.
3. Lord SR, Sherrington C, Menz H, Close J. *Falls in Older People: Risk Factors and Strategies for Prevention*. 2nd ed. Cambridge: Cambridge University Press, 2007.
4. Tinetti ME, Williams CS. Falls, injuries due to falls, and the risk of admission to a nursing home. *N Engl J Med* 1997;337:1279-1284.
5. Solomon L. Osteoporosis and fractures of the femoral neck in South African Bantu. *J Bone Joint Surg* 1968;50B:2-13.
6. Kwan MM, Close JCT, Wong AKW, Lord SR. Falls incidence, risk factors, and consequences in Chinese older people: A systematic review. *J Am Geriatr Soc* 2011;59:536-543.
7. Tinetti ME, Baker DI, McAvay G, et al. A multifactorial intervention to reduce the risk of falling among elderly people living in the community. *N Engl J Med* 1994;331:821-827.
8. Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev* 2012:9.
9. Cameron ID, Gillespie LD, Robertson MC, et al. Interventions for preventing falls in older people in care facilities and hospitals. *Cochrane Database Syst Rev* 2012:12.
10. Close J, Ellis M, Hooper R, et al. Prevention of falls in the elderly trial (PROFET): A randomised controlled trial. *Lancet* 1999;353:93-97.
11. Sherrington C, Whitney JC, Lord SR, Herbert RD, Cumming RG, Close JCT. Effective exercise for the prevention of falls: A systematic review and meta-analysis. *J Am Geriatr Soc* 2008;56:2234-2243.
12. Clemson L, Fiatarone Singh M, Bundy A, et al. The LiFE study, embedding balance and strength training in daily life activity to reduce falls in older people: A randomised trial. *BMJ* 2012;345:e4547.
13. Campbell AJ, Robertson MC, Gardner MM, et al. Psychotropic medication withdrawal and a home-based exercise program to prevent falls: A randomized, controlled trial. *J Am Geriatr Soc* 1999;47:850-853.
14. Haran MJ, Cameron ID, Ivers RQ, et al. Effect on falls of providing single lens distance vision glasses to multifocal glasses wearers: VISIBLE randomized controlled trial. *BMJ* 2010;340:c2265.
15. Shaw F, Bond J, Richardson DA, et al. Multifactorial intervention after a fall in older people with cognitive impairment and dementia presenting to the accident and emergency department: Randomised controlled trial. *BMJ* 2003;326:73.
16. Haines TP, Bennell KL, Osbourne RH, Hill KD. Effectiveness of targeted falls prevention programme in subacute hospital setting: Randomised controlled trial. *BMJ* 2004;328:676-679.
17. Healey F, Monro A, Cockram A, Adams V, Heseltine D. Using targeted risk factor reduction to prevent falls in older in-patients: a randomised controlled trial. *Age and Ageing* 2004;33:390-395.
18. Cumming RG, Sherrington C, Lord SR, et al. Cluster randomised trial of a targeted multifactorial intervention to prevent falls among older people in hospital. *BMJ* 2008;336:758-760.
19. Kerse N, Butler M, Robinson E, Todd M. Fall prevention in residential care: A cluster, randomized, controlled trial. *J Am Geriatr Soc* 2004;52:524-531.