

# Community-based health efforts for the prevention of falls in the elderly

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**Abstract:** Falls are a major public health problem in the elderly population. The associated health care cost is great. It has therefore become an important public health matter to evaluate those interventions that might be effective in reducing the risk of falls. Risk factors that predict an increased risk of falling are described. We discuss interventions that can be employed in the community to reduce the risk of falls and associated injuries by discipline, including physiotherapy, occupational therapy, and physician-led interventions. We also discuss the cost-effectiveness of such interventions.

**Keywords:** fall, fracture, prevention, public health

## Introduction

Falls are a major public health problem in the elderly population. Every year accidental falls occur in nearly one-third of those aged more than 65 years, with 10% of these falls resulting in serious injury.<sup>1</sup> Falls lead to reduced levels of independence, poorer quality of life, and high levels of anxiety.<sup>2</sup>

The associated health care cost is great. In the United States, more than 2.6 million people aged above 65 years suffer a fall requiring medical attention annually, resulting in over US\$19 billion in medical costs.<sup>3</sup> In the UK, nearly 650,000 people above the age of 60 years fall and require a visit to hospital every year and the annual cost approaches £1 billion.<sup>4</sup> In one area of Australia, falls in those aged above 65 years cost A\$83 million annually,<sup>5</sup> while the cost of fall-related admissions to one Irish hospital for 1 year was €11 million.<sup>6</sup> A recent review found the average cost of a fall requiring hospitalization to be US\$26,483.<sup>7</sup>

As the population ages, an increasing number of people are at risk of falls and fall-related injuries. It has therefore become an important public health matter to evaluate those interventions that might be effective in reducing the risk of falls. Many of these interventions can be safely delivered in a cost-effective manner outside the hospital setting. We discuss measures aimed at reducing rates of falls and fall-related injuries that can be employed in the community to help alleviate the health care burden associated with falls in the elderly.

## Methods

PubMed, ScienceDirect, and the Cochrane databases were searched for high-quality review articles and prospective trials. Observational data and retrospective trials have been referenced where appropriate. Risk factors and methods of assessing risk

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in order to determine who will be most likely to benefit are first addressed. We describe interventions that can be employed in the community and in high-risk groups to reduce risk of falls and associated injuries by discipline, including physiotherapy, occupational therapy, and physician-led interventions. We also discuss some of the available data describing cost-effectiveness of such programs.

## Risk factor assessment

A variety of interventions has been identified that may reduce risk of falling or suffering a fracture. However, not every intervention is effective in every patient group.<sup>8</sup> An important part of developing a cost-effective program that works is identifying those most likely to benefit from it, for example, those at greatest risk of falling.

A number of individual features in the patients' history are helpful in identifying an increased risk of falling. A history of falling is one of the strongest predictors of suffering a fall in the future.<sup>1</sup> Gait problems, age, depression, cognitive impairment, and psychotropic medication use also indicate increased risk of falls among elderly community dwellers.<sup>9-11</sup> A meta-analysis confirms that balance impairment imparts a moderately increased risk of falling.<sup>12</sup>

Early work from the MEDOS group – a Europe-wide study examining the epidemiology of hip fractures – found that individual factors associated with high-risk falls were difficult to identify. A diverse range of patient and environmental features associated with falls that cause fractures was described. This led the authors to the conclusion that developing a widely applicable program for risk factor modification would be costly and difficult.<sup>13</sup> However, there is accumulating evidence that with increasing numbers of risk factors, there is an increased risk of falling.<sup>9,10</sup>

## Prediction tools

A number of tools have been studied for their value in predicting whether a person is likely to fall or not. Tromp et al developed a risk stratification tool using four predictors of increased risk of falls in a prospective cohort study. Those predictors for increased risk of recurrent falls were previous falls, urinary incontinence, visual impairment, and functional limitations.<sup>14</sup> Reaction times, the Berg balance scale, activities-specific balance confidence scale, and postural sway have all been found to be valid and reliable, and can be used to identify individuals at increased risk of falling.<sup>15,16</sup>

One review of 20 risk stratification tools described widely varying sensitivity and specificity, but a sufficient number were useful enough to recommend against developing yet

more instruments.<sup>17</sup> Although primarily aimed at institutional use, they may be useful in identifying those at increased risk of falls postdischarge. Tools such as the 6-minute walk test have also been validated in the community, with the caveat that validation studies have not been performed in all settings or across all subpopulations, such as those with cognitive impairment.<sup>18</sup>

## Exercise

Home-based exercise programs have been shown to improve standard measures of balance, an effect that is preserved over time.<sup>19</sup> There is good evidence that muscle strengthening and balance retraining are effective in reducing falls and fall-related injuries, both individually and as part of a multidisciplinary approach. The randomized controlled FAME study compared an individually tailored exercise program with instructions for exercising at home. The study found a 54% reduction in falls among women aged above 65 years receiving the exercise program. A reduction in death, hospitalization, or transfer to nursing home care at 3-year follow-up was also seen.<sup>20</sup> Tinetti et al reported a prospective trial looking at exercise as part of a multifaceted approach to reducing falls, including adjustment to medications and behavioral instruction. The incidence of falls in the intervention group ( $n = 153$ ) was reduced from 47% to 35% ( $P = 0.04$ ) after 1 year of follow-up.<sup>21</sup> Exercise aimed at reducing falls can be delivered at home, and has been shown in a meta-analysis to be effective in this setting.<sup>22</sup>

A meta-analysis of seven randomized trials found that planned exercise programs reduce the incidence of falls in an at-risk population.<sup>23</sup> This finding is supported by a Cochrane review by Gillespie et al, which found that multicomponent group exercise reduces rate and risk of falling.<sup>24</sup> In addition, Sherrington et al identified particular features of programs that are effective at reducing rates of falling. Those features were a greater total amount of exercise, and an emphasis on more challenging balance exercises.<sup>25</sup> These interventions are particularly effective at reducing falls in community dwellers, and may be beneficial even in the very elderly (those above 85 years of age).<sup>22,26</sup> Such exercise programs can be delivered in the home by a trained nurse and have been shown to be cost-effective.<sup>27</sup>

## The need for a step-down program

A step-down program is a period of less-intensive therapy after the initial intervention has taken place. There is a rationale behind exploring the possible benefits of such a program in reducing risk of falls. For example, a randomized trial of

elderly individuals in Finland compared an intensive balance retraining program as part of a multifactorial intervention to a single counseling session. A significant reduction in the incidence of falls requiring medical treatment was seen on completion of a 12-month intervention, but not at 3-year follow-up, suggesting the need for continued intervention, possibly in the form of a step-down program.<sup>28,29</sup> A similar prospective French study demonstrated no significant reduction in falls despite an improvement in tests of balance following 10 sessions of exercise compared with no exercise. However, falls occurred at a later time in the intervention group, suggesting an early benefit that is not sustained once the exercise program has ended.<sup>30</sup>

One of the only described step-down programs, a study of 200 elderly community dwellers in Hong Kong, found a significant improvement in balance and reduction in falls and fall-related injuries following weekly attendance at a multidisciplinary falls-prevention clinic for 12 weeks. The falls clinic was supplemented with a 9-month step-down program which included a weekly exercise class. The authors note that this step-down program is important in maintaining the initial benefit seen with the falls clinic.<sup>31</sup> A community falls-prevention program based on exercise and education is operational in Falun, Sweden. Bjerre and Schelp found the program to be effective in reducing fall-related injuries, but observed a waning effect over time. The authors concluded that continuous reinforcement is necessary to maintain the program's effectiveness.<sup>32</sup>

## Tai-Chi

As a community intervention, regular Tai-Chi has been proposed as a practical method of delivering regular exercise. Randomized trials have come to differing conclusions regarding its effectiveness. Tai-Chi improves muscle strength and measures of balance, but programs see high withdrawal and low adherence rates.<sup>33-35</sup> A more recent meta-analysis of Tai-Chi included nine randomized trials, with the conclusion that there is insufficient evidence to recommend Tai-Chi as an effective method of preventing falls.<sup>36</sup>

## Future considerations

A review of current physiotherapy practice in the UK has shown that among those who have fallen and suffered a fracture, those that have suffered a non-hip fracture (for example, a wrist fracture) receive appropriate evaluation and secondary prevention exercises less often than those who have suffered a hip fracture. Levels of implementation among neither group met with national guidelines.<sup>37</sup> Furthermore, current levels

of knowledge among this group of health professionals may be insufficient to meet the demands of a well-functioning exercise program specifically targeted at prevention of falls.<sup>38</sup> For future planning, one component of a comprehensive multifactorial falls-prevention program might involve targeting education at trainee exercise professionals.

## Occupational therapy

Home hazards are significantly associated with falls and fall-related injuries.<sup>39</sup> One review highlighted environment-related factors, poor balance, and dizziness as being the most commonly reported individual causes for falls.<sup>40</sup> A home visit by an occupational therapist with recommendations for home hazard modification is a well-described component of a multidisciplinary falls-prevention clinic, and has been shown to reduce falls rates in those at high risk.<sup>24,41</sup> Home modification may not reduce rates of falling in those not at high risk. In addition, a Cochrane review found that this intervention is not effective in injury prevention, despite a reduction in rate of falls.<sup>42</sup>

Salkeld et al have demonstrated that home hazard modification is cost-effective in those who have fallen within the previous 12 months, while Frick et al report that home modification provides the best value in reduction of falls.<sup>43,44</sup> Early work suggests that self-reporting of home hazards using an adapted version of a tool employed by professionals correlates well with risk of falls.<sup>45</sup> This would likely reduce costs further, while promoting a proactive approach to reducing risk of falls.

In terms of reducing injuries associated with falls, hip protectors have been previously advocated as reducing hip fracture incidence in those at greatest risk.<sup>46</sup> Compliance among elderly individuals dwelling in high-risk community is very poor however, and they have not proven effective in this group.<sup>47</sup>

## Medical intervention

A number of comparatively simple medical interventions are effective at reducing rates of falling in the general population and in those at high risk, and could be implemented by general practitioners. Vitamin D supplementation has been shown to significantly reduce risk of falls in elderly individuals dwelling in communities, provided dietary calcium intake is 512 mg/day or more.<sup>48</sup> A randomized controlled trial has shown that withdrawal of psychotropic agents has been shown to reduce the risk of falling; this is supported by a large amount of observational data.<sup>49,50</sup> Use of sedatives or antidepressants is associated with an increased rate

of falling, as is polypharmacy, highlighting the need for a judicious risk–benefit analysis in those at an increased risk of falling.<sup>51,52</sup> A randomized trial evaluating an initiative to modify prescribing patterns among general practitioners, for example, reduction of nonsteroidal anti-inflammatory drug use, found a reduced rate of falls and injuries at 12 months.<sup>53</sup>

Other measures effective at reducing risk of falls in particular settings include referral for cataract surgery and insertion of a dual-chamber cardiac pacemaker if indicated.<sup>54,55</sup>

In addition to the above measures aimed at reducing risk of falls, medical intervention can help reduce morbidity by reducing fall-related injury. Studies examining whether combined calcium and vitamin D reduce fractures in the community have produced mixed results; compliance may be the major confounder as the intervention has proven beneficial when treatment is supervised.<sup>56</sup> Risedronate has been shown to reduce the risk of suffering a hip fracture in elderly women with osteoporosis.<sup>57</sup>

## Use of education in fall prevention

An education program aimed at increasing awareness of the risks associated with falling can have beneficial effects. A Swedish study carried out in a town of 80,000 people targeted certain groups such as opticians, podiatrists, and operators of gyms. The study demonstrated a reduction in falls and fall-related disability. The cost incurred by falls was also reduced to a greater extent than that seen nationally in Sweden. The reduction in hip fractures seen in hospital was 48%.<sup>58</sup>

A prospective study has shown that simple education alone is ineffective at reducing the incidence of falls.<sup>59</sup> Peer-delivered education may promote greater participation, and has been shown to improve falls-prevention awareness. Participants have a more proactive approach to preventing recurrent falls, although this intervention has not been shown to lead to a reduction in falls.<sup>60</sup>

## Adherence rates

Education may attenuate the problem of low levels of acceptance of fall-management strategies seen among those at greatest risk. In a survey (n = 5440) to determine how willing elderly people would be to participate in falls-prevention activities, more than 40% of people would definitely not attend group sessions of strength and balance retraining.<sup>61</sup> Larsen et al (n = 7543) report that never-married males aged 66–84 years accept relatively simple falls-prevention measures as little as 30% of the time. The figures for widows

of the same age, while greater at 57%, indicate that a major stumbling block to implementing a successful community-based strategy exists.<sup>62</sup> Even a randomized trial achieved participation rates of just over 60% for attendance at exercise sessions.<sup>28</sup>

## Cost-effectiveness

Community-based falls-prevention programs is an attractive proposition. Approaches to delivering a multidisciplinary falls-prevention program have been described and are available to model future programs; their uptake has been advocated by the Center for Disease Control in the United States following a review of 20 years of efforts to reduce the incidence of falls and the associated costs.<sup>63–65</sup> The interventions are generally well tolerated; the potential gain in terms of health economics is great. In New South Wales, Australia, such a multidisciplinary program has been shown to have a benefit to cost ratio of 20.6:1, having generated savings of up to A\$16.9 million over a 4-year period, in a population of 400,000.<sup>66</sup> A systematic review found single-factor interventions, such as the Otago Exercise Program in New Zealand to provide the best value for money, while also finding cost-effectiveness in customized, multifactorial interventions and home safety measures.<sup>67</sup>

Despite potential gains including cost reduction, falls-prevention programs have not become a widely used tool in modern health care. Moller postulates that difficulty in proving benefit coupled with a low political profile contributes to the lack of funding generally awarded to such programs.<sup>68</sup>

## Discussion

A variety of interventions has been studied widely for the reduction of risk of falls in the community. Although some interventions have shown benefit when studied in isolation, several trials, randomized trials and meta-analyses, have confirmed the efficacy of a multifactorial falls-prevention program. The number needed to treat to prevent one fall/year was 32 for a single intervention (home modification) compared with seven for a multidisciplinary intervention in one randomized trial.<sup>21,69–74</sup> A meta-analysis has found that single interventions may be as beneficial as a multicomponent intervention, provided the single intervention is targeted at a particular risk factor such as poor balance.<sup>75</sup>

Effective interventions include the following:

- Muscle strengthening and balance retraining as part of an individually tailored exercise program
- A home visit by an occupational therapist with recommendations for home hazard modification can reduce

rates of falling in high-risk groups, for example, those with a history of falling

- A prescribing modification course for general practitioners
- Withdrawal of psychotropic medications where possible and referral for cataract surgery or cardiac pacemaker insertion where indicated

Potentially useful interventions that warrant further study include Tai-Chi exercise classes, the use of step-down programs, and public-awareness campaigns particularly targeted at community workers likely to encounter those at high risk of falling, for example, opticians. Education and reinforcement should be evaluated as a means of improving adherence to interventions proven to be effective.

Finally, controversies persist with regard to the strength of evidence supporting current interventions.<sup>76</sup> McClure et al found population-based programs for reducing falls to be efficacious but point out that further randomized trials are needed to increase the level of evidence available.<sup>77</sup>

## Conclusions

Multidisciplinary falls-prevention strategies have been shown to be effective, while single intervention strategies are effective in high-risk populations. There is evidence to suggest that population-based interventions to reduce rates of falls are cost-effective.

## Disclosure

The authors report no conflicts of interest in this work.

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