

Exercise and falls prevention in older people

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Abstract

Falls are not an inevitable result of ageing, but they are the most serious and frequent home accident among older people. Falls are a major reason for admission to hospital and residential care setting, even when no serious injury has occurred. Falls are therefore costly for society as well as causing considerable suffering, morbidity and mortality. Multidisciplinary multi-factorial intervention programmes that include risk factor assessment, screening and appropriate intervention have been shown to be effective in reducing falls whilst balance and strengthening exercise is effective both as a standalone intervention and as part of a multidisciplinary intervention.

Keywords

Exercise, balance, postural stability, fall prevention, older people.

Introduction

A fall may be the first indication of undetected illness¹ and repeated falls often herald a decline in an older person's functional ability.²⁻⁴ Indeed, fall-induced injuries are increasing more rapidly than the demographic predilections in the older population can account for⁵ with modern surgery no longer able to improve on its outcomes.⁶ Therefore, effective prevention of falls and, indeed, osteoporosis^{4,7-8} are the keys to preventing disability and death. Nearly half of nursing home admissions are due to postural instability⁹ and older people themselves fear hip fracture and subsequent nursing home admission.¹⁰ Although falls in older people account for over 10% of the Ambulance Service workload, nearly 40% are not admitted to hospital.¹¹ Some of the difficulty of rising from the floor may be due to shock or injury, a fear of further damage to the body by trying to move, but for many lack of physical fitness is an important cause.¹² Recent reviews and guidelines suggest multi-disciplinary falls assessment and intervention, including exercise, should be considered alongside osteoporosis diagnosis and management to reduce the number of falls and fall-related injuries.^{1-2,13-16} ProFaNE (Prevention of Falls Network Europe),¹⁷ a European thematic aimed at disseminating good practice, is working to produce detailed clinical assessment and management protocols that all professionals involved in the care of

older people can access. This article will review the risk factors for falling, the evidence behind exercise interventions to reduce falls and will discuss possible exercise referral routes.

Prevalence and consequences of falls

Approximately 30% of people aged over 65 years fall each year and after the age of 75 years the rates are higher.²⁻³ Between 60% and 70% of previous fallers will fall again,¹⁸ contrasting with the lower incidence seen in healthy older people (<15%).¹⁹ Frequent fallers (>3 p.a.) have poor outcomes, nearly a third are admitted to hospital, nursing care or die within one year.²⁰ Between 20% and 30% of those who fall suffer injuries that reduce mobility and independence and increase risk of premature death. Incidence rates for falls in nursing homes and hospitals are 2-3 times greater than in the community and complication rates are also considerably higher. Ten to 25% of institutional falls result in fracture, laceration or need for hospital care.²

A fall or injury can have a devastating effect on the individual's independence and quality of life, often leading to a spiral of inactivity and further decline. The consequences of falling include death, injury (the most serious of which is fracture of the proximal femur), institutionalisation, fear (of a future fall), decreased activity, functional deterioration, social isolation, depression and reduced quality of life.^{2-3, 21} The complications associated with a long lie (being unable to get up from the floor after a fall) include pressure sores, hypothermia, pneumonia, rhabdomyolysis (and associated acute renal failure), venous thromboembolic disease, the psychological effects of helplessness and death.²²⁻²³

Risk factors for falls and fall-related injuries

Risk factors for falls have been classified into two types: intrinsic and extrinsic factors.^{3,7,24} Intrinsic risk factors include medical conditions (such as Parkinson's disease, stroke, dementia) as well as multiple medications,^{2,13} which may really only be an indication of the person's medical condition.²⁴⁻²⁵ Other intrinsic risk factors include poor balance and

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strength, age, gender and eyesight.^{20, 26-27} Extrinsic factors are social and physical factors that relate to the external environment and include obstacles, slippery surfaces, poor lighting and poor footwear.^{3,7} Falls among older people aged less than 75 years are more likely to be due to extrinsic factors than for those aged 75 years and over.⁷ Although some falls have medical causes (syncope, epilepsy), most are due to an extrinsic cause. We all 'trip' and 'slip' but can normally right ourselves relatively easily and safely; at some point we lose the ability to correct this challenge to our balance mechanisms (intrinsic) because of poor balance, co-ordination or strength.

Muscular performance appears to be a key factor in maintaining upright posture in dynamic situations. This can be illustrated by the change in incidence of fractures with increasing age. Wrist fractures become more common in those aged over 40 years and remain prevalent up to the age of 65 years; over the age of 65 years wrist fractures become less common because of slower reaction times and inability to extend an arm in time to break the fall, thus the older individual is more likely to land heavily on the hip and trunk; hence fractures of the hip become more prevalent after the age of 80 years.⁷ Epidemiological studies have shown that a lifetime's history of regular physical activity can reduce the risk of hip fracture by up to 50% and much of this benefit is thought to result from a reduction in falls.²⁸ Almost 90% of hip fractures result from the impact of a fall.²⁹ A lack of vigorous exercise in the preceding 2 weeks has been associated with increased risk of wrist fracture.³⁰

Compromised strength and power and associated difficulties with functional tasks are characteristic of fallers.^{23,31} It seems likely that lower limb muscle power is important in correcting a displacement or movement error fast enough to prevent the fall or reduce the severity of the effects of the fall. Indeed, muscle power is strongly related to ability to perform everyday tasks.³² Reduced sensory input (seen with increasing age and compounded by medications, oedema, arthritis etc.) exacerbates the inefficiency of the musculo-skeletal system. Several studies have shown reduced strength (isometric and isokinetic)³³ and power (explosive) of the lower limb³² and reduced balance (static and dynamic) are more prevalent in fallers,^{20,23} as is asymmetry of lower limb power.³² Many of the risk factors for postural instability are purely due to inactivity and ageing muscles.²⁶ Balance is a complex automatic integration of several body systems. With age and inactivity these unconscious processes may not integrate as well or as quickly so that maintaining balance and preventing injurious falls may require ever increasing focus of attention and fatiguing effort. The "stops walking when talking" phenomena reflects this difficulty.³⁴

Fear of further falling (the 'Geriatric 3Fs') is the most commonly reported anxiety among older people³⁵ and falls and fear of falling are associated with increased anxiety and depression (post fall syndrome³⁶), decreased mobility, reduced social contact, higher medication use, and increased dependence on medical and social services and informal carers.^{9, 37-39} Fear of falling can also cause older

people to limit their movement,²² not just in terms of habitual activity but also in their normal body movements.³⁸⁻³⁹ This unwillingness to move can lead to poor compliance with exercise interventions and even avoidance of a particular activity that led to a past fall.⁴⁰

Falls and activity levels

Importantly, there may be a U-shaped relationship between the amount of physical activity and the number of falls, with a higher incidence of falls in both the least active and the most active.⁴¹ Nursing home residents have a higher incidence of falls than independently living older people despite spending up to 90% of their time either sitting or lying down.⁴² Falls in independent older people take place during periods of maximal activity²⁷ and yet fallers are likely to be less active than their non-falling counterparts.²⁰ Some people can fall whilst rambling, others just transferring from their chair to standing. This will, of course, mean that different exercise interventions will be required for people of different physical functions.¹²

Whilst it is acknowledged that some risk factors are not modifiable with exercise (i.e. age, gender, chronic medical conditions, non-correctable vision problems), others, such as physical activity, environment and the effects of medication, can be positively influenced through appropriate education and intervention.² Modifiable risk factors, with the use of specific exercise, include poor balance and fear of falling, low strength and power, poor gait and functional ability, depression, urinary urgency and incontinence, postural hypotension, and arthritic pain (see Table 1).¹²

Interventions to reduce falls

Recent reviews and guidelines suggest multi-disciplinary falls assessment and intervention, including exercise, should be considered alongside osteoporosis diagnosis and management to reduce the number of falls and fall-related injuries.^{2-4, 7, 24} These stem from the highly effective PROFET trial.⁴³ One systematic review,⁴⁴ showed multi-factorial intervention trials to be the most effective at reducing risk of falls (pooled Relative Risk (RR) 0.82) but that exercise only programmes also show benefit (pooled RR 0.86).

Not modifiable with exercise	Modifiable with exercise
Age	Poor balance
Sex	Fear of further falls (confidence)
Chronic medical conditions	Muscle strength and power
Medications	Gait
Environment	Functional ability
Non-correctable visual problems	Depression
	Urinary incontinence
	Postural hypotension
	Arthritic pains

Table 1. Potential for exercise interventions to modify risk factors for falls

Paper

Exercise interventions

Despite the considerable evidence that exercise is a key component of a multi-factorial fall prevention intervention,⁴⁴⁻⁴⁵ some exercise-only interventions have shown little or no effect on falls risk despite improvements in known risk factors (e.g. strength).⁴⁵ It appears that individualised exercise interventions with balance training at the core of the programme are most effective for those at risk of falls,⁴⁶⁻⁵³ including those with significant risk of fracture.⁵⁶⁻⁵⁸

In New Zealand, a targeted home exercise programme, targeting women aged over 80 years, a population at high risk of falls, was taught to participants in their own homes by a physiotherapist and compared to social visits as a control.⁴⁶ Exercises were individually prescribed from a set number of warm up, muscle strength and balance training exercises to perform 3 times a week for a year. They were also encouraged to walk outdoors at their desired pace building up to 30 minutes 2-3 times a week. The physiotherapist visited each intervention participant four times over the first two months following on with regular telephone contact. The exercise group had a significantly lower rate of falls (IRR 0.47 95% CI 0.04-0.90) and relative hazard for first four falls (IRR 0.68 95%CI 0.52-0.90). The relative hazard for first fall with injury was also significantly lower (IRR 0.61 95% CI 0.39-0.97). This exercise approach, now called the Otago Exercise Programme was then investigated in a further randomised controlled trial.⁴⁷ This time the exercise was delivered by a district nurse who had attended a week-long training course given by a research physiotherapist. Falls were reduced by 46% following exercise (IRR 0.54 95%CI 0.32-0.90). There was a significant difference between the effect of the exercise programme on falls when those aged 80 years and over were compared with those aged 75-79 years, with the exercise having no significant effect on falls in the younger age group. This programme was then studied in routine healthcare settings.⁴⁸ Falls in the exercise centres were reduced by 30% (IRR 0.70 95%CI 0.59-0.84).

In those aged over 65 years, with poor strength and balance, modified T'ai Chi appears effective as a preventative group exercise.⁴⁹ Modified T'ai Chi over a 48 week period, however, was not beneficial to reducing falls in an older (aged 70 years and over) group with signs of frailty.⁵⁰ In those aged over 70 years, a 15 week group-based exercise programme had a more significant effect on falls risk than a vision check or home safety check.⁵¹ The effect was even more impressive in the same research group's next trial lasting one year.⁵³ Those aged over 65 years, with impairments in lower limb strength, poor balance or slow reaction time, had a 40% lower rate of falls than those not taking part in a group-based exercise and home exercise plan lasting one year.⁵³ Although the trial lasted a year, reduction in falls rate was seen throughout the trial period.

In the UK, independent living frequent fallers halved their risk of falls (IRR 0.46, 95% CI 0.34 to 0.63) with 9 months of weekly group balance and strength exercises,

led by a postural stability exercise instructor, combined with twice weekly home exercises.⁵⁵ The women undertaking this falls management exercise (FaME) had significantly lower mortality and morbidity at 3 year follow up than the randomised control group.⁵⁵ The exercise intervention consisted of progressive resistance, gait, balance, functional activity, floor work, endurance and flexibility training. The exercise was individually tailored in both type and intensity, with most exercises in weight-bearing positions, reducing upper limb support.

On a population / public health basis, encouraging physical activity and the provision of exercise sessions as part of a wider campaign including literature, medication reviews and environmental changes has been shown to decrease fall related injuries.⁵⁹ One large population approach trial, over 10 years, has seen a reduction in fracture rate⁶⁰ by advocating increased physical activity and other lifestyle changes.

Is all exercise good for fallers?

There are as many trials of exercise that have been unsuccessful at reducing falls as have been effective.^{15,44-45} A Cochrane review¹⁵ of 9 trials that neither individualised/adapted the exercise programme nor progressed the balance challenges did not show a significant reduction in the number of fallers (RR: 0.89, 95%CI 0.78 to 1.01); these findings underline the value of a tailored approach rather than those based on a "one size fits all" methodology. One long term (ten-year) follow-up of regular walkers showed the importance of specificity: although the health and mobility of the walkers was better than that of sedentary individuals, there was no significant reduction in the number of falls walkers had compared to the group who no longer regularly walked.⁶¹

There are special concerns when older people, who have poor balance, increase their levels of physical activity and exercise. It is likely that, in some individuals, preparatory strength and flexibility training is needed before balance challenging exercise commences. One brisk walking intervention in patients with a previous Colles fracture actually increased the risk of falls compared to not walking.⁶² For those who have balance deficits perhaps safer options on the content of the exercises are necessary.¹² There is also concern that certain types of exercises (e.g. abdominal curls) may increase the risk of future vertebral fractures whilst other exercises (back extensions) may help reduce future fractures.⁵⁸

There may be a point at which people become too frail to benefit from balance exercise. For example, there is evidence to suggest that risk factors for falls differ in a non-linear pattern in institutionalised older people; those who cannot rise from a chair being at lowest risk of falls.⁶⁴ Therefore exercise interventions aimed at increasing mobility in cognitively impaired or chair / bed bound residents may actually serve to increase risk of falls. No studies examining exercise alone in institutional dwellers have demonstrated effective reductions in falls but multifactorial interventions that had a strong exercise component have shown significant risk reductions.⁶⁵⁻⁶⁷

Specialist professional training is likely to improve effectiveness and reduce likelihood of inappropriate exercise.⁶⁸⁻⁶⁹ Therefore an assessment of the functional capacity of the individual should lead to appropriate referral to specialist professionals.⁶⁸

Exercise Referral Routes

Effective exercise can reduce the risk of a fall, help avoid a 'long lie' and can maintain threshold levels of strength and power necessary to remain independent. The National Service Framework for Older People⁴ acknowledges the evidence that targeted exercise can help in the prevention and management of falls and in rehabilitation after the event. Guidelines for best practice have been clearly laid out for a range of multidisciplinary professionals involved in the provision of physical activity for older people with a high risk of falls.⁷⁰ Yet, despite all this knowledge, there is still scant community provision for people at high risk of falls.

A further challenge is to ensure a continuum of exercise and physical activity provision to fill the current gap between the hospital-based rehabilitation setting, where work is done on an individual or very small group basis led by a therapist, and the much more active 'senior' exercise classes, which may have up to 25 older people in a group, that can be found in community settings. Where does the therapist refer their patient after they leave the 6-8 week provision that might be found at a falls clinic? In order for the exercise to be effective we know that the person must continue the balance challenges for up to a year for a valuable reduction in risk of falls and fall related injuries. The Department of Health funded the development of a specialist exercise training qualification for health and exercise professionals to help address this need – The Postural Stability Instructor. The Merton, Sutton and Wandsworth Falls and Injury Prevention Exercise Service piloted this training and is cited as a model of good practice in the National Service Framework.⁴ A range of exercise opportunities is also important so that an individual has choice and a provision

that meets their needs and is more likely to start and continue the intervention. This will be determined by how receptive the patient is to the recommendation⁷¹ and by how capable they are of carrying it out independently, safely and effectively.⁶⁸ Referral to an exercise-prescription scheme is appropriate if the patient is likely to need motivation, supervision, monitoring, and help in choosing the right type of activity for a specific health outcome(s).⁶⁹ However, recent research suggests that older people will be more receptive and more likely to undertake an exercise intervention if the information provided discusses the wider benefits of exercise to their quality of life and maintenance of independence and autonomy than just to prevent falls.⁷¹

Conclusion

There is strong evidence that physical activity across the life span is important in preserving adequate to good skeletal health⁷² and preventing fractures.⁷³ Exercise, even at advanced ages and in people of varying physical activities, can improve balance, strength and other risk factors for falls and injury.⁷⁴ The evidence for the promotion and provision of safe, effective, exercise to prevent falls is strong.^{2, 15, 59} Unlike UK cardiac rehabilitation, where there is a referral pathway from Phase 3 to Phase 4 in most primary care trusts, provision of such exercise opportunities for those with a history of falls is still scant. A recent British Geriatrics Society Survey on Falls Services provision in the UK was disappointing; 32% of replies suggested no local service for the management of falls and only 69% suggesting a formal exercise programme was part of the service.⁷⁵ Even more concerning was the response that 41% of exercise programmes reported no strength or balance training, the two key components of a successful exercise programme for fallers.⁷⁵ The Geriatrician is in a powerful position to increase awareness of evidence based interventions^{24, 76} and ensure that the patient who falls and who would benefit from appropriate exercise receives the most effective long term support for managing their risk.

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Paper

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