

## HOW TO DO IT

# Practical implementation of an exercise-based falls prevention programme

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### Abstract

Muscle weakness and impaired balance are risk factors underlying many falls and fall injuries experienced by older people. Fall prevention strategies have included exercise programmes that lower the risk of falling by improving strength and balance. We have developed an individually tailored, home-based, strength and balance retraining programme, which has proven successful in reducing falls and moderate fall injuries in people aged 80 years and older. Here we describe a simple assessment of strength and balance and the content and delivery of a falls prevention exercise programme.

**Keywords:** *exercise, falls, older people*

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### Introduction

Exercise programmes designed for falls prevention in older people should address three major areas—strength, balance and endurance. Those programmes that have improved these have been shown in randomized controlled trials to lower the risk of falling [1–3].

We describe the practical implementation of a successful home-based exercise programme designed to improve strength, balance and endurance [4]. The exercise programme has been tested in four separate controlled trials involving over 1000 people aged 65 years and older. It has been found to be effective in reducing falls and moderate injuries in those aged 80 years and older. In one trial, falls risk was reduced over 2 years [5]. Study participants were identified from computerized registers at general practices and were not highly selected. People were eligible to take part if they were able to move around within their own home, able to comply with the study requirements and not currently receiving physiotherapy. After 1 year, about half the participants were still completing the exercise programme three or more times a week. The cost-effectiveness of the programme has been established and will be reported elsewhere.

The exercise programme is based on four premises:

- The programme needs to be individually tailored because older people vary considerably in their physical capacity and health and in their response to exercise.
- The programme will need to be increased in difficulty, because there will be initial improvement in strength and balance.
- A stable, sustainable programme should be established after a series of visits from the exercise instructor and will need checking two to three times a year thereafter.
- A walking programme to increase physical capacity should complement the strength and balance programme.

Key fall risk indicators that can be used to identify those people who are at the highest risk of falling are shown in Table 1. People at high risk of falling due to muscle weakness and impaired balance should be invited to participate. These people can be identified by quick, simple tests carried out at home or in the consulting room.

**Table 1.** Risk indicators useful for identifying individuals suitable for a strength and balance retraining programme

Age 80+ years	Previous falls
Female	Recent surgery
Recent illness	Impaired balance
Impaired strength	

### Identification and assessment of impaired strength and balance

Lower limb muscle strength and balance can be assessed and scored using two quick physical functioning assessments: the chair stand test [6] and the four-test balance scale [7]. Failure to complete either of these tests indicates deficits in strength and balance.

#### Chair stand test

- A straight-backed firm chair with no armrests should be used.
- Place the chair with a wall behind for safety.
- Instruct the person to stand up and sit down as quickly as possible, five times with the arms folded.
- Using a stopwatch, record in seconds the time taken to stand up and sit down five times.
- Allow a maximum of 2 min to complete the test.

#### Four-test balance scale

- The four-test balance scale includes four timed static balance tasks of increasing difficulty that are completed without assistive devices (The tasks are illustrated in Figure 1).
- No practices are allowed for any of the four tests and they should be carried out in bare feet.
- The person can be helped by the assessor each time to assume the position and the person should then indicate when she is ready to begin the test unaided.
- If the person cannot assume the position, the test is failed at that stage.
- Each position must be held for 10 s before the person progresses to the next level of difficulty.
- Timing is stopped if (i) the person moves their feet from the proper position, (ii) the assessor provides contact to prevent a fall or (iii) the person touches the wall with a hand.

### Programme implementation

The introduction of a personalized strength and balance retraining exercise programme is a new concept for many older people. It is essential that the older person can confidently carry out the exercises prescribed and that the rationale and benefits of strength and balance retraining are understood. Both active and frail elderly people fall [8], and an exercise programme should meet the physical capabilities of different individuals.

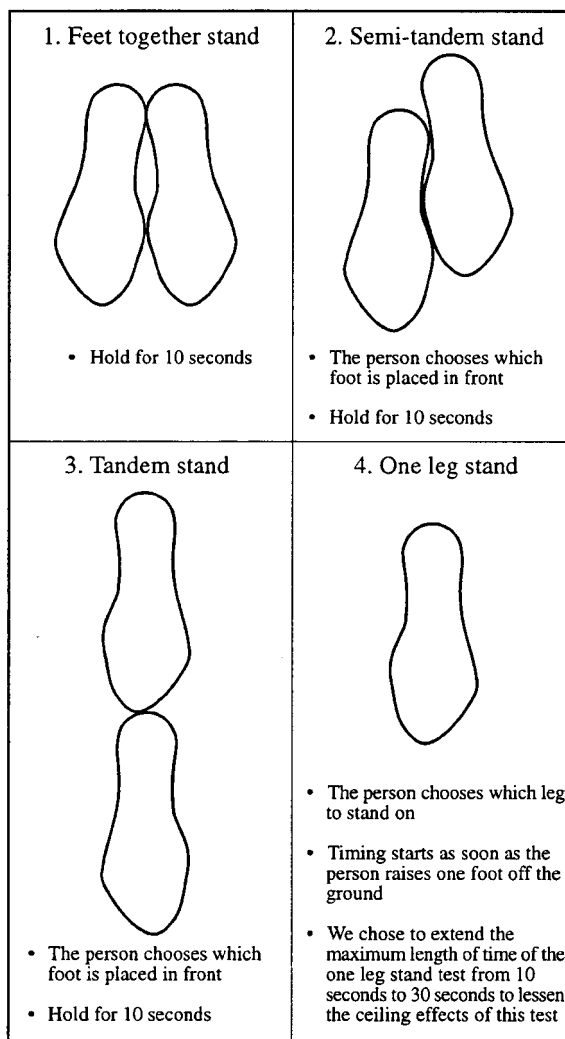


Figure 1. The four-test balance scale.

#### Exercise instructor

We recommend that physiotherapists or health professionals trained by a suitably qualified physiotherapist implement the exercise programme. The instructor should have a working relationship with the person's general practitioner so that the intensity of the exercise programme and progress with the programme can be discussed when necessary. In our trials, exercise instructors worked half time (on average) for 18 months to recruit and deliver the programme for 1 year to around 100 people.

#### Exercise programme schedule

We recommend the exercise instructor:

- Carries out four home visits over a period of 2 months, followed by booster visits every 6 months, and between home visits telephones the person every month.

- Allows up to 1 h for each visit; the first visit is usually the longest.

### Programme resources

- Each participant receives an exercise booklet and ankle cuff weights.
- The booklet includes illustrations and instructions in large print relating to each exercise (see Figure 2).
- The exercise booklet is organized by the exercise instructor during the session as each individual exercise is prescribed.
- Ankle cuff weights are used to provide resistance during strengthening exercises. We prefer ankle cuff weights to resistance bands because we have found them easier for the older person to manage.
- Ankle cuff weights are available in a range of styles and weights. They must be able to be added to or replaced with heavier weights as the person progresses on the programme.
- We have used hospital, orthotic department weights consisting of soft cloth bags filled with lead shot (Figure 3). The weights fasten with Velcro and are wrapped around the lower leg at the ankle.
- The weight should be able to be taken on and off the leg easily by the older person.

### Starting the exercise programme

In the first visit to the participant's home the instructor should aim to establish a good working relationship, assess factors that will modify the programme, make baseline strength and balance measurements and start the exercise programme.

To start the programme we suggest showing the older person the exercise booklet with which she will be working. The instructor should take the person through the starting exercises, ensuring she is safe and confident with each one and can understand the illustrations and instructions. It may be necessary to write additional notes beside some of the exercises. The person should know that the exercises do not have to be done all at once and can be divided up over the day. The exercise booklet should include the instructor's contact telephone number.

We try to involve family members and the general practitioner in recruitment and in carrying out the programme. This may be an effective way of encouraging participation, particularly for more frail people [9].

### Strength training

A moderate-intensity strength retraining programme aimed at reducing falls should target the major muscles of the leg. The strengthening exercises we used are shown in Table 2.

## BACK ON HEELS

- Stand up tall side on to the bench
- Hold on with your hand
- The feet are shoulder width apart
- Come back on to the heels raising the front of both feet off the floor
- Lower the feet to the ground
- Repeat this exercise 20 times

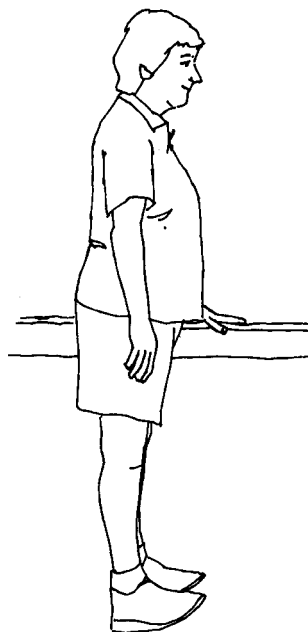


Figure 2. Examples of instruction and illustration from the exercise booklet.

Hip extensors, knee extensors, hip abductors and ankle muscles are targeted because they are important for transferring, standing up from a chair and walking, and these movements are not performed as well by fallers as by non-fallers [10–12]. The ankle dorsiflexor and plantarflexor muscles are targeted because they are important for recovery of balance [13]. Ankle cuff weights are used to provide resistance to the hip abductor, knee flexor and knee extensor muscles; the ankle muscles can be strengthened using body weight alone [14]. Strengthening the lower body is especially important for the prevention of falls, and lower-body strength is lost at a faster rate compared with upper-body strength [15].

About 5 min of gentle warm-up exercises are carried out before the programme begins and a light ankle cuff weight is used initially to minimize muscle soreness. If muscle pain develops, people are advised to stop the

Table 2. Levels and number of repetitions for the strengthening and balancing exercises

Exercise	Level			
	1	2	3	4
<b>Strengthening</b>				
Knee extensor, knee flexor, hip abductor	10 repetitions of each exercise with ankle cuff weights to provide resistance to the muscles			
Ankle plantarflexors (up on toes)	Hold support	No support		
Ankle dorsiflexors (back on heels)	Hold support	No support		
<b>Balance retraining</b>				
Knee bends	Hold support	No support	No support, repeat	No support, ×3
	10 repetitions	No support	or hold support, repeat	
Backward walking	10 steps, 4 times	Hold support		No support
Walking and turning around	Make figure of 8, twice	Hold support		
Sideways walking	10 steps, 4 times	Hold support	No support	
Tandem stance	10 s	Hold support		
Tandem walk	10 steps, repeat	No support		
Heel walking	10 steps, 4 times		Hold support	No support
Toe walking	10 steps, 4 times		Hold support	No support
Sit to stand	± hands for support	5 stands, two hands	10 stands, no support	No support
		or 10 stands, two hands	or 10 stands, one hand, repeat	10 stands, no support, repeat



Figure 3. Ankle cuff weights: soft cloth bags filled with lead shot, wrapped round the lower leg and fastened with Velcro at the ankle.

exercises until the pain lessens. The exercise instructor checks the exercise technique and reviews the amount of weight originally prescribed.

### Choosing the right intensity

Try the ankle cuff weights on the quadriceps muscle first with the person sitting in a straight-backed chair. When sitting opposite the person in a chair, demonstrate the exercise. Ask the person to carry out a set of quadriceps strengthening exercises. The starting weight for the ankle cuff weights is chosen by determining the amount of weight the person can use to perform 8–10 good-quality repetitions before fatigue. We recommend starting people aged 80 years and older on 1 or 2 kg. In our current home programme participants are using between 1 and 8 kg.

There should be minimal substitution of other muscle groups. It is important to use the correct breathing technique (inhale before a lift, exhale during the lift, and inhale as the weight is lowered to the starting position). The exercise should be done slowly (2–3 s to lift the weight, 4–6 s to lower the weight) and through the functional range of active joint movement [16].

The person should aim for two sets of 10 repetitions in the session before progressing to a heavier weight. Progressions onto a heavier weight should take place at the second visit rather than the first to allow the person to become accustomed to using the weights. The person should rest between sets for 1–2 min. For all other strengthening exercises, get the person to exercise in a standing position as this is thought to aid balance as well as strength. The starting weight will need to be reassessed for each muscle group on each leg.

### Duration and frequency

Strength training 3 days a week is recommended, although strength training twice weekly is associated with 80–90% of the benefits gained with more frequent training [17]. People should always have a rest day in between muscle strengthening exercises, to allow for muscle recuperation and development.

### Safety with strength training

The exercise instructor must weigh up the extra benefit to the older person associated with using heavier weights and the potential risk of adverse side effects (injury, cardiovascular events).

People do not feel unduly tired after the exercises as the programme emphasizes balancing and moderate-intensity strengthening exercises rather than high-intensity strengthening exercises.

People with rheumatoid arthritis or osteoarthritis should lift the weight within the pain-free range of movement. The person should be asked to report to the exercise instructor any changes in physical symptoms or exacerbations of existing medical conditions such as arthritic pain.

People should be advised to stop exercising and to contact their general practitioner if they experience dizziness, chest pain and/or shortness of breath while exercising or muscle pain that does not ease.

### Balance retraining

Balance needs to be stressed to improve [18, 19], and dynamic balance exercises have been recommended for improving balance rather than assuming that static balance training will transfer over to improved balance during (dynamic) activities of daily living [20]. Balance exercises are closely related to lifestyle and function: for example, moving from a sit to stand position, walking and turning around and knee bends [21].

The balance retraining exercises we used, with progressions from level 1, the first or easiest, through to level 4, the most difficult, are shown in Table 2. It is important to explain to people that the purpose of the exercises is not only to maintain balance but also to recover balance by using the legs rather than grasping furniture or benches with the arms.

### Choosing the right balance exercises

Balance exercises progress from holding on to a stable supporting structure such as heavy furniture to performing the exercise independent of support. The starting level of each exercise is dependent on the baseline physical functioning and health status of the older person. Not all older people will necessarily start at the first level of each exercise or be prescribed all the balancing exercises.

### Duration and frequency

Exercise programmes that have successfully reduced falls in older people have required the participants to carry out balancing (and strengthening) exercises 3 days a week [4] and twice daily for 15–20 min [1, 2]. We recommend that balance exercises are carried out at least 3 days a week.

### Safety with balance training

We suggest observing the participant during the holding version of each balance exercise before prescribing the exercise without holding support. If the participant is exercising with no holding support, the instructor must be confident that the older person can recover balance using lower-body strategies.

### Walking

We recommend that walking is included in falls prevention exercise programmes. Recent evidence suggests that moderate-intensity strength training improves gait stability [22].

### Prescribing walking times

We suggest aiming for 30 min of walking [23] and the person should be instructed to walk at their usual pace. The best way to achieve 30 min or more may be to break it up into 10-min sessions over the day. Help the person incorporate walking times into daily activities by suggesting strategies such as getting off the bus a block early to walk home and using the stairs rather than lifts or escalators.

### Follow-up visits

The aims of the follow-up visits are to increase the difficulty of the strength and balance retraining exercises.

The instructor should be mindful that for most of the time the older person must exercise without supervision. Too rapid increases in the intensity of the exercises or the ankle cuff weights for strengthening may decrease compliance. The exercise programme may require modifying and perhaps restarting after illness. Feedback and encouragement from the exercise instructor are very important. A schedule for the exercise programme implementation and follow-up is given in Table 3.

### Summary

Aim to include frail, older people in the exercise programme. These people have the most to gain from interventions that can improve strength and balance.



**Table 3.** Schedule for the exercise programme implementation

The exercise instructor carries out a series of home visits to prescribe and progress the individually tailored strength and balance retraining exercises. We suggest visits at week 1, week 2, week 4 and week 8 of the programme with a booster visit every 6 months

The participant is instructed to carry out the set of exercises three times a week, and to walk twice a week aiming for 30 min (this can be broken down to three sessions of 10 min walks)

Between home visits the exercise instructor telephones the participant every month to check on his/her progress and to maintain motivation

Start the programme slowly. Muscle strengthening and balance retraining exercises need to be continued if exercise benefits are to be sustained [18]. Monthly telephoning is an effective way of maintaining contact after the home visits have been completed.

Walking and other activities promoting physical activity should be encouraged but on their own will not lower falls risk. They should be part of comprehensive strength and balance training programmes.

Home-based exercise programmes may well be used in conjunction with group programmes, for example meeting once a week at a club with friends to reinforce the programme.

Most falls occur because of multiple interacting factors. Assessment and treatment of other fall-related problems will be necessary, but leg muscle weakness and poor balance are so common, in older women especially, that specific strength and balance exercises need to be part of any falls prevention programme.

### Key points

- Older people can be assessed for impairments in strength and balance using simple tests. Inability to complete these tests indicates the person may benefit from an exercise programme.
- Adequate resistance must be applied to muscles in order to increase muscle strength. This typically involves the use of strengthening equipment, such as ankle cuff weights.
- Individually tailored balancing and strengthening exercises should be carried out at least 3 days a week.
- Follow-up visits and regular contact are important for long-term compliance and programme re-evaluation.

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## Falls prevention exercise programme

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