A CDC Compendium of Effective Fall Interventions:

What Works for Community-Dwelling Older Adults

Centers for Disease Control and Prevention
National Center for Injury Prevention and Control

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What Works for Community-Dwelling Older Adults

3rd Edition

by
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National Center for Injury Prevention and Control
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CONTENTS

Introduction

Older adults value their independence and a fall can significantly reduce their ability to remain self-sufficient. More than one-third of people aged 65 and older fall each year, and those who fall once are two to three times more likely to fall again.[1] Among older adults, falls are the leading cause of both fatal and nonfatal injuries[2] and are responsible for significant disability, hospitalization, loss of independence, and reduced quality of life.[3] Most fractures among older adults are caused by falls.[4] Falls also have a huge economic impact. Direct medical costs for fall injuries total $34 billion annually.[5] However, we know that falls are not an inevitable result of aging. In recent years, systematic reviews of fall intervention studies have established that prevention interventions can reduce falls.[6]

More than one-third of people aged 65 and older fall each year, and those who fall once are two to three times more likely to fall again.

Purpose

This report is intended to showcase specific interventions for which there is published evidence of the intervention's ability to reduce falls among community-dwelling older adults. The compilation of this information can help public health practitioners, senior service providers, clinicians, and others who want to address falls in their community.

[1] Tromp AM, Pluijm SMF, Smit JH, et al. Fall-risk screening test: a prospective study on predictors for falls in community-dwelling elderly. *Journal of Clinical Epidemiology* 2001;54(8):837–844.

[2] Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Web–based Injury Statistics Query and Reporting System (WISQARS) [online]. Accessed August 15, 2013.

[3] Wolinsky F D, Fitzgerald J F, Stump T E. The effect of hip fracture on mortality, hospitalization, and functional status: a prospective study. *American Journal of Public Health* 1997.

[4] Jager TE, Weiss HB, Coben JH, Pepe PE. Traumatic brain injuries evaluated in U.S. emergency departments, 1992–1994. *Academic Emergency Medicine* 2000;7(2):134–40.

[5] Stevens JA, Corso PS, Finkelstein EA, Miller TR. The costs of fatal and nonfatal falls among older adults. *Injury Prevention* 2006a;12:290–5.

[6] Gillespie, LD, Robertson, MC, Gillespie, WH, Sherrington C, Gates S, Clemson LM, Lamb SE. Interventions for preventing falls in older people living in the community. *Cochrane Database of Systematic Reviews* 2012, Issue 9. Art. No.: CD007146. DOI: 10.1002/14651858.CD007146.pub3.

Process

For this 3rd edition of the *Compendium*, CDC gathered information about fall prevention studies that met the following criteria:

- Published in the peer-reviewed literature
- Included community-dwelling adults aged 60 and older
- Used a randomized controlled study design
- Was specifically designed to be a fall prevention intervention
- Measured falls or the proportion of fallers as an outcome
- Demonstrated statistically significant positive results in reducing older adult falls
- Took place in a community or clinical setting

This selection methodology differed from previous versions in that the selected age criteria was changed from 65 and older to 60 and older. Interventions implemented in clinical settings also were included. A literature review was conducted in 2014 and identified 12 interventions published between January 1, 2009 and September 30, 2014. We also identified seven interventions published before 2009 that met the expanded criteria.

See Appendix A for details about the selection process and methods used for the earlier editions.

Content

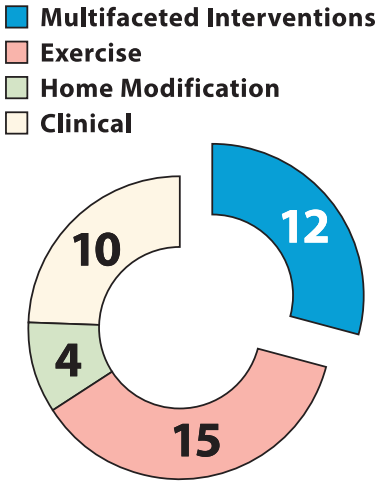
The *Compendium* classifies interventions into two main groups: single interventions and multifaceted interventions.

Multifaceted interventions address multiple fall risk factors. Some multifaceted interventions include an assessment of each participant's fall risk factors and provide an individually tailored intervention plan.

Single interventions address a specific fall risk factor (e.g. treating gait and balance issues with physical therapy). Single interventions are further categorized as exercise, home modification, and clinical interventions.

Twenty nine single interventions (15 exercise interventions, 4 home modification interventions, and 10 clinical interventions) and 12 multifaceted interventions are included in the 3rd edition of the *Compendium*. Information about each intervention was obtained from the published study and by direct communication with the study's principal investigator. Each is presented using a standardized format that includes a short summary of the intervention, study results, and a section describing additional details about the intervention. These include:

Types of Intervention



Note: The color coding in this chart uses a different percentage of the section color (saturation) to assist color blind readers in viewing the differences between sections.

- Purpose
- Program setting
- Content
- Number of sessions
- Duration
- Type of provider
- Provider's training
- Key elements
- Available materials
- Contact information for the principal investigator.

At the end of each section are tables comparing the participating populations, study characteristics, and intervention characteristics.

The *Compendium* also contains appendices. These include figures illustrating the intervention selection process; a bibliography of the research interventions; and supplemental materials, such as assessment instruments.

SINGLE INTERVENTIONS

Exercise

Stay Safe, Stay Active
Barnett, et al. (2003)

This study used weekly structured group sessions of moderate-intensity exercise, held in community settings, with additional exercises performed at home. Participants were 40 percent less likely to fall and one-third less likely to suffer a fall-related injury compared with those who did not receive the intervention.

Population: Participants were individuals at risk of falling because of lower limb weakness, poor balance, and/or slow reaction time. All were aged 67 or older and lived in the community. About two-thirds of participants were female.

Geographic Locale: Southwest Sydney, Australia

Focus: Improve balance and coordination, muscle strength, reaction time, and aerobic capacity.

Program Setting: Classes were conducted in local indoor lawn bowling and sports clubs that hosted community programs for various sports and exercise activities, comparable to community exercise, sports, and recreation facilities in the United States. Many lawn bowling and sports clubs also included other indoor attractions such as restaurants, meeting facilities, and movies.

Content: The classes were designed by a physical therapist (PT) to address physical fall risk factors: balance and coordination, strength, reaction time, and aerobic capacity. Each class began with five to ten minutes of warm-up that included stretching of the major lower limb muscle groups and ten minutes of cool-down that included gentle stretching, relaxation, and controlled-breathing practice. Each class included music chosen by the participants.

The classes included the following types of exercises:

- Balance and coordination exercises, including modified Tai Chi exercises, practice in stepping and in changing direction, dance steps, and catching and throwing a ball
- Strengthening exercises, including exercises that used the participant's weight (e.g., sit-to-stand, wall press-ups) and resistance-band exercises that worked both upper and lower limbs
- Aerobic exercises, including fast-walking practice with changes in pace and direction

As the classes progressed, the complexity and speed of the exercises and the resistance of the bands were steadily increased.

Participants also took part in a home exercise program using content from the exercise class and recorded their participation in a home exercise diary.

Duration: A total of 37 one-hour classes were conducted once a week over a one-year period.

Delivered by: Nationally accredited exercise instructors who had been trained to conduct this exercise program by a licensed PT (accredited by Australia's National Association for Gentle Exercise). The study used currently accredited exercise leaders who already had a good understanding of the exercise principles.

Before classes began, regular meetings were held with the exercise leaders to discuss the content and how the classes would be run, giving the leaders ownership in the program. Training included approximately six hours of additional meetings, discussion, and practice sessions before beginning the program. During the classes, instructors were visited by the PT for support once each term.

Minimum Level of Training Needed: Information was not provided by the principal investigator.

Key Elements:

- This study used health practitioners to assess and recruit participants. General practitioners are in an ideal position to both identify older people at risk of falls and to support their participation in an exercise program when appropriate.
- The program used existing services and facilities in the community, so it is likely to be sustainable and transferable to other settings.

Available Materials: In addition to the guidance received during the exercise sessions, participants received:

- A home exercise program based on class content*
- A "hot tips" sheet listing practical strategies for avoiding falls such as where to place hands and feet if a loss of balance occurs*

** See Appendix C-1*

Study Citation: Barnett A, Smith B, Lord S, Williams M, Baumand A. Community-based group exercise improves balance and reduces falls in at-risk older people: A randomized controlled trial. *Age and Ageing*. 2003 Jul;32(4):407–14.

Contact

Practitioners interested in using this intervention may contact the principal investigator for more information:

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The Otago Exercise Program

Campbell, et al. and Robertson, et al. (1997, 1999, 2001, 2005)

This program, tested in four randomized controlled trials and one controlled multi-center trial, was an individually tailored program of muscle-strengthening and balance-retraining exercises of increasing difficulty, combined with a walking program. This extensively tested fall prevention program is now used worldwide.

Overall, the fall rate was reduced by 35 percent among program participants compared with those who did not take part. The program was equally effective for men and women. Participants aged 80 years and older who had fallen in the previous year showed the greatest benefit.

Note: This study has been translated for use in the United States. *See page 11 for more information.*

Population: Participants were aged 65 to 97 years and lived in the community.

Geographic Locale: Dunedin, New Zealand

Focus: Improve strength and balance with a simple, easy-to-implement, and affordable home-based exercise program.

Program Setting: The program was conducted in participants' homes. It was intended for people who did not want to attend, or could not reach, a group exercise program or recreation facility.

Content: A physical therapist (PT) or nurse visited each participant at home four times over the first two months (at weeks one, two, four, and eight) and again for a booster session at six months. To maintain motivation, participants received telephone calls once a month during the months when no visits were scheduled.

The first home visit lasted one-hour and all subsequent visits took about half an hour. During each visit, the PT or nurse prescribed a set of in-home exercises (selected at appropriate and increasing levels of difficulty) and a walking plan.

The exercises included:

- Strengthening exercises for lower leg muscle groups using ankle cuff weights
- Balance and stability exercises such as standing with one foot in front of the other and walking on the toes
- Active range of motion exercises such as neck rotation and hip and knee extensions

Participant safety was ensured by tailoring the exercise program and by giving participants instructions and an illustration for each exercise.

Duration: The exercises took about 30 minutes. Participants were encouraged to complete the exercises three times a week and to walk outside the home at least two times a week. Exercises then were continued on an ongoing basis. In three trials, the exercise program was prescribed for one year and in one trial it was extended to two years.

Delivered by: The program was delivered by either a PT experienced in prescribing exercises for older adults or a nurse who was given special training and received ongoing supervision from a PT.

Minimum Level of Training Needed: PTs can deliver the program immediately after reading the manual. Nurses can be trained to deliver the program after a two-day training program and with ongoing supervision by a PT.

Key Elements: PTs should understand the research evidence on which the program is based and avoid adding or subtracting exercises from the set used in the trials, as this particular combination of exercises worked to reduce falls.

Available Materials: The Otago Exercise Programme instruction guide, which describes the program exercises, is available to health professionals at www.acc.co.nz/PRD_EXT_CSMP/groups/external_providers/documents/publications_promotion/prd_ctrb118334.pdf.

Study Citation:

Primary studies

Campbell AJ, Robertson MC, Gardner MM, Norton RN, Tilyard MW, Buchner DM. Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. *British Medical Journal*. 1997 Oct 25;315(7115):1065–9.

Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Falls prevention over 2 years: A randomized controlled trial in women 80 years and older. *Age and Ageing*. 1999 Oct;28(6):513–8.

Campbell AJ, Robertson MC, La Grow SJ, Kerse NM, Sanderson GF, Jacobs RJ, Sharp DM, Hale LA. Randomised controlled trial of prevention of falls in people aged ≥75 with severe visual impairment: The VIP trial. *British Medical Journal*. 2005 Oct 8;331(7520):817–20.

Robertson MC, Devlin N, Gardner MM, Campbell AJ. Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 1: Randomised controlled trial. *British Medical Journal*. 2001 Mar 24;322(7288):697–701.

Robertson MC, Gardner MM, Devlin N, McGee R, Campbell AJ. Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 2: Controlled trial in multiple centres. *British Medical Journal*. 2001 Mar 24;322(7288):701–4.

Supplemental Articles

Gardner MM, Buchner DM, Robertson MC, Campbell AJ. Practical implementation of an exercise-based falls prevention programme. *Age and Ageing*. 2001 Jan;30(1):77–83.

Robertson MC, Campbell AJ, Gardner MM, Devlin N. Preventing injuries in older people by preventing falls: A meta-analysis of individual-level data. *Journal of the American Geriatrics Society*. 2002 May;50(5):905–11.

Contact

Practitioners interested in using this intervention may contact the principal investigator for more information:

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U.S. Program Contact

In 2011, CDC funded the translation of the Otago Exercise Program for dissemination and implementation in the U.S.

As implemented in the U.S., the key features of the Otago Exercise Program are:

1. Delivered only by PTs or PT assistants.
2. Provides a minimum of five visits over eight weeks with a follow-up visit at six months.
3. Takes place in the older adult's home or in an outpatient setting.
4. Encourages the PTs to find ways to help older adults adhere to the program. This may include encouraging the caregiver to exercise with the older adult or having participants perform their Otago exercises in a group setting.

To support adoption of the Otago Exercise Program, CDC has published an implementation guide for PTs and has partnered with other organizations to develop:

- An online training program for PTs.
- Additional implementation resources (videos, handouts, etc.).

Available Materials: Tools to Implement the Otago Exercise Program in the U.S. are available at http://www.med.unc.edu/aging/cgec/exercise-program/tools-for-practice/.

Online training is available at: http://www.med.unc.edu/aging/cgec/exercise-program.

Practitioners interested in learning more may contact:

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Or visit the course website at: http://www.med.unc.edu/

LiFE (Lifestyle Approach to Reducing Falls Through Exercise)

Clemson, et al. (2012)

This study evaluated the effectiveness of two exercise interventions to reduce falls: an integrated balance and strength training intervention that focused on embedding exercises into daily life (LiFE), and a structured balance and strength exercise program performed three times a week.

Both interventions were tailored for participants and increased in difficulty during the intervention. Only the LiFE program was effective in reducing falls. Participants in the LiFE program experienced 31 percent fewer falls compared to the control group.

Population: Participants were community-dwelling adults aged 70 or older who had experienced two or more falls or one fall with a self-reported injury in the previous 12 months. More than half were female.

Geographic Location: Sydney, Australia

Focus: Integrate balance and strength training exercises into daily activities.

Program Setting: Sessions were conducted in the participants' homes.

Content: This program consisted of five to seven in-home sessions where an implementer (a physical therapist [PT], occupational therapist [OT], or exercise physiologist) worked with each participant to add seven balance strategies (e.g., reducing base of support) and seven strength training strategies (e.g., bending knees) to their daily activities. The implementer worked with participants to upgrade the exercises over the course of the intervention. For instance, standing with one foot placed in front of the other (tandem stand) uses the balance strategy, "reduce base of support" and can be upgraded to standing on one foot as the participant becomes better at balancing.

The initial session lasted about 90 minutes; all subsequent sessions lasted 40–60 minutes.

- During Session One, the implementer:
  - Assessed the ability and daily activities of the participant.
  - Chose and demonstrated one to two LiFE balance exercises and one to two LiFE strength exercises.
  - Provided background on the principles behind challenging balance and strengthening muscles.
  - Worked with the participant to develop an Activity Plan for how, when, and where the exercises would be performed.
  - Provided the participant with the LiFE Participant manual that contains instructions and examples of LiFE balance and strength activities.

- Encouraged the participant to plan and record where and when they would do each exercise.
- During Sessions two through five, the implementer:
- Encouraged participants to suggest how they could perform LiFE exercises during daily activities and how they might upgrade these exercises (i.e., make them more challenging over time).
- Provided a new Activity Plan for each session that included current exercises, upgraded exercises, and two to four new exercises.
- Reviewed and confirmed exercise techniques for safety.
- During two booster sessions, the implementer:
  - Finished embedding the seven balance and seven strength LiFE strategies if they were not completed.
  - Reviewed the participant's current exercises and encouraged finding more opportunities to embed them in routines and to upgrade them.
  - Emphasized performing the exercises safety.
  - Encouraged participant to continue doing these new exercises.

Examples of LiFE Program exercises			
Strategy	**Exercise**	**Setting**	**Upgraded exercise**
Balance Training			
Reduce base of support	Tandem stand Tandem walking	Brushing teeth Ironing Walking down the hallway	Standing on one leg
Move to the limits of sway	Lean to one side as far as possible	Talking on the telephone	Hold longer Reduce base of support
Strength Training			
Bend your knees	Squatting instead of bending your back	Putting laundry away in drawers Putting a plate away in the kitchen cupboard	Emptying the dishwasher Put the dishwashing liquid on a lower shelf

Duration: Training sessions were held once a week for five weeks with two booster sessions if needed. Sessions lasted 40–90 minutes. The implementer encouraged participants to do the prescribed exercises as often as possible each day over the course of the 12-month intervention period.

Delivered By: This program was delivered by a PT, OT, or exercise physiologist. Each participant worked with only one member of the intervention team. However, all of the implementers met regularly to discuss any issues and to contribute suggestions and upgrades for all participants.

Minimum Level of Training Needed: A PT, OT, or exercise physiologist experienced with the LiFE approach. Those interested in implementing the intervention MUST read the trainer's manual and do the LiFE program themselves before teaching it to older adults. The therapist should understand the importance of planning, prompts, and practice to reinforce learning new habits.

LiFE does not prescribe a set number of times to do a LiFE activity. Rather it is focused on seeking opportunities to "do more." The assessment and planning tools have been carefully designed to reflect this approach to behavior change.

Key Elements:

- Understanding the principles underlying the balance and strength exercises.
- Planning when, where, and how to incorporate the exercises, including using prompts.
- Understanding how to upgrade the exercises.
- Having the participant practice the exercises safely so they feel challenged over time.
- Working with the participant to develop and embed LiFE exercises into daily activities.

Available Materials:

Clemson L, Fiatarone Singh M, Munro J. Lifestyle-Integrated Functional Exericse (LiFE) Program to reduce falls. Participant's manual. Sydney: Sydney University Press; 2014.

Clemson L, Fiatarone Singh M, Munro J. Lifestyle-Integrated Functional Exericse (LiFE) Program to reduce falls. Trainer's manual. Sydney: Sydney University Press; 2014.

The Daily Routine Chart, Life Assessment Tool, LiFE Balance and Strength Activity Planner's and the Activity Plan are all freely downloadable from Sydney University Press: http://ses.library.usyd.edu.au/handle/2123/10627.

Study Citation: Clemson L, Fiatarone Singh MA, Bundy A, Cumming RG, Manollaras K, O'Loughlin P, et al. Integration of balance and strength training into daily life activity to reduce rate of falls in older people (the LiFE study): randomised parallel trial. *British Medical Journal* (Clinical Research Ed). 2012;345:e4547.

Supplemental Article

Clemson L, Singh MF, Bundy A, Cumming RG, Weissel E, Munro J, Manollaras K, Black D. LiFE Pilot Study: A randomised trial of balance and strength training embedded in daily life activity to reduce falls in older adults. *Australian Occupational Therapy Journal* 2010;57(1):42–50.

Contact

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Erlangen Fitness Intervention
Freiberger, et al. (2007)

This study examined two interventions to reduce falls: a psychomotor intervention that focused on body awareness, body experience, and coordination; and a fitness intervention that focused on functional skills, strength, endurance, and flexibility. Both interventions included group classes, home-based exercises, and physical activity recommendations.

Only the fitness intervention was effective in reducing falls. Compared to the control group, participants in the fitness group experienced 23 percent fewer falls.

Population: The participants were community-dwelling, physically active people in very good health, aged 70 or older. Slightly more than half were male.

Geographic Locale: Erlangen, Germany

Focus: Improve functional skills, strength, endurance, and flexibility.

Program Setting: The group classes were conducted at the University of Erlangen-Nuremberg, Institute of Sport Science. The home-based portion was carried out in participants' homes.

Content: This program consisted of group exercise classes, home-based exercises, and recommendations for increasing physical activity levels such as walking or biking daily.

Each session lasted one hour. Approximately one-third of the time was spent on each of the components:

- Strength and flexibility training (including the use of dumbbells, ankle weights, weight-bearing exercises, and joint flexibility).
- Balance and motor coordination training (including standing balance, dynamic weight transfers, stepping strategies, motor control when performing activities of daily living, motor control under time pressure and sensory awareness).
- Endurance training (including normal walking and Nordic walking).

Group discussions were conducted at the beginning and end of each session to outline the goals of the program and to review progress.

Duration: One-hour classes were held twice a week for 16 weeks. In addition, participants were instructed to perform selected exercises at home on a daily basis between sessions and after the program ended.

Delivered by: The program was supervised by two trainers, preferably a man and a woman, who had backgrounds in sports science. This training is similar to that received by physical education teachers. It included knowledge of physical education, kinesiology, motor control, and motor learning. Trainers also had experience working with older persons, which they generally gained during the course of their academic studies.

Minimum Level of Training Needed: Trainers need to have a background in physical therapy, psychology, sports science, or as a personal trainer. Trainers also need to have experience working with older adults and attend a two-day training session, or to attend a comprehensive four-day training if they do not have experience working with older adults.

Training should include age-related changes in physical, cognitive and social dimensions (e.g., changes in muscle mass, loss of strength and power); fear of falling and how to address it; how to perform the strength, balance, and gait training exercises; and an introduction to public health theories and models, such as the Health Belief Model.

Key Elements:

- Strength, endurance, and functional skill exercises, including balance and gait training, should increase in intensity over the duration of the program.
- Trainers must attend the program training.

Available Materials: A course manual has been published in German (Freiberger E, Schöne D. *Sturzprophylaxe im Alter*. Deutscher Aerzteverlag: Köln). In addition, there is a German web site with information about fall prevention and trainers' education at www.standfestimalter.de.

Study Citation: Freiberger E, Menz HB, Abu-Omar K, Rütten A. Preventing falls in physically active community-dwelling older people: A comparison of two intervention techniques. *Gerontology*. 2007 Aug;53(5):298–305.

Supplemental Article

Freiberger E, Menz HB. Characteristics of falls in physically active community-dwelling older people. *Zeitschrift für Gerontologie und Geriatrie*. 2006 Aug;39(4):261–7.

Contact

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Senior Fitness and Prevention (SEFIP)

Kemmler, et al. (2010)

This study evaluated the effectiveness of an exercise intervention that consisted of two structured high-intensity group classes and two home exercise sessions per week. After 18 months, participants were 46 percent less likely to fall and 67 percent less likely to suffer a fall-related injury compared with those who did not receive the intervention.

Population: Participants were women aged 65 or older who lived in the community and were not taking medications that could affect bone health (e.g., bisphosphonates, hormone therapy).

Geographic Locale: Erlangen-Nuremberg, Germany

Focus: Determine the effect of high intensity exercise on falls, fractures, coronary heart disease (CHD) risk factors, and health care costs.

Program Setting: This program took place in community gymnasiums.

Content: This program consisted of high-intensity group exercise classes and a home-based exercise routine.

Each group session lasted 60 minutes and included four components:

1. A 20 minute warm-up/aerobic dance sequence with progressively higher-impact elements
2. A 5 minute period that included static and dynamic balance training
3. A 15 minute period that included functional gymnastics, isometric strength training, and stretching sequences
   - Floor exercises for trunk, hip and leg muscles
   - Exercises were replaced every 6 to 18 weeks by more strenuous ones.
4. A 15 minute circuit training period
   a. Upper body exercises
      - Low and high belt rowing
      - Shoulder raises
      - Continuous stretching using elastic belts (Thera-Band)
   b. Dynamic weight-bearing leg exercises

The home exercise sessions emphasized strength and flexibility (including using Thera-bands). Every 12 weeks, the home exercises were made more difficult. The exercise trainer encouraged participants to practice their home exercises consistently.

Duration: Two 60-minute group classes and two 20-minute home exercise sessions were conducted weekly. The intervention lasted 18 months.

Delivered by: This program was delivered by certified exercise instructors under the guidance of the principal investigator.

Minimum Level of Training Needed: Certified exercise instructors with experience teaching older adults.

Key Elements:

- Resistance exercises.
- Exercises that include high impact elements.
- Exercises to improve general coordination and balance.
- Exercises that become more challenging over time.

Available Materials: None at this time.

Study Citation: Kemmler W, von Stengel S, Engelke K, Häberle L, Kalender WA. Exercise effects on bone mineral density, falls, coronary risk factors, and health care costs in older women: the randomized controlled senior fitness and prevention (SEFIP)study. *Arch Intern Med*. 2010 Jan 25;170(2):179–85.

Supplemental Article

von Stengel S, Kemmler W, Engelke K, Kalender WA. Effects of whole body vibration on bone mineral density and falls: results of the randomized controlled ELVIS study with postmenopausal women. *Osteoporosis International*. 2011 Jan;22(1):317–25.

Contact

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Adapted Physical Activity Program
Kovacs, et al. (2013)

This study evaluated an exercise program adapted for older women. One-hour classes were held twice a week for 25 weeks. Exercises were tailored to each participant's physical abilities and became more difficult as the study progressed.

Participants were 60 percent less likely to fall compared to those who did not receive the intervention.

Population: Participants were community-dwelling women aged 60 and older who had not exercised regularly in the past six months.

Geographic Location: Budapest, Hungary

Focus: Improve balance, decrease risk of falls, and improve quality of life.

Program Setting: The exercise program was conducted in the gymnasium of a local sports center.

Content: A physical therapist (PT) and a PT student assistant led a class of 30–38 participants. The PT encouraged participants to choose the music that was played during the structured exercises.

The exercises were tailored to the abilities of each participant and became more difficult over the 25-week intervention by increasing the number of repetitions or the duration. The PT increased the difficulty of the ball games by reducing the ball's size and increasing the ball's weight over the course of the intervention.

While participants exercised, the PT explained how the exercises related to movements used in everyday situations

Each class included:

- A 5–10 minute warm up that included stretching.
- A 20–25 minute period of structured exercises and functional activities.
  - Exercises included raising arms over head while seated, partial squats, tandem stepping, and high stepping in place.
  - Functional activities included sit to stand, stand to sit, and walking and turning.
- A 20–25 minute group activity such as a relay race or ball game. Participants choose which group activity they preferred for each session.
  - Relay races included walking on toes, walking backward and stepping in and out of hoops as part of the course.
  - Ball games included adapted basketball and an adapted form of catch.
- A 5–10 minute cool-down.

Duration: Classes were held one-hour twice a week and lasted for 25 weeks.

Delivered By: A PT with extensive geriatric experience and assisted by a physical therapy student. PTs in Hungary must have a minimum of three years of supervised work before he/she is permitted to practice alone.

Minimum Level of Training Needed: This program should be delivered by a PT with three or more years of experience to ensure the effectiveness and safety of the program.

Key Elements:

- Exercise sessions should be held at least twice a week and continue for at least six months.
- Each session must include all components. Exercises should be tailored for participants with limited abilities (e.g. performed slower, doing fewer repetitions, using lighter objects and balls, or with support).
- Each session must include functional activities (e.g., sit to stand and stand to sit, walking, and stepping in different directions).
- Exercises should be accompanied by brief explanations about how the exercises relate to movements used in everyday situations.

Available Materials: A more detailed description of the structured and group exercises is available in the Appendix C-2.

Study Citation: Kovács E, Prókai L, Mészáros L, Gondos T. Adapted physical activity is beneficial on balance, functional mobility, quality of life and fall risk in community-dwelling older women: a randomized single-blinded controlled trial. *European Journal of Physical and Rehabilitation Medicine*. 2013 Jun;49(3):301–10.

Contact

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Tai Chi: Moving for Better Balance
Li, et al. (2005)

This study compared the effectiveness of a six-month program of Tai Chi classes with a program of stretching exercises. Participants in the Tai Chi classes had fewer falls and fewer fall injuries, and their risk of multiple falls was decreased 55 percent.

Note: This study has been translated for use in the United States. See page 23 for more information.

Population: Participants were inactive adults aged 70 or older. Three-quarters were female. All participants lived in the community.

Geographic Locale: Portland, Oregon, United States.

Focus: Improve balance and physical performance with Tai Chi classes designed for older adults.

Program Setting: The Tai Chi program was conducted in community settings such as local senior centers and adult activity centers.

Content: The program included 24 Tai Chi forms that emphasized weight shifting, postural alignment, and coordinated movements. Synchronized breathing aligned with Tai Chi movements was integrated into the movement routine.

Each session included instructions in new movements as well as a review of movements from previous sessions. Each practice session incorporated musical accompaniment.

Each hour-long session included:

- A 5- to 10-minute warm-up period
- Practice of Tai Chi movements
- A 5- to 10-minute cool-down period

Practicing at home was encouraged and monitored using a home-practice log.

Duration: One-hour classes were held three times a week for 26 weeks, followed by a six-month period in which there were no organized classes.

Delivered by: Experienced Tai Chi instructors who followed the classical Yang style, which emphasizes multidirectional weight shifting, body alignment, and coordinated movement of the arms, legs, and trunk.

Minimum Level of Training Needed: Instructors should be familiar with the fundamental principles of Tai Chi and the major postures and movements, be able to follow the training protocol, and have experience teaching physical activity to older adults.

Key Elements:

- Program settings can include facilities such as senior centers, adult activity centers, and community centers.
- An average class size of 15 is ideal for effective learning and teaching.
- For this program to be successful, participants should attend Tai Chi classes at least two times a week and participate actively in class.
- Tai Chi can also be used in rehabilitative settings where the emphasis is on retraining balance in older adults.

Available Materials: No intervention materials were available at the time of publication.

Study Citation: Li F, Harmer P, Fisher KJ, McAuley E, Chaumeton N, Eckstrom E, Wilson NL. Tai Chi and fall reductions in older adults: A randomized controlled trial. *Journal of Gerontology*. 2005 Feb;60A(2):187–94.

Contact

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U.S. Program Contact

As implemented in the U.S., the key features of the Y's efforts in Moving For Better Balance are:

1. A reduced number of Tai Chi forms. This program uses 8 modified forms of Tai Chi instead of the 24 used in the study intervention.
2. The Y is able to scale the program through a YMCA instructor delivery network.

Practitioners interested in learning more may contact:

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Australian Group Exercise Program

Lord, et al. (2003)

This study evaluated a 12-month group exercise program for frail older adults. The program was tailored to each participant's abilities. Overall, the fall rate was 22 percent lower among participants, and 31 percent lower among participants who had fallen in the previous year, compared with those who did not take part in the program.

Population: Ages ranged from 62 to 95 although nearly all were 70 years or older. Most study participants were female. Participants lived in retirement villages and most were independent.

Geographic Locale: Sydney and Wollongong, Australia

Focus: Increase participants' strength, coordination, gait and balance, and increase their ability to carry out activities of daily living such as standing up from a chair and climbing stairs.

Program Setting: Programs were conducted in common rooms in residential care community centers and senior centers within the retirement villages.

Content: The group classes included weight-bearing exercises and balance activities that were challenging but not so difficult as to discourage participation or cause any adverse events. The program emphasized social interaction and enjoyment.

The program consisted of four successive three-month terms. The first term included understanding movement, how the body works, training principles, and basic exercise principles. This was followed by progressive strength training and increasingly challenging balance exercises, using equipment to maintain interest. In each term, the exercise sessions built on the skills acquired in the previous term.

Each one-hour class had three components:

- A 5- to 15-minute warm-up period that included chair-based activities, stretching large muscle groups, and later in the program, slow to moderate walking.
- A 35- to 40-minute conditioning period that included aerobic exercises, strengthening exercises, and activities to improve balance, hand-eye and foot-eye coordination, and flexibility.

As the program progressed, the number of repetitions of each exercise increased, beginning with four repetitions at week 2 and reaching 30 by week 10. Thirty repetitions were maintained for rest of the program.

- A 10-minute cool-down period that included muscle relaxation, controlled breathing, and guided imagery.

Duration: One-hour classes were held twice a week for 12 months. The program consisted of four successive three-month terms.

Delivered by: Six exercise instructors were trained to deliver the program. All had previously completed a training course conducted by the Australian Council for Health, Physical Education and Recreation, on leading exercise programs for frail, older people. The project coordinator regularly observed the instructors to provide support and to monitor program fidelity and consistency.

Everyone involved in implementing the program received specific one-day training and met regularly to discuss issues and training updates.

Minimum Level of Training Needed: Instructors should have taken an exercise instructor course as well as a specific course on teaching exercise to older adults.

Key Elements: Information was not provided by the principal investigator.

Available Materials: No intervention materials were available at the time of publication.

Study Citation: Lord SR, Castell S, Corcoran J, Dayhew J, Matters B, Shan A, Williams P. The effect of group exercise on physical functioning and falls in frail older people living in retirement villages: A randomized, controlled trial. *Journal of the American Geriatrics Society*. 2003 Dec;51(12):1685–92.

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Yaktrax® Walker
McKiernan (2005)

This study tested the effectiveness of the Yaktrax® Walker, a lightweight traction device that fits over shoes, to prevent falls among older adults when walking outdoors on ice and snow.

During the winter months, participants in the Yaktrax® intervention group were half as likely to slip and about 60 percent less likely to fall, compared to the group that wore their usual winter footwear. Participants in the intervention group also experienced significantly fewer minor fall-related injuries.

Reprinted with permission of the Yaktrax® Walker. Yaktrax® is a Registered Trademark of Implus Footcare LLC.

Population: Participants were community-dwelling adults aged 65 or older who had fallen at least once in the previous year. About 60 percent were female.

Geographic Locale: Rural central and northern Wisconsin, United States

Focus: Using a traction device that fits on shoes to improve stability when walking on ice and snow.

Program Setting: Participants used the Yaktrax® Walker on their own in the community.

Content: Participants were given a Yaktrax® Walker that was sized to fit the external length of their usual winter footwear. Participants had to be able to put on the Yaktrax® Walker correctly.

After reviewing the Yaktrax® Walker instruction manual with each participant, the research study coordinator spent approximately 30 minutes training the participant and then had the participant practice putting on the Yaktrax® Walker.

Participants were told to only wear the device outdoors when there was ice or snow. They were instructed that the Yaktrax® Walker should never be worn indoors or on smooth outdoor non-ice surfaces.

Duration: This study took place during the winter of 2003–04.

Delivered by: A research study coordinator.

Minimum Level of Training Needed: Instructors should read the manual and practice putting the Yaktrax® Walker on themselves and others.

Key Elements:

- People must be able to safely put on and take off the Yaktrax® Walker or leave the device on a dedicated pair of shoes or boots that are only worn out of doors.

- Shoes should be measured to assure proper fit of Yaktrax® Walker.
- Yaktrax® Walker must not be worn indoors.
- Yaktrax® Walker should be inspected for breakage and replaced if broken.

Available Materials: Instructions that accompany the device are sufficient for consumer use.

Study Citation: McKiernan FE. A simple gait-stabilizing device reduces outdoor falls and non-serious injurious falls in fall-prone older people during the winter. *Journal of the American Geriatrics Society*. 2005 Jun;53(6):943–7.

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Veterans Affairs Group Exercise Program
Rubenstein, et al. (2000)

This study evaluated a structured group exercise program for fall-prone older men. At the end of the three-month program, participants were two-thirds less likely to fall compared with those who did not take part in the program.

Note: This study calculated the fall rate as the number of falls per hour of physical activity.

Population: All participants were aged 70 or older and lived in the community. All were males who had at least one of these fall risk factors: leg weakness; impaired gait, mobility, and/or balance; and/or had fallen two or more times in the previous six months.

Geographic Locale: Los Angeles, California, United States

Focus. Increase strength and endurance and improve mobility and balance using a low- to moderate-intensity group exercise program.

Program Setting: The program was conducted at a Veterans Affairs ambulatory care center.

Content:

- Strength training included hip flexion, extension, abduction, and adduction; knee flexion and extension; squats, dorsiflexion, and plantar flexion.

Over the first four weeks, participants increased each exercise from one to three sets of 12 repetitions.

Resistance levels also were increased progressively. The rate of progression was modified for subjects with physical limitations.

- Endurance training used bicycles, treadmills, and indoor walking sessions. Endurance training alternated between cycling (once a week), using a treadmill (twice a week), and indoor walking that included a walking loop as well as two flights of stairs (twice a week).

Heart rates were monitored to ensure that participants did not exceed 70 percent of their heart rate reserve.

- Balance training used a rocking balance board, balance beam, obstacle course, and group activities such as balloon volleyball and horseshoes.

Balance training sessions were held twice a week and increased in difficulty over the 12-week program.

Duration: Three 1½-hour sessions a week for 12 weeks.

Delivered by: Exercise physiology graduate students with training from experienced exercise physiologists or physical therapists (PTs).

Minimum Level of Training Needed: Facilitators should have approximately two weeks of on-the-job training by an experienced exercise physiologist or PT.

Key Elements:

- Using a group format and providing a wide variety of exercise activities
- Focusing on strength, balance, and endurance
- Providing personal encouragement and reinforcement

Available Materials: No materials were available at time of publication.

Study Citation: Rubenstein LZ, Josephson KR, Trueblood PR, Loy S, Harker JO, Pietruszka FM, Robbins, AS. Effects of a group exercise program on strength, mobility, and falls among fall-prone elderly men. *Journal of Gerontology: Medical Sciences*. 2000 Jun;55A(6):M317–21.

Contact

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Falls Management Exercise (FaME) Intervention
Skelton, et al. (2005)

This study examined the effectiveness of an individualized, tailored group and home-based exercise intervention designed to improve participants' dynamic balance and core and leg strength, and to recover their ability to get down to and up from the floor.

After 36 weeks, the fall rate in the exercise group was reduced by one-third. Over the entire study, which included a 50-week follow-up period, the fall rate was reduced by 54 percent.

Population: Participants were women aged 65 or older, living independently, who had fallen three or more times in the previous year.

Geographic Locale: London, United Kingdom

Focus: Improve balance and strength.

Program Setting: Group classes were conducted at four locations in London in Community Leisure Centers (gym facilities that have rooms for exercise classes). Home exercises were performed in participants' homes.

Content: Before starting the program, participants were assessed for asymmetry in strength or balance and specific problems with strength, balance, and flexibility.

Five basic functional tests were used:

- Shoulder flexibility
- Hamstring flexibility
- Timed Up And Go
- 180 degree turn
- Functional Reach

Participants also received a health screening and were evaluated for fear of falling (FES-I), fracture risk (Black score), quality of life (SF12), and confidence in maintaining balance (ConfBal).

Falls Management Exercise (FaME) group classes were based on the Otago Exercise Programme, which includes exercises for endurance and flexibility as well as floor exercises. The exercises meet the American College of Sports Medicine guidelines for adults over age 65.

Class exercises were tailored to the abilities of the group and home exercises were tailored to each participant's needs and abilities. All exercises became more challenging (that is, increased in intensity or difficulty) as the program progressed. For example, classes used individualized resistance bands and progressively reduced levels of support (seated and supported options moving to unsupported options).

Home exercises addressed asymmetry in strength or balance by prescribing additional repetitions or sets for the weaker side.

Class exercises focused on:

- Improving first static then dynamic balance
- Muscle and bone strength (e.g., Thera-Bands, free weights, low-impact side stepping and standing squats, etc.)
- Endurance (e.g., marching, side stepping)
- Flexibility of five major muscle groups
- Gait (e.g., side and backward walking)
- Functional skills (e.g., sit to stand)
- How to avoid falling (e.g., compensatory stepping)
- Functional floor exercises (e.g., crawling, rolling, back extensions, and side leg lifts)

Note: These exercises were introduced after at least eight weeks of preparatory physical therapy to restore the skills needed to get down to and up off the floor.

The home exercise program consisted of:

- Warm-up
- 10-minute endurance session
- Otago exercises along with additional resistance-band strengthening exercises
- Developmental flexibility exercises
- Cool-down

Participants wore hip protectors during the exercise sessions in group classes and at home to reduce the risk of hip fractures. They were not encouraged to wear them at other times.

Duration:

- The pre-exercise assessment lasted about 40 minutes.
- One-hour group classes were held once a week for 36 weeks.
- 30 minutes of home exercises were done twice a week.

Delivered by: Postural Stability Instructors. These are qualified "exercise for the older person" instructors, physical therapists (PTs), and occupational therapists (OTs) who have taken the five-day training course, "Exercise for the Prevention of Falls and Injuries in Frailer Older People."

Minimum Level of Training Needed: The United Kingdom has national education standards governing the training content for exercise instructors working with special populations, including older people.

After instructors are trained to work with older people, they can train as Postural Stability Instructors, focusing on older people at high risk of falling. PTs and OTs do not have to become an exercise instructor in order to take this training.

The five-day training course to become a Postural Stability Instructor is considered postgraduate-level training. It involves 54 contact hours of theory and practical delivery and 100 noncontact hours. The qualification is based on successfully completing a 40-minute practical exam, a case study on a faller, and a theoretical paper.

More information about the course content can be found at www.laterlifetraining.co.uk.

The United Kingdom Chartered Society of Physiotherapists endorses the Postural Stability Instructor training course. Additional information can be found at www.csp.org.uk.

Key Elements:

- To be successful, the exercise program should last at least 36 weeks.
- It should include a minimum of two hours per week of combined group and home exercises.
- Exercise must be progressive, continually increasing in intensity, resistance, weight, and challenging balance.
- Exercises must be tailored to each individual's needs and abilities, both in group classes and at home.
- It is desirable but not essential to include floor work to reduce fear of falling and improve falls self-efficacy.

Available Materials: The participants' home exercise booklet is available at http://www.ageuk.org.uk/documents/en-gb/id8950%20strength%20and%20balance%20book.pdf?dtrk=true.

Information about the accredited Postural Stability Instructor course in the United Kingdom is available at www.laterlifetraining.co.uk.

The training manual for the Postural Stability Instructor course can be purchased from www.laterlifetraining.co.uk.

Study Citation: Skelton D, Dinan S, Campbell M, Rutherford O. Tailored group exercise (Falls Management Exercise—FaME) reduces falls in community-dwelling older frequent fallers (an RCT). *Age and Ageing*. 2005 Nov;34(6):636–9.

Supplemental Articles

Skelton DA, Dinan SM. Exercise for falls management: Rationale for an exercise program aimed at reducing postural instability. *Physiotherapy Theory and Practice*. 1999 Jan;15(2):105–20. Available at: www.laterlifetraining.co.uk/documents/ExerciseFallsManage.PDF.

Iliffe A, Kendrick D, Morris R, Skelton D, Gage H, Dinan S, Stevens Z, Pearl M, Masud T. Multi-centre cluster randomised trial comparing a community group exercise programme with home based exercise with usual care for people aged 65 and over in primary care: Protocol of the ProAct 65+ trial. *Trials*. 2010 Jan;11(1):6–10.

Skelton DA, Stranzinger K, Dinan SM, Rutherford O. BMD improvements following FaME (falls management exercise) in frequently falling women age 65 and over: An RCT. *Journal of Aging and Physical Activity*. 2008 Jul;16(Suppl):S89–90.

Skelton DA. The Postural Stability Instructor: Qualification in the United Kingdom for effective falls prevention exercise. *Journal of Aging and Physical Activity*. 2004 Jul;12(3):375–6.

Skelton DA. Effects of physical activity on postural stability. *Age and Ageing*. 2001 Nov;30 (Suppl 4):33–9.

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Music-Based Multitask Exercise Program
Trombetti, et al. (2011)

This study evaluated the effectiveness of Jaques-Dalcroze eurhythmics, a music-based multitask exercise program, to improve gait and balance and reduce falls among high risk older adults. Experienced instructors led a one-hour class once a week for six months. At the end of the six-month program, participants were 54 percent less likely to fall compared to those who did not participate in the program.

Population: Participants were community-dwelling adults aged 65 and older with an increased risk of falling, defined as having had one or more self-reported falls, balance impairment, or being physically pre-frail. Most participants were female.

Geographic Location: Geneva, Switzerland

Focus: Improve gait and balance using Jaques-Dalcroze eurhythmics classes modified for older adults.

Program Setting: Classes were conducted in common areas of residential retirement communities.

Content: A certified and experienced Jaques-Dalcroze instructor led each session and played the piano. The program included a combination of gait and balance movements, flexibility training, and coordinated movements of multiple joints (e.g., rotating a ball in your hand while moving your arms and walking).

Participants wore thin soled shoes. The instructor constantly changed the music so participants could not predict the rhythm and had to adapt their movements in response. The participants helped select the style of music played.

Each one-hour class had three segments:

A 5–10 minute warm-up that included stretching exercises.

A 40 minute core-content period composed of multitask and balance challenging exercises. Basic exercises consisted of walking in time to the music and responding to changes in the music's rhythmic patterns. Upper body exercises included sequences using percussion instruments or balls.

Other typical exercises included quick reaction exercises, walking out of rhythm, and multidirectional weight shifting. Exercises gradually became more difficult over the six month period.

The instructor requested participants to maintain a high level of attention and respond quickly to verbal instructions and changes in the rhythm of the music.

A 5–10 minute cool-down period.

Duration: A one-hour class once a week for six months.

Delivered by: Certified exercise instructors experienced in teaching Jaques-Dalcroze eurhythmics to older adults.

Minimum Level of Training Needed: Instructors should be trained in Jaques-Dalcroze eurhythmics instruction and have experience teaching older adults.

Key Elements:

- This program should be led by an experienced Jaques-Dalcroze instructor.
- An average class size of 15-18 is ideal for effective learning and teaching.
- To maintain program fidelity, the program should not be altered.

Available Materials: Information about the Jaques-Dalcroze eurhythmics certification program in the United States is available at http://www.dalcrozeusa.org/.

Study Citation: Trombetti A, Hars M, Herrmann FR, Kressig RW, Ferrari S, Rizzoli R. Effect of music-based multitask training on gait, balance, and fall risk in elderly people: a randomized controlled trial. *Archives of Internal Medicine*. 2011 Mar 28;171(6):525–33.

Supplemental Articles

Wahli-Delbos M. La Rythmique Jaques-Dalcroze, un atout pour les seniors. Geneva: Editions Papillon; 2010.

Hars M, Herrmann FR, Fielding RA, Reid KF, Rizzoli R, Trombetti A. Long-term exercise in older adults: 4-year outcomes of music-based multitask training. *Calcified Tissue International*. 2014 Nov;95(5):393–404.

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Central Sydney Tai Chi Trial
Voukelatos, et al. (2007)

This study evaluated the effectiveness of community-based Tai Chi programs to reduce falls among people aged 60 or older. One-hour classes were offered once a week for 16 weeks in community settings by experienced instructors who taught their regular programs using several styles of Tai Chi.

After the 24-week follow-up period, the fall rate among Tai Chi participants was one-third lower, and the rate of multiple falls was 46 percent lower, than the rates for participants who did not take Tai Chi.

Population: Participants were healthy people aged 60 or older who lived in the community. About 84 percent were female.

Geographic Locale: Sydney, Australia

Focus: Improve balance and reduce falls

Program Setting: Community Tai Chi classes were conducted at locations such as town halls and senior centers. Locations were based on accessibility (e.g., accessible by public transportation, room accessible without climbing stairs), geographic diversity, and options for no- or low-cost sustainability after the study was completed.

Content: The majority of classes used modified Sun-style Tai Chi although a small proportion used Yang-style Tai Chi or a mixture of several styles. Detailed information about Tai Chi styles was not collected.

Instructors followed a set of guidelines that focused on teaching physical activity to older people and contained suggestions about how to incorporate key elements, such as relaxation, into the Tai Chi program. Some classes had the option to buy a video and/or booklet about the type of Tai Chi they were learning.

Duration: One-hour per week for 16 weeks.

Delivered by: Experienced Tai Chi instructors or instructors experienced in teaching physical activity to older people.

Minimum Level of Training Needed: Instructors must have at least five years' experience as a Tai Chi instructor or have experience teaching physical activity to older people and attend an intensive weekend workshop about the basic principles of Tai Chi.

Key Elements:

- Limit class size to 12 people to maximize the attention each participant can get from the instructor.
- Incorporate relaxation and lowered center of gravity exercises into each class.

- It is important that participants maintain an upright (straight) posture at all times to reduce the risk of falling. Forms of Tai Chi that require participants to squat while moving or to get into positions that are not totally upright should be modified appropriately.
- Instructors need to be aware of participants' comfort levels as well as any medical or physical conditions that may limit their ability to perform certain Tai Chi movements.
- Tai Chi movements should be introduced gradually so that participants are not exposed to too many new movements at once.

Available Materials:

- Tai Chi Principles for Falls Prevention in Older People*
- Guidelines for Instructors Working with Older People*

**See Appendix C-3.*

Study Citation: Voukelatos A, Cumming RG, Lord SR, Rissel C. A randomized, controlled trial of Tai Chi for the prevention of falls: The Central Sydney Tai Chi trial. *Journal of the American Geriatrics Society*. 2007 Aug;55(8):1185–91.

Supplemental Article

Voukelatos A. The Central Sydney Tai Chi trial: A randomized controlled trial investigating the effectiveness of Tai Chi in reducing falls in older people. PhD thesis, University of Sydney, 2010.

Contact

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Simplified Tai Chi
Wolf, et al. (1996)

This study compared a 15-week program of Tai Chi classes that used 10 simplified movements with a balance training program. After four months, the risk of falling more than once among participants in the Tai Chi classes was almost half that of people in the comparison group.

Participants reported that after the study they were better able to stop themselves from falling by using their environment and appropriate body maneuvers. After the study ended, almost half the participants chose to continue meeting informally to practice Tai Chi.

Population: All were 70 years or older and lived in the community. Most study participants were female.

Geographic Locale: Atlanta, Georgia, United States

Focus: Improve strength, balance, walking speed, and other functional measures among seniors using Tai Chi.

Program Setting: The program used facilities in a residential retirement community.

Content: Participants were taught a simplified version of Tai Chi. The 108 existing Tai Chi forms were synthesized into a series of 10 composite forms (see Appendix C-4) that could be completed during the 15-week period. The composite forms emphasized all elements of movement that generally become limited with age.

Exercises systematically progressed in difficulty. The progression of movements led to gradually reducing the base of standing support until, in the most advanced form, a person was standing on one leg. This progression also included increasing the ability to rotate the body and trunk as well as performing reciprocal arm movements. These exercises were led during the group sessions; however, individuals were encouraged to practice these forms on their own, outside of the group setting.

Image 1: This image depicts a Tai Chi form

Duration: The 15-week program included:

- Twice weekly 25-minute group sessions
- Weekly 45-minute individual contact time with the instructor
- Twice daily 15-minute individual practice sessions at home without an instructor

Delivered by: A Tai Chi Quan grand master with 50 years of experience instructed the classes and met individually with participants. A nurse/coordinator maintained contact with participants to ensure their participation.

Minimum Level of Training Needed: Information was not provided by the principal investigator.

Key Elements: This program needs to be led by a very experienced Tai Chi grand master. No elements should be changed in order to replicate these results among older adults who are similar to study participants.

Available Materials: Illustrations of the 10 Tai Chi exercises are in Appendix C-4.

Study Citation: Wolf SL, Barnhart HX, Kutner NG, McNeely E, Coogler C, Xu T. Reducing frailty and falls in older persons: An investigation of Tai Chi and computerized balance training. *Journal of the American Geriatrics Society.* 1996 May;44(5):489–97.

Supplemental Article

Wolf SL, Coogler C, Xu T. Exploring the basis for Tai Chi Chuan as a therapeutic exercise approach. *Archives of Physical Medicine and Rehabilitation*. 1997 Aug;78(8):886–92.

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Multi-target Stepping Program
Yamada, et al. (2013)

This study evaluated the effectiveness of a multi-target stepping (MTS) program with exercise compared to a walking program with exercise. Participants in the MTS program had fewer falls and fewer fall-related fractures. The fall rate was 65 percent lower among people who took part in the program compared to those who did not.

Population: Participants were community-dwelling adults aged 65 and older who could walk independently and did not have severe cognitive impairment. Slightly more than half were female.

Geographic Location: Kyoto, Japan

Focus: Improve stepping performance, gait, balance, and control of foot movements.

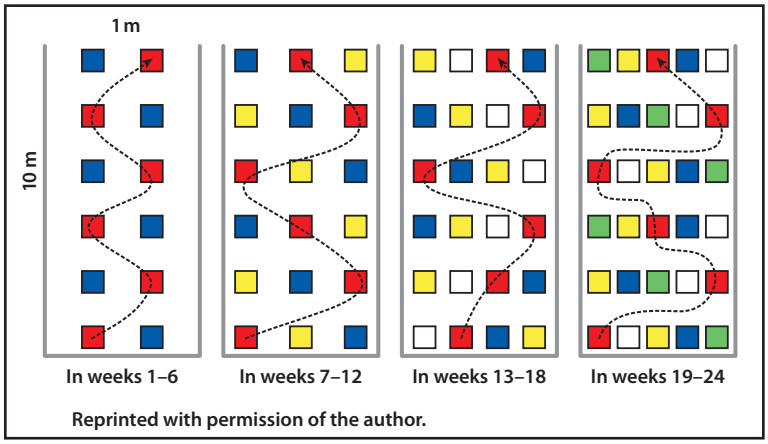
Program Setting: An academic health center that included a fitness center for older adults.

Content: The MTS program consisted of stepping on colored squares in a prescribed order at the participant's own pace. This was repeated four times each session. Participants attended sessions twice a week for 24 weeks.

An exercise trainer taped 15 rows of four inch paper squares onto a very thin (about 0.1 in), rubber mat 33 feet long by 3.3 feet wide. Each square was spaced two feet apart. A square with a new color was added every six weeks. The number of squares in each row increased from two to five over the course of 24 weeks.

- Weeks 1–6: two squares (red and blue)
- Weeks 7–12: three squares (red, blue, and yellow)
- Weeks 13–18: four squares (red, blue, yellow, and white)
- Weeks 19–24 five squares (red, blue, yellow, white, and green)

Each row contained at least two squares of different colors and their arrangement was randomized.



This picture illustrates the progression of the 24-week MTS course

Participants stepped on the same color square during the entire course. The other colored square(s) served as distractors. Participants could step on the squares with either foot and were allowed to take as many steps as needed to reach their next target square. The course changed each week and became progressively more difficult.

A physical therapist (PT) or exercise trainer instructed each participant, who wore flat-soled shoes, to walk through the course at their own pace. It typically took one to two minutes to complete the course. After each trial, the PT or exercise trainer provided feedback, such as "You missed the second square, please pay more attention the next time you try."

Both intervention and control participants took part in a 30 minute exercise class twice a week that included mild strength training, balance and flexibility exercises.

Duration: The MTS sessions took seven minutes and were held twice a week for 24 weeks.

Delivered by: A PT and exercise trainer who were experienced in working with older adults. The main role of the PT was risk management in the event of a fall or other injury, although he also provided instruction and feedback. The exercise trainer did not receive any additional training for this intervention.

Minimum Level of Training Needed: Exercise instructors experienced in working with older adults.

Key Elements: The course should become gradually more difficult, based on the physical ability of each participant.

Available Materials: No intervention materials were available at publication.

Study Citation: Yamada M, Higuchi T, Nishiguchi S, Yoshimura K, Kajiwara Y, Aoyama T. Multitarget stepping program in combination with a standardized multicomponent exercise program can prevent falls in community-dwelling older adults: a randomized, controlled trial. *Journal of the American Geriatrics Society*. 2013;61(10):1669–75.

Supplemental Articles

Yamada M, Aoyama T, Arai H, Nagai K, Tanaka B, Uemura K, Mori S, Ichihashi N. Complex obstacle negotiation exercise can prevent falls in community-dwelling elderly Japanese aged 75 years and older. *Geriatriatric Gerontology International*. 2012 Jul;12(3):461–7.

Yamada M, Tanaka B, Nagai K, Aoyama T, Ichihashi N. Rhythmic stepping exercise under cognitive conditions improves fall risk factors in community-dwelling older adults: Preliminary results of a cluster-randomized controlled trial. *Aging Mental Health*. 2011 Jul 1;15(5):647–53.

Yamada M, Tanaka B, Nagai K, Aoyama T, Ichihashi N. Trail-walking exercise and fall risk factors in community-dwelling older adults: preliminary results of a randomized controlled trial. *Journal of the American Geriatrics Society*. 2010 Oct;58(10):1946–51.

Contact

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The following three tables summarize the study population characteristics, study methodology, and intervention characteristics of the 15 Single Interventions focused on exercise.

Table 1. Summary Table of Studies and Study Population

Study	No. Study Participants	Mean Age	% Female	Race/Ethnicity	Socioeconomic Status (SES)	Previous Falls	Other Characteristics
Barnett 2003	163	75	67%	90% used English as primary language	Study conducted in low SES areas	42% fell in past year	27% lived alone
Campbell 1997	233	84	100%	Most were White	20% used community services	44% fell in past year	
Clemson 2012	317	83	55%	Most were white	46% education >high school (HS)	90% had fall w/ injury in past year	
Freiberger 2007	152	75	39%	100% White	33% education >HS Mean income $5,458/month	34% fell in past 6 months	
Kemmler 2010	246	69	100%	NA*	NA	Fall rate=0.39 falls/ person in 6 months before study	
Kovacs 2013	76	68	100%	100% White	58 % > 12 years education	38% fell in past year	
Li 2005	256	77	70%	90% White	92% education ≥HS 68% income <$35,000	37% fell in past 3 months	48% lived alone
Lord 2003	551	80	86%	100% White	NA	34% fell in past year	22% in assisted living housing
McKiernan 2005	113	74	60%	100% White	NA	100% fell in past year	
Rubenstein 2000	59	75	0%	95% White	63% education >HS	56% fell in past 6 months	73% married
Skelton 2005	81	73	100%	Most were White	Most were retired healthcare workers w/ at least some HS education	100% ≥3 falls in past year	Mean number of medications=4 15% used canes
Trombetti 2011	134	76	96%	100% White	79% education < HS	55% fell in past year	
Voukelatos 2007	702	69	84%	Most were White	44% education ≥HS	34% fell in past year	
Wolf 1996	200	76	81%	Most were White	77% education >HS	36% fell in past year	
Yamada 2013	264	77	67%	100% Asian	NA	34% fell in past year	

**No information available*

Table 2. Study Methodology

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Barnett 2003	Southwest Sydney, Australia	Recruited while patients in general practice clinics or attending hospital-based physical therapy clinics	Age ≥65 & >1 physical impairment associated w/ fall risk (lower limb weakness, poor balance, slow reaction time)	Cognitively impaired or had degenerative or medical conditions that precluded participating in an exercise program	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Postal surveys sent to participants each month. If not received within 2 weeks, participant was interviewed by telephone.	12 months	Fall rate	IRR[a]=0.60 (0.36–0.99)	None
			Fall w/ injury rate	IRR[a]=0.66 (0.38–1.15)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Campbell 1997	Dunedin, New Zealand	Women registered with a general practice in Dunedin were invited by general practitioner to take part	Age >80 & able to move around within their own home	Cognitively impaired or receiving physical therapy	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Participants given 12 pre-addressed & stamped monthly fall calendar postcards. If one was not received, participant was interviewed by telephone.	12 months	Fall rate	RR[b]=0.67 ($p<0.05$)	None
			First fall	HR[c]=0.81 (0.56–1.16)	
			First fall with injury	HR[c]=0.61 (0.39–0.97)	

*[a] Incidence Rate Ratio [b] Relative Rate [c] Hazard Ratio [d] Relative Risk [e] Rate Ratio per 1,000 hrs of activity * Results shown with 95% confidence intervals*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Clemson 2012	Sydney, Australia	Veterans, spouses & war widows recruited by mailings to Department of Veteran's Affairs database in Sydney & 3 general databases.	Age ≥70, ≥2 falls or one fall w/ injury in past 12 months	Moderate or severe cognitive impairment, lack of conversational English, inability to ambulate independently, neurological condition that severely impacted gait/mobility, nursing home residence, or terminal illness	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Daily calendar mailed monthly with blinded follow-up telephone calls to non-responders	12 months	Fall rate (structured vs control)	IRR[c]=0.81 (0.56–1.17)	One patient in structured exercise had groin strain; One LiFE participant had a pelvic stress fracture
			Fall rate (LiFE vs control)	IRR[c]=0.69 (0.48–0.99)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Freiberger 2007	Erlangen, Germany	Recruited from a health insurance company membership database	Age ≥70, community-dwelling, & able to walk independently	Unable to walk independently or cognitively impaired	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly fall calendars. If not returned, participant received a follow-up telephone call. If a fall occurred, the participant was interviewed by telephone.	12 months	Number of fallers	RR[d]=0.77 (0.60–0.97)	NA
			Number of multiple fallers	RR[d]=0.87 (0.75–1.01)	
			Fall rate	RR[b]=0.64 (0.38–1.06)	
			Time to first fall (fitness vs control)	337 ±9 days vs. 216 ±15 days	

*[a] Incidence Rate Ratio [b] Relative Rate [c] Hazard Ratio [d] Relative Risk [e] Rate Ratio per 1,000 hrs of activity * Results shown with 95% confidence intervals*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Kemmler 2010	Erlangen-Nuremberg, Germany	Members of Siemens Health Insurance recruited by mail between May 2005 and January 2006	Age ≥65, living independently	History of alcoholism or Cushing's syndrome, use of medications (bisphosphonate, hormone therapy, glucocorticoids & laxatives) that affect bone metabolism or fall risk, inflammatory disease, secondary osteoporosis, past participation in an exercise study, very low physical capacity, or participation in sports in past 10 years	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Fall calendars w/ monthly telephone calls for non-responders	18 months	Fall Rate	RR[d]= 0.60 (0.47–0.76)	None
			Number of fallers	RR[a]=0.54 (0.35–0.84)	
			Number of fallers w/injury	RR[a]=0.33 (0.15–0.74)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Kovacs 2013	Budapest, Hungary	Recruited by an advertisement in a local newspaper	Age ≥60, community dwelling.	Personal doctor did not recommend, neurological disease, cardiovascular disease, severe lower limb pain, or participated in an exercise program in past 6 months	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly fall diary	6 months	Number of fallers	RR[a]= 0.40(0.17–0.92)	None

*[a] Incidence Rate Ratio [b] Relative Rate [c] Hazard Ratio [d] Relative Risk [e] Rate Ratio per 1,000 hrs of activity * Results shown with 95% confidence intervals*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Li 2005	Portland, Oregon, United States	Subjects enrolled in the Legacy Health System in Portland, OR were sent letters from their physicians encouraging them to participate	Age ≥70, inactive, ambulatory, no chronic medical problems that would limit participation, had a physician's clearance to participate	Cognitively impaired, in poor health, or had difficulty w/ language or transportation	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Falls recorded daily in a fall calendar that was collected by a research assistant.	12 months	Fall rate	RR[d] = 0.35 (p<0.001)	None
			Multiple fall rate(≥2 falls)	RR[d] = 0.45 (0.30–0.70)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Lord 2003	Sydney & Wollongong, Australia	Residents of self-care & intermediate-care retirement villages that attended information sessions & then were approached individually	Age ≥62	Cognitively impaired, had a medical condition that prevented participation in an exercise program, or already attended exercise classes of equivalent intensity	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Completed monthly questionnaires. If not received within a week after end of the month, received a home visit or telephone call. Nursing staff at each intermediate-care site also kept a falls record book.	12 months	Fall rate	RR[d]=0.78 (0.62–0.99)	None
			Fall rate for participants w/ no falls at baseline	RR[d]=0.88 (0.65–1.20)	
			Fall rate for participants w/ falls at baseline	RR[d]=0.69 (0.48–0.99)	

*[a] Incidence Rate Ratio [b] Relative Rate [c] Hazard Ratio [d] Relative Risk [e]Rate Ratio per 1,000 hrs of activity * Results shown with 95% confidence intervals*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
McKiernan 2005	Rural Central & Northern Wisconsin, United States	Recruited using a database of people who had fallen in the past year & been treated in a clinic or ED, one direct mailing, or an announcement in local print media	Age ≥65, community-dwelling, fell in past year, ambulatory w/o a walking aid, capable of putting on Yaktrax® Walker & using it appropriately, able & willing to maintain a fall diary	Incapable of walking w/o a walking aid or unable to use Yaktrax® Walker correctly	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Participants kept a fall diary that they submitted at the end of the study.	10,724 observation-days	Outdoor slip	RR=0.50 (0.26–0.96)	None
			Outdoor fall	RR=0.45 (0.23–0.85)	
			Outdoor fall on day walked on snow or ice	RR=0.42 (0.26–0.92)	
			Outdoor injurious fall	RR=0.10 (0.02–0.53)	
			Outdoor injurious fall on day walked on snow or ice	RR=0.13 (0.03–0.66)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Rubenstein 2000	Los Angeles, California, United States	Male patients at VA Ambulatory Care Center recruited through flyers & telephone screening	Age >70, ambulatory, had at least 1 of 4 risk factors (lower extremity weakness, impaired gait, impaired balance, or >1 fall in past 6 months)	Exercised regularly, cardiac or pulmonary disease, dementia, terminal illness, severe joint pain, unresponsive, depression, or progressive neurologic disease	No
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Questioned about falls & injuries every 2 weeks by phone or in-person	12 weeks (at end of intervention)	Activity-adjusted fall rate	RR[e]=0.37 (p=0.027)	None

*[a] Incidence Rate Ratio [b] Relative Rate [c] Hazard Ratio [d] Relative Risk [e] Rate Ratio per 1,000 hrs of activity * Results shown with 95% confidence intervals*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Skelton 2005	London, United Kingdom	Posters, local & national newspapers, local radio stations	Female, age ≥65, ≥3 falls in past year	Acute rheumatoid arthritis, uncontrolled heart failure or hypertension, significant cognitive impairment, significant neurological disease or impairment, or previously diagnosed osteoporosis	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Falls diaries were returned every 2 weeks by mail. Every fall was followed up by telephone to determine the circumstances & outcome.	20 months	Fall rate	IRR[c]=0.66 (0.49–0.90)	None
			Fall w/injury rate	IRR[c]=0.60 (0.33–1.07)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Trombetti 2011	Geneva, Switzerland	Recruited from the local community through multiple strategies including advertisements in local newspapers	Age ≥65, community dwelling, no experience w/ Jaques-Dalcroze eurhythmics except during childhood, increased risk of falling (≥1 falls, balance impairment defined as a score >2 on Tinetti test, or physical frailty)	Neurological disease associated w/ motor deficit or orthopedic disease that significantly affects gait/ balance, a medical condition such as terminal illness, or fully dependent on assistive device	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Fall diary mailed monthly to study coordinator. Follow-up phone calls were made to non-responders	12 months	Risk for >1 fall	RR[d]=0.61 (0.39–0.96)	None
			Risk for ≥ 2 falls	RR[d]=0.19 (0.06–0.63)	
			Fall rate	IRR[a]=0.46 (0.27–0.79)	
			Time to first fall	HR[c]=0.53 (0.30–0.94)	

*[a] Incidence Rate Ratio [b] Relative Rate [c] Hazard Ratio [d] Relative Risk [e]Rate Ratio per 1,000 hrs of activity * Results shown with 95% confidence intervals*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Voukelatos 2007	Sydney, Australia	Recruited through advertisements in local community newspapers	Age >60, had not practiced Tai Chi in past 12 months	Degenerative neurological condition, dementia, severely debilitating stroke, severe arthritis, marked vision impairment, or unable to walk across a room unaided	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Participants recorded falls daily & mailed calendars to study coordinator monthly. If not received within 2 weeks after the end of the month, the participant was contacted by telephone.	24 weeks	Number of falls		An instructor tried to help a participant into a movement & the participant twisted a ligament.
			After 16 weeks follow-up	IRR[a]=0.73 (0.50–1.07)	
			After 24 weeks follow-up	IRR[a]=0.67 (0.47–0.94)	
			Participants w/ ≥2 falls after 24 weeks follow-up	RR[d]=0.54 (0.28–0.96)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Yamada 2013	Kyoto, Japan	Recruited by an advertisement in a local newspaper	Aged≥65, community dwelling , no severe cognitive impairment (Rapid Dementia Screening Test score <5), certified for long-term care insurance service, able to walk independently, willing to participate, no significant hearing or vision loss, access to transportation, & had not exercised in the past 12 months	Serious visual impairment, severe cardiac, pulmonary, or musculoskeletal disorder, Parkinson's disease, history of stroke, or current use of psychotropic drugs.	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly fall diary w/ telephone follow-up if needed	12 months after the end of the intervention	Fall rate	IRR[a]= 0.35(0.19–0.66)	None

*[a] Incidence Rate Ratio [b] Relative Rate [c] Hazard Ratio [d] Relative Risk [e]Rate Ratio per 1,000 hrs of activity * Results shown with 95% confidence intervals*

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Wolf 1996	Atlanta, Georgia, United States	Community seniors & residents of an independent living facility, recruited through advertisements & direct contact	Age ≥70, ambulatory, willing to participate weekly for 15 week program & at 4-month follow-up	Severe cognitive impairment or debilitating condition such as metastatic cancer, Parkinson's disease, stroke, or profound visual deficits	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly calendar or monthly phone calls from staff.	7–20 months	Fall risk	RR[d]=0.53 (0.32–0.86)	None
			≥1 falls w/ injury	RR[d]=0.81 (0.33–2.02)	

*[a] Incidence Rate Ratio [b] Relative Rate [c] Hazard Ratio [d] Relative Risk [e] Rate Ratio per 1,000 hrs of activity * Results shown with 95% confidence intervals*

Table 3. Intervention Characteristics

Study	Focus	Providers	Structure	Number of Sessions	Provider Contact Time
Barnett 2003	Exercise program to improve balance, coordination, strength, reaction time, & aerobic capacity	Accredited exercise instructors trained to provide intervention	Group exercise classes	37 weekly 1-hour classes	Classes: 37 hours
Campbell 1997	Improve strength & balance w/ simple home-based exercise program	Physical therapist or nurse	One-on-one exercise training at home	½ hour exercise program 3 times a week ½ hour walking 3 times a week	4 home visits: 1-hour each
Clemson 2012	Integrate balance & strength training into personal lifestyle	Physical therapist or occupational therapist	One-on-one	5 regular sessions, 2 booster sessions & 2 follow-up phone calls	Initial visit: 90 minutes 5–7 follow-up visits: 40–60 minutes each
Freiberger 2007	Improve functional skills, strength, endurance, & flexibility	Specially trained instructors w/ a background in sport science & experience working w/ older adults	Group classes w/ individual practice at home	1-hour class 2 times a week for 16 weeks	Classes: 32 hours
Kemmler 2010	High intensity exercise	Certified trainers	Group exercise w/ individual practice at home	1-hour class 2 times a week for 78 weeks 20-minute home training sessions 2 times a week for 78 weeks	Classes: 156 hours
Li 2005	Improve balance & physical performance	Experienced Tai Chi instructors who followed the classical Yang style	Group exercise classes	1-hour class 3 times a week for 26 weeks	Classes: 78 hours
Kovacs 2013	Improve balance, decrease risk of falls, & improve quality of life.	A physical therapist	Group exercise	1-hour class 2 times a week for 25 weeks	Classes: 50 hours
Lord 2003	Increase strength, coordination, balance & gait, & improve activities of daily life	Trained exercise instructors certified in leading programs for older adults	Group exercise classes	1-hour class 2 times a week for 12 months (4 3-month terms)	Classes: 96 hours
McKiernan 2005	Using a traction device that fits on shoes to improve stability when walking on ice & snow	Research coordinator	Participants used the device on their own	1 introductory session	Introductory session: ½ hour

Table 3. Intervention Characteristics, Continued

Study	Focus	Providers	Structure	Number of Sessions	Provider Contact Time
Rubenstein 2000	Increase strength & endurance, improve mobility & balance	Exercise physiology graduate student w/ on-the-job training or experienced physical therapist	Group exercise classes	1½-hour class 3 times a week for 12 weeks	Classes: 54 hours
Skelton 2005	Improve balance & strength	Postural Stability Instructors	Group exercise classes & home-based exercises	1 pre-exercise assessment 36 weekly 1-hour group exercise classes A 30-minute exercise session 2 times a week for 36 weeks	Pre-exercise assessment: 40 minutes Classes: 36 hours
Trombetti 2011	Multitask training for gait & balance improvements as well as fall reduction	Experienced exercise instructors	Group exercise	24 weekly 1-hour classes	Classes: 24 hours
Voukelatos 2007	Improve balance & reduce falls	Community-based Tai Chi instructors	Group exercise classes	16 weekly 1-hour classes	Classes: 16 hours
Wolf 1996	Improve strength, balance, walking speed, & physical functioning	Tai Chi master	Group classes w/ individual practice at home	25-minute group classes 2 times a week for 15 weeks 15-minute practice at home 2 times a week	Classes: 12 hours
Yamada 2013	Improve stepping performance, gait, balance, & control of foot movements	A physical therapist & exercise instructor	One-on-one	5–7 minute sessions twice a week for 24 weeks	Classes: 4 hours

Home Modification

The VIP Trial
Campbell, et al. (2005)

This study looked at the effectiveness of two interventions to reduce falls and fall injuries in older people with poor vision. The home safety program consisted of a home hazard assessment by an occupational therapist (OT) followed by home modifications and recommendations for behavior change. The home exercise program consisted of a combination of strength and balance exercises (the Otago Exercise Program modified for people with poor vision) plus vitamin D supplements.

Only the home safety program was effective in reducing falls. The home safety group had 61 percent fewer falls and 44 percent fewer injuries compared to those who received social visits.

Population: Participants were community-dwelling seniors aged 75 or older with poor vision. Two-thirds of the participants were female.

Geographic Locale: Dunedin and Auckland, New Zealand

Focus: Assess and reduce home hazards and encourage changes in behavior.

Program Setting: The program took place in participants' homes.

Content: An OT conducted a home safety assessment and made suggestions for modifications. The assessment consisted of a walk-through of the participant's home using a checklist to identify hazards. It included a discussion about items, behavior, or lack of equipment that could lead to falls. The OT and participant then agreed on which recommendations to implement.

The OT helped the participant obtain any necessary equipment and oversaw payment for the home modifications. Home modifications and equipment costing more than NZ$200 were funded by the local Board of Health and items costing less were funded by the participant or from research funds. The OT made a follow-up visit if equipment needed to be installed.

Duration: The intervention consisted of one or two home visits. The first visit lasted about two hours. If the OT needed to approve new equipment, she made a second visit two to three weeks later. The second visit lasted about 45 minutes.

Delivered by: OTs who attended a two-day training course.

Minimum Level of Training Needed: One half-day training is necessary for OTs to become familiar with the specific focus on falls prevention among people with poor vision.

Key Elements:

- The OT's advice rather than the environmental changes was key.
- A trained and experienced OT is critical to the success of this intervention.

Available Materials: The *Westmead Home Safety Assessment* checklist is available but not the modified version used in the VIP trial.

Clemson L. *Home fall hazards: A guide to identifying fall hazards in the homes of elderly people and an accompaniment to the assessment tool, the Westmead Home Safety Assessment (WeHSA)*. West Brunswick, Victoria: Co-ordinates Publications, 1997.

Study Citation: Campbell AJ, Robertson MC, La Grow SJ, Kerse NM, Sanderson GF, Jacobs RJ. Randomised controlled trial of prevention of falls in people aged ≥75 with severe visual impairment: The VIP trial. *British Medical Journal*. 2005 Oct 8;331(7520):817–25.

Supplemental Article

La Grow SJ, Robertson MC, Campbell AJ, Clarke GA, Kerse NM. Reducing hazard related falls in people 75 years and older with significant visual impairment: How did a successful program work? *Injury Prevention*. 2006 Oct;12(5):296–301.

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Home Visits by an Occupational Therapist
Cumming, et al. (1999)

This study used an occupational therapist (OT) who visited participants in their homes, identified environmental hazards and unsafe behaviors, and recommended home modifications and behavior changes.

Fall rates were reduced by one-third but only among men and women who had experienced one or more falls in the year before the study.

Population: All participants were 65 or older and lived in the community. More than half of the participants were female.

Geographic Locale: Sydney, Australia

Focus: Assess and reduce home hazards.

Program Setting: The program was conducted in participants' homes.

Content: The OT visited each participant's home and conducted an assessment using the standardized Westmead Home Safety Assessment form (see Available Materials below). The OT identified environmental hazards such as slippery floors, poor lighting, and rugs with curled edges, and discussed with the participant how to correct these hazards.

Based on standard occupational therapy principles, the OT also assessed each participant's abilities and behaviors, and how each functioned in his or her home environment. Specific unsafe behaviors were identified such as wearing loose shoes, leaving clutter in high-traffic areas, and using furniture to reach high places. The OT discussed with each participant ways to avoid these unsafe behaviors.

Two weeks after the initial home visit the OT telephoned each participant to ask whether they had made the modifications and to encourage them to adopt the recommended behavioral changes.

Duration: One-hour home visit with a follow-up telephone call two weeks later. Total contact time was approximately two hours.

Delivered by: An OT with two years of experience.

Minimum Level of Training Needed: A degree in occupational therapy is the minimum qualification needed to conduct the home assessments, develop the recommendations, and supervise the home modifications.

Key Elements:

- Using an experienced OT is critical.
- These researchers emphasized that this study should not be used to justify widespread, untargeted home modification programs implemented by people who do not have skills in caring for older people.

Available Materials: Information on the falls prevention kit, which includes the Westmead Home Safety Assessment form and a booklet that gives background information on falls and hazards can be purchased from the following company:

Co-ordinates Therapy Services
PO Box 59, West Brunswick
Victoria 3055, Australia

Tel: +61 (3) 9380 1127
Fax: +61 (3) 8080 5996
E-mail: jenny@therapybookshop.com

Study Citation: Cumming RG, Thomas M, Szonyi M, Salkeld G, O'Neill E, Westburg C, Frampton G. Home visits by an occupational therapist for assessment and modification of environmental hazards: A randomized trial of falls prevention. *Journal of the American Geriatrics Society.* 1999 Dec;47(12):1397–1402.

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Falls-HIT (Home Intervention Team) Program
Nikolaus, et al. (2003)

This study provided home visits to identify environmental hazards that can increase the risk of falling, provided advice about possible changes, offered assistance with home modifications, and provided training in using safety devices and mobility aids.

The fall rate for participants was reduced 31 percent. The intervention was most effective among those who had experienced two or more falls in the past year; the fall rate for these participants was reduced 37 percent.

Population: Participants were frail community-dwelling older adults who had been hospitalized for conditions unrelated to a fall and discharged to home. Participants showed functional decline, especially in mobility. All were 65 or older and lived in the community. Three-quarters were female.

Geographic Locale: Mid-sized town, Southern Germany

Focus: Assess and reduce fall hazards in participants' homes.

Program Setting: Intervention team members contacted patients once or twice while they were hospitalized to explain the program. The program took place in participants' homes.

Content: The first home visit was conducted while the participant was still hospitalized. Two team members, an occupational therapist (OT) with either a nurse or a physical therapist (PT), depending on patient's anticipated needs, conducted a home assessment. They identified home hazards using a standardized home safety checklist and determined what safety equipment a participant needed.

During two to three subsequent home visits, an OT or nurse met with the participant to:

- Discuss home hazards
- Recommend home modifications
- Facilitate necessary modifications
- Teach participants how to use safety devices and mobility aids when necessary

Duration: The program consisted of two or more home visits, each lasting about 1½ hours. After the participant was discharged from the hospital, three home visits typically were needed to provide advice on recommended home modifications and to teach the participant how to use safety devices and mobility aids. On average, the total individual contact time was eight hours.

Delivered by: The home intervention team was composed of a PT, OT, three nurses, a social worker, and a secretary. OTs generally worked with all participants. Depending on individual need, either a PT or nurse also helped the participant. The social worker was available to provide information about ambulatory services and to help participants complete applications for additional money from the mandatory care insurance.

Minimum Level of Training Needed: Information was not provided by the principal investigator.

Key Elements: Participants met all intervention team members at the hospital before they were discharged, which facilitated follow-up.

Available Materials: A standardized home safety checklist is available in German only.

Study Citation: Nikolaus T, Bach M. Preventing falls in community-dwelling frail older people using a home intervention team (HIT): Results from the randomized falls-HIT trial. *Journal of the American Geriatrics Society*. 2003 Mar;51(3):300–5.

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Home Assessment and Modification

Pighills, et al. (2011)

This study examined the effectiveness of home assessment and modification to reduce falls. The intervention was delivered in the participants' homes by either an occupational therapist (OT) or by a home care worker (HCW). After identifying potential home hazards and risky behaviors, the OT or HCW discussed their findings with the participant. Together they agreed on specific home modifications and behavior changes.

The intervention was only effective when it was implemented by OTs. Fall rates were reduced 46 percent among those who received home assessments by OTs.

Population: Participants were community-dwelling adults aged 70 or older who had fallen in the past year. About two-thirds of participants were female.

Geographic Location: Yorkshire, England.

Focus: Assess and reduce home hazards and unsafe behaviors that increased fall risk.

Program Setting: The intervention occurred in participants' homes.

Content: An OT visited each participant's home and conducted an assessment using the Westmead Home Safety Assessment (WeHSA) as a guide. The WeHSA identifies 72 categories of hazards and provides a comprehensive list of items and behaviors that the OT should identify. During the visit, the OT observed the participant performing daily activities in the home and identified behaviors that could increase fall risk.

The OT and participant discussed the identified hazards and behaviors and worked together to generate mutually acceptable solutions. The OT provided a written summary of the agreed upon recommendations to the participant and made referrals for equipment if needed.

The OT called the participant after four weeks to determine if he or she was following the recommendations.

Duration: Each home assessment lasted 1½–2 hours.

Delivered by: OTs who attended a half day training course. The course trainer, an OT with 19 years of experience, used the WeHSA to assess a video of a sample patient carrying out activities in their own home. The OTs were instructed to use the principles outlined in the WeHSA to evaluate the safety of the person in their home, shown in the video, and to suggest modifications.

The professional experience of the OTs ranged from less than a year to more than 20 years.

Minimum Level of Training Needed: A degree in occupational therapy.

Key Elements:

- Conduct a functional assessment. The OT should observe the older adult perform tasks in their home.
- Acknowledge the older adult's capacity to act independently and to make his or her own choices.
- Determine modifications and changes jointly with the older adult.

Available Materials: Clemson L. *Home fall hazards: A guide to identifying fall hazards in the homes of elderly people and an accompaniment to the assessment tool, the Westmead Home Safety Assessment (WeHSA).* West Brunswick, Victoria: Co-ordinates Publications, 1997.

Study Citation: Pighills AC, Torgerson DJ, Sheldon TA, Drummond AE, Bland JM. Environmental assessment and modification to prevent falls in older people. *Journal of the American Geriatrics Society*. 2011;59(1):26–33.

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The following three tables summarize the study population characteristics, study methodology, and intervention characteristics for the four single focused interventions highlighting home modification

Table 1. Summary Table of Studies and Study Population

Study	No. Study Participants	Mean Age	% Female	Race/Ethnicity	Socioeconomic Status (SES)	Previous Falls	Other Characteristics
Campbell 2005	391	84	68%	99% European 0.3% Maori 0.5% Other	NA*	45% fell in past year	53% lived alone 10% received home health (personal care) services 84% age-related macular degeneration 43% cataract 3% diabetic retinopathy 15% glaucoma
Cumming 1999	530	77	57%	100% White	NA	31% fell in past year	37% used a walking aid
Nikolaus 2003	360	82	73%	98% White	NA	30% ≥2 falls in past year	All showed functional decline, especially in mobility
Pighills 2011	238	79	67%	100% White	NA	100% ≥2 falls in past year	

**No information available*

Table 2. Study Methodology

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Campbell 2005	Dunedin and Auckland, New Zealand	Participants identified from Royal New Zealand Foundation of the Blind, university and& hospital low vision clinics, & ophthalmology practices	Age >75, poor vision (visual acuity 6/24 or worse)	Unable to walk around own home, currently receiving physical therapy, or unable to understand study requirements	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Pre-paid, addressed, tear-off monthly postcard calendars. Independent assessors called participants to record circumstances of falls & any resulting injuries.	12 months	Fall rate	IRR[a] = 0.39 (0.24–0.62)	None
			Fall w/ injury rate	IRR[a] = 0.56 (0.36–0.87)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Cumming 1999	Sydney, Australia	Recruited while a hospital patient or among people attending outpatient clinics or a local senior center	Age ≥ 65 & ambulatory	Cognitively impaired & not living w/ someone who could give informed consent & report falls, or planned to have a home assessment by an occupational therapist	No
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly falls calendar were completed daily & returned by mail each month. If not received w/in 10 days, participant was contacted by telephone.	12 months	Fall rate for participants w/ no falls at baseline	RR[b] = 1.03 (0.75–1.41)	None
			Fall rate for participants w/ falls at baseline	RR[b] = 0.64 (0.50–0.83)	

[a] *Incidence Rate Ratio* [b] *Relative Rate* [c] *Hazard Ratio* [d] *Relative Risk*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Nikolaus 2003	Mid-sized town, Southern Germany	Recruited while inpatients at a geriatric clinic	Lived at home before hospital admission, had multiple chronic conditions or functional deterioration, & was discharged to home	Severe cognitive impairment, terminal illness, or lived >15 km away	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Participants kept a falls diary & also were contacted monthly by phone.	12 months	Fall rate	IRR = 0.69 (0.51–0.97)	None
			Fall rate for participants w/ ≤1 fall at baseline	IRR = 0.91 (0.72–1.22)	
			Fall rate for participants w/ ≥2 falls at baseline	IRR = 0.63 (0.43–0.94)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Pighills 2011	Yorkshire, England	Residents of the catchment area of Airdale National Health Service Trust, recruited by mail	Age ≥70, community dwelling, had experienced ≥1 falls in the past year	Living in a nursing home or residential clinic, currently receiving occupational therapy, or hx of falls-specific OT in the past year	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly fall calendars, blinded telephone calls for non-responders	12 months	Fall rate (OT group v control)	IRR=0.54 (0.36–0.83)	None
			Fall rate (Trained assessor v control)	IRR=0.78 (0.51–1.21)	

[a] *Incidence Rate Ratio* [b] *Relative Rate* [c] *Hazard Ratio* [d] *Relative Risk*

Table 3. Intervention Characteristics

Study	Focus	Providers	Structure	Number of Sessions	Provider Contact Time
Campbell 2005	Assess & reduce home hazards & encourage changes in behavior	Occupational therapist	One-on-one	1–2 home visits	Initial home visit: 2 hours Follow-up visit: 45 minutes
Cumming 1999	Assess & reduce home hazards	Occupational therapist	One-on-one	1-hour home assessment & follow-up telephone call	Total about 2 hours
Nikolaus 2003	Assess & reduce home hazards	Home intervention team incl. 3 nurses, a PT, an OT, & a social worker	Home visits	>2 (usually 3-4) home visits of about 1½ hours each	Home visits: 8 hours on average
Pighills 2011	Assess & reduce home hazards.	Occupational therapists	One-on-one	1 home visit & 1 follow-up telephone call	Total: 2–2 ½ hours

Clinical

Three-Year Study of Vitamin D (Cholecalciferol) Plus Calcium

Bischoff-Ferrari, et al. (2006)

This study evaluated the effectiveness of a three-year vitamin D (cholecalciferol) and calcium supplementation program in reducing falls among older adults. Although the study included both men and women, the intervention was only effective among women. After three years, women in the intervention group were 46 percent less likely to fall once compared to women who did not participate in the program.

Population: Participants were community-dwelling adults aged 65 or older.

Geographic Location: Boston, Massachusetts

Focus: Investigate the effectiveness of long term vitamin D and calcium supplementation on falls.

Program Setting: A study center at a research institution.

Content: Research staff met with participants at the beginning of the study to perform an initial assessment. They collected medical history, height and weight, blood samples, and information on nutrition, physical activity, tobacco use, and alcohol use. Participants were given a six-month supply of 700 IU vitamin D and 500 mg calcium supplements and told to take these once a day at bedtime. Participants visited the study center every six months to repeat the assessment and to receive additional supplements.

Duration: Participants visited the study center once every six months; a visit lasted 2–3½ hours. They took vitamin D and calcium supplements daily for three years.

Delivered by: A research manager and research assistants delivered the intervention. A physician developed the intervention, trained the research coordinators, and provided technical assistance.

Minimum Level of Training Needed: This intervention could be delivered by a nurse's aide or other allied health professional within a clinical setting.

Key Elements: A dose of 700 IU taken orally every day. Adhering to the supplementation schedule is critical.

Available Materials: No intervention materials were available at the time of publication.

Study Citation: Bischoff-Ferrari HA, Orav EJ, Dawson-Hughes B. Effect of cholecalciferol plus calcium on falling in ambulatory older men and women: a 3-year randomized controlled trial. *Archives of Internal Medicine*. 2006 Feb 27;166(4):424–30.

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Psychotropic Medication Withdrawal
Campbell, et al. (1999)

This study tested the effectiveness of psychotropic medication withdrawal and/or a home-based exercise program in reducing falls among older adults. Only the medication withdrawal was effective in reducing falls. Participants who had their psychotropic medications withdrawn were 64 percent less likely to fall compared with the comparison group.

Population: Participants were community-dwelling adults aged 65 or older who were currently taking a psychotropic medication (defined as a benzodiazepine or other hypnotic drug, antidepressant, or major tranquilizer) and whose general practitioner thought they might benefit from psychotropic medication withdrawal.

Geographic Location: Dunedin, New Zealand

Focus: Reduce psychotropic medication use among older adults.

Program Setting: Initial assessments were performed at home and in a research clinic. The trial medications were provided to participants in their homes.

Content: General practitioners (GP) identified patients they thought could benefit from discontinuing psychotropic medications. These were defined as benzodiazepines, other hypnotic drugs, antidepressants, and major tranquilizers. The research trial GP completed a physical examination and provided a basic overview of the study. A research nurse collected baseline data on patients' current medication and falls history.

A pharmacist reformulated each psychotropic medication into capsules to prevent both participants and researchers from knowing who was receiving the withdrawal intervention. The control participants received their own medication at the original dose throughout the trial. For participants randomized to the withdrawal group, all psychotropic medications were reduced gradually over 14 weeks by diluting active ingredients with an inert substance on the following schedule:

- Start of study: 100 percent active medication
- At 2 weeks: 80 percent active medication
- At 4 weeks: 60 percent active medication
- At 8 weeks: 40 percent active medication
- At 11 weeks: 20 percent active medication
- From 14 weeks until the end of the trial, capsules contained no active medication

To implement this intervention in a community setting, physicians would prescribe a gradual reduction in dose and/or frequency over time to help their patients withdraw successfully.

Although this study did not include a counselling component, the authors noted that a psychologist should be involved to help participants adjust to issues such as changing sleep patterns.

Duration: The GP conducted the initial assessment at a clinic visit. A research nurse took half an hour to conduct an initial assessment at the participant's home. Medication was tapered off gradually over 14 weeks.

Delivered by: A GP explained the interventions. A nurse assessed fall history and current medication use. A pharmacist reformulated the medications.

Minimum Level of Training Needed: A physician with knowledge about medications that increase falls risk.

Key Elements: Gradually withdrawing rather than suddenly stopping psychotropic medications.

Available Materials: The 2012 AGS Beers Criteria for Potentially Inappropriate Medication Use in Older Adults is available at http://www.americangeriatrics.org/files/documents/beers/2012AGSBeersCriteriaCitations.pdf.

Study Citation: Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Psychotropic medication withdrawal and a home-based exercise program to prevent falls: A randomized controlled trial. *Journal of the American Geriatrics Society.* 1999 Jul;47(7):850–3.

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Active Vitamin D (Calcitriol) as a Falls Intervention

Gallagher, et al. (2007)

This study evaluated the effectiveness of three different supplementation interventions at reducing falls. Participants were assigned to hormone therapy, hormone therapy and active vitamin D supplementation (0.25 µg [micrograms] calcitriol twice daily), or active vitamin D supplementation alone. Only the active vitamin D supplementation group experienced a reduced rate of falls. After three years, women who took active vitamin D supplements experienced 38 percent fewer falls than women who did not.

Population: Participants were community-dwelling women. The average age of participants was 72 at the start of the intervention.

Geographic Location: Omaha, Nebraska

Focus: Investigate the effectiveness of long term active vitamin D supplementation on falls.

Program Setting: A study center at a research institution.

Content: Research coordinators met with participants at the beginning of the study to perform an initial assessment. They conducted a physical examination and collected medical history and information on nutrition. Participants were given a six-month supply of 0.25 µg calcitriol and were instructed to take them twice daily. Participants visited the study center at six and twelve weeks and then every six months for follow-up assessments and to receive additional supplements.

Duration: Participants visited the study center once every six months; a visit lasted 45–60 minutes. Participants took active vitamin D supplements twice daily for three years.

Delivered by: All research coordinators were trained by a physician and had a college degree (bachelors). An endocrinologist oversaw the intervention. A physician wrote a prescription of calcitriol for each participant.

Minimum Level of Training Needed: Allied health professionals, with the supervision of a physician could conduct the assessments and provide information about vitamin D supplementation. A physician would be needed to prescribe calcitriol and to monitor any side effects.

Key Elements: Information was not provided by the principal investigator.

Available Materials: No intervention materials were available at the time of publication.

Study Citation: Gallagher JC, Fowler S, Sherman SS. Combination treatment with estrogen and calcitriol in the prevention of Age-Related Bone Loss. *Journal of Clinical Endocrinology and Metabolism* 86:3618–3628, 2001.

Supplemental Articles

Gallagher JC, Rapuri PB, Smith LM. An age related decrease in creatinine clearance is associated with an increase in number of falls in untreated women but not in women receiving calcitriol treatment. *Journal of Clinical Endocrinology and Metabolism*. 2007 Jan 92:51–58, 2007.

Gallagher JC, Rapuri P, Smith L. Falls are associated with decreased renal function and insufficient calcitriol production by the kidney. *Journal of Steroid Biochemistry and Molecular Biology*. 2007 Mar;103(3–5):610–3.

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VISIBLE (Visual Intervention Strategy Incorporating Bifocal and Long-distance Eyewear) Study

Haran, et al. (2010)

This study tested the effectiveness of an optometry intervention that provided older adults who normally used multifocal lenses with single lens distance glasses to wear outdoors. Although falls were not reduced among participants overall, falls were decreased 40 percent among participants who regularly took part in outdoor activities. Outdoor falls increased among participants who did not regularly engage in outdoor activities.

Population: Participants were high risk community-dwelling adults aged 65 or older. Participants were considered high risk if they had fallen in the previous 12 months, scored ≥15 seconds on the Timed Up and Go test, or were aged 80 or older. About 65 percent were female.

Geographic Location: Sydney and Illawarra, Australia

Focus: Increase use of single lens distance glasses for outdoor activities among older adults who normally wear multifocal glasses

Program Setting: An optometrist's office

Content:
During an initial visit an optometrist:

- Performed a standard visual assessment
- Recorded participant's current type of glasses
- Updated the current multifocal prescription as needed
- Prescribed single lens distance glasses
- Encouraged use of transition or tinted distance lenses

At the second visit, approximately one-month later, the optometrist:

- Dispensed and fitted new glasses
- Demonstrated how multifocal glasses can cause falls by distorting depth perception and limiting the ability to see obstacles. The optometrist:
  - Had participants look at images through the upper and lower portion of their multifocal lenses and through single distance lenses (depth perception and visual contrast tests)
  - Showed photographs of street scenes and steps with and without simulated blurred lower field to reinforce how multifocal glasses may increase fall risk

- Advised using single lens glasses for most walking and standing activities, in particular:
  - Walking up or down outdoor stairs
  - Walking outside, in shopping centers, and in unfamiliar buildings (e.g., other people's homes)
  - Exiting public transport or personal vehicles
- Discouraged single lens distance glasses for:
  - activities inside their own home,
  - seated tasks,
  - driving, and
  - low risk tasks that require changes in depth of focus while standing or walking (e.g., cooking and shopping at the supermarket)
- Provided a reminder card and instruction booklet

Duration: The initial visit lasted 15–20 minutes and the second visit was about 30 minutes. Participants were encouraged to wear their single lens glasses while outdoors for the duration of the intervention.

Delivered by: An optometrist conducted all initial study visits and the majority of second visits. If this optometrist was unavailable, an alternative optometrist, research assistant, or study investigator conducted the education and counselling component of the second visit.

Minimum Level of Training Needed:
An optometrist is needed to prescribe distance glasses to eligible candidates. Either an optometrist or optical technician could fit the glasses. An optical technician with 1-hour of additional training could perform the activities carried out during the second visit. Counselling and education could be delivered by an optometrist or optical technician, or, with additional training, by a person with allied health, nursing, or a medical background.

Key Elements:

- Applying this intervention only to people who leave their homes daily.
- Educating and counselling participants about the importance of using single lens glasses to prevent falls outdoors.
- Using the streetscape photographs to reinforce how multifocal lenses affect depth perception and perceived contrast.
- Providing wallet cards and pamphlets as memory aids for some participants.

Available Materials: Pictures of the depth perception and visual contrast tests, the photographs of street and step scenes, and the contents of the wallet card are located in Appendix C-5

Study Citation: Haran MJ, Cameron ID, Ivers RQ, Simpson JM, Lee BB, Tanzer M, et al. Effect on falls of providing single lens distance vision glasses to multifocal glasses wearers: VISIBLE randomised controlled trial. *British Medical Journal (Clinical research ed).* 2010;340:c2265.

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Vitamin D to Prevent Falls After Hip Fracture

Harwood, et al. (2004)

This study evaluated the effectiveness of vitamin D supplementation with or without calcium in reducing falls among older women who had sustained a hip fracture. Participants received either a single injection of D2 (300,000 IU), a single injection of D2 (300,000 IU) with daily oral calcium supplementation (1000 mg), or a daily oral dose of D3 (800 IU) with calcium (1000 mg). After 1 year, participants who received the intervention were 52 percent less likely to fall compared to those who received no supplementation. Not enough women participated to detect differences in effectiveness by the type of vitamin D received.

Population: Participants were community-dwelling women aged 65 or older who underwent surgery for a hip fracture.

Geographic Location: Nottingham, United Kingdom

Focus: Investigate the effects of different vitamin and calcium supplementation regimens on bone mineral density, serum vitamin D, serum parathyroid hormone, and on rate of falls among older women who have fractured their hip.

Program Setting: A geriatric rehabilitation ward.

Content: A research nurse met with participants within seven days of surgery for a hip fracture to assess bone mineral density and to collect medical history, height and weight, blood, and information on nutrition, physical activity, tobacco use, and alcohol use. The nurse provided participants with either a single injection of D2 (300,000 IU) and no calcium, a single injection of D2 (300,000 IU) plus a month's prescription of oral calcium (500 mg tablets to take twice daily) or with a month's prescription of combined oral 800 IU vitamin D and 1000 mg calcium.

The research team contacted the participant's general practitioner to inform them of the plan of care, and request that they prescribe the study dose of oral supplements and avoid prescribing additional vitamin D or other osteoporosis drugs during the intervention. The participant's general practitioner prescribed one to three month supplies of oral supplements at a time. Patients took their own tablets, or were supervised by family members or home care workers to do so. Participants visited the study center at 3, 6, and 12 months post hip surgery to report falls.

Duration: The initial visit lasted an hour. Follow-up visits occurred at 3, 6, and 12 months and lasted 15 minutes. Participants who received oral supplements took them daily for a year.

Delivered by: A research nurse and general practitioner.

Minimum Level of Training Needed: Information was not provided by the principal investigator.

Key Elements:

- Vitamin D supplementation after hip fracture improves bone mineral density one year later and reduces falls incidence.
- Oral calcium supplementation is required as well as vitamin D.
- Three hundred thousdand IU vitamin D2 does not give adequate supplementation for a whole year.

Available Materials: No intervention materials were available at the time of publication.

Study Citation: Harwood RH, Sahota O, Gaynor K, Masud T, Hosking DJ; Nottingham Neck of Femur (NONOF) Study. A randomised, controlled comparison of different calcium and vitamin D supplementation regimens in elderly women after hip fracture: The Nottingham Neck of Femur (NONOF) Study. *Age and Ageing*. 2004;33(1):45–51.

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Cataract Surgery
Harwood, et al. (2006)

This study evaluated the effectiveness of first eye cataract surgery in reducing falls compared with a control group who were awaiting surgery. After 12 months, participants in the intervention group had experienced 34 percent fewer falls than those who did not have cataract surgery.

Population: Participants were women aged 70 or older with cataract who had no prior eye surgery.

Geographic Location: Nottingham, United Kingdom

Focus: Determine if first cataract surgery reduces falls.

Program Setting: This intervention was conducted in either an ophthalmologist's office or an optometrist-led cataract clinic.

Content: An optometrist assessed patients for cataracts during routine visits and if eligible, referred them to the study. An initial assessment was conducted one to two weeks later. During the assessment, an ophthalmic research nurse collected the participant's medical (e.g., history of falls, depression) and ophthalmic (i.e., use of glasses, eye problems) history and conducted a full eye exam.

An ophthalmologist performed the cataract surgery by phacoemulsification and implanted a silicon intraocular lens within three weeks after the initial assessment. Ninety-nine percent of women had local anesthetic and the surgery lasted 15–30 minutes. The ophthalmologist reassessed the participant's vision four weeks after surgery.

Duration: The initial assessment took 60 minutes. The cataract surgery lasted 15–30 minutes.

Delivered by: An ophthalmic research nurse conducted the initial assessment and vision tests. An ophthalmologist performed the surgery.

Minimum Level of Training Needed: An ophthalmologist would be needed to perform cataract surgery. The vision tests could be performed by an optometrist or optometry technician.

Key Elements:

- Assess for cataracts during routine visits.
- Early surgery is beneficial for operable cataract.

Available Materials: No intervention materials were available at the time of publication.

Study Citation: Harwood RH, Foss AJ, Osborn F, Gregson RM, Zaman A, Masud T. Falls and health status in elderly women following first eye cataract surgery: a randomised controlled trial. *British Journal of Ophthalmology*. 2005 Jan;89(1):53–9.

Supplemental Article

Foss AJ, Harwood RH, Osborn F, Gregson RM, Zaman A, Masud T. Falls and health status in elderly women following second eye cataract surgery: a randomized controlled trial. *Age and Ageing*. 2006 Jan;35(1):66–71.

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Pacemaker Surgery
Kenny, et al. (2001)

This study evaluated the effectiveness of surgical insertion of a dual chamber pacemaker at reducing falls among older adults with cardioinhibitory carotid sinus hypersensitivity (CSH). After 12 months, participants in the intervention group experienced 58 percent fewer falls than those who did not have the surgery.

Population: Participants were community-dwelling adults aged 50 or older with cardioinhibitory CSH and who had gone to the emergency department because of an unexplained fall. Mean age of participants was 73. More than half were women.

Geographic Location: Newcastle Upon Tyne, United Kingdom

Focus: Determine if cardiac pacing reduces falls among older adults with CSH.

Program Setting: This intervention took place in the surgical ward of a hospital.

Content: Research staff screened older adults who visited the emergency department for falls. If patients reported an unexplained fall (not caused by a slip or a trip or attributable to a medical cause) they were eligible for clinical assessment from the Cardiovascular Investigation Unit (CIU). The CIU screened the patients for other causes of falls such as medications and gait and balance issues. The CIU screened for cardioinhibitory CSH by massaging the carotid sinus while continually monitoring blood pressure and heart rate. Patients that screened positive for cardioinhibitory CSH received a rate response dual-chamber pacemaker.

Duration: The initial assessment took 60 minutes. The pacemaker surgery lasted two to three hours and patients stayed in the hospital overnight.

Delivered by: A surgeon delivered this intervention. A nurse or physician performed the initial screening.

Minimum Level of Training Needed: A physician experienced at performing a pacemaker surgery. Screening for cardioinhibitory CSH should be done by a health professional experienced at performing carotid sinus massage.

Key Elements: Information was not provided by the principal investigator.

Available Materials: None at this time.

Study Citation: Kenny RA, Richardson DA, Steen N, Bexton RS, Shaw FE, Bond J. Carotid sinus syndrome: a modifiable risk factor for nonaccidental falls in older adults (SAFE PACE). *The Journal of American College of Cardiology*. 2001 Nov 1;38(5):1491–6.

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Study of 1000 IU Vitamin D Daily for One Year

Pfeifer, et al. (2009)

This study evaluated the effectiveness of a one-year vitamin D and calcium supplementation program in reducing falls among older adults compared to a calcium only supplementation program. After one year, the intervention participants were 27 percent less likely to fall. After an additional eight months, participants were 39 percent less likely to fall compared to those who did not receive vitamin D.

Population: Participants were community-dwelling adults aged 70 or older with vitamin D (25[OH] D) serum levels below 78 nmol/l (nanomoles per liter)

Geographic Location: Bad Pyrmont, Germany

Focus: Investigate the effectiveness of long term vitamin D supplementation on falls.

Program Setting: A study center at a research institution.

Content: At the beginning of the study, a physician met with participants and collected medical history, height and weight, blood, and information on nutrition, physical activity, tobacco use, and alcohol use.

Participants were given a four month supply of 500 IU of vitamin D and 500 mg of calcium supplements and told to take the supplements twice daily at breakfast and dinner. Participants were told to avoid taking additional vitamin D and calcium supplements. The participants visited the clinic every four months to have their progress monitored and to receive additional supplements.

Duration: Participants took vitamin D and calcium supplements twice a day for one year and were monitored for an additional eight months. Participants attended five 1-hour clinical visits over the 20-month study period

Delivered by: This intervention was delivered by a physician.

Minimum Level of Training Needed: A nurse, with the supervision of a physician, could deliver this intervention. A physician needs to make the recommendation.

Key Elements:

- Physicians should discuss possible benefits and side effects with each patient.
- It may be beneficial to assess medical history and dietary habits.
- Measuring 25(OH) D serum levels in every patient is not necessary.
- A good personal relationship between the physician and patient increases compliance.

Available Materials: No intervention materials were available at the time of publication.

Study Citation: Pfeifer M, Begerow B, Minne HW, Suppan K, Fahrleitner-Pammer A, Dobnig H. Effects of a long-term vitamin D and calcium supplementation on falls and parameters of muscle function in community-dwelling older individuals. *Osteoporosis International*. 2009 Feb;20(2):315–22.

Supplemental Article

Pfeifer M, Begerow B, Minne HW, Nachtigall D, Hansen C. Effects of a short-term vitamin D(3) and calcium supplementation on blood pressure and parathyroid hormone levels in elderly women. *Journal of Clinical Endocrinology and Metabolism*. 2001 Apr;86(4):1633–7.

Contact

Practitioners interested in using this intervention may contact the principal investigator for more information:

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Quality Use of Medicines Program
Pit, et al. (2007)

This intervention focused on:

- Designing a convenient system for reviewing medicine within routine general practice visits.
- Teaching physicians to conduct medication reviews with their older patients.

Certain medications increase the risk of falling. Participating physicians received instruction on geriatric prescribing and a financial incentive to review medications. The physicians recruited their patients to participate in the study. Participants completed the Medication Risk Assessment (MRA) form in the waiting room and showed this feedback to their physician. After 12 months, participants in the intervention group were 39 percent less likely to fall and 46 percent less likely to experience a fall-related injury than those whose physician's did not receive the educational program.

Population: Participants were adults 65 or older who lived in the community and were recruited by their general practitioners (GPs) to participate in this study.

Geographic Location: Hunter Region, New South Wales, Australia

Focus: Educate GPs about the importance of reviewing medications with their older patients.

Program Setting: This intervention was conducted in the GP's office.

Content: The intervention consisted of three parts: 1) education, 2) MRA, and 3) completion of a Medication Review Checklist (MRC).

A behavioral scientist conducted an initial 15-minute session and introduced the intervention to the physician and clinical staff. A clinical pharmacist who was experienced in conducting medication reviews visited each GP twice. The pharmacist also provided materials about prescribing for older adults, the MRC and the MRA for patients. The MRA contained a list of 31 risk factors for experiencing medication issues (e.g., taking more than four medications/day, medication side effects).

Patients completed the MRA in the waiting room. The GP later reviewed the Assessment to determine if the patient would benefit from a medication review.

The MRC contained a list of potential problems and possible solutions. Problems included:

- Number of medications prescribed to patient.
- Patient compliance in taking prescribed medications.
- If the patient was prescribed specific drug categories (e.g., benzodiazepines, NSAIDS, over-the-counter medicines).
- If the patient had experienced any adverse drug reactions.
- After reviewing the patient's medications, the GP initiated appropriate prescribing changes.

An MRC was completed for each at-risk patient. Physicians received a monetary incentive after completing 10 MRCs.

Duration: The introductory session lasted 15 minutes. Each GP received two 1-hour educational sessions from the pharmacist. Office staff reported that it took on average 3.5 minutes per patient to hand out the risk assessments and to answer any questions. Medication reviews took place during regular office visits and lasted 15–20 minutes.

Delivered by: A behavioral scientist explained the intervention to the GP and office staff. A clinical pharmacist explained the medication-related issues. GPs conducted medication reviews.

Minimum Level of Training Needed: A pharmacist or physician with experience conducting medications reviews should lead the education sessions. A physician should conduct the medication reviews.

Key Elements:

- To maintain program fidelity the program should not be altered.
- An understanding of behaviour change theory.

Available Materials: The medication risk self-assessment for patients, and a MRC are available in Appendix C-6.

Study Citation: Pit SW, Byles JE, Henry DA, Holt L, Hansen V, Bowman DA. A Quality Use of Medicines program for general practitioners and older people: a cluster randomised controlled trial. *Medical Journal of Australia*. 2007 Jul 2;187(1):23–30.

Supplemental Articles

Pit, SW. Improving quality use of medicines for older people in general practice. University of Newcastle (Australia); 2004. PhD thesis.

Pit, SW, Byles, JE. Older Australians' medication use: self-report by phone showed good agreement and accuracy compared with home visit. *Journal of Clinical Epidemiology*. 2010 63:428–34.

Pit, SW, Byles, JE, Cockburn, J. Prevalence of self-reported risk factors for medication misadventure among older people in general practice. *Journal of Evaluation in Clinical Practice*. 2008 14(2), 203–208.

Pit, SW, Byles, JE. Accuracy of telephone self-report of drug use in older people and agreement with pharmaceutical claims data. *Drugs and Aging*. 2008 25(1), 7–80.

Pit, SW, Byles, JE, Henry, DA, Holt, L, Hansen, V, Bowman, D. (2007) Quality Use of Medicines Program for general practitioners and older people: a cluster randomised controlled trial. *Medical Journal of Australia*. 2007 187(1), 23–30.

Pit, SW, Byles, JE, Cockburn, J. Medication review: patient selection and general practitioner's report of medication-related problems and actions taken. *Journal of the American Geriatrics Society*. 2007 55(6), 927–934.

Contact

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Podiatry & Exercise Intervention
Spink, et al. (2011)

This study tested the effectiveness of a podiatry intervention coupled with exercise and education to prevent falls among older adults with disabling foot pain and an increased risk of falls.

- Disabling foot pain was defined as foot pain lasting for at least a day within the last month and a positive response of "some days" or "most/every days" to at least one item on the Manchester foot pain and disability index.
- Participants were considered at increased risk of falling if they had fallen in the previous 12 months, scored greater than one on the physiological profile assessment tool, or took >10 seconds on the alternate stepping test.

Intervention components included orthoses (custom molded shoe inserts), advice about and subsidies to pay for safe footwear, a foot and ankle exercise program, and fall prevention education. Overall, the fall rate for the intervention group was 36 percent lower than for the control group.

Population: Participants were adults aged 65 and older who lived in the community and were not cognitively impaired. All participants reported disabling foot pain and were at increased risk for falling. Over two-thirds of participants were female.

Geographic Location: Melbourne, Australia

Focus: A podiatry intervention to reduce fall risk among older adults with disabling foot pain.

Program Setting: A podiatrist fitted participants with customized shoe inserts and provided advice about safe footwear and fall prevention education at a health science clinic. The recommended exercises were performed at home.

Content:
Foot orthoses: The podiatrist issued participants shoe inserts (FormthoticsTM) that were heat molded to the participants' foot shape and customized with 3mm of cushioning material to redistribute pressure away from any painful plantar lesions.

Footwear: The podiatrist also assessed participants' outdoor footwear using a validated form. Inappropriate footwear included heels over 1¾", narrow heels, no ankle support, and a fully worn or smooth sole.

For participants with inappropriate footwear, the podiatrist provided a handout with pictures that illustrated safe and unsafe shoes, information about retailers of orthopedic footwear, and a subsidy to use toward purchasing safer shoes.

Exercise: The exercise component consisted of a 30-minute foot and ankle exercise routine that participants performed at home three times a week for six months. Participants received an instruction booklet and DVD that detailed the exercises. These included:

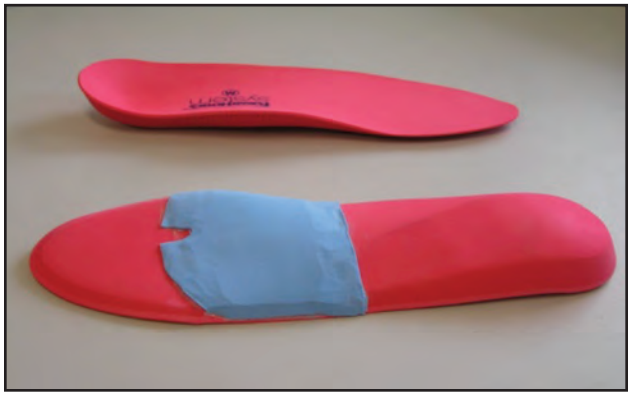
- Calf and toe stretches (using a rubber band).
- Strength training for the ankles (heel raises and using a Theraband™) and toes (using an archxerciser).
- Range of motion exercises such as ankle circling.
- Participants were instructed to increase the number of repetitions and/or level of resistance as the study progressed, based on their ability.

Education: The podiatrist used the Australian government produced booklet entitled Don't Fall for It, Falls can be Prevented, which outlines fall risk factors and prevention strategies.

Duration:
Foot orthoses: Participants were instructed to wear their shoe inserts every day during the six months of the intervention period.

Exercise: 30 minutes three times a week for six months.

Education: Fall prevention education and information about appropriate footwear were provided during a single visit lasting 45–60 minutes. The podiatrist contacted participants at 1, 4, 12, and 20 weeks after their visit to provide encouragement, promote adherence, and to answer questions



Delivered by: A podiatrist with experience in older adult fall prevention delivered the general falls prevention education and instructions about safe footwear. He also fitted the participants with their shoe inserts and gave each participant a booklet and a DVD detailing the foot and ankle exercises.

Minimum Level of Training Needed: Podiatrist or other health professional with experience in delivering exercise programs and prescribing foot orthoses.

Key Elements: Foot and ankle exercises performed three times a week.

Available Materials: "Podiatry and Fall Research Project: Project Booklet" that includes the safe shoe handout and foot and ankle exercise program*

**See Appendix C-7*

Study Citation: Spink MJ, Menz HB, Fotoohabadi MR, Wee E, Landorf KB, Hill KD, et al. Effectiveness of a multifaceted podiatry intervention to prevent falls in community dwelling older people with disabling foot pain: randomised controlled trial. *British Medical Journal (Clinical Research Ed).* 2011;342:d3411.

Supplemental Article

Barton CJ, Bonanno D, Menz HB. Development and evaluation of a tool for the assessment of footwear characteristics. *Journal of Foot Ankle Research*. 2009 Apr 23;2:10.

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The following three tables summarize the study population characteristics, study methodology, and intervention characteristics for the 10 Single Focused clinical interventions.

Table 1. Summary Table of Studies and Study Population Characteristics

Study	No. Study Participants	Mean Age	% Female	Race/Ethnicity	Socioeconomic Status (SES)	Previous Falls	Other Characteristics
Bischoff-Ferrari 2006	445	71	55%	97% White 2.7 % Black 0.2% Asian	NA*	NA	
Campbell 1999	72	75	78%	Most were White	NA	44%	Mean number of medications=6
Gallagher 2004	245	72	100%	NA	NA	100%	
Haran 2010	606	80	65%	Most were White	NA	37% had ≥2 in past year	
Harwood 2004	150	81.2	100%	Most were White	NA	100%	100% had a hip fracture
Harwood 2005	306	78.5	100%	Most were White	NA	About 50% fell in past year	Mean number of medications=4
Kenny 2001	175	73	60%	NA	NA	100%	
Pfeifer 2009	242	76.5	75%	100% white	100%≥12 year of education	NA	
Pit 2007	849 older adults; 20 General practitioners	NA	59%	NA for doctors; Patients mostly white	NA	25%	
Spink 2011	305	74	69%	67% born in Australia	75% received a state funded pension 24% had primary level education only	56% fell in past year; 31% >2 falls in past year	34% lived alone

**No information available*

Table 2. Study Methodology

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Bischoff-Ferrari 2006	Boston, Massachusetts	Participants recruited through mailing lists and presentations	≥65	Use of bisphosphonate, calcitonin, estrogen, tamoxifen citrate, or testosterone (w/ in 6 mo) or fluoride (w/in 2 yrs); hx of renal disease or renal stone(w/in 5 yr); current cancer, hyperparathyroidism, dietary calcium intake > 1500 mg/d, laboratory evidence of kidney or liver disease; or bilateral hip surgery	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Participants sent a postcard after every fall. Falls also were recorded every 6 months during clinical visits.	3 years	Fall risk, overall	OR[f]=0.77(0.51–1.15)	Hypercalciuria, constipation, epigastric distress, sweating
			Fall risk, female	OR[f]=0.54(0.30–0.97)	
			Fall risk, male	OR[f]=0.93 (0.50–1.72)	
			Fall risk, less active female	OR[f]=0.35(0.15–0.81)	

[a] *Incidence Rate Ratio* [b] *Relative Rate* [c] *Hazard Ratio* [d] *Relative Risk* [e] *Rate Ratio per 1,000 hrs of activity* [f] *Odds Ratio*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Campbell 1999	Dunedin, New Zealand	Identified from general practice registers	≥65 years old; currently taking a benzodiazepine, other hypnotic, antidepressant, or major tranquillizer; ambulatory in own home; not receiving physical therapy; physician though patient would benefit from psychotropic medication withdrawal	Cognitive impairment	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly fall calendars	44 weeks	Fall Rate	RR[b] = 0.34 (0.16–0.73)	None
			Number of fallers	RR[b] = 0.61 (0.32–1.17)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Gallagher 2004	Omaha, Nebraska	Mailing lists used to contact women in the Omaha, Nebraska area	Age 65 to 77 years, not osteoporotic (femoral neck density in normal range	Severe chronic illness, primary hyperparathyroidism, active renal stone disease, or use of thiazide estrogen, fluoride, diuretics, bisphosphonates or anticonvulsants in past 6 months	No
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	In person at week 6, 3 months & then every 6 months	3 years	Number of fallers	RR[d]=0.62 (0.54–0.93)	Hypercalcaemia, hypercalciuria;

[a] *Incidence Rate Ratio* [b] *Relative Rate* [c] *Hazard Ratio* [d] *Relative Risk* [e] *Rate Ratio per 1,000 hrs of activity* [f] *Odds Ratio*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Haran 2010	Sydney and llawarra regions of New South Wales, Australia	Recruited between May 2005 and June 2007	Community dwelling; age ≥80 or age ≥65 & fell in past 12 months or failed the TUGT; used multifocal lenses >3x week; had seen an optometrist or ophthalmologist in past 12 months	Current use of single lens glasses	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly fall diary w/ telephone follow up if needed	13 months after randomization (Average 12 months after receiving glasses)	Fall rate (Overall)	IRR[a]= 0.92(0.73–1.16)	Fall related fractures in both groups. Intervention group experienced more non-fall related injuries. Increased number of outdoor falls in intervention members who were less active
			Fall rate (High outside activity)	IRR[a]=0.60 (0.42–0.87)	
			Fall rate (Low outside activity)	IRR[a]=1.29 (0.95–1.75)	
			Fall rate (Outside falls, overall)	IRR[a]=1.00 (0.78–1.28)	
			Fall rate (Outside falls-High outside activity)	IRR[a]=0.61 (0.42–0.87)	
			Fall rate (Outside falls-Low outside activity)	IRR[a]=1.56 (1.11–2.19)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Harwood 2004	Nottingham, United Kingdom	Women admitted to orthogeriatric rehab ward w/in 7 days of surgery for hip fracture	Recent surgery for hip fracture, previous community residence, previously independent in activities of daily life	Previously institutionalized, disease or medication known to affect bone metabolism, < 7 on 10-point mental status test	No
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	In person interviews at 3, 6, and 12 months	12 months	Number of fallers	RR[d]=0.48(0.26–0.90)	None reported

[a] Incidence Rate Ratio [b] Relative Rate [c] Hazard Ratio [d] Relative Risk [e] Rate Ratio per 1,000 hrs of activity [f] Odds Ratio

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Harwood 2005	Nottingham, United Kingdom	Participants referred to program by optometrist	Aged > 70 years w/ cataract & no previous ocular surgery	Cataract not suitable for surgery by phacoemulsification, severe refraction error in 2nd eye, visual field deficits, severe co-morbid eye disease affecting visual acuity, registered partially sighted as a result of cataract, or memory problems	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly fall diary w/ telephone or in person interviews	12 months	Fall rate	RR[b]=0.66 (0.45–0.95)	None reported
			Number of fallers	RR[d]=0.95 (0.68–1.33)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Kenny 2001	Newcastle Upon Tyne, United Kingdom	Older adults who were seen in an emergency room because of an unexplained fall	Age ≥50 w/ cardio-inhibitory carotid sinus syndrome who were seen in an ER because of an unexplained fall	Cognitive impairment, medical explanation for fall, blind, documented accident caused fall, lived outside the study, contraindication to cardioinhibitory CSM, or taking medications known to cause a hypersensitive response to cardioinhibitory CSM	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Weekly fall diary	12 months	Fall rate	OR[f]=0.42 (0.23–0.75)	None reported

[a] Incidence Rate Ratio [b] Relative Rate [c] Hazard Ratio [d] Relative Risk [e] Rate Ratio per 1,000 hrs of activity [f] Odds Ratio

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Pfeifer 2009	Bad Pyrmont, Germany	Recruited by newspaper advertisements and mailing lists	Age ≥60, community dwelling w/ vitamin D serum level below 78 nmol/l	Hypercalcemia or primary hyperparathyroidism; fractures of extremities due to osteoporosis; therapy w/a thiazide, vitamin D, vitamin D metabolite, calcitonin, bisphosphonate, estrogen, anti-estrogen (w/in 6 mo) or fluoride treatment (w/in 2 yrs); intolerance to study medication; chronic renal failure; serum creatinine >20% upper limit of reference range, hx of drug or alcohol abuse; >7 cups coffee/day; >20 cigarettes/day; scheduled holidays out of the current latitude during the study period; diabetes mellitus; or severe cardiovascular disease	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly fall diary and follow-up phone calls	20 months	Number of fallers at 12 months	RR[d]=0.73(0.54–0.96)	None
			Number of fallers at 20 months	RR[d]=0.61(0.34–0.76)	

[a] *Incidence Rate Ratio* [b] *Relative Rate* [c] *Hazard Ratio* [d] *Relative Risk* [e] *Rate Ratio per 1,000 hrs of activity* [f] *Odds Ratio*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Pit 2007	Hunter Region, New South Wales, Australia	General practitioners randomly selected from a network of practices and their patients	GPs: at their current practice at least 12 months & who worked 10 hour/wk Patients aged >65, community-dwelling	Confused patients not accompanied by a caregiver	No
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Interviewed by telephone or at home at baseline, 4 months, and 12 months	12 months	Number of fallers	RR[d]=0.61 (0.41–0.91)	None
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Spink 2011	Melbourne, Australia	Recruited between July 2008 and September 2009 from a database of people who were using podiatry services at the La Trobe University Health Sciences clinic in Bundoora Victoria, AU	Aged ≥65,community-dwelling cognitively intact, reported: disabling foot pain, a fall in the past 12 months, or took >10 seconds on alternate stepping test, or scored >1 on physiological profile	Neurodegenerative disorder, leg amputation, inability to walk 10 m w/out walking aid, did not speak English, leg surgery planned in next 2 months or that occurred in the 3 months before start of study	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly fall calendars with follow-up telephone calls	12 months	Number of fallers	RR[d]= 0.85 (0.66–1.08)	None
			Number of multiple fallers	RR[d]=0.63 (0.38–1.04)	
			Fall rate	IRR[a]=0.64 (0.45–0.91)	

[a] *Incidence Rate Ratio* [b] *Relative Rate* [c] *Hazard Ratio* [d] *Relative Risk* [e] *Rate Ratio per 1,000 hrs of activity* [f] *Odds Ratio*

Table 3 Intervention Characteristics

Study	Focus	Providers	Structure	Number of Sessions	Provider Contact Time
Bischoff-Ferrari 2006	Investigate the effectiveness of long term vitamin D & calcium supplementation on falls	A physician & allied health staff	One-on-one	7 clinic visits	Clinic visits: 7 hours
Campbell 1999	Reduce psychotropic medication use among older adults	A physician & nurse	One-on-one	2 assessments. 5 home visits by research nurse to provide new medication	Clinical Assessment: 30–60 minutes Home visits: 30 minutes
Gallagher 2004	Active vitamin D supplementation	A physician & allied health staff	One-on-one	10 one-hour clinic visits	Clinic visits: 10 hours
Haran 2010	Provide single lens distance glasses for older adults who are at risk & normally wear multifocal glasses	Optometrist	One-on-one	2 optometry sessions of 45–50 minutes each	Optometry sessions: approx. 1½ hours
Harwood 2004	Investigate the effects of different vitamin D & calcium supplementation regimens	A physician & allied health staff	One-on-one	Four 30-minute clinic visits	Clinic visits: 2 hours
Harwood 2005	Determine if cataract surgery reduces falls	An ophthalmologist	One-on-one	1 assessment 1 surgery	Assessment: 60 minutes Surgery: 30 minutes
Kenny 2001	Pacemaker surgery for older adults w/ cardioinhibitory carotid sinus hypersensitivity	A surgeon	One-on-one	Two 90 minute assessments 1 surgery	Assessments: 3 hours Surgery: 2–3 hours
Pfeifer 2009	One-year vitamin D & calcium supplementation	A physician	One-on one	Five 1-hour clinical assessments	Clinical assessment: 5 hours
Pit 2007	Educate GPs about the importance of reviewing medications w/ their older patients	A behavioral scientist and clinical pharmacist provided education to GPs. GPs assessed patients' medications	One-on-one	1 physician and office staff session 2 physician education sessions 1 medication review	Physician/staff education: 15 minutes Physician education: 1 hour Medication review: 15–20 minutes
Spink 2011	Prevent falls w/ podiatry intervention plus foot & ankle exercises	Podiatrist	One-on-one assessment w/home-based exercises	1 podiatry session 30-minute exercise routine 3 times a week for 24 weeks	Podiatry visit: 1 hour

MULTIFACETED INTERVENTIONS

Stepping On
Clemson, et al. (2004)

This study used a series of seven small group sessions to teach fall prevention strategies to community-dwelling older adults. The fall rate among participants was reduced about 30 percent compared with those who did not receive the intervention. The intervention was especially effective for men. The fall rate among male participants was reduced almost two-thirds.

Note: This study has been translated for use in the United States. *See page 106 for more information.*

Population: Participants were individuals who had fallen in the past year or who were concerned about falling. All were 70 or older and lived in the community. Most study participants were female.

Geographic Locale: Sydney, Australia

Focus: Improve self-efficacy, empower participants to make better decisions and learn about fall prevention techniques, and make behavioral changes.

Program Setting: Initial sessions were conducted in easily accessible community settings. Refreshments were provided before and after the sessions to give participants an opportunity to talk to each other and with the facilitators and content experts. Follow-up visits took place in the participants' homes.

Content: The program addressed multiple fall risk factors: improving lower limb balance and strength, improving environmental and behavioral safety in both the home and community, and encouraging vision and medical screenings to check for poor vision and possible medication problems.

Each session covered different aspects to reducing fall risk:

- Session one: Risk appraisal; introducing balance and strength exercises
- Session two: Review and practice exercises; how to move safely in the home
- Session three: Hazards in and around the home and how to remove or reduce them
- Session four: How to move safely in the community; safe footwear and clothing
- Session five: Poor vision and fall risk; the benefits of vitamin D, calcium, and hip protectors
- Session six: Medication management; review of exercises; more strategies for moving safely in the community
- Session seven: Review of topics covered in program
- Follow-up home visit: Review of fall prevention strategies; assist with home adaptations and modifications, if needed
- Three-month booster session: Review achievements and how to maintain motivation

Duration:

- Seven weekly two-hour program sessions
- A 1–1½-hour home visit, six weeks after the final session
- A 1-hour booster session three months after the final session

Delivered by: An occupational therapist (OT) facilitated the program and conducted the home visits.

A team of content experts, trained by the OT and guided by the Stepping On manual, led the sessions. These included:

- A physical therapist (PT) who introduced the exercises and led a segment on moving about safely
- An OT who led segments on home safety, community safety, behavioral methods to sleeping better, and hip protectors
- An older adult volunteer from the Roads and Traffic Authority who spoke on pedestrian safety
- A retired volunteer nurse from the Medicine Information Project who discussed how to manage medications
- A mobility officer from the Guide Dogs who spoke on coping with low vision (The Stepping On manual has a topics section that outlines the information required to run this session)

Minimum Level of Training Needed: The program should be facilitated by a health professional with experience both in group work and in working with older adults in community settings.

This program requires a PT, an OT, a person trained in road safety for older drivers who can discuss pedestrian safety, a low vision expert, and a nurse or community pharmacist who can discuss medications. Other potentially useful content experts include a podiatrist or perhaps a nutritionist. All content experts need to receive training in fall prevention.

Key Elements: Using content experts is critical. It is also important to let each expert know what is expected of them, to provide feedback, and to make sure each focuses on fall prevention.

The Stepping On manual is essential for all program facilitators as it provides a step-by-step guide to running the seven-week group program. It outlines topic areas and provides the background information for each content expert.

Chapters Include:

- Essential background information for understanding the conceptual underpinning of the program and the group process
- Valuable content information for all the key fall prevention areas that can be used to train local experts participating in the program

- A guide to useful resources
- Handouts for group participants
- Ideas on recruitment and evaluation

Available Materials: The program manual *Stepping On: Building Confidence and Reducing Falls. A Community-Based Program for Older People* by Dr. Lindy Clemson is available at Freiberg Press Inc. PO Box 612 Cedar Falls, IA 50613, United States E-mail: bfreiberg@cfu.net

Study Citation: Clemson L, Cumming RG, Kendig H, Swann M, Heard R, Taylor K. The effectiveness of a community-based program for reducing the incidence of falls in the elderly: A randomized trial. *Journal of the American Geriatrics Society*. 2004 Sep;52(9):1487–94.

Contact

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U.S. Program Contact

In 2011, CDC funded the translation of Stepping On for dissemination and implementation in the U.S.

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PROFET (Prevention of Falls in the Elderly Trial)
Close, et al. (1999)

This study provided medical assessments for fall risk factors with referrals to relevant services and an occupational therapy home hazard assessment with recommendations for home modifications. After 12 months, those in the intervention group were 60 percent less likely to fall once and 67 percent less likely to fall repeatedly (at least three times), compared with those who did not receive the intervention.

Population: Participants were seniors who had been treated for a fall in a hospital emergency department. All were aged 65 or older and lived in the community. Two-thirds of participants were female.

Geographic Locale: London, United Kingdom

Focus: Identify medical risk factors and home hazards, and provide referrals and/or recommendations to reduce fall risk and improve home safety.

Program Setting: The medical assessment took place in an outpatient hospital clinic. The occupational therapy assessment took place in participants' homes.

Content: The medical assessment was conducted soon after the fall that was treated in the emergency room. It included assessments of visual acuity, postural hypotension, balance, cognition, depression, and medication problems. The results were used to identify and address problems that could contribute to fall risk. Participants received referrals to relevant services, as appropriate, based on identified risk factors.

The home assessment was conducted during a single visit. The occupational therapist (OT) identified environmental hazards in the home such as uneven outdoor surfaces, loose rugs, and unsuitable footwear. Based on findings, the OT provided advice and education regarding safety within the home, made safety modifications to the home with the participant's consent, and provided minor safety equipment.

The OT made social service referrals for participants who required hand rails, other technical aids, adaptive devices such as grab bars and raised toilet seats, and additional support services.

Duration: The average length of the medical assessment was 45 minutes. The average length of the home assessment was 60 minutes.

Delivered by: A physician specializing in geriatrics conducted the medical assessment. An OT delivered the home hazard assessment.

Minimum Level of Training Needed: This program could be implemented by:

- Appropriately trained geriatricians
- General practitioners with a strong interest in older adult health
- Trained physical therapists or nurses with the support of a general practitioner in case medication modification, referrals to specialists, or other medical services were required

Key Elements: For medication review and modification, a medical specialist rather than a general practitioner is recommended.

Available Materials:

- Folstein mini-mental state examination (see Supplemental Articles)
- Modified Geriatric Depression Scale (see Supplemental Articles)
- Snellen vision assessment chart
- Medical assessment form*—the form used in the outpatient hospital clinic setting
- Accident and emergency assessment tool*—the instrument used in the emergency department to identify people at high risk of falling and those who should be referred for a comprehensive geriatric assessment
- Environmental hazards checklist*—the checklist used to guide the home assessment

** See Appendix C-8.*

Study Citation: Close J, Ellis M, Hooper R, Glucksman E, Jackson S, Swift C. Prevention of Falls in the Elderly Trial (PROFET): A randomised controlled trial. *Lancet*.1999 Jan 9;353(9147):93–7.

Supplemental Articles

Folstein MF, Folstein SE, McHugh PR. "Mini-mental state." A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*. 1975 Nov;12(3):189–98.

Sheikh J, Yesavage J. Geriatric Depression Scale (GDS): Recent evidence and development of a shorter version. *Clinical Gerontology*. 1986;5(1/2):165–72.

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Accident & Emergency Fallers
Davison, et al. (2005)

This multifaceted intervention was designed for people who fell repeatedly. Participants received a medical fall risk assessment by a geriatrician at the hospital and had in-home assessments by physical therapists (PTs) and occupational therapists (OTs). Each participant received an individualized intervention designed to reduce their fall risk factors.

After 12 months, the fall rate in the intervention group was 36 percent lower than the rate in the comparison group.

Population: Participants were men and women aged 65 or older. All had experienced at least one fall in the past year and also had been treated in the emergency department for another fall or fall injury. About three-quarters of participants were female.

Geographic Locale: Newcastle, United Kingdom

Focus: Identify and modify each participant's fall risk factors.

Program Setting: The medical assessment was conducted in a hospital and the physical therapy and home assessments were conducted in participants' homes.

Content: After taking a medical and fall history, a physician conducted a full clinical examination that included vision, medication review, a neurological examination, and a cardiovascular assessment. Postural blood pressure was assessed and laboratory tests and an electrocardiogram were performed.

Interventions for identified fall risk factors followed recognized treatment recommendations. Each participant was referred to relevant specialists as needed, such as to an optometrist for vision correction or cataract removal; given advice or medication to reduce orthostatic hypotension; and had medications associated with falls stopped, reduced, or modified.

The PT evaluated each participant's gait and balance and, if necessary, provided gait re-education and the functional training program used in the Yale FICSIT (Frailty and Injuries: Co-operative Studies of Intervention Studies) study (See Koch, et al. and Tinetti, et al. under Supplemental Articles). The main intervention was exercise to strengthen the proximal leg muscles and ankle dorsiflexion muscles. If needed, participants were given assistive devices, had their footwear modified or replaced, and were referred to a podiatrist.

An OT used a room-by-room environmental fall hazard checklist, the User Safety and Environmental Risks (USER) checklist, to identify potential hazards throughout the home including the kitchen, bathroom, bedroom, and stairs (See Hagedorn, et al. under Supplemental Articles). Specific areas included the position and condition of furniture, cabinets and shelving heights, loose rugs and tripping hazards, grab bars and handrails, toilet height, and lighting (including the use of night lights).

Environmental interventions followed published criteria (See Tideiksaar under Supplemental Articles) and included advice about reducing home hazards as well as suggestions for specific home modifications.

Duration: On average, participants visited the hospital twice for the medical intervention. The initial hospital assessment took one hour and the medical intervention visit was 20 minutes. Participants received two physical therapy intervention visits; the initial physical therapy assessment took 45 minutes and the intervention lasted 15 minutes. The occupational therapy visit took 45 minutes and the follow-up visit about one month later lasted 20 minutes.

Delivered by: A physician performed the medical assessments and made appropriate referrals to specialists; a PT conducted the gait and balance assessment and re-education; and an OT conducted the home hazard assessment and recommended home modifications.

Minimum Level of Training Needed: This intervention requires a variety of highly trained health care professionals. Complex individualized interventions of this type cannot be implemented by individuals with lower levels of training.

Key Elements: Multifactorial assessments and interventions conducted by highly trained individuals in each of the three disciplines.

Available Materials: No additional materials are available.

Study Citation: Davison J, Bond J, Dawson P, Steen IN, Kenny RA. Patients with recurrent falls attending accident and emergency benefit from multifactorial intervention: A randomised controlled trial. *Age and Ageing*. 2005 Mar;34(2):162–8.

Supplemental Articles

Koch M, Gottschalk M, Baker DI, Palumbo S, Tinetti ME. An impairment and disability assessment and treatment protocol for community-living elderly persons. *Physical Therapy*. 1994 Apr;74(4):286–94.

Tinetti ME, Baker DI, McAvay G, Claus EB, Garrett, P, Gottschalk M, Koch ML, Trainor K, Horwitz RI. A multifactorial intervention to reduce the risk of falling among elderly people living in the community. *New England Journal of Medicine*. 1994 Sept 29;331(13):821–7.

Hagedorn R, McLafferty S, Russell D. The User Safety and Environmental Risk Checklist (USER). In: Anonymous falls: Screening and risk assessment for older people in the community. *Worthing Priority Care NHS Trust*. 1998:48–57.

Tideiksaar R. Preventing falls: Home hazard checklists to help older patients protect themselves. *Geriatrics*. 1986 May;41(5):26–8.

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The NoFalls Intervention

Day, et al. (2002)

This study looked at the effectiveness of group-based exercise in preventing falls when used alone or in combination with vision improvement and/or home hazard reduction. The intervention components focused on increasing strength and balance, improving poor vision, and reducing home hazards.

The group-based exercise was the most potent single intervention; when used alone, it reduced the fall rate by 20 percent. Falls were reduced further when vision improvement or home hazard reduction was combined with exercise. The most effective combination was the group-based exercise with both vision improvement and home hazard reduction. Participants who received all three components were one-third less likely to fall.

Population: All participants were aged 70 or older and lived in the community. Sixty percent were female.

Geographic Locale: City of Whitehorse, Melbourne, Australia

Focus: Increase strength and balance, improve poor vision, and reduce home hazards.

Program Setting: The exercise program was delivered in community settings such as exercise rooms in fitness centers and community health centers. The vision intervention was delivered via usual services available in the community. Participants went to their optometrist or ophthalmologist if they had one. If any further action was required, it was facilitated using normal services such as hospitals for cataract surgery, optometrists for new glasses, and general practitioners or ophthalmologists for medication if required. The home hazard intervention was conducted in participants' homes.

Content:
Exercise: The exercise intervention consisted of weekly one-hour classes plus daily home exercises. Classes were designed by a physical therapist (PT) to improve flexibility, leg strength, and balance. About one-third of the exercises were devoted to balance improvement. Exercises were adjusted for participants with limitations. Music was played during the sessions.

Leaders provided a social time with coffee and tea after each session to talk informally about exercise improvements and opportunities.

Vision improvement: The vision intervention included referral to an appropriate eye care provider if a participant's vision fell below predetermined criteria during the baseline assessments for visual acuity, contrast sensitivity, depth perception, and field of view. Criteria for referral included more than four lines difference between the line of smallest letters read correctly on the high and low contrast sections of the vision chart or any loss of field of view.

A referral was recommended if:

(1) A potential visual deficit was identified and the participant was not already receiving treatment, or

(2) If a deficit had been identified previously but the participant had not received treatment during the previous 12 months. The intervention consisted of the participant receiving the recommended treatment by an appropriate specialist.

Home hazard reduction: The home hazard assessment consisted of a walk-through using a checklist for those rooms used in a normal week. The checklist included a comprehensive section defining the different areas of the house and specific hazards. The checklist was divided into rooms or areas of the house—access points (main entry door, back door, etc.), hallways, stairwells, dining room, living room, den, bedrooms, and wet areas (kitchen, bathroom, laundry rooms). Within each of these areas, the focus was on steps and stairs, floor surfaces, lighting, and some key furniture items or fixtures such as a favorite chair or bathroom fixtures.

After the assessment, the results were discussed with the participant and potential interventions described in the checklist were suggested. If the participant agreed to the intervention, it was determined who would carry it out. Hazards could be removed or modified by the participant, their family, the City of Whitehorse home maintenance program, or some other person. Study staff visited the participants' homes and provided quotes for the materials needed for the suggested modifications; labor was provided free of charge.

Duration:
Exercise: Weekly one-hour group classes for 15 weeks and 25 minutes of daily home exercises.

Vision improvement: Duration depended on the specific intervention (such as cataract surgery or new glasses).

Home hazard reduction: Duration depended on the length of time the home modifications were left in place by the participant.

Delivered by:
Exercise: Classes were led by trainers who were accredited to lead exercise classes for older adults, and were trained in the NoFalls program by the PT who designed the program.

Vision improvement: Initial assessment was conducted by nurses with up to a half-day training required on the vision assessment. Detailed vision assessment was conducted by each participant's usual eye care provider, general practitioner, local optometrist, or ophthalmologist.

Home hazard reduction: Home assessments were conducted by research nurses who followed the study protocol for assessment with one-day of training required on the home hazard assessment. Modifications were undertaken by participants, their family or a private contractor, or by the City of Whitehorse home maintenance program.

Minimum Level of Training Needed: Exercise: Requires a basic level of exercise leadership training such as that received by a PT or certified fitness instructor.

Vision and home hazard assessments: Nurses or other allied health professionals with the appropriate training.

Key Elements: Although the most effective single component was the NoFalls exercise program, the complete program should be followed because partial implementation may not reduce falls.

Available Materials: The NoFalls exercise program manual, which was developed for trained professionals, is available free of charge in electronic format at www.monash.edu.au/muarc/projects/nofalls/.

These researchers have not made the home assessment protocol available because this intervention component by itself was not effective.

Study Citation: Day L, Fildes B, Gordon I, Fitzharris M, Flamer M, Lord S. Randomised factorial trial of falls prevention among older people living in their own homes. *British Medical Journal*. 2002 Jul 20;325(7356):128–33.

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The SAFE Health Behavior and Exercise Intervention

Hornbrook, et al. (1994)

The Study of Accidental Falls in the Elderly (SAFE) health behavior intervention was a program of four group classes on how to prevent falls. The classes addressed environmental, behavioral, and physical risk factors and included exercise with instructions and supervised practice. The home safety portion included a home inspection with guidance and assistance in reducing fall hazards.

Overall, participants were 15 percent less likely to fall compared with those who did not receive the intervention. Male participants showed the greatest benefit.

Population: All were participants were 65 or older and lived in the community. About 60 percent of participants were female.

Geographic Locale: Portland, Oregon, and Vancouver, Washington, United States

Focus: Reduce risky behaviors, improve physical fitness through exercise, and reduce fall hazards in the home.

Program Setting: No information was available on where risk education and group exercise classes took place. Home safety inspections were conducted in participants' homes.

Content: The SAFE health behavior intervention consisted of four 1½-hour group classes that used a comprehensive approach to reducing fall risks. Classes addressed environmental, behavioral, and physical risk factors.

Classes included:

- A slide presentation on common household risks
- Discussions of behavioral risks such as walking on ice or using a chair to reach high places
- A self-appraisal of home hazards using a specially designed form
- Small group sessions during which participants worked together to develop action plans

Each class session also had an exercise component that included a brief demonstration of fall prevention exercises and about 20 minutes of supervised practice. Participants received a manual describing the exercises and were encouraged to begin walking at least three times a week.

The exercises were chosen to:

- Actively involve all parts of the body
- Maintain full range of motion of all joints

- Strengthen muscles
- Improve posture
- Improve balance

During the home safety inspection, the assessor inspected the participant's home and identified fall hazards using a standard protocol. The assessor encouraged the participant to remove or repair the hazards identified during this initial visit. The participant was also given fact sheets on how to obtain technical and financial assistance for making repairs and modifications to his or her home.

After the four classes were completed, the assessor returned to the participant's home to check on the progress of repairs and to offer financial and technical assistance if needed, as well as discounts on safety equipment.

Duration:

- Two home visits, each lasting about 15 minutes
- Four weekly 1½-hour classes (including 20 minutes of supervised exercise) over a one-month period

Delivered by:

- The home inspection was performed by a BA-level home assessor who was trained during a two-day program that included practice assessments of elderly volunteers' homes.
- The fall prevention program and exercise sessions were delivered by MA-level lifestyle change experts with various backgrounds including health behavior change and sports training. Each group meeting was conducted by a team consisting of a lifestyle change expert and a physical therapist.

Minimum Level of Training Needed: Information was not provided by the principal investigator.

Key Elements: Information was not provided by the principal investigator.

Available Materials: No intervention materials were available at the time of publication. Please contact the principal investigator for information on how to obtain the exercise manual.

Study Citation: Hornbrook MC, Stevens VJ, Wingfield DJ, Hollis JF, Greenlick MR, Ory MG. Preventing falls among community-dwelling older persons: Results from a randomized trial. *The Gerontologist*. 1994 Feb;34(1):16–23.

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Falls Team Prevention Program
Logan, et al. (2010)

This study examined the effectiveness of a team-based, individually tailored intervention designed to reduce falls among older adults. The multifaceted intervention included group education, group and home-based strength and balance exercises, medication review, blood pressure screening, and home hazard assessments and modifications. After 12 months, the fall rate was 55 percent lower among people who took part in the program compared to those who did not.

Population: Participants were adults aged 60 or older who lived in the community (95 percent) or nursing homes (5 percent), and had called emergency services for an ambulance because of a fall, but were not taken to a hospital.

Geographic Location: Nottinghamshire, United Kingdom

Focus: Increase strength and balance, identify inappropriate medications, and reduce home hazards.

Program Setting: Programs were conducted primarily in patients' homes. Optional group sessions were offered at community centers.

Content: The falls team was composed of an occupational therapist (OT), physical therapist (PT), and a nurse. The team provided participants with as many home sessions as they deemed clinically necessary.

- The OT and PT led optional group sessions twice a week for six weeks. These included group exercises and fall prevention education (e.g., reducing home hazards, information about safe footwear).
- A nurse reviewed participants' medications and assessed their blood pressure.
- The PT taught the strength and balance exercises to participants in their homes. The PT used exercises from the Postural Stability program that was based on the FaMe and Otago Exercise programs (See pages 8 and 30).
- The OT conducted the home hazard assessments and suggested modifications. The OT provided equipment (e.g., grab bars), advice (e.g., improved lighting), and taught participants how to get up from a fall.
- Referrals (e.g., family physician for follow-up, social services for home care) were made if needed.

Duration:

- Group sessions lasted two hours. These were held twice a week for six weeks on an ongoing basis. The first hour was devoted to strength and balance exercises and the second hour to fall prevention education.

- Strength and balance sessions in the home lasted one-hour and were conducted once a week for a minimum of six weeks. However, sessions were continued for as long as the PT deemed necessary.
- Conducting the home hazard assessments and modifications took an hour, with subsequent follow-up if needed.
- Reviewing medications and screening blood pressure lasted about 30 minutes.

Delivered by: The intervention was delivered by a team composed of an OT, a PT, and a nurse.

Minimum Level of Training Needed: This intervention requires a variety of highly trained health care professionals. A PT who has experience with the Postural Stability program should deliver strength and balance exercises. An OT should conduct the home hazard assessments and modification recommendations. A nurse should complete the medication review.

Key Elements: Qualified health care professionals should continually assess the participants over the length of the program. The duration and the intensity should be modified as needed based on these ongoing assessments.

Available Materials: The educational materials were modified from the *Guide to Action to Prevent Falls*, available at: http://eprints.nottingham.ac.uk/1414.

Information about the accredited Postural Stability Instructor course in the United Kingdom is available at: http://www.laterlifetraining.co.uk.

Study Citation: Logan PA, Coupland CA, Gladman JR, Sahota O, Stoner-Hobbs V, Robertson K, et al. Community falls prevention for people who call an emergency ambulance after a fall: randomised controlled trial. *British Medical Journal (Clinical Research Ed).* 2010;340:c2102.

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KAAOS (Falls and Osteoporosis Clinic)

Palvanen, et al. (2014)

This study evaluated the effectiveness of a multidisciplinary falls risk assessment [assessment (by a doctor, nurse, and physical therapist [PT]) followed by appropriate interventions and follow-up if necessary. After one year, participants were 28 percent less likely to fall and 26 percent less likely to have an injurious fall compared to those who did not participant in the intervention.

Population: Participants were community-dwelling adults aged 70 and older with an increased risk of falling or fall induced injury.

- Participants were considered at increased risk of falling or fall induced injury if they had self-reported mobility issues, or more than two falls in previous 12 months, or a previous fracture, or history of hip fracture in a close relative, or confirmed or suspected osteoporosis, or a BMI <19, or illness that increases the risk of osteoporosis, falls, and fractures.

Geographic Location: Tampere and Lappeenranta, Finland

Focus: Identify and modify risk factors for falls at a center-based falls clinic.

Program Setting: The intervention occurred at two falls clinics situated within health care centers.

Content: During the initial visit, the intervention team conducted a three hour assessment of fall risk factors for each participant.

- A nurse
  - collected basic information and body measurements,
  - assessed cognitive function, and
  - measured blood pressure including postural blood pressure.
- A PT
  - tested physical function using the Short Physical Performance Battery and the Timed Up and Go-test.
- A physician
  - conducted a thorough medical examination including a review of medications.
- A PT or nurse
  - conducted a one hour home hazard assessment on a separate day.

Risk Factor	Intervention
Assessed by physician:	
General medical history and examination	Referred to primary care physician.
Medications	Recommended reduction of drugs known to increase risk of falling. Withdrawal of redundant psychotropic medications.
Visual impairment	Referral to optician or ophthalmologist for glasses if necessary. Referral to ophthalmologist for cataracts.
Assessed by a PT:	
Low mobility	Referral to home or group strength and balance program if needed. The home training session lasted 45 minutes two to three times a week. Group classes were led by an exercise instructors experienced at teaching older adults and were 45 minutes once per week. Exercises were strength and balance focused and included half-squats, heel walking, and tandem-walking. Hip protectors, mobility assistive devices, and anti-slip shoe devices were recommended if deemed necessary.
Low physical activity	Prescription for increased physical activity according to functional ability.
Assessed by a nurse:	
Nutrition	Vitamin D and calcium supplementation recommended if dietary intake assessed as inadequate (>1000–1500 mg Calcium/day, >600–800 IU vitamin D/day). The physician wrote a prescription if necessary.
Alcohol and smoking	Reduction of alcohol advised. Cessation of smoking recommended.
Assessed by a PT or nurse:	
Home hazards	In-home visit; recommend grab bars, mats for slippery floors; assessed lighting, security lights, smoke alarms and fire extinguishers, placement of wires and cords.

A nurse made a telephone call twice (after three months and again after nine months) to check adherence to the prescribed interventions and to provide further recommendations as needed. The participant visited the falls clinic at 6 months and 12 months after the initial intervention to receive a booster assessment from the doctor, nurse, and PT. The PT revaluated mobility, emphasized increasing physical activity, and measured adherence to at-home or group balance and training exercises. The nurse and doctor measured adherence to their previous recommendations and provided additional guidance if needed. The visit lasted 2¼ hours.

Duration:

- Three-hour fall risk assessment (one-hour each with the physician, nurse, and PT)
- One-hour home hazard assessment
- 45 minutes of home balance and strength training two to three times per week if necessary
- 45 minutes of group balance and strength exercise once per week if necessary
- Two short telephone calls three and nine months after the initial assessment
- Two, 2¼ hour follow-up visits (45 minutes each with physician, nurse, and PT) at six and twelve months after the initial assessment

Delivered by: Assessment and individualized interventions were conducted by physicians, nurses, and physical therapists.

Minimum Level of Training Needed: This intervention requires a variety of trained health care professionals including a physician, nurse, and PT. Preparation for conducting the baseline assessments requires a half-day training session.

Key Elements:

- Measuring functional ability and recommending strength and balance training
- Performing a medication review and eliminating/reducing medications that increase falls
- Assessing nutrition and prescribing supplementation if necessary
- Assessing home hazards and providing modifications and referrals
- Medical referrals, hip protectors and assistive devices, if indicated

Available Materials: The structured home exercise handout and home hazard assessment checklist are available in Finnish.

Study Citation: Palvanen M, et al. Effectiveness of the Chaos Falls Clinic in preventing falls and injuries of home-dwelling older adults: a randomised controlled trial. *Injury* 2014;45(1):265–71.

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Multifactorial Fall Prevention Program
Salminen, et al. (2009)

This multifaceted fall intervention consisted of a geriatric fall risk assessment with counseling and guidance in fall prevention; home hazards assessment and modification; group and home-based exercise; group lectures on topics related to fall prevention; and monthly participation in a psychosocial group.

The intervention did not reduce falls overall. However, falls were decreased 41 percent in participants who had experienced three or more falls in the previous year and 50 percent in participants with more symptoms of depression.

Population: Participants were seniors aged 65 or older who lived in the community or in housing that provided occasional assistance, had no or little cognitive impairment, and had experienced at least one fall in the past year. Eighty-four percent of participants were female.

Geographic Locale: Pori, Finland

Focus: Assess and address each participant's specific fall risk factors, improve physical fitness, provide information and counseling on fall prevention, assess and modify home hazards, and provide psychological support.

Program Setting: The fall risk assessment, counseling, and group exercise classes were conducted in the Pori Health Center or at home for those participants living in assisted housing. Lectures and psychosocial groups were held in a senior center. The home-based exercises and home assessment were carried out in participants' homes.

Content: A geriatrician assessed each participant for medical factors that could increase their risk of falling such as disorders affecting balance and gait, the use of psychoactive medications, depression, and poor eyesight. If needed, referrals were made to an ophthalmologist for vision correction and to the primary care physician for follow-up on recommended medication changes. All participants who were not already taking calcium and vitamin D supplements were prescribed 500 mg calcium and 400 IU of vitamin D per day.

A public health nurse provided oral and written information about reducing personal fall risk factors as well as facts about safe environments, healthy diets, calcium and vitamin D supplements, and the use of hip protectors.

Trained nursing students conducted home hazard assessments using a detailed form. Participants were given oral and written instructions for safety modifications. A follow-up of the home modifications was made one year later.

A physical therapist (PT) led a group exercise class every two weeks. This included:

- 5 minutes of warm-up
- 15 minutes of balance, coordination, and weight-shifting exercises. Each exercise was performed for 45 seconds followed by 30 seconds of rest.

- 20 minutes of circuit training for muscle strength. Two to four circuits were performed with 3 to 5 minutes of rest between circuits.
- 5 to 10 minutes of cool-down

The intensity of the exercises was increased progressively over time, based on the PT's judgment of each person's fitness level.

Participants also performed similar exercises at home three times a week. Participants received written information on performing home exercises based on the PT's judgment of their physical condition.

Once a month, a lecture was given by a health professional on various topics including causes of falls, fall prevention, medications that can increase fall risk, nutrition, exercise, and home hazards.

Also once a month, participants attended a psychosocial group that provided recreational activities (e.g., discussing various topics such as news headlines, a musical performance, memory disorders, or exercise; reading poetry) and psychological support.

Duration:

- 45-minute fall risk assessment
- 45-minute home hazard assessment
- 45-minute information and counseling session
- 45- to 50-minute group exercise class once every two weeks plus 25 minutes of exercise at home three times per week
- 1 hour health lecture once a month
- 1 hour psychosocial group session once a month

Delivered by: A geriatrician conducted the fall risk assessment; a trained public health nurse provided information and counseling on fall prevention; trained nursing students conducted the home hazards assessment and psychosocial group sessions; a PT facilitated the group exercise sessions; and various health professionals (e.g., geriatricians, public health nurses, PTs, dieticians, podiatrists) gave lectures on topics related to falling.

Minimum Level of Training Needed: Risk assessments can be conducted by a trained nurse with referrals, if needed, to a general practitioner who specializes in geriatrics. Exercise groups can be supervised by a well-trained volunteer or physical therapy student.

Key Elements:

- Individual risk factor assessment, treatment, and/or referral by a physician
- Exercise classes led by a trained PT or PT student, combined with at-home exercises tailored to each participant
- Exercise intensity must increase progressively over time

- Monthly lectures by various health professionals on topics related to falling, followed by a question and answer period
- Individual guidance on fall prevention
- Home hazards assessment and written safety recommendations
- Monthly psychosocial group sessions

Available Materials: Materials are available only in Finnish.

Study Citation: Salminen MJ, Vahlberg TJ, Salonoja MT, Aarnio PTT, Kivelä SL. Effect of a risk-based multifactorial fall prevention program on the incidence of falls. *Journal of the American Geriatrics Society*. 2009 Apr;57(4):612–9.

Supplemental Articles

Sjösten NM, Salonoja M, Piirtola M, Vahlberg T, Isoaho R, Hyttinen H, Aarnio P, Kivelä SL. A multifactorial fall prevention programme in home-dwelling elderly people: A randomized-controlled trial. *Public Health*. 2007 Apr;121(4):308–18.

Sjösten NM, Salonoja M, Piirtola M, Vahlberg TJ, Isoaho R, Hyttinen HK, Aarnio PT, Kivelä SL. A multifactorial fall prevention programme in the community-dwelling aged: Predictors of adherence. *European Journal of Public Health*. 2007 Oct;17(5):464–70.

Vaapio S, Salminen M, Vahlberg T, Isoaho R, Aarnio P, Kivelä S-L. Effects of risk-based multifactorial fall prevention on health-related quality of life among the community-dwelling aged: A randomized controlled trial. *Health and Quality of Life Outcomes*. 2007 Apr;5:20–7.

Salminen M, Vahlberg T, Sihvonen S, Piirtola M, Isoaho R, Aarnio P, Kivelä SL. Effects of risk-based multifactorial fall prevention on maximal isometric muscle strength in community-dwelling aged: A randomized controlled trial. *Aging Clinical and Experimental Research*. 2008 Oct;20(5):487–93.

Salminen M, Vahlberg T, Sihvonen S, Sjösten N, Piirtola M, Isoaho R, Aarnio P, Kivelä SL. Effects of risk-based multifactorial fall prevention on postural balance in the community-dwelling aged: A randomized controlled trial. *Archives of Gerontology and Geriatrics*. 2009 Jan-Feb;48(1):22–7.

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Nijmegen Falls Prevention Program (NFPP) for adults with Osteoporosis

Smulders, et al. (2010)

This study evaluated a 5½-week multicomponent falls exercise program designed to reduce falls among older adults with osteoporosis. The program consisted of six elements: 1) education, 2) an obstacle course, 3) walking exercises, 4) weight-bearing exercises, 5) correction of gait abnormalities, and 6) training for how to fall safely. Participants were 39 percent less likely to fall compared to those who did not receive the intervention.

Population: Participants were community-dwelling adults aged 65 or older with osteoporosis and a history of falls (one or more falls in the previous 12 months).

Geographic Location: Arnhem-Nijmegen, the Netherlands

Focus: Improve balance, decrease fall risk, and enhance quality of life among older adults with osteoporosis.

Program Setting: The program was conducted at a rehabilitation center in a local hospital. Participants were encouraged to incorporate walking and weight bearing exercises into their daily lives.

Content: A physical therapist (PT) and an occupational therapist (OT) led sessions twice a week for 5½ weeks. Sessions included 10 participants and consisted of one or more key elements:

- Education—60 minutes
  - Explanation of osteoporosis
  - Overview of medications
  - Simulations of situations in which people were likely to fall
- An obstacle course—90 minutes
  - Navigating a complex course (e.g. uneven pavement, slopes, stepping stones)
  - Motor dual task (e.g., walking in pairs while holding a stick)
  - Limited visual input (e.g., walking in dim light)
  - Cognitive dual task (e.g., listening to a story while walking through an obstacle course)
- Walking exercises—30 minutes
  - Changes in speed and direction
  - Walking while handling a ball
  - Following commands (e.g., stop, turn)

- Weight-bearing exercises—15 minutes
  - Walking up stairs
  - Lifting and reaching exercises
- Correction of gait abnormalities—45 minutes
  - Trunk extension and rotation
  - Hip, knee, and ankle extension exercises
- Falling safely techniques—30 minutes
  - Weight shifting
  - Learning to fall sideways, forward, and backward as safely as possible
  - Learning to get up safely from the ground

Session elements:

- Session 1: Education
- Session 2: Correction of gait abnormalities and obstacle course
- Session 3: Falling safely techniques , weight-bearing exercises, and walking exercises
- Session 4: Correction of gait abnormalities and obstacle course
- Session 5: Education, falling safely techniques, weight-bearing exercises, and walking exercises
- Session 6: Correction of gait abnormalities and obstacle course
- Session 7: Falling safely techniques , weight-bearing exercises, and walking exercises
- Session 8: Correction of gait abnormalities and obstacle course
- Session 9: Education, falling safely techniques, weight-bearing exercises, and walking exercises
- Session 10: Correction of gait abnormalities and obstacle course
- Session 11: Falling safely techniques and weight bearing exercises

Duration: Sessions were held twice a week for 5½ weeks. Each session lasted between 1 and 2¾ hours.

Delivered by: A PT led the walking and weight bearing exercises and the sessions devoted to correcting gait abnormalities. An OT led the educational sessions that covered home safety. The PT and OT jointly delivered the initial education session, the obstacle course, and the training in how to fall safely.

The PTs and OTs attended a two-day training course that covered the theoretical and practical background of the program. The PTs attended an additional one-day course on functional walking.

Minimum Level of Training Needed: This program should be delivered by a PT and OT with additional training in teaching older adults with osteoporosis how to fall safely.

Key Elements:

- The obstacle course, especially the emphasis on dual task activities
- Training in teaching older adults with osteoporosis how to fall safely
- Walking exercises in a distracting environment

Available Materials: No materials were available at the time of publication.

Study Citation: Smulders E, Weerdesteyn V, Groen BE, Duysens J, Eijsbouts A, Laan R, van Lankveld W. Efficacy of a short multidisciplinary falls prevention program for elderly persons with osteoporosis and a fall history: a randomized controlled trial. *Archives of Physical Medical Rehabilitation*. 2010;91(11):1705–11.

Supplemental Articles

Weerdesteyn V, Rijken H, Geurts AC, Smits-Engelsman BC, Mulder T, Duysens J. A five-week exercise program can reduce falls and improve obstacle avoidance in the elderly. *Gerontology*. 2006;52(3):131–41.

Smulders E, Weerdesteyn V, Groen BE, Duysens J, Eijsbouts A, Laan R, van Lankveld W. The development of a multi-modal fall prevention program for persons with osteoporosis M.L. Vincent, T.M. Moreau (Eds.), *Accidental falls: causes, preventions and interventions*, Nova Publisher Inc, New York (2008), pp. 185–201.

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The Winchester Falls Project

Spice, et al. (2009)

This study evaluated the effectiveness of two fall interventions. The primary care intervention consisted of fall risk assessments by nurses followed by referrals to other professionals. The secondary care intervention involved multidisciplinary fall risk assessments [by a physician, nurse, physical therapist (PT), and occupational therapist (OT)], followed by appropriate interventions and follow-up if necessary. Only the secondary care intervention was effective in reducing falls.

Compared to the group who received usual care, participants in the secondary care multidisciplinary intervention were half as likely to fall, a third less likely to sustain a fall-related fracture, and 55 percent less likely to die in the year following the intervention.

Population: Participants were community-dwelling adults aged 65 or older who had sustained two or more falls in the previous year. About three-quarters were female.

Geographic Locale: Mid Hampshire, United Kingdom

Focus: Assess fall risk factors and provide individualized interventions.

Program Setting: Baseline assessments were conducted in a multidisciplinary clinic with referrals for interventions and follow-up if necessary.

Content: Participants received a standardized assessment for fall risk factors that included psychoactive medications; visual impairment; neurological, musculoskeletal, and/or cardiovascular problems; poor mobility; postural hypotension; improper footwear; environmental hazards; and alcohol use.

Individualized interventions included medication changes; physical therapy interventions such as strength, balance, and gait training; occupational therapy interventions such as corrective shoes, adaptive equipment, and home visits to reduce fall hazards; nursing interventions such as monitoring postural hypotension; and social services interventions such as increasing home help.

Risk Factor	Intervention
Assessed by physician:	
General medical history and examination	Refer to appropriate specialists.
Medications	Stop medications when possible. Add medication where appropriate. Make recommendations to primary care physician. Reduce or stop psychoactive medications.
Visual impairment	Recommend optician if one has not been seen in 2 years or if there is a change in vision. Refer to ophthalmologist when appropriate (e.g., cataracts).
Alcohol use	Advise to reduce or stop.
Assessed by a nurse:	
Postural hypotension	Refer to primary care nurse for monitoring.
Review of continence	Refer to community nurse.
Assessed by a PT:	
Poor mobility	Provide physical therapy interventions such as strength, balance, and gait training. Exercise instruction. Provide mobility aids.
Assessed by an OT:	
Improper footwear	Share information on footwear. Refer for orthotics or corrective shoes.
Environmental hazards	Recommend in-home visit. Suggest adaptive equipment. Recommend grab bars. Refer to local organizations specializing in home safety assessments for security advice, and to install window or door locks, security lights, smoke alarms etc., if necessary.
Personal and domestic activities of daily living	Provide daily living advice. Refer to social services for assistance.

Duration: Fall risk assessments took about two hours. The amount and duration of the follow-up interventions varied by the type of interventions received.

Delivered by: Assessments and individualized interventions were implemented by physicians, nurses, PTs, and OTs.

Minimum Level of Training Needed: This intervention requires a variety of highly trained health care professionals. Preparation for conducting the baseline assessments requires a half-day training session.

Key Elements: Physicians, nurses, PTs, and OTs used a structured in-depth assessment instrument.

Available Materials: Structured assessment instrument*

**See Appendix C-9.*

Study Citation: Spice CL, Morotti W, George S, Dent THS, Rose J, Harris S, Gordon CJ. The Winchester falls project: A randomised controlled trial of secondary prevention of falls in older people. *Age and Aging*. 2009 Jan;38(1):33–40.

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Yale FICSIT (Frailty and Injuries: Cooperative Studies of Intervention Techniques)

Tinetti, et al. (1994)

This study used a tailored combination of intervention strategies based on an assessment of each participant's fall risk factors. Participants were about 30 percent less likely to fall compared with people who did not receive the intervention.

Population: Participants were members of a health maintenance organization. All were 70 or older and lived in the community. Most participants were female.

Geographic Locale: Farmington, Connecticut, United States

Focus: Identify and modify each participant's risk factors.

Program Setting: The intervention was delivered to participants in their homes.

Content: This program provided an individualized intervention for each participant. The content varied based on the fall risk factors identified. Possible intervention components included medication adjustment, recommendations for behavioral change, education and training, home-based physical therapy, and a home-based progressive balance and strengthening exercise program.

The selection of interventions was guided by decision rules and priorities. No participant received more than three balance and strength training programs.

Risk Factor	Intervention
Assessed by a nurse practitioner:	
Postural hypotension	Behavioral recommendations such as elevating the head of the bed and using ankle pumps. Made changes in medications.
Use of sedative-hypnotic medication	Education, discontinued medication, non-pharmacological alternatives.
Use of 4+ prescription medications	Reviewed medications with primary care physician. The final decision on medication changes was made by the primary care physician.
Inability to transfer safely to bathtub or toilet	Training in transfer skills, home modifications (e.g., installing grab bars and a raised toilet seat).
Environmental hazards	Home modifications (e.g., removing rugs and installing railings).
Assessed by a physical therapist:	
Gait impairments	Gait training, use of assistive devices, balance and/or strengthening exercises.
Impairments in transfer skills or balance	Training in transfer skills, home modifications, balance exercises (progressing through 4 levels of difficulty).
Impairment in leg or arm strength or in range of motion	Progressive strengthening exercises with resistance bands and putty, increasing resistance after participant could complete 10 repetitions. Exercises were performed for 15–20 minutes twice a day.

Duration: The intervention was conducted over a three-month period. The amount and duration of contacts varied by the type of interventions received.

Delivered by: A nurse practitioner and physical therapist (PT) conducted the risk factor assessments. Medication adjustments were undertaken in cooperation with the participant's primary physician who made the final decision on medication changes. The PT conducted all physical therapy and supervised exercise sessions.

Minimum Level of Training Needed: The assessment requires at least a well-trained paraprofessional such as a PT assistant or licensed practical nurse (LPN). The intervention needs at least a BA-level nurse. The physical therapy portion requires a PT or OT, or a PT or OT assistant with supervision by a PT or OT.

Key Elements: The assessments need to be clearly linked to the intervention components. The minimum risk factor interventions include (1) postural blood pressure and behavioral recommendations; (2) medication review and reduction (especially psychoactive medications); (3) balance, strength, and gait assessments and interventions; and (4) environmental assessment and modification.

It is essential that the progressive balance and strength exercise program includes both supervised and at-home (unsupervised) components.

Available Materials: Intervention materials including risk factor assessments and treatment worksheets, medication reduction strategies, balance exercises, home safety checklists, and information sheets can be requested through the intervention web site www.fallprevention.org.

Study Citation: Tinetti ME, Baker DI, McAvay G, Claus EB, Garrett P, Gottschalk M, Koch ML, Trainor K, Horwitz RI. A multifactorial intervention to reduce the risk of falling among elderly people living in the community. *New England Journal of Medicine*. 1994 Sept 29;331(13):821–7.

Supplemental Articles

Koch M, Gottschalk M, Baker DI, Palumbo S, Tinetti ME. An impairment and disability assessment and treatment protocol for community-living elderly persons. *Physical Therapy*. 1994 Apr;74(4):286–94.

Tinetti ME, Baker DI, Garrett PA, Gottschalk M, Koch ML, Horwitz RI. Yale FICSIT: Risk factor abatement strategy for fall prevention. *Journal of the American Geriatrics Society*. 1993 Mar;41(3):315–320.

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A Multifactorial Program
Wagner, et al. (1994)

This study tested a moderate-intensity intervention that used tailored strategies based on assessments of each participant's risk factors. After one year, participants were 10 percent less likely to fall and 5 percent less likely to have an injurious fall, compared with people who received usual medical care.

Population: All participants were 65 or older and lived in the community. About 60 percent of participants were female.

Geographic Locale: Seattle, Washington, United States

Focus: Reduce disability and/or falls by: improving physical fitness, modifying excessive alcohol use, improving home safety, reducing psychoactive medication use, and improving hearing and vision.

Program Setting: Participants received the assessments and interventions from a nurse at local health maintenance organization (HMO) centers. Participants conducted a home assessment or had it done by a family member or volunteer.

Content: The assessments consisted of simple screening tests for six risk factors. The intervention content varied based on the individual's risk factors.

Risk Factor	Intervention
Inadequate exercise	Participated in a 2-hour exercise orientation class testing fitness, given exercise instruction, and encouraged to begin a program of brisk walking.
Use of a psychoactive drug	Reviewed medications using a pharmacist and sent written recommendations to the participant's primary care provider.
Impaired vision	Corrected when possible. Participants with uncorrectable visual impairments received information about available community resources.
Impaired hearing	Had a hearing aid evaluation. Program provided behavioral intervention classes for participants with uncorrectable deficits.
Excessive alcohol use	Referred to an alcohol treatment program if alcoholism was suspected, or given an instructional booklet that provided strategies for limiting use.
Home hazards	Assessed home safety using an instructional home safety checklist.

Duration: The initial visit consisted of a 1- to 1½-hour interview. The length and number of subsequent sessions varied by the type of interventions selected for each participant.

Delivered by: The program was delivered by a single nurse educator who received brief training by the research team. There was no formal curriculum because only one nurse was involved. Either trained volunteers or participants' family members completed the home safety assessment using the provided checklist.

Minimum Level of Training Needed: Information was not provided by the principal investigator.

Key Elements: The nurse's follow-up phone contacts and home visits may have had positive effects on participants' health that were independent of the interventions for specific risk factors.

Available Materials: No intervention materials were available for distribution at the time of publication.

Study Citation: Wagner EH, LaCroix AZ, Grothaus L, Leveille SG, Hecht J, Artz K, Odle K, Buchner DM. Preventing disability and falls in older adults: A population-based randomized trial. *American Journal of Public Health*. 1994 Nov;84(11):1800–6.

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The following three tables summarize the study population characteristics, study methodology, and intervention characteristics for the 12 Multifaceted Interventions.

Table 1. Summary Table of Studies and Study Population Characteristics

Study	No. Study Participants	Mean Age	% Female	Race/Ethnicity	Socioeconomic Status (SES)	Previous Falls	Other Characteristics
Clemson 2004	310	78	74%	NA*	52% had below average weekly income	65% fell in past year	
Close 1999	397	78	68%	NA	NA	65% fell in past year	61% lived alone
Davison 2005	313	77	72%	Most were White; none were Asian or Black	70% education <8th grade 4% education >HS Participants included all social classes	100% fell in past year; average was 3 falls	
Day 2002	1,090	76	60%	77% born in Australia	Study conducted in mainly middle class area	6% fell in past month	54% lived alone 47% married
Hornbrook 1994	3,182	73	62%	90% White	33% education >HS	15% fell in past year	37% lived alone 56% married
Logan 2010	204	82.5	65	99% White	53% Unskilled workers or never worked	100% fell in past 3 months; 72% had ≥2 falls in past 3 months 2	56% of intervention and 66% of control lived alone
Palvanen 2014	1,314	77.6	86%	100% White	All participants were retired and received state benefits	36% fell in past 6 months	Mean number of medications= 5.6
Salminen 2009	591	74	84%	100% White	27% education >6th grade 72% completed 6th grade 2% education <6th grade All participants were retired	100% fell in past year 41% fell once in past year	53% lived alone 45% married
Smulders 2010	96	71	94%	100% White	NA	100%	
Spice 2009	375	82	74%	Most were White	NA	100% ≥2 falls in past year	59% lived alone
Tinetti 1994	301	78	69%	NA	31% education >HS	43% fell in past year	44% married
Wagner 1994	1,559	73	59%	93% White	25% education >16 years 35% income <$15,000	33% fell in past year	

**No information available*

Table 2. Study Methodology

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Clemson 2004	Sydney, Australia	Community residents recruited through referrals, advertisements, & community organizations	Age >70, had fell in past year or had a fear of falling, spoke English	Cognitively impaired or homebound	No
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Participants mailed in a pre-addressed, stamped calendar each month.	14 months	Fall rate, overall	RR[b] = 0.69 (0.50–0.96)	None
			Fall rate, males	RR[b] = 0.32 (0.17–0.59)	
			Fall rate, females	RR[b] = 0.96 (0.50–1.85)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Davison 2005	Newcastle, United Kingdom	Community seniors treated in EDs for a fall were mailed a survey to determine their fall hx. Repeat fallers were recruited by telephone.	Age >65 treated in ED for a fall or fall injury, & who had a fall in past year	Cognitively impaired, had >1 previous episode of syncope, immobile, blind, aphasic, or had a clear medical explanation for their fall	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Participants completed weekly fall diaries that they returned every month for 12 months. After 1 year, all participants' hospital records were reviewed for falls.	12 months	Number of falls	RR[d] = 0.64 (0.46–0.90)	None
			Number of fallers	RR[d] = 0.95 (0.81–1.12)	
			Neck or femur fractures	RR[d] = 0.48 (0.04–5.29)	
			Other fracture	RR[d] = 0.53 (0.20–1.39)	
			Fall-related ED visit	RR[d] = 0.90 (0.55–1.47)	
			Fall-related hospital admission	RR[d] = 0.80 (0.41–1.56)	

[a] *Incidence Rate Ratio* [b] *Relative Rate* [c] *Hazard Ratio* [d] *Relative Risk* [e] *Rate Ratio per 1,000 hrs of activity* [f] *Odds Ratio*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Day 2002	Melbourne, Australia	Identified from electoral roll & through general practitioners. Subjects were sent letters & then contacted by telephone.	Age ≥70, owned or leased home & able to make home modifications	Planning to move w/in 2 years; recent physical activity w/ a balance component; unable to walk 10–20 m w/o rest, help, or angina; severe respiratory or cardiac disease; cognitively impaired; made recent major home modifications; or did not have physician approval	No
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly calendar postcards completed daily & returned by mail. If not received within 5 working days after end of month, participant was interviewed by telephone.	18 months	Fall rates	Exercise alone: RR[b] = 0.82 (0.70–0.97) Exercise + vision: RR[b] = 0.73 (0.58–0.91) Exercise + home mod: RR[b] = 0.76 (0.60–0.95) Exercise + vision + home mod: RR[b] =0.67 (0.51–0.88)	None

[a] *Incidence Rate Ratio* [b] *Relative Rate* [c] *Hazard Ratio* [d] *Relative Risk* [e] *Rate Ratio per 1,000 hrs of activity* [f] *Odds Ratio*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Hornbrook 1994	Portland, Oregon & Vancouver, Washington metro area, United States	Members of a Kaiser Permanente HMO were recruited by mail	Age ≥65 & ambulatory	Blind, deaf, housebound, terminally ill, non-English speaking, severely mentally ill, not willing to travel or lived >20 mi. from research center	Yes Also "near falls"
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Fall reported by postcard immediately. Participant interviewed by telephone about circumstances & consequences. Monthly diaries monitored quarterly by mail or telephone for self-reported falls, fall injuries & medical care.	24 months	Fall risk, overall	OR = 0.85 ($p<0.05$)	None
			Fall risk, males	OR = 0.82 ($p<0.05$)	
			Fall risk, males age 75+	OR = 0.53 ($p<0.05$)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Logan 2010	Nottinghamshire, UK	Nottinghamshire, UK; w/in primary trust of Nottingham City, Rushcliffe, Broxtowe and Hucknall, and Gedling. Includes city, suburban, and rural populations. Recruited over 16 months beginning in Sep 2005	Age ≥60, in the geographic area of interest, had called the East Midland Ambulance Service because of a fall but was not taken to the hospital	Unable to give consent, too ill to participate, or already in a falls prevention rehabilitation program	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly fall diary w/ telephone follow-up if needed	12 months	Fall rate	IRR[a]=0.45 (0.35–0.58)	None
			Time to first fall	HR[c] 0.20 (0.23–0.44)	
			Number of fallers	RR[d]=0.56 (0.78–0.94)	

[a] *Incidence Rate Ratio* [b] *Relative Rate* [c] *Hazard Ratio* [d] *Relative Risk* [e] *Rate Ratio per 1,000 hrs of activity* [f] *Odds Ratio*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Palvanen 2014	Tampere and Lappeenranta, Finland	Referred to clinic by self, relative or primary care doctor	Community-dwelling aged ≥70, 1 fall risk factor: mobility issues, ≥3 falls in past 12 months, previous fracture, hip fracture in 1st degree relative, osteoporosis, low body weight, or illness that increased the risk of falls, fracture or osteoporosis	Inability to give consent, disabilities that prevented physical activity, or terminal illness	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Collected every 3 months using telephone interviews & during clinic visits.	12 months	Fall rate	IRR[a]=0.72 (0.61–0.91)	None
			Fall rate	HR[c]=0.78 (0.67–0.91)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Salminen 2009	Pori, Finland	Announcements in local newspapers, pharmacies, health centers, hospitals, & private clinics; also through written invitations from health professionals	Age 65+, ≥1 fall in past year, little or no cognitive impairment (MMSE ≥17), living in community or in housing that provided occasional assistance	Cognitively impaired, unable to walk 10 m independently w/ or w/o walking aids	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Participants mailed fall diaries monthly. If one was not received, participants were reminded by telephone. Participants also reported falls as they occurred by phone to research assistants.	12 months	Fall rate for participants w/ ≥3 falls in previous year	IRR[a] = 0.59 (0.38–0.91)	2 participants stopped while exercising because they felt unwell 3 falls w/o injury occurred during exercise
			Fall rate for participants w/ more symptoms of depression	IRR[a] = 0.50 (0.28–0.88)	

[a] *Incidence Rate Ratio* [b] *Relative Rate* [c] *Hazard Ratio* [d] *Relative Risk* [e] *Rate Ratio per 1,000 hrs of activity* [f] *Odds Ratio*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Smulders 2010	Nijmegan, Netherlands	Identified from databases of DXA scans, mail to members of Dutch Osteoporosis Patient Council, by advertising	Age ≥65, community-dwelling, w/ osteoporosis (DXA femoral neck or lower back T-score -2.5), 1 fall in past year, & able to walk 15min w/o a walking aid	Severe cardiac, pulmonary, or musculoskeletal disorders or disorders associated w/ higher fall risk (e.g. neurologic disorders)	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly fall calendar w/ follow-up phone call if necessary	12 months	Fall rate	RR[b]= 0.61 (0.40–0.94)	None
			Number of fallers	RR[d]= 0.87 (0.56–1.34)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Spice 2009	Nijmegan, Netherlands	Identified from databases of DXA scans, mail to members of Dutch Osteoporosis Patient Council, by advertising	Age ≥65, community-dwelling, w/ osteoporosis (DXA femoral neck or lower back T-score -2.5), 1 fall in past year, & able to walk 15min w/o a walking aid	Severe cardiac, pulmonary, or musculoskeletal disorders or disorders associated w/ higher fall risk (e.g. neurologic disorders)	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Monthly fall calendar w/ follow-up phone call if necessary	12 months	Fall rate	RR = 0.76 (0.58–0.98)	None
			Fall per person-week	RR = 0.69 (0.52–0.90)	

[a] *Incidence Rate Ratio* [b] *Relative Rate* [c] *Hazard Ratio* [d] *Relative Risk* [e] *Rate Ratio per 1,000 hrs of activity* [f] *Odds Ratio*

Table 2. Study Methodology, Continued

Study	Location	Study Population & Recruitment	Inclusion Criteria	Exclusion Criteria	Defined Falls
Tinetti 1994	Southern Connecticut, United States	Members of an HMO, contacted first by letter & then screened by telephone	Age ≥70, ambulatory in own home, had at least 1 of 9 risk factors (postural hypotension, used sedatives, ≥4 medications, inability to transfer, gait impairment, loss of strength or range of motion, home hazards)	Cognitively impaired or had participated in vigorous sports or walking for exercise in past month	No
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	A monthly falls calendar was returned by mail. If not received or if it indicated a fall, participant was interviewed by telephone.	12 months	Fall rate	RR = 0.76 (0.58–0.98)	None
			Fall per person-week	RR = 0.69 (0.52–0.90)	
Study	**Location**	**Study Population & Recruitment**	**Inclusion Criteria**	**Exclusion Criteria**	**Defined Falls**
Wagner 1994	Seattle, Washington, United States	Random sample of HMO members sent an introductory letter followed by a mail questionnaire	Age 65+, ambulatory, & independent in ADLs	Institutionalized or seriously ill	Yes
	Method of Recording Falls	**Length of Follow-up**	**Measured Outcomes**	**Results***	**Adverse Effects**
	Mailed survey at baseline, at 1 & 2 years. If not returned, participants were interviewed by telephone. Fall injuries were identified through self-report & hospital discharge files.	24 months	Difference in % falling		None
			Falls, Year 1	9.3% (4.1–14.5)	
			Falls, Year 2	+2.2% n.s	
			Falls w/ injury, Year 1	-4.6% (p<0.01)	
			Falls w/ injury, Year 2	+3.3% n.s.	

[a] *Incidence Rate Ratio* [b] *Relative Rate* [c] *Hazard Ratio* [d] *Relative Risk* [e] *Rate Ratio per 1,000 hrs of activity* [f] *Odds Ratio*

Table 3. Intervention Characteristics

Study	Focus	Providers	Structure	Number of Sessions	Provider Contact Time
Clemson 2004	Learn fall prevention techniques, improve self-efficacy, & make behavioral changes	Occupational therapist & team of trained content experts	Small group classes	7 weekly 2-hour classes 1 home visit 6 weeks after the final class 1 booster session 3 months after the final class 1 medical assessment	Classes: 14 hours Home visit: 1 to 1½ hours Booster: 1½ hours
Close 1999	Identify medical risk factors & home hazards, provide referrals & recommendations to reduce fall risk, & improve home safety	Physician & occupational therapist	One-on-one	1 home assessment 1 medical assessment	Home assessment: 1 hour Medical assessment: 45 minutes
Davison 2005	Identify & modify each participant's fall risk factors	Physician, physical therapist, & occupational therapist	Hospital-based medical exam & treatment followed by PT & OT in-home assessments & risk factor reduction	2 hospital sessions 2 physical therapy visits 1 occupational therapy visit w/ 1 follow-up visit 15 weekly 1-hour classes	Medical assessment: 1 hour Medical intervention: 20 minutes PT assessment: 45 minutes PT intervention: 15 minutes OT assessment: 45 minutes Follow-up visit: 20 minutes Classes: 15 hours
Day 2002	Improve strength & balance, improve poor vision, & reduce home hazards	State accredited trained for the intervention	Group exercise classes	Vision assessment & treatment, home assessment & modification	Vision management: NA Home modification: NA

Table 3. Intervention Characteristics, Continued

Study	Focus	Providers	Structure	Number of Sessions	Provider Contact Time
Hornbrook 1994	Reduce risky behaviors, improve physical fitness, & reduce home hazards	BA-level assessor trained for intervention, a health behaviorist, & a physical therapist	Group exercise classes & home visits	4 weekly 1½-hour classes (incl. 20 minutes group exercise) 2 15-minute home visits	Classes: 6 hours Home visits: ½ hour
Logan 2010	Reduce risky behaviors, improve physical fitness, & reduce home hazards	Occupational therapist, physical therapist, & nurse	One-on-one w/ optional group classes	12 twice weekly 2-hour classes 6 or more 1-hour PT home visits 11 home assessment 1 medical assessment	Classes: 24 hours Physical therapy: 6 hours Home assessment: 1 hour Medical Assessment: 1 hour
Palvanen 2014	Identify & modify each participants fall risk factors	A physician, PT, & nurse	Assessment: One-on one Intervention: varied by type of intervention	Assessment: 3 hours Intervention: varied by type & number of interventions received	Varied
Salminen 2009	Assess & address each participant's fall risk factors, improve physical fitness, provide information & counseling on fall prevention, assess & modify home hazards, & provide psychological support	Geriatrician, trained public health nurse, trained nursing students, physical therapist, & various health professionals	One-on-one combined w/ group classes	1 fall risk assessment 1 counseling & information session 1 home assessment 12 1-hour health lectures 12 1-hour psychosocial group sessions 45- to 50-minute group exercise classes every 2 weeks for 26 weeks Home exercises 3 times a week for 52 weeks	Risk assessment: 45 minutes Counseling: 45 minutes Home assessment: 45 minutes Health lectures: 12 hours Psychosocial group sessions: 12 hours Exercise classes: 10–11 hours

Table 3. Intervention Characteristics, Continued

Study	Focus	Providers	Structure	Number of Sessions	Provider Contact Time
Smulders 2010	Improve balance, decrease fall risk, & improve quality of life for women w/ osteoporosis.	A physical therapist & occupational therapist	Group education & exercises	11 sessions comprised of education, exercise & obstacle course navigation	Sessions: 18 ½ hours
Spice 2009	Assess fall risk factors & provide individualized interventions	Doctor, nurse, physical therapist, & occupational therapist	One-on-one assessment w/ follow-up interventions	1 fall risk assessment Length & number of subsequent sessions varied by type of intervention(s)	Risk assessment: 2 hours Intervention: varied
Tinetti 1994	Identify & modify each participant's fall risk factors	Medication adjustments coordinated w/ participant's primary physician, exercise conducted by PT	Varied by type of intervention	Varied by type & number of interventions received	Varied
Wagner 1994	Reduce disability &/or falls by addressing 6 specific risk factors	Specially trained nurse-educator	Home visit w/ follow-up behavioral intervention	1 initial interview Length & number of subsequent sessions varied by type of intervention(s)	Initial interview: 1 to 1½ hours Intervention: varied

Appendix A: Intervention Study Selection Process

In 2003, the RAND Corporation was commissioned by the Centers for Medicare and Medicaid Services (CMS) to review and analyze the existing research on fall prevention interventions. They conducted a comprehensive literature search and reviewed 826 intervention studies, of which 95 met the following selection criteria: (1) included adults aged ≥65 years; (2) used a randomized controlled trial or controlled clinical trial study design; (3) identified falls as an outcome; and (4) measured the number of falls at least three months after the start of the intervention. Of the 95 studies, 57 had falls as a primary outcome and 38 of the 57 reported either the number of subjects who fell at least once or the monthly rate of falling. RAND included these 38 studies in their meta-analyses to determine the effectiveness of fall prevention interventions (categorized as exercise, education, environmental modification, or multiple component interventions).

Beginning with the 38 studies RAND included in their meta-analysis (used by permission, L. Rubenstein, personal communication), CDC identified those that met the following inclusion criteria: (1) included community-dwelling adults aged ≥65 years; (2) used a randomized controlled study design; (3) measured falls as a primary outcome; and (4) demonstrated statistically significant positive results for at least one fall outcome (e.g., showed statistically fewer falls for intervention participants). As illustrated in Figure 1, CDC excluded one study that focused on nursing home residents, four that did not include falls as a primary outcome, and 25 that did not demonstrate statistically significant, positive results. Of the remaining eight, two described the same study and were combined. Lastly, CDC identified seven studies published after the RAND Report that met the established criteria. In total, the first edition of the *Compendium* included 14 studies published before December 31, 2004.

Updates in the Second Edition

In 2009, CDC undertook to update the original *Compendium*. A comprehensive literature search of randomized controlled trials of fall interventions published between January 1, 2005 and December 31, 2009 identified 86 studies. As Figure 2 illustrates, two interventions were excluded because they were already in the *Compendium*. Of the remaining 84 studies, CDC excluded 20 that were not randomized controlled trials, 15 that did not focus on community-dwelling adults aged ≥65 years, 27 that did not include falls as a primary outcome, and 14 that did not demonstrate statistically significant, positive results. In total, eight studies published between January 2005 and December 2009 were added to the *Compendium*.

Updates in the Third Edition

n 2014, CDC updated the *Compendium* again by conducting a comprehensive literature search of randomized controlled trials of fall interventions. The search included literature published between January 1, 2009 and August 31, 2014.

MEDLINE was searched using the following terms "fall and prevention OR accidental falls [MESH]" AND "randomized control trial OR controlled clinical trial" AND "Aged". MEDLINE search identified 386 studies. PubMed was searched using the same criteria and identified two additional, unique interventions for a total of 388.

As Figure 2 illustrates, 39 interventions were excluded as duplicate listings in MEDLINE and 171 were excluded because they were not fall intervention studies (excluded studies included: cost-benefit analyses, fall RCT protocol papers, drug trials where falls were a side effect, and cross-sectional papers that used RCT data). Of the remaining 178 studies, CDC excluded two that were already in the *Compendium*, 91 that did not include falls as an outcome (e.g., outcome measured changes in gait and balance, fear of falling, or scores on functional tests were used as proxy for fall risk), nine that were not randomized controlled trials or did not have adequate control groups (intervention did not have a placebo or usual care group e.g. compared in-person Tai Chi to a Tai Chi video intervention), 25 that did not focus on community-dwelling adults aged ≥60 years, and 36 that did not demonstrate statistically significant, positive results. In situations where the same research group had published a pilot intervention and a subsequent follow-up and both were effective at reducing falls, the follow-up paper is included and the pilots are listed as supplemental materials; three pilot interventions were excluded for this. Lastly CDC used the 2012 Cochrane review to identify clinically focused interventions that had previously been excluded. There were seven studies that met the criteria and have been added to this edition of the *Compendium*. In total, 19 studies, were added to the *Compendium*.

Figure 1. Flow chart showing the selection process for studies used in the first edition of the *Compendium*

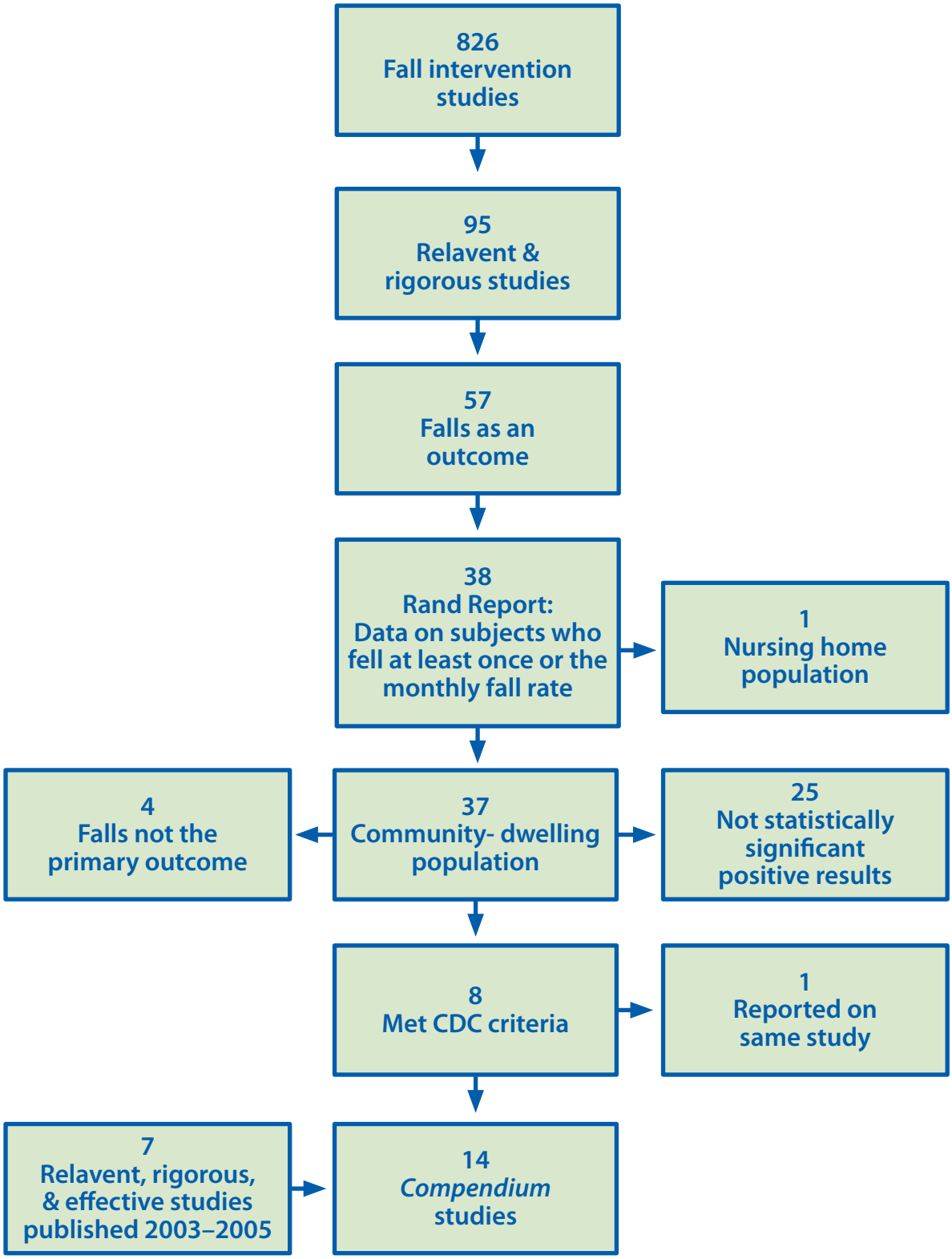
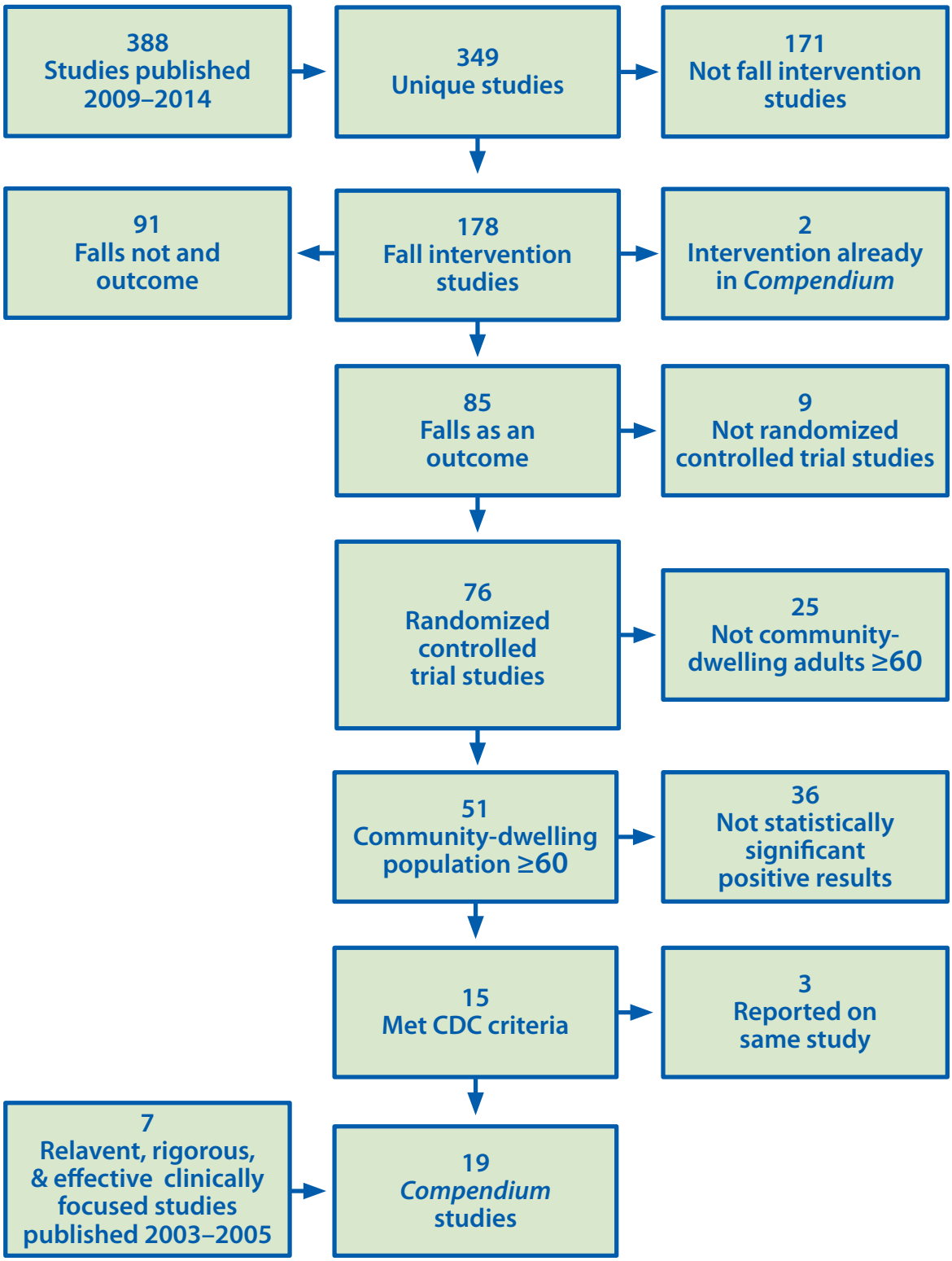


Figure 2. Flow chart showing the selection process for studies used in the third edition of the *Compendium*



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**Supplemental Article*

Appendix C: Original Intervention Materials

Appendix C-1 Barnett Materials Exercises

1.Warm Up

Breathe in deeply through nose, lift arms above head and stretch. Lower arms and breathe out 6 times.

2. Shoulder rolls (flexibility)

Gently rotate shoulders up to ceiling, backwards, and down. Then reverse: up, forward and down. 6 times each way.

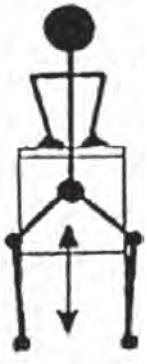
3. March on spot (mobility)

Hold onto chair with 2 hands. Walking on the spot. Try to lift knees a bit higher than usual. Step 10 times with each leg.

4. Ankle (strength)

Hold onto chair. Rise up onto toes of both feet, hold for 5 seconds, then lower. Keep heels on the floor and lift toes off the floor; hold for 5 seconds. Repeat both movements 6 times.

5. Knee bend (strength)

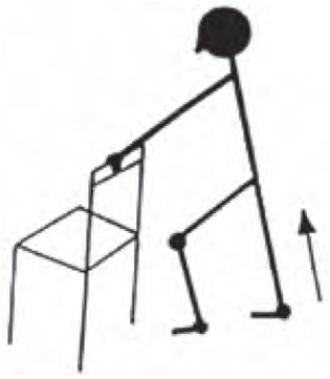


Hold onto chair. Stand with knees soft and back straight. Keeps knees pointing over toes. Bend your knees gently, and then raise your body by straightening your knees. Do this 6 times.

6. Sit to Stand (strength)

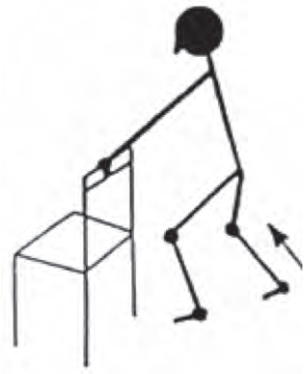
Sit in chair against wall. Stand up without using your hands 6 times. If this is too hard, use a pillow on the chair to start until you get stronger.

7. Calf (stretch)



Hold onto chair; stretch one leg behind, toes facing forward, gently bend front knee until you feel a stretch in your calf. Hold stretch for 10 seconds. Do 6 stretches.

8. Calf (stretch)



Hold onto chair, stretch as in previous exercise. When you feel the stretch in your back calf, keep the heel of that foot on the ground, and slightly bend the back knee.

General Information on Exercise

As we age our muscles tend to become less flexible and strong, and our joints become stiffer. This can affect our balance. Exercise is the best way to improve strength and mobility. Greater strength and mobility means you may be able to recover your balance if you lose it, therefore avoiding a fall.

Tips for Exercising

- Wear comfortable clothes and shoes
- Drink some water before and after the exercise.
- Do exercises slowly and gently
- If you feel pain STOP that exercise and discuss with your exercise leader or project manager
- If you feel breathless or dizzy, STOP and rest.

Well done. You have now completed all the exercises. If you have any questions or concerns regarding the exercise program please don't hesitate to contact your gentle exercise leader or project manager.

Stage 1 Home Program—Stay Safe Stay Active: Falls Prevention in Primary Care 2001, SWSAHS

Stay Safe Stay Active Daily Exercise Program (Stage 1)

1. Warm up

2. Shoulder rolls (Flexibility)

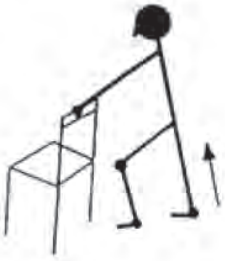
3. March on spot (mobility)

4. Ankle (strength)

5. Knee bend (strength)

6. Sit to Stand (strength)

7. Calf (stretch)



8 Calf (stretch)

Thank you Sally Castell for your diagrams

Stay Safe Stay Active Daily Exercise Program (Stage 2)

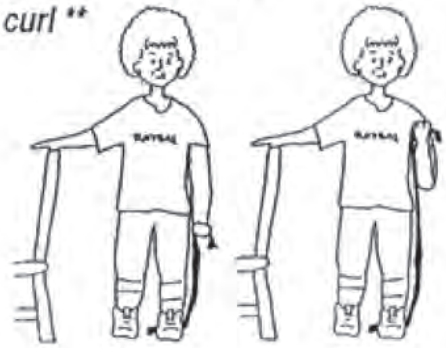
1. Hip to the side *

2. Foot Circles *

3. Lift leg backwards *

4. Shoulder blade exercises**

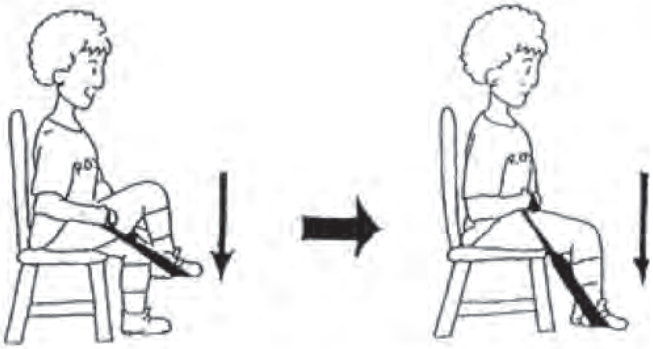
5. Arm curl **



6. Knees in and out **

7. Ankle Pumps **

8. Hip extension **



Thank you to Stay on Your Feet* and Roybal - Boston University** for allowing us to use your diagrams

Stay Safe Stay Active Daily Exercise Program (Stage 2)

1. **Medications**
   Discuss with GP or Pharmacist if you feel they may be causing drowsiness or dizziness.
2. **The environment**
   Loose rugs, slippery surfaces, unsecured cords, poor lighting especially at night, and spills of water or grease, all increase the risk of falling. Try and clear away clutter, especially where you need to walk, and secure rugs with grippers to the floor. Mop up any spills immediately.
3. **Shoes**
   Wear non-slip shoes that fit well, and have laces or Velcro fastening. Shoes with medium or low heels, which are rounded, are better than high thin heels. Slippers and thongs are not a good idea, as they do not offer enough support. Be careful of wet or slippery surfaces.
4. **Hearing**
   A loss of hearing can cause dizziness and balance problems, see your GP if this occurs. It could be something as simple as a lump of wax.
5. **Vision**
   Adequate lighting is very important, do not forget to turn the light on if you get up at night, or keep a nightlight on - keep your glasses by your bed! Bifocals can make going up and down stairs difficult as they alter the perception of where the stair edges are. When walking outside in the sun it is useful to wear a broad rimmed hat, it helps you pick up contrasts on the ground such as steps and edges. Remember to have annual eye tests, as this can detect any changes in your vision.
6. **Good diet**
   Eat a well balance diet, and don't allow yourself to become too thin.
7. **Colds/Sinus**
   If you have a cold or sinus problems then take extra care as this can affect your balance.
8. **Walking aid**
   If you use a walking aid, make sure the rubber on the bottom is not worn, and keep it by your bed at night in case you need to get up.

   If you do fall in the house do not panic. Stay still for a few minutes to get over the shock. If you are OK try to slide yourself over to a sturdy piece of furniture, sofa, bed or chair and position yourself along side of it. Get into a kneeling position and gradually push yourself up and sit down until you recover. If you are unable to move try to cover yourself with something to keep warm until help arrives.

Appendix C-2 Kovacs Materials

Exercises	Purpose	Means of progression and adaptation
First part: Structured exercises with music chosen by participants		
Lift arms over head Lower arms to side and reach toward the floor	Strengthening of trunk muscles Posture correction	Increase repetitions from 4–8
Standing		
Steps in multiple directions	BOS[1] change	Amount of support Increase repetitions and speed of stepping
Reaching overhead and to side behind a chair	COG[2] change in direction of reach	Amount of support Increasing distance of reaching
Partial squats	Strengthen lower limb muscles	Increase repetitions from 4–8
Turning while standing	Functional activity	Increase repetition and turning speed
Tandem standing	Decrease of BOS[1] while standing	Increase duration
Sit to stand and stand to sit	Functional activity	Increase repetitions
Stepping in place with high knees	BOS[1] change in dynamic context	Increase height of stepping
Second part: physical activity chosen by participants: relay race OR ballgames		
Heel walking Toe walking Walking on line	BOS[1] change in functional context	Increase distance
Walking on exercise mat	Walking on uneven terrain	Increase distance Decrease mat stiffness
Slalom walking between cones	BOS[1] change in functional context	Increase number of cones Decrease distance between cones
Walking backward		Increase distance
Picking up and transferring objects placed on the floor	Ankle and hip balance strategy training involving practicing dual task	Change size and weight of objects
Stepping in and out of hoops placed on the floor	BOS[1] change in functional context	Increase number of hoops and decrease distance between hoops
Ballgames		
Catching and throwing balls in different directions	Vestibular stimulation Multiple task activity	Decreasing size and increasing weight of the ball. Begin with a balloon then progress to heavier and smaller balls. The speed of the game will increase
Adapted basketball	Vestibular stimulation Multiple task activity	Increase length of play and size of course

[1]BOS: Base of Support [2]COG: Center of Gravity

Appendix C-3 Voukelatos Materials

Tai Chi Principles for Falls Prevention in Older People

The following notes are suggestions for incorporation into a Tai Chi program specifically targeting falls prevention in older people.

BALANCE—the key element to preventing a fall

Balance has been shown to decrease with age; however, some aspects of balance can be enhanced through training.

Key elements to incorporate into a Tai Chi program

Relaxation → relaxes muscles → lowers center of gravity

Lowered center of gravity → increases load on lower limbs → over time increases sensation and awareness of lower limb movement.

Transfer of weight

Shifting body weight from leg to leg through incremental movements. Start with a small range of movement and gradually build up to a wide, square base stance.

Muscle strength

Muscle bulk and therefore strength decrease with age. A bent knee stance and movement works to strengthen lower limb muscle (particularly the quadriceps muscles) (however, always work to an individual's limitations. If a bent knee stance is too difficult, then do the movement without bent knees).

Instability

This involves issues such as increased body sway, low mobility, and postural instability. Increasing age is also associated with reduced sensation in lower limbs and is consequently associated with a loss of righting reflexes and an increase in body sway, which can lead to falls.

Gait: decreased stepping height and decreased stride length.

Women tend to have a narrow walking and standing base, closer foot placement, erect posture → difficult to step down from stools/benches.

Men tend to have a small-stepped gait, wider walking and standing base, and stooped posture.

Tai Chi addresses gait problems by teaching "correct" movement of lower limbs. This is done by lifting lower limbs from the knee rather than the foot; lifting lower limbs without misaligning the pelvis; and teaching to place heel down first when moving forward (toes first when moving back). Also, teaching movement with appropriate weight transfer, posture, and slightly bent knees improves stride length.

Posture: Tai Chi also teaches participants to maintain a relaxed posture with an elongated spine.

Coordination/Mobility: Tai Chi consists of a moving from one stance to another in a slow, coordinated, and smooth way. This trains students in improved mobility and increased body awareness.

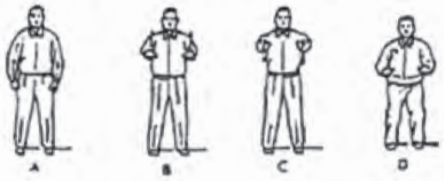
Guidelines for Instructors Working with Older People

- Important to maintain an upright (straight) posture at all times.
- Incremental movement is needed in teaching older people.
- Instructors need to be well aware of an individual's comfort level and not go beyond that.
- In bent knee stance, must remember to introduce bent knee gradually throughout the 16-week period while staying within comfort levels of individuals.
- Remember to keep the center line of gravity as perpendicular as possible and center within the base stance.
- Tai Chi leaders also have to be mindful of any medical or physical conditions students might have that would interfere with standard Tai Chi movements. For example, if a practitioner has had a hip replacement then the range of movements involving hips may be limited.

Appendix C-4 Wolf Materials

Directions and Therapeutic Elements for Learning 10 Forms of Tai Chi

FORM 1. OPENING FORM



FORM 2

FORM 3

FORM 4

FORM 5

FORM 6

FORM 7

FORM 8

FORM 9

FORM 10

FORM 1. Directions

1. Stand upright with feet shoulder-width apart, toes pointing forward, arms hanging naturally at sides. Look straight ahead (1A).
2. Raise arms slowly forward to shoulder level, palms down.

   The hands do not go above the shoulders and the elbows are held in (1B & 1C).
3. Bend knees as you press palms down gently, with elbows dropping towards knees. Look straight ahead (1D).

FORM 1. Therapeutic elements 3, 4

This "warm-up" form begins with non-stressful bilateral stance where all thoughts other than those about movement clear the head. Attention is directed to relaxing all muscles except those of the legs—the feet are to "stick to the ground." As movement begins, concentration is directed to move all four extremities at the same constant speed that begins and ends concomitantly in the arms and legs.

FORM 2. Directions

The body is turned slightly to the left, with left foot at 9 o'clock for a left bow stance. The left forearm and back of hand are at shoulder level, while right hand is at the side of fight hip, palm down. Look at left forearm (2A). Turn torso slight to left (9 o'clock) while extending left hand forward, palm down. Turn torso slightly right while pulling both hands down in a curve past abdomen, until right hand is extended sideways at shoulder level, palm up, and left forearm is across chest, palm turned inward. Shift weight onto right leg. Look at right hand (2B). past face, palm turned slowly outward, while left hand moves in a curve past abdomen up to shoulder level with palm turned slowly obliquely inward (4B & 4C).

FORM 2. Therapeutic elements 1–7

The trunk and head rotate while both feet remain on floor. The arms move in asymmetrical positions so that the center of mass is extended further from left to right due to arm positions. The trunk and head are kept erect so that rotation is around a central axis. The body weight is predominantly on a flexed leg for greater balance and strength mechanism.

FORM 3. Directions

Look straight ahead; face 9 o'clock with weight on left leg in a bow stance and hands forward at shoulder height in a pushing position (3A). Turn both palms downward as right hand passes over left wrist, moves forward, then to the right until it is on the same level with left hand. Separate hand shoulder-width apart and draw them back to the front of abdomen, palms facing obliquely downward. At the same time, sit back and shift weight onto right leg, slightly bent, raising toes of left foot. Look straight ahead (3B & 3C).

FORM 3. Therapeutic elements 1–4 & 7

The body center of mass moves diagonally posteriorly than other forms with a decreased base of support from only heel contact of the left leg, demanding greater balance and strength than the previous form. The trunk rotation is decreased and the arm movement is symmetrical

FORM 4. Directions

Turn torso to the left (10–11 o'clock), shifting weight to left leg. Move left hand in a curve past face with palm turned slowly leftward, while right hand moves up to the front of left

shoulder with palm turned obliquely inward. As right hand moves upward, fight foot and left foot are parallel and 10 to 20cm apart. Look at right hand (4A). Turn torso gradually to the right (1 to 2 o'clock), shifting weight onto right leg.

At the same time, move right hand continuously to right

While the legs are symmetrical, weight is shifted laterally. The arms are asymmetrical, the trunk and had rotate with arm movement. Both knees are flexed and weight shifts to the leg on the side to which the arms are moving.

FORM 5. Directions

Turn torso slightly to the fight, moving right hand down in a curve past abdomen and then upward to shoulder level, palm up and arm slightly bent. Turn left palm up and place toes of left foot on floor. Eyes first look to the right as body turns in that direction, and then to look at left hand (5A & 5B).

FORM 5. Therapeutic elements 1–7

Again a smaller base of support with the majority of weight on one extremity. The arm on the weight bearing side is curved back into shoulder extension. Done on the right leg and then reversed and done on the left leg. Again trunk rotates at the end of the movement.

FORM 6.Directions

Hold torso erect and keep chest relaxed. Move arms in a curve without stretching them when you separate hands. Use waist as the axis in body turns. The movements in taking a bow stance and separating hands must be smooth and synchronized in tempo. Place front foot slowly in position, heel coming down first. The knee of front leg should not go beyond toes while rear leg should be straightened, forming a 45 with ground. There should be a transverse distance of 10 to 30cm between heals. Face 9 o'clock in final position.

FORM 6. Therapeutic elements 1–7

Hand assumes a position of holding a ball initially. Movements in the form are diagonals and rotations of the trunk and head. Movements slide back and forth in and out of 6A and 6B, and then position is reversed for right and left.

FORM 7. Directions

Turn torso to the right (11 o'clock) as right hand circles up to ear level with arm slightly bent and palm facing obliquely upward, while left hand moves to the front of the right part of chest, palm facing obliquely downward. Look at right hand (7A). Turn torso to the left (9 o'clock) as left foot takes a step in that direction for a left bow stance. At the same time, right hand draws leftward past right ear and, following body turn, pushes forward at nose level with palm facing forward, while left hand circles around left knee to stop beside left hip, palm down. Look at fingers of right hand (7B & 7C).

FORM 7. Therapeutic elements 1–7

This form begins in the position of 7 A, but with both feet flat on the floor. They remain on the floor throughout the exercise. Move in and out of the position 7 A, B, C, A, B, C, then reverse right-left positions.

FORM 8. Directions

Continue to move hands in a downward-inward-upward curve until wrists come in front of chest, with right hand in front and

both palms turned inward. At the same time, draw right foot to the side of left foot, toes on floor. Look forward to the right (SA). Separate hands, turning torso slightly to S o'clock and extending both arms sideways at should level with elbows slightly bent and palms turned outward. At the same time, raise right knee and thrust foot gradually towards 10 o'clock. Look at right hand (8B & 8C).

FORM 8. Therapeutic elements 1–7

With the elderly, the kick is only a small part of their available range. The form is utilized for kicking with both dorsiflexion and plantar flexion of the foot. Forms 8 and 9 are the most stressful for maintaining balance due to the small base of support and the extreme movement of the kicking leg. However, forms are done continuously with slow movements and a strong degree of concentration. The range for the kick is not extreme in the elderly.

FORM 9. Directions

Shift weight onto right leg and draw left foot to the side of right foot, toes on floor. At the same time, move both hands in a downward-inward-upward curve until wrists cross in front of chest, with left hand in front and both palms facing inward. Look forward to the left (9A & 9B). Separate hands, extending both arms sideways at shoulder level, elbows slightly bent and palms facing outward. Meanwhile, raise left knee and thrust foot gradually towards 4 o'clock. Look at left hand (9C & 9D).

FORM 9. Therapeutic elements 1–7

The same as Form S but right and left are reversed.

FORM 10. Directions

Turn palms forward and downward while lowering both hands gradually to the side of hips. Look straight ahead (10A, 10B & 10C).

FORM 10. Therapeutic elements

This is a warm-down form like Form 1 and constitutes both a physical and mental ending of the exercise.

Materials reprinted with permission from Wolf SL, Coogler C, Xu T. Exploring the basis for Tai Chi Chuan as a therapeutic exercise approach. Archives of Physical Medicine and Rehabilitation. 1997;78:886–892.

Appendix C-5 Haran Materials

The optometrist re-administering the tests of depth perception (figure A) and distance edge contrast sensitivity (Figure B) with participants viewing the visual stimuli through upper and lower portion of their multifocal lenses and distance lenses. A chin rest was used to prevent neck flexion, thereby forcing the person to look through the lower portion of the multifocal lens during testing.

FIGURE A—DEPTH PERCEPTION—HOWARD-DOHLMAN device at 3 meters

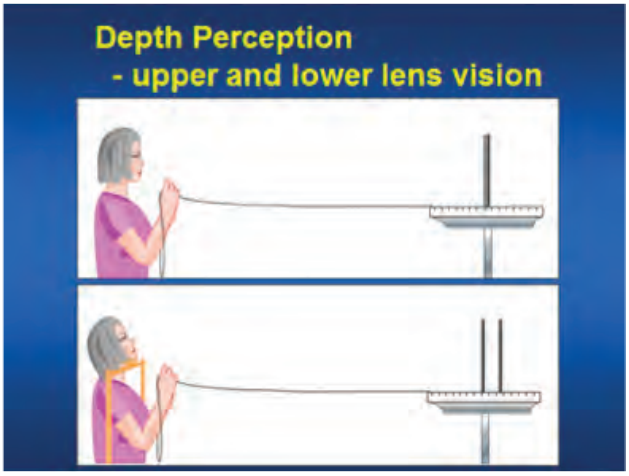


Figure B—VISUAL CONTRAST—135 cm Melbourne Edge Test

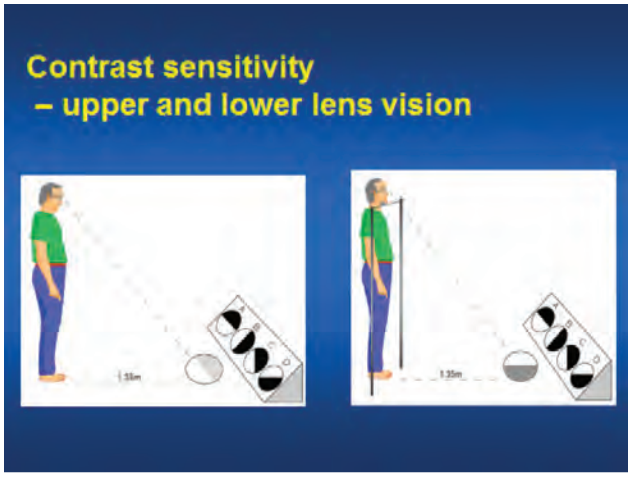


FIGURE C—Streetscape

Image A

Image B

Figure C. Simulated view of street scenes as viewed through single lens distance glasses and bifocal glasses. The footpath misalignment (the commonest reported environmental factor involved in outdoor falls) is clearly seen in Image A but blurred in Image B.

FIGURE D—View of shaded stairs

a) Seen through distance glasses

b) Seen through bifocal glasses

SIDE 1 of card

When to use your new DISTANCE GLASSES:

- Walking on stairs indoors and outside
- Getting into or out of a vehicle
- Walking in a street or shopping centre
- Walking in buildings other than your home
- Walking in gardens or on uneven ground

(Please turn over)

SIDE 2 of card

Use your BI, TRI & MULTIFOCALS when:

- Walking in your own home on level ground
- Sitting at a desk, table or on a lounge
- Driving
- Working at a bench
- Selecting items from a shelf

Appendix C-6 Pit Materials

The University of Newcastle

Medication Review Checklist - Aged 65+

(to be completed by patient's usual GP)

Practice Record

Patient details:

Name:

Date of review _____ DOB _____ Male ☐ Female ☐

Who manages drugs? Self/ spouse/family/nurse/other

Name and contact details carer _____

Allergies _____

History of Averse Drug Reaction (ADR): _____

BP sitting _____ BP standing: _____

Medication review conducted as part of (please tick ✓)*:

Health Assessment at Practice (Item 700)	☐	Case conference (items 740-773)	☐
Regular check up consultation at practice	☐	DVA health assessment	☐
Specific medication review consultation at practice	☐	Health Assessment in home(Item 702)	☐
Regular check up consultation home visit	☐	Specific medication review consultation home visit	☐
Care planning (Item 720-728)	☐		
Other (specify) _____	☐		

** Checklist always to be completed by patient's usual GP.*

1. Awareness of all medications used

How many drugs are prescribed by you or other doctors? ☐

How many of the prescribed drugs does patient use? ☐

How many non prescription drugs, including OTCs and complementary ("herbal") medicines does patient use? ☐

2. Compliance issues (tick if done ✓)

Did you ask patient to explain what each drug is for? ☐

Did you ask patient how s/he takes each drug? ☐

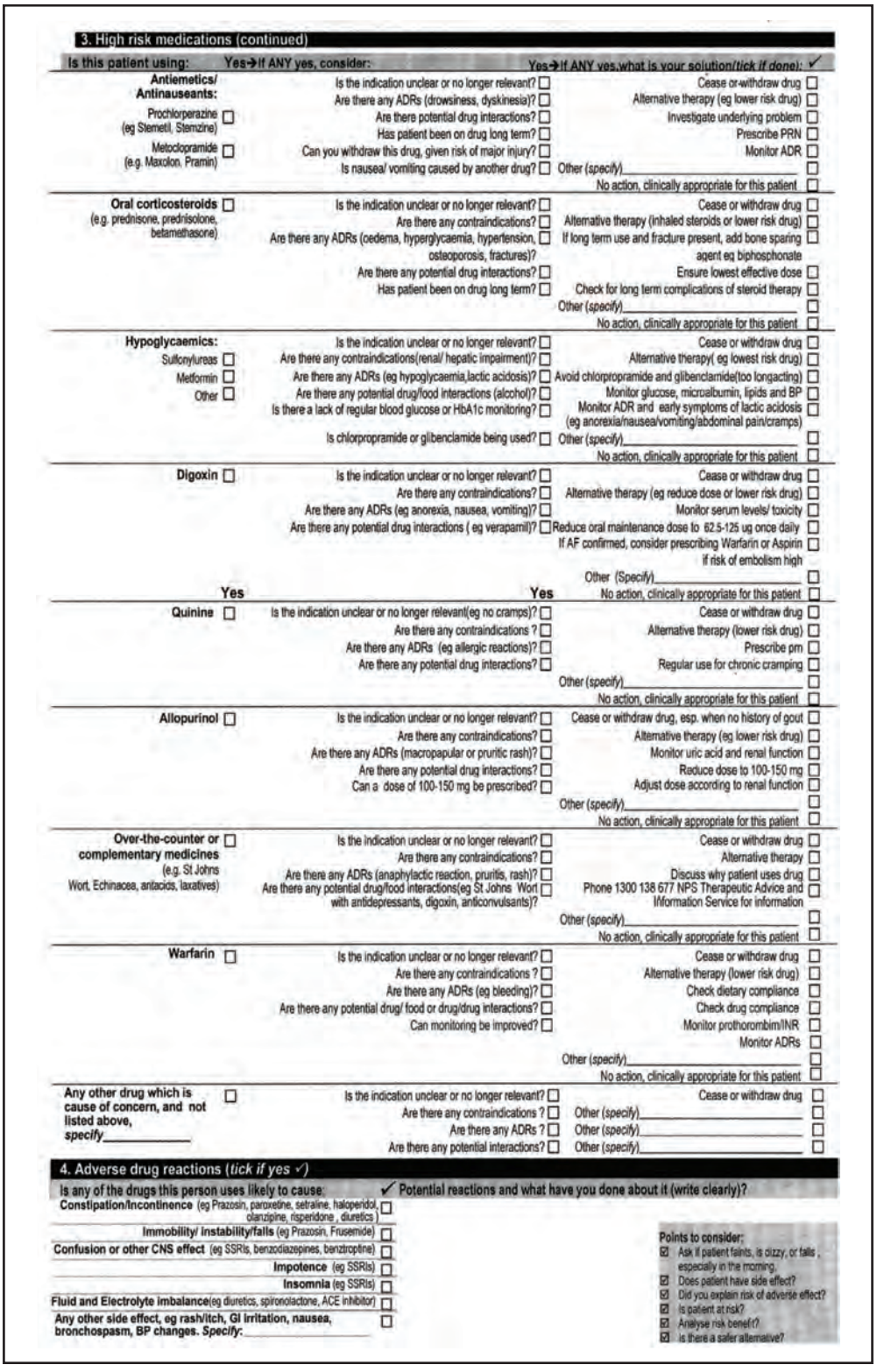
2. Compliance issues

For any drug, is this person:	No	Yes➡ If ANY yes, what is your solution *(tick if done ✓)*:	
Having trouble remembering to take the drug	☐	☐	Generate medication card ☐
Having trouble knowing why s/he takes the drug	☐	☐	Simplify: reduce frequency of dosing and number of medications ☐
Having trouble taking multiple/some or all of the medications	☐	☐	Offer alternatives(eg change timing, ask spouse to help reminding to take drug, brand substitution) ☐
Having trouble taking drug because of an adverse reaction(ADR)	☐	☐	Explain the need for drug ☐
Having trouble affording the medications	☐	☐	Check technique ☐
Having trouble reading the label	☐	☐	Alternative devices ☐
Having trouble understanding the label	☐	☐	Refer to Community Pharmacist (may recommend to use different bottle) ☐
Having trouble opening, applying or inhaling the drug	☐	☐	Compliance aids (eg Webster Pack) ☐
Other, *(please specify)*_____	☐	☐	Education including written information ☐
Would this patient benefit from a medication card?	☐	☐	Consumer Medicines Information ☐
Does person take some drugs in a different manner to how they were prescribed?	☐	☐	Other, please specify_____ ☐

3. High risk medications

Is patient using:	Yes ➡If ANY yes, consider all of these:	Yes ➡If ANY yes,what is your solution *(tick if done)*✓
Benzodiazepines ☐ **TCAs** ☐ **SSRIs** ☐ **Antipsychotics** ☐ **Other sedatives/ hypnotics/ tranquilizer/ antidepressants** ☐	Is the indication unclear or no longer relevant? ☐ Are there any contraindications? ☐ Are there any ADRs(eg falls, drowsiness, post. hypotension)? ☐ Are there potential drug interactions(eg 2 psychotropics)? ☐ Can you withdraw this drug, given risk of major injury ? ☐ Is patient **unaware** of risk? ☐ Has patient been on drug long term? ☐ Would patient benefit from a 6 monthly review of the socio-psychological situation? ☐ Would patient benefit from non-drug therapy? ☐	Cease or withdraw drug ☐ Alternative therapy (e.g. lower risk drug) ☐ If benzodiazepine and appropriate, prescribe PRN ☐ Non-drug treatment (eg sleep advise) ☐ Monitor side effects ☐ Trial withdrawal for long-term benzodiazepine users ☐ Other *(please specify)*_____ ☐ No action, clinically appropriate for this patient ☐
NSAIDs ☐ **Selective COX_2 inhibitor** ☐ **Other analgesics** ☐	Is the indication unclear or no longer relevant? ☐ Are there any contraindications? ☐ Are there any ADRs (hypertension, gastric bleeding, oedema, CHF, renal failure)? ☐ Are there any potential drug interactions (eg diuretics)? ☐ Is higher risk NSAID being used(eg piroxicam/ ketoprofen)? ☐ Is there another more appropriate drug(eg paracetamol)? ☐ Is drug used continuous or long term? ☐ Has patient been taking this drug continuously since it was first prescribed? ☐	Cease or withdraw drug ☐ Non drug treatment (eg physiother., exercise/ rest, weight loss) ☐ Use lower risk drug (ibuprofen or diclofenac) for NSAIDs/ COX_2 users and monitor effectiveness ☐ Prescribe regular paracetamol with lower dose NSAIDs ☐ Prescribe NSAIDs PRN ☐ Patients with osteoarthritis: use paracetamol+ top up with NSAIDs ☐ Perform N of 1 trials to prove patient which drug actually works ☐ Other *(please specify)*_____ ☐ No action, clinically appropriate for this patient ☐
Loop diuretics ☐ **Thiazide diuretic** ☐ **Potassium chloride** ☐ **Potassium sparing diuretic** ☐	Is the indication unclear or no longer relevant? ☐ Are there any relative contraindications(eg gout, diabetes)? ☐ Are there any ADRs (eg electrolyte imbalance)? ☐ Are there potential drug interactions(eg combination of thiazide diuretics, ACE inhibitor and NSAIDs/ COX2s)? ☐ Are K sparing diuretics, K supplements or ACE inhibitors being used together? ☐ Can a lower effective maintenance dose be prescribed (eg <25mg for hydrochlorthiazide for hypertension)? ☐	Cease or withdraw drug ☐ Alternative therapy ☐ Monitor renal function and electrolytes ☐ Reduce dose ☐ Administer in the morning to avoid diuresis interfering with sleep ☐ Other *(please specify)*_____ ☐ No action, clinically appropriate for this patient ☐
Beta blockers ☐ **Alpha blockers** ☐ **ACE inhibitors** ☐ **Calcium channel blockers** ☐	Is the indication unclear or no longer relevant? ☐ Are there any contraindications (eg asthma, COPD for beta blockers)? ☐ Are there any ADRs (eg syncope, postural hypotension)? ☐ Are there any potential drug interactions (eg betablockers and calcium channel blockers)? ☐	Cease or withdraw drug ☐ Alternative therapy ☐ Reduce dose ☐ Monitor electrolytes ☐ Other *(please specify)*_____ ☐ No action, clinically appropriate for this patient ☐
H_2 antagonists ☐ **Proton pump inhibitors** ☐	Is the indication unclear or no longer relevant? ☐ Are there any potential drug interactions? ☐ Can you try to withdraw this drug? ☐	Cease or withdraw drug ☐ Investigate underlying problem ☐ Helico bacter Pylori eradication therapy ☐ Other (specify)_____ ☐ No action, clinically appropriate for this patient ☐

**If the patient is using more than 1 drug in one class, and if one of the issues to consider applies to one drug but not the other drug, please tick yes.*



3. High risk medications (continued)

Is this patient using:	Yes→If ANY yes, consider:	Yes→If ANY yes,what is your solution/*tick if done*): ✓
Antiemetics/ Antinauseants:	Is the indication unclear or no longer relevant? ☐ Are there any ADRs (drowsiness, dyskinesia)? ☐ Are there potential drug interactions? ☐ Has patient been on drug long term? ☐ Can you withdraw this drug, given risk of major injury? ☐ Is nausea/ vomiting caused by another drug? ☐	Cease or withdraw drug ☐ Alternative therapy (eg lower risk drug) ☐ Investigate underlying problem ☐ Prescribe PRN ☐ Monitor ADR ☐ Other (*specify*)_____ ☐ No action, clinically appropriate for this patient ☐
Prochlorperazine (eg Stemetil, Stemzine) ☐ Metoclopramide (e.g. Maxolon, Pramin) ☐		
Oral corticosteroids ☐ (e.g. prednisone, prednisolone, betamethasone)	Is the indication unclear or no longer relevant? ☐ Are there any contraindications? ☐ Are there any ADRs (oedema, hyperglycaemia, hypertension, osteoporosis, fractures)? ☐ Are there any potential drug interactions? ☐ Has patient been on drug long term? ☐	Cease or withdraw drug ☐ Alternative therapy (inhaled steroids or lower risk drug) ☐ If long term use and fracture present, add bone sparing agent eg biphosphonate ☐ Ensure lowest effective dose ☐ Check for long term complications of steroid therapy ☐ Other (*specify*)_____ ☐ No action, clinically appropriate for this patient ☐
Hypoglycaemics: Sulfonylureas ☐ Metformin ☐ Other ☐	Is the indication unclear or no longer relevant? ☐ Are there any contraindications(renal/ hepatic impairment)? ☐ Are there any ADRs (eg hypoglycaemia,lactic acidosis)? ☐ Are there any potential drug/food interactions (alcohol)? ☐ Is there a lack of regular blood glucose or HbA1c monitoring? ☐ Is chlorpropramide or glibenclamide being used? ☐	Cease or withdraw drug ☐ Alternative therapy(eg lowest risk drug) ☐ Avoid chlorpropramide and glibenclamide(too longacting) ☐ Monitor glucose, microalbumin, lipids and BP ☐ Monitor ADR and early symptoms of lactic acidosis (eg anorexia/nausea/vomiting/abdominal pain/cramps) ☐ Other (*specify*)_____ ☐ No action, clinically appropriate for this patient ☐
Digoxin ☐	Is the indication unclear or no longer relevant? ☐ Are there any contraindications? ☐ Are there any ADRs (eg anorexia, nausea, vomiting)? ☐ Are there any potential drug interactions (eg verapamil)? ☐	Cease or withdraw drug ☐ Alternative therapy (eg reduce dose or lower risk drug) ☐ Monitor serum levels/ toxicity ☐ Reduce oral maintenance dose to 62.5-125 ug once daily ☐ If AF confirmed, consider prescribing Warfarin or Aspirin if risk of embolism high ☐ Other (Specify)_____ ☐ No action, clinically appropriate for this patient ☐
Yes	**Yes**	
Quinine ☐	Is the indication unclear or no longer relevant(eg no cramps)? ☐ Are there any contraindications ? ☐ Are there any ADRs (eg allergic reactions)? ☐ Are there any potential drug interactions? ☐	Cease or withdraw drug ☐ Alternative therapy (lower risk drug) ☐ Prescribe prn ☐ Regular use for chronic cramping ☐ Other (*specify*)_____ ☐ No action, clinically appropriate for this patient ☐
Allopurinol ☐	Is the indication unclear or no longer relevant? ☐ Are there any contraindications? ☐ Are there any ADRs (macropapular or pruritic rash)? ☐ Are there any potential drug interactions? ☐ Can a dose of 100-150 mg be prescribed? ☐	Cease or withdraw drug, esp. when no history of gout ☐ Alternative therapy (eg lower risk drug) ☐ Monitor uric acid and renal function ☐ Reduce dose to 100-150 mg ☐ Adjust dose according to renal function ☐ Other (*specify*)_____ ☐ No action, clinically appropriate for this patient ☐
Over-the-counter or complementary medicines ☐ (e.g. St Johns Wort, Echinacea, antacids, laxatives)	Is the indication unclear or no longer relevant? ☐ Are there any contraindications? ☐ Are there any ADRs (anaphylactic reaction, pruritis, rash)? ☐ Are there any potential drug/food interactions(eg St Johns Wort with antidepressants, digoxin, anticonvulsants)? ☐	Cease or withdraw drug ☐ Alternative therapy ☐ Discuss why patient uses drug ☐ Phone 1300 138 677 NPS Therapeutic Advice and Information Service for information ☐ Other (*specify*)_____ ☐ No action, clinically appropriate for this patient ☐
Warfarin ☐	Is the indication unclear or no longer relevant? ☐ Are there any contraindications ? ☐ Are there any ADRs (eg bleeding)? ☐ Are there any potential drug/ food or drug/drug interactions? ☐ Can monitoring be improved? ☐	Cease or withdraw drug ☐ Alternative therapy (lower risk drug) ☐ Check dietary compliance ☐ Check drug compliance ☐ Monitor prothorombim/INR ☐ Monitor ADRs ☐ Other (*specify*)_____ ☐ No action, clinically appropriate for this patient ☐
Any other drug which is cause of concern, and not listed above, *specify*_____ ☐	Is the indication unclear or no longer relevant? ☐ Are there any contraindications ? ☐ Are there any ADRs ? ☐ Are there any potential interactions? ☐	Cease or withdraw drug ☐ Other (*specify*)_____ ☐ Other (*specify*)_____ ☐ Other (*specify*)_____ ☐

4. Adverse drug reactions (*tick if yes* ✓)

Is any of the drugs this person uses likely to cause:	✓ Potential reactions and what have you done about it (write clearly)?
Constipation/Incontinence (eg Prazosin, paroxetine, setraline, haloperidol, olanzipine, risperidone , diuretics) ☐	
Immobility/ instability/falls (eg Prazosin, Frusemide) ☐	
Confusion or other CNS effect (eg SSRIs, benzodiazepines, benztroptine) ☐	
Impotence (eg SSRIs) ☐	
Insomnia (eg SSRIs) ☐	
Fluid and Electrolyte imbalance(eg diuretics, spironolactone, ACE inhibitor) ☐	
Any other side effect, eg rash/itch, GI irritation, nausea, bronchospasm, BP changes. *Specify*: _____ ☐	

Points to consider:
- ☑ Ask if patient faints, is dizzy, or falls , especially in the morning.
- ☑ Does patient have side effect?
- ☑ Did you explain risk of adverse effect?
- ☑ Is patient at risk?
- ☑ Analyse risk benefit?
- ☑ Is there a safer alternative?

		Yes	No	Don't know
1. How old are you? ☐ years. Are you *(please tick ☑)*: Male ☐ Female ☐				
2. Do you have 3 or more health conditions? *(please tick ☑)*		☐	☐	☐
3. In general, would you say your health is poor?		☐	☐	☐
4. Have you changed your general practitioner in the past 3 months?		☐	☐	☐
5. Do you have more than one doctor involved in your care, including other general practitioners or specialists?		☐	☐	☐
6. Have you been in hospital, hostel or nursing home in the past month?		☐	☐	☐
7. Do you live alone?		☐	☐	☐
8. Have you had a fall in the past 12 months?		☐	☐	☐
9. In the last month have you:	had trouble sleeping	☐	☐	☐
	felt drowsy or dizzy	☐	☐	☐
	Felt nauseous	☐	☐	☐
	Had stomach problems	☐	☐	☐
	Had a skin rash or itch	☐	☐	☐
	leaked urine	☐	☐	☐
	Been constipated	☐	☐	☐
10. How many medicines do you use? *(Write number in box.)* ☐				

Medicines includes all medicines prescribed by your doctor or any other doctor, including specialists, medicines bought from your chemist, supermarket or health food store, medicines you take only occasionally, herbal medicines, vitamins, minerals, puffers, creams, patches, eye drops, and laxatives.

If you do NOT take any medicines, then there is no need to fill in the rest of this page.

		Yes	No	Don't know
11. Have you started a new medicine in the last 4 weeks?		☐	☐	☐
12. Do you use:	Any medicine that helps you sleep	☐	☐	☐
	Any medicines for your nerves, stress, anxiety or depression	☐	☐	☐
	Any medicines your doctor does not know about	☐	☐	☐
13. Have you been taking any medicines for more than 6 months?		☐	☐	☐
14. For any medicine, you currently use, do you have any:				
	trouble with side effects	☐	☐	☐
	trouble remembering to take the medicine	☐	☐	☐
	trouble knowing what your medicine is for	☐	☐	☐
	trouble using many medicines at once	☐	☐	☐
	trouble affording the medicine	☐	☐	☐
	trouble reading the label	☐	☐	☐
	trouble understanding the label	☐	☐	☐
	trouble opening bottles or packets/ applying the medicine	☐	☐	☐
15. Have you had more than 4 changes to your medicines in the past 12 months?		☐	☐	☐
16. Do you share medicines among family and friends?		☐	☐	☐
17. Has your doctor asked you to bring ALL your medicines to an appointment so he can have a look at them, in the past 12 months?		☐	☐	☐

Please give all forms to your doctor.

DOCTOR'S USE ONLY:	Medication Review beneficial: Yes/ No.	Patient agrees: Yes/ No

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Appendix C-7 Spink Materials

Appendix 1: FOOTWEAR ASSESSMENT TOOL

1. FIT

Foot length ☐ ***Thumb width*** ☐

Fit of shoe (length) – rule of thumb (wearer's thumb)

Palpation:	good ☐	too short (< ½ thumb) ☐	too long (> 1 ½) ☐
Straw =	good ☐	too short (< ½ thumb) ☐	too long (> 1 ½) ☐

Fit of shoe (width) – grasp test	good ☐	too narrow ☐	too wide ☐
Fit of shoe (depth)	good ☐	too shallow ☐	

2. GENERAL

Age of shoe 0 – 6 months ☐ 6 – 12 months ☐ > 12 months ☐

Footwear style

walking shoe ☐	athletic shoe ☐	oxford shoe ☐	moccasin ☐
boot ☐	ugg-boot ☐	high heel ☐	Thong/flip-flop ☐
slipper ☐	backless slipper ☐	court shoe ☐	mule ☐
sandal ☐	surgical/bespoke ☐	other (specify) ☐	

Materials (upper)	leather ☐	synthetic ☐	mesh ☐	other	
Materials (outsole	rubber ☐	plastic ☐	leather ☐	other	

Weight ☐ ***Length*** ☐ ***Weight/length*** ☐

3. GENERAL STRUCTURE

Heel height =

0 – 2.5 cm ☐ 2.6 – 5.0 cm ☐ > 5.0 cm ☐

Forefoot height (measured at point of the 1st and MTPJs) =

0 – 0.9 cm ☐ 1.0 – 2.0 cm ☐ > 2.0 cm ☐

Longitudinal profile (heel – forefoot difference) =

flat (0 – 0.9 cm) ☐ small heel rise (1 – 3 cm) ☐ large heel rise (> 3 cm) ☐

Last (centre goniometer at 50% shoe length) =

straight (< 5°) ☐ semi-curved (5 – 15°) ☐ curved (> 15°) ☐

Fixation of upper to sole

board ☐ combination ☐ slip-lasted ☐

Forefoot sole flexion point

at level of MTPJs ☐ proximal to 1st MTPJ ☐ distal to 1st MTPJ ☐

4. MOTION CONTROL PROPERTIES

Density single ☐ dual ☐

Fixation none ☐ laces ☐ straps/buckles ☐ Velcro ☐ zips ☐
Number of eyelets ☐

Heel counter stiffness (20mm above bottom or upper)
no heel counter ☐ minimal (> 45°) ☐ moderate (< 45°) ☐ rigid (0-10°) ☐

Midfoot sole sagittal stability
minimal (> 45°) ☐ moderate (< 45°) ☐ rigid (0-10°) ☐

Midfoot sole frontal stability (torsional)
minimal (> 45°) ☐ moderate (< 45°) ☐ rigid (0-10°) ☐

5. CUSHIONING

Presence none ☐ heel ☐ heel/forefoot ☐

Lateral Midsole hardness	soft		firm		hard	
Durometer readings	1st		2nd		3rd	mean
Medial Midsole hardness	soft		firm		hard	
Durometer readings	1st		2nd		3rd	mean
Heel sole hardness (centre of inside heel shoe interface)	soft		firm		hard	
Durometer readings	1st		2nd		3rd	mean

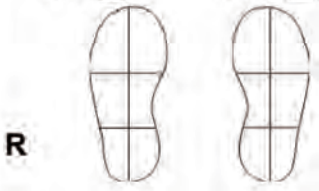
6. WEAR PATTERNS

Upper medial tilt (> 10°) ☐ neutral ☐ lateral tilt (> 10°) ☐

Midsole medial compression signs ☐ neutral ☐ lateral compression signs ☐

Tread pattern ***A*** textured ☐ smooth (i.e. no pattern) ☐
B not worn ☐ partly worn ☐ fully worn ☐

Outsole wear pattern none ☐ normal ☐ lateral ☐ medial ☐



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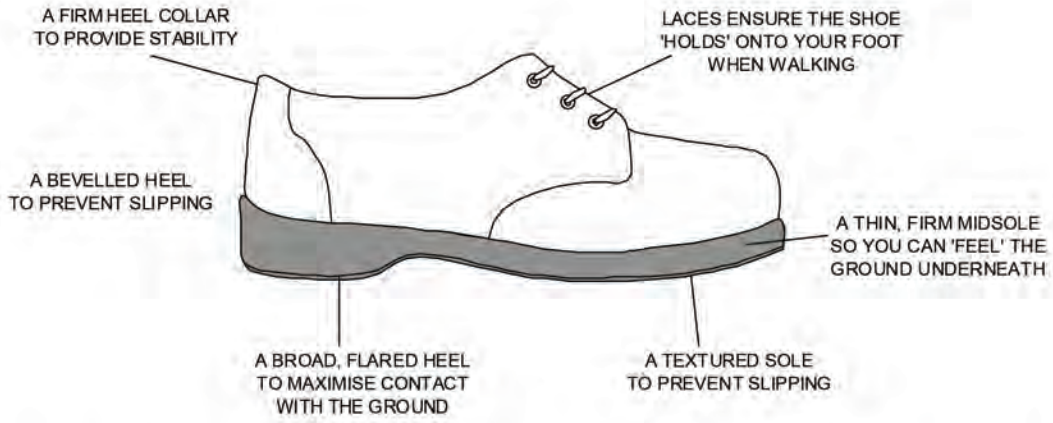
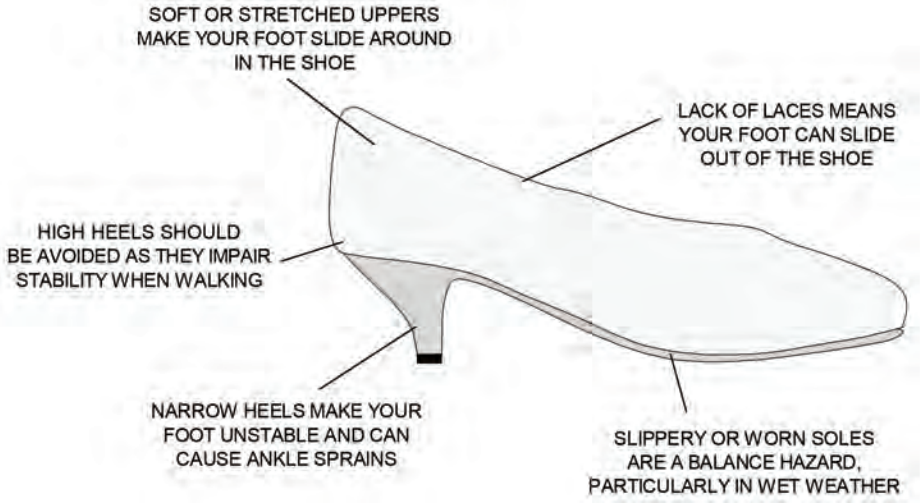
3. Safe shoe information

What makes a shoe safe ?



What makes a shoe unsafe ?



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5. Exercise Program

Increased strength and range of motion of the joints has been shown to prevent falls.

You have been given the following exercise program to perform to help improve your strength and movement in the feet and ankles. Please perform this **three times a week** on days that are convenient to you.

The following pages contain instructions and pictures describing the exercises that were demonstrated to you at the appointment. Please use the instructions and pictures to help you as you perform your exercise program. If you have a DVD player at home, you would have been also given an accompanying instructional DVD for the program.

You may experience some muscles soreness from doing your exercises. This is normal with any strengthening program. If the muscle soreness makes it uncomfortable to continue with the exercises, stop them for a couple of days until you feel better, then resume again.

If the soreness does not improve after 48 hours, or if the soreness interferes with your ability to sleep, stand or walk, stop all exercises and contact Martin Spink on **9479 5258**.

Remember to tick the days on the exercise calendar that you performed the exercise program.

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FALLS TRIAL HOME EXERCISE PROGRAM

WARM UP EXERCISE

1. Ankle circling

INSTRUCTIONS

Setup

1. Sit comfortably in a chair with both feet on the ground.

Clockwise circling exercise

1. Lift one foot off the ground and hold it up in the air.
2. Using slow and gentle movements, rotate ankle and circle foot in a clockwise direction, making as large a circle as possible.
3. Repeat 10 circles in clockwise direction, then place foot down to rest.
4. Lift the other foot off and repeat 10 clockwise circles using this foot.

Anti-clockwise circling exercise

1. Lift the first foot off the ground again and hold it up in the air.
2. This time, rotate the ankle and circle the foot in an anti-clockwise direction again making as large a circle as possible.
3. Repeat 10 circles in an anti-clockwise direction and then place the foot down to rest.
4. Lift the other foot off and repeat 10 anti-clockwise circles using this foot.

Dosage

Do only 1 set of 10 circles in each direction on each foot.

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THERABAND EXERCISES

Attaching your theraband

Theraband

You have been provided with a piece of theraband that has been double-looped and knotted at its ends.

Attach the theraband loop around the leg of a sturdy table as shown:

1. Hold the double-looped theraband horizontal to the table leg with the knotted end pointing away from the table.

2. Loop the knotted end over the smooth end.

3. Pull the smooth end through and tighten the theraband around the table leg to ensure that it is secure.

Resistance

Start with _____ theraband.

Once you can complete all 3 sets of 10 repetitions of the theraband exercises without any difficulty, progress onto _____ theraband

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2. Ankle Inversion (turn-in) Exercise

INSTRUCTIONS

Setup

1. Place chair side-on to the table just behind where the theraband is attached and sit in it with your feet flat on the ground.

Inversion (turn-in) Exercise

1. Loop the free end of the theraband around your foot that is closest to the table, at the level of the base of the toes.

2. Pull your foot away from the table until the band is taut.
3. Place your hands on your exercising knee to prevent the knee from turning during the exercise.

4. Use your foot to pull on the theraband by slowly turning your foot away from the table leg and finishing with the inside sole of your foot off the ground facing away from the table leg.
5. Slowly return the foot back to flat on the ground.
6. Repeat exercise for 10 times.

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3. Ankle Eversion (turn-out) Exercise

INSTRUCTIONS

Eversion (turn-out) Exercise

1. When you have finished with the inversion exercise, remove the theraband from around the inside of your foot and loop it around the outside of your other foot in the same manner, at the level of the base of the toes.

2. Pull your foot away from the table until the band is taut.

3. Place your hands on your exercising knee to prevent the knee from turning during the exercise.

4. Use your foot to pull on the theraband by slowly turning your foot away from the table leg and finishing with the outside sole of your foot off the ground facing away from the table leg.

5. Slowly return the foot back to flat on the ground.

6. Repeat exercise for 10 times.

Dosage

Do 3 sets of 10 repetitions.
Have a 30 second rest in between each set.

Turn the chair around and repeat the movements with the opposite feet. As before start with the inside foot for inversion, then change the theraband to the outside foot for eversion.

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4. Ankle Dorsiflexion (toe-up) Exercise

INSTRUCTIONS

Setup

1. Sit in a chair with both feet flat on the ground.

Exercise

1. Lift your toes on both feet off the ground as high as you can and hold for 10 seconds.
2. Ensure that your heels remain in contact with the ground at all times.

Dosage

Start with 1 set of 3 repetitions, holding for 10 seconds each time.

If you can do 3 repetitions without difficulty or muscle soreness the next day, increase by 1 rep to 4 repetitions of 10 seconds.

Keep increasing the number of repetitions until you reach 10 repetitions. It does not matter if you do not reach 10 repetitions.

You only need to do 1 set of repetitions for this exercise.

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5. Arch Exercise

INSTRUCTIONS

Setup

1. Sit in the chair with your feet on the ground and the ArchExerciser placed close to the exercising foot.

2. Position the exercising foot on the ArchExerciser as shown, with your heel on the grey-pad and your toes over the slider.

Exercise

1. Grip the slider with your toes and pull it back towards the heel by arching the middle of your foot.
2. Do not allow the heel to slide backwards or lift off the grey-pad.
3. Pull the slider back as far as possible, then slowly release it by relaxing your foot.
4. Repeat 10 times.

Dosage

Do 3 sets of 10 repetitions on each foot.

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6. Toe Strengthening Exercise

INSTRUCTIONS

Picking up marbles with toes

Setup

1. Sit comfortably in a chair.
2. Place 20 marbles on the floor and an empty container by the side of the marbles.

Exercise

1. Use your toes to pick up a marble off the floor.

2. Release it into the container.
3. Keep picking up the marbles with your toes until all 20 marbles have been picked up and released into the container.
4. Tip the marbles out onto the floor again, and repeat the exercise with your other foot.

Dosage

Repeat the exercise twice on each foot, each time picking up 20 marbles.

If you have difficulty with picking up all 20 marbles with your toes, just pick as many as you are able to.

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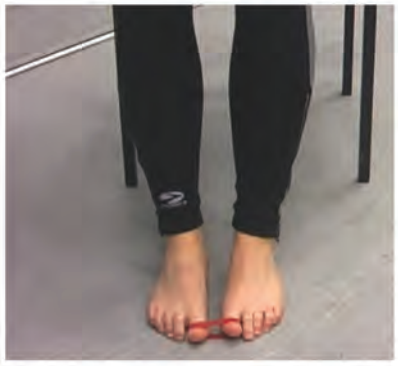
7. Big Toe Stretch

INSTRUCTIONS

Big toe pull

Setup

1. Sit comfortably in a chair.
2. Loop the rubber band provided around both your big toes.



Exercise

1. Slide one foot away from the other until you feel a comfortable stretch in your big toes from the rubber band.
2. Keep both feet on the ground and hold the stretch in the big toes for 20 seconds.
3. Relax and return the foot back to starting position.
4. Repeat 3 times.

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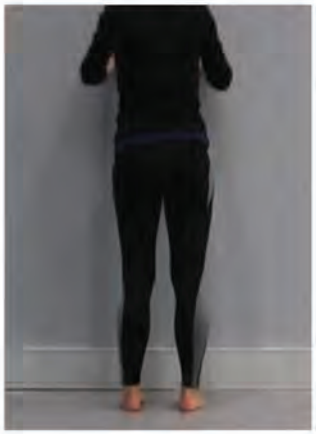
8. Double Heel Raise Exercise

INSTRUCTIONS

Rising up on toes

Setup

1. Stand in front of a wall with hands on the wall for balance with your feet flat on the ground at a comfortable distance apart.



Exercise

1. Slowly rise up onto your toes on both feet.
2. Rise up as high as you can, then slowly lower yourself back down onto the ground.
3. Repeat the exercise for 10 times.

Dosage

Do 3 sets of 10 repetitions.
Have a 30 second rest in between each set.

Progression

Start with 10 repetitions.

Once you can complete all 3 sets of 10 repetitions without any difficulty or soreness next day, increase the number of repetitions by 2 to 12, and do 3 sets of 12 repetitions.

Keep increasing the number of repetitions by 2 up to 50 as you are able to. It does not matter if you cannot go up to 50 repetitions.

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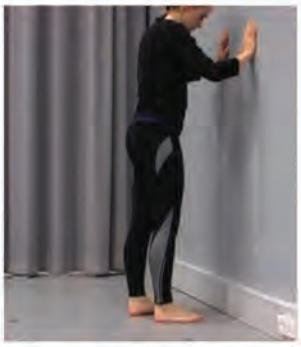
9. Calf Stretch in Standing

INSTRUCTIONS

Setup

1. Stand in front of a wall with your hands on the wall for balance, feet flat on the ground at a comfortable distance apart.



2. Place one foot backwards about a step length.
   Ensure the back heel is flat on the ground at all times.
   Keep your hips, knees and toes pointing forwards and square to the wall at all times.

Stretch

1. Keeping the back leg straight, slowly bend the front knee and bring yourself toward the wall.
2. Lean towards the wall until you feel a stretch in the calf muscle at the back of your leg.
3. If you have gone as far as you can and cannot feel a stretch, move your foot a little further behind and try again.
4. Once you feel a medium-strong stretch in the back leg, stop and hold the stretch for 20 seconds.
5. After 20 seconds, relax and have a little rest. Then repeat the stretch again.
6. Repeat the stretch 3 times on 1 leg. Then change foot by placing the other leg behind and repeat 3 stretches on times on the other leg.

Dosage
Repeat 3 times on each leg or as able.
Hold the stretch for 20 seconds each time.

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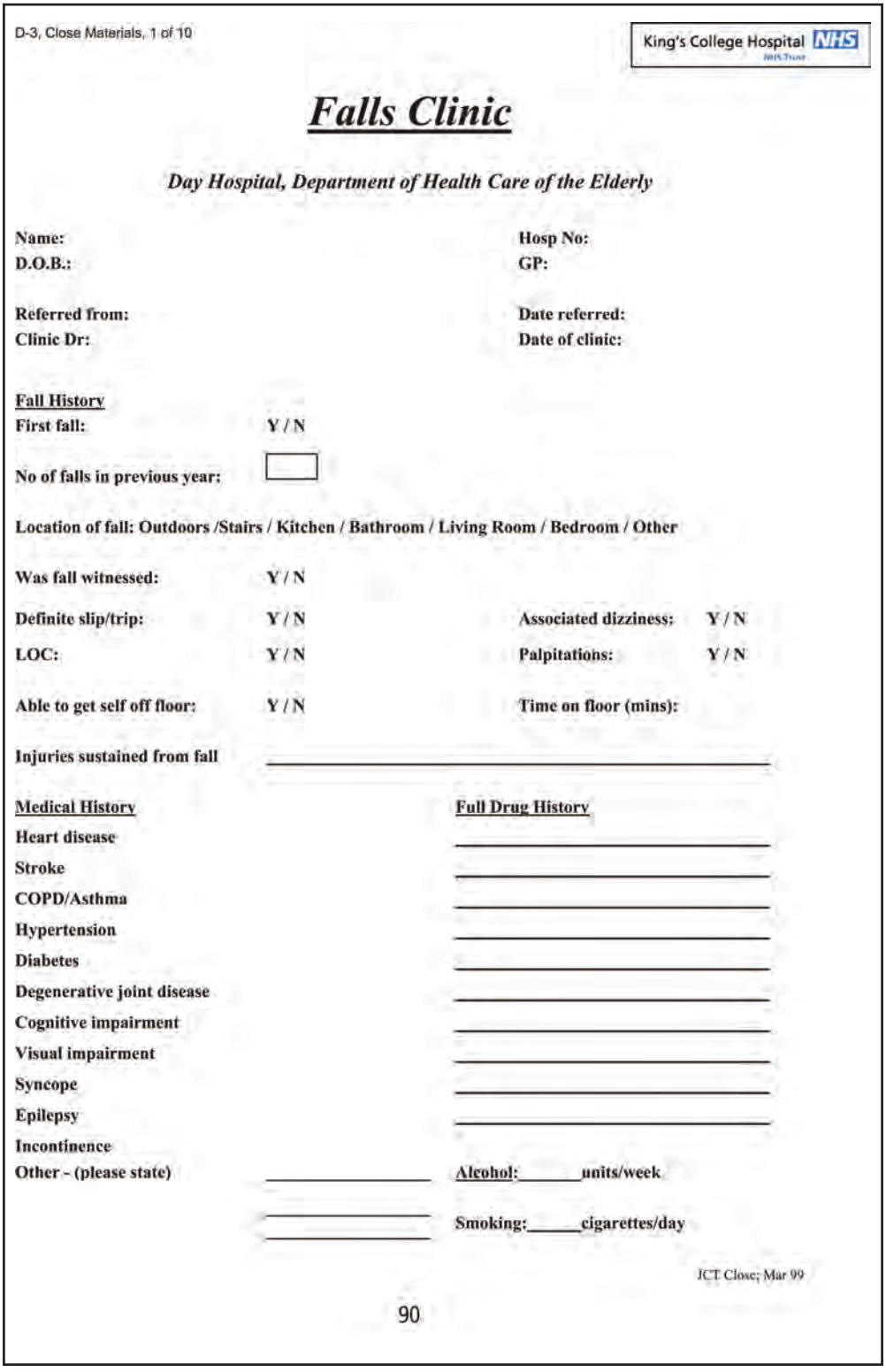
SUMMARY OF EXERCISES AND DOSAGES

Name	Dosage	Increments
1. Ankle Circling Exercise	1 set x 10 circles in each direction on each foot	No increment
2. Ankle Inversion (turn-in) Exercise	3 sets x 10 repetitions on each foot, 30 seconds rest between sets	Increase resistance strength of Theraband™
3. Ankle Eversion (turn-out) Exercise	3 sets x 10 repetitions on each foot, 30 seconds rest between sets	Increase resistance strength of Theraband™
4. Ankle Dorsiflexion (toe-up) Exercise	1 set of repetitions, holding 10 seconds each time	Start with 3 repetitions, increase repetitions by 1 as able until you reach 10 repetitions
5. Arch Exercise	3 sets x 10 repetitions on each foot, 30 seconds rest between sets	Increase amount of slider bar retraction as able
6. Toe Strengthening Exercise (Picking up marbles with toes)	2 sets x 20 marbles on each foot, 30 seconds rest between sets	If you have difficult with picking up marbles, start with picking as many as you can and increase as able up to 20.
7. Big Toe Stretch (Big toe pull)	1 set x 3 repetitions holding 20 seconds each time	Increase distance of toe stretch as able
8. Double Heel Raise Exercise (Rising up on toes)	3 sets x 10 repetitions, 30 second rest between sets	Increase repetitions in each set by 2, up to 50 repetitions as able
9. Calf Stretch in Standing	1 set x 3 repetitions on each leg, holding 20 seconds each time	Increase distance of behind foot as able

Appendix C-8 Close Materials



D-3, Close Materials, 1 of 10

King's College Hospital NHS

Falls Clinic

Day Hospital, Department of Health Care of the Elderly

Name: **Hosp No:**
D.O.B.: **GP:**

Referred from: **Date referred:**
Clinic Dr: **Date of clinic:**

Fall History
First fall: Y / N

No of falls in previous year: ☐

Location of fall: Outdoors /Stairs / Kitchen / Bathroom / Living Room / Bedroom / Other

Was fall witnessed: Y / N

Definite slip/trip: Y / N **Associated dizziness:** Y / N
LOC: Y / N **Palpitations:** Y / N

Able to get self off floor: Y / N **Time on floor (mins):**

Injuries sustained from fall _____

Medical History
Heart disease
Stroke
COPD/Asthma
Hypertension
Diabetes
Degenerative joint disease
Cognitive impairment
Visual impairment
Syncope
Epilepsy
Incontinence
Other - (please state) _____
_____
_____

Full Drug History
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Alcohol:_____**units/week**

Smoking:_____**cigarettes/day**

JCT Close; Mar 99

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D-3, Close Materials, 2 of 10

Social Circumstances

Lives in: Flat / House / Bungalow / WCF / Residential Home / Nursing Home

Lives alone: Y / N **Stairs: Yes / No**

Lambeth / Southwark / Other **Usually able to go out: Yes / No**

Mobility:	**Independent**	**Services:**	**MOW**	**Carer:**	**None**
	Stick		**HH**		**Spouse**
	Frame		**Personal Care**		**Other family**
	Wheelchair		**District Nurse**		**Friend/neighbour**
			Day Centre		
			Day Hospital		

Examination

AMT

Age
Time (to nearest hour)
Address for recall
Year
Location
Recognition of two persons
Date of Birth
WW2
Present monarch
Count backwards 20 – 1

Score:_____ /10 (If <8 do MMSE)

Weight:_____kg
Height: _____m

Pulse: _____bpm
regular / irregular
BP sitting:
BP standing:

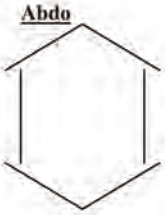
Visual acuity
R Eye
L Eye

CVS:

Carotid bruits: Yes / No
Valvular defect: Yes / No
LVF: Yes / No
RHF Yes / No
CCF Yes / No

RS

Abdo



JCT Close, Mar 98

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D-3, Close Materials, 3 of 10

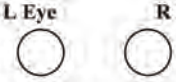
Cranial Nerve Deficit:

_____

_____

_____

Visual Fields: L Eye R Eye



Cataract Formation: Yes / No

Hearing: Normal / Shout / Hearing Aid

PNS:

Tone

R Arm	L Arm
R Leg	L Leg

Reflexes

	R	L
Biceps		
Triceps		
Supinator		
Knee		
Ankle		
Plantars		

Power

Arms	R	L
Shoulder abduction		
Shoulder adduction		
Elbow flexion		
Elbow extension		
Wrist flexion		
Wrist extension		
Finger abduction		
Finger adduction		
Opposition		

Legs	R	L
Hip flexors		
Hip extensors		
Knee flexion		
Knee extension		
Ankle dorsiflexion		
Ankle plantiflexion		

Joint deformities

Hands
Elbows
Shoulders
Spine
Hips Knees
Ankles

Lower limb

Sensation Intact: Yes / No
Proprioception intact Yes / No
Vibration intact Yes / No

Good foot care Yes / No
Sensible footwear Yes / No

Timed Up and Go: _____secs

MMSE (if indicated) _____/30

GDS – 15 Question Form_____/15

JCT Close: Mar 99

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D-3, Close Materials, 4 of 10

Summary

Likely Cause of Fall

_____
_____
_____

Risk Factors for Falls

_____
_____
_____
_____
_____
_____

Planned investigations and/or modifications

_____
_____
_____
_____

Follow up Arrangements

_____
_____

Referrals

FBC **LFT's**

U&E **TFT's**

ECG **Vit D**

Urinalysis

Signature: **Print** **Date:**

JCT Close: Mar 99

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D-3, Close Materials, 5 of 10

PROFET – Environmental Assessment

Name: **Number:**

			At time of fall	In the home	In the environment
Slip Hazards	**1**	Liquid/solid spills			
	2	Wet floors			
	3	Incorrect footwear			
	4	Loose mats on polished floors			
	5	Rain, sleet, snow, ice			
	6	Change from wet to dry surface			
	7	Unsuitable floor surface			
	8	Dusty floors			
	9	Sloping surfaces			
Trip Hazards	**10**	Loose floorboards / tiles			
	11	Loose and worn mats / carpets			
	12	Uneven outdoor surfaces			
	13	Holes / cracks			
	14	Change in surface level – ramps, steps, stairs			
	15	Cables across walking areas			
	16	Obstructions			
	17	Bumps, ridges and protruding nails etc			
	18	Low wall and floor fixtures, door catches, door stops etc.			
Risk Factors	**19**	Organisation of walkways			
	20	Badly placed mirrors / reflections from glazing			
	21	Poor or unsuitable lighting			
	22	Wrong cleaning regime / materials			
	23	Moving goods, carrying, pushing or pulling a load			
	24	Rushing around			
	25	Distractions			
	26	Fatigue			
	27	Effects of alcohol			
	28	Effects of other drugs			
	29	Other factor (describe)			

Close-PROFET.

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D-3, Close Materials, 6 of 10

King's College Hospital NHS

Falls Assessment Proforma

Accident & Emergency, Department of Health Care of the Elderly
Falls Specialist Practitioner – Bleep 929 Mon-Fri

Name: Hosp No Attending Dr

Date of attendance: Time:

Fall History

First fall: Y / N

***No of falls in previous year:** ☐ **(>1 = high risk)**

***Location of fall: Indoors / Outdoors** **(indoors = high risk)**

Was fall witnessed: Y / N

Definite slip/trip: Y / N Associated dizziness: Y / N

LOC: Y / N Palpitations: Y / N

***Able to get self off floor:** Y / N **(N=high risk)** Time on floor (mins):

Medical History ****Full Drug History (4+ meds = high risk)***

Heart disease _____
Stroke _____
COPD/Asthma _____
Hypertension _____
Diabetes _____
Degenerative joint disease _____
Cognitive impairment _____
Visual impairment _____
Syncope _____
Epilepsy _____
Incontinence
Other - (please state) _____

Smoking: no/week

Alcohol: _____units/week

Social Circumstances

Lives in: Flat / House / Bungalow /Maisonette/ WCF / Residential Home / Nursing Home

Lives alone: Y / N Stairs: Yes / No

Lambeth / Southwark / Other Usually able to go out: Yes / No

Mobility: Independent
Stick
Frame
Wheelchair

Services: MOW
HH
Personal Care
District Nurse
Day Centre
Day Hospital

Carer: None
Spouse
Other family
Friend/neighbour

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D-3, Close Materials, 7 of 10

Examination

GCS: BM
Temp: Pulse: BP; Lying / Standing /

AMT

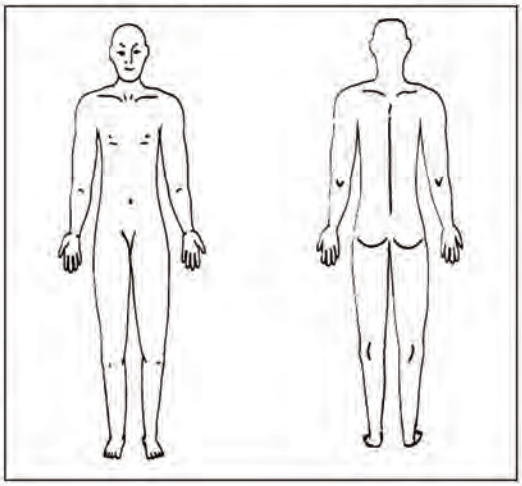
Age
Time (to nearest hour)
Address for recall
Year
Location
Recognition of two persons
Date of Birth
WW2
Present monarch
Count backwards 20 – 1

Score: /10

Injuries Sustained

Head injury – no laceration
Head injury - laceration
Fracture _____
Laceration requiring stitches _____
Laceration but no stitches _____
Superficial bruising _____
No injury

Indicate site of injury including pressure areas



Relevant Systems Examination

Current Level of Function

No change from pre-fall level of function
Decreased mobility/function but able to go home
Decreased mobility/function – unable to discharge

Results

_____
_____
_____

Conclusions

Likely cause of fall: simple slip/trip, acute illness, multifactorial, unexplained

Comments

_____
_____
_____

*** High risk – recommend referral to Falls Clinic if Falls Nurse not available to assess**

Outcome:

Home with GP letter
Admit to CDU
Refer to Falls Clinic / Day Hospital
Refer to Rapid Response
Refer to DHE (Out-Patients)
Refer for hospital admission

Signature: _____ Print Name:_____ Date:_____

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Appendix C-9 Spice Materials

Winchester Falls Project—Structured Secondary Assessment Domains

Question 1—Basic information

Name: _____

Address: _____

GP:_____

DOB: _____

Date of assessment: _____

Date of referral:_____

Question 2—Home

House/flat/bungalow/sheltered/RH/NH/ independent

Question 3—Walks

Independent/stick/frame

Question 4—Carers

Independent/family/carers

Question 5—Bowels

Independent/continent or continent with help or incontinent occasionally or incontinent or stoma

Continence aids _____

Question 6—Bladder

Independent/continent or continent with help or incontinent occasionally or incontinent or catheter

Continence aids _____

Question 7—Falls history

How many times has/she or he fallen before this last fall: once/2–5/>5

Has the patient sustained an injury during any fall: yes/no

If yes, which sort: _____

Head injury: yes/no

Fracture/dislocation: yes/no (please specify)

_____

_____

Laceration requiring medical attention: yes/no

Bruising: yes/no

Others: yes/no (please specify)

_____

_____

Definite slip/trip: yes/no

Loss of consciousness: yes/no

Associated dizziness/palpitations: yes/no

Vertigo: yes/no

Presyncope: yes/no

Question 8—Drug history

List all medications (including over the counter and prescribed)

_____

_____

_____

_____

Question 9—Drugs

Is the patient taking any of the following drugs:

Diuretics _____

Hypnotic/sedative _____

Antidepressant _____

Digoxin _____

Cardiovascular _____

Anti-parkinsonian _____

Question 10—Alcohol consumption

CAGE score _____

Total number of units/week _____

Question 11—Smoking

Do you smoke: yes/no

If yes: cigarettes/pipe/cigars

Question 12—Past medical history

Heart disease _____

Stroke/TIA _____

Respiratory disease _____

Hypertension _____

Diabetes _____

Epilepsy _____

Parkinson's disease _____

Visual problems: wears glasses and last eye check within 2 years _____

Joint disease _____

Other neurological disease _____

_____

Other diseases: _____

_____

_____

Question 13—Examination BP

Weight _____

BP lying _____

BP standing immediately _____

BP at 1 minute _____

BP at 3 minutes _____

Question 14—MTS _____

Question 15—Vision _____

Visual acuity with glasses/pin hole: _____

Right _____

Left _____

Question 16—Pulse _____

Question 17—Rhythm _____

Question 18—Heart sounds _____

Question 19—Cranial nerves

Range of eye movements _____

Visual fields _____

Fundi _____

Pupils _____

Other findings _____

_____

_____

Question 20—Peripheral neurology

Tone (right and left) _____

Power (right and left) _____

Reflexes (right and left) _____

Sensation (right and left) _____

Cerebellar (right and left) _____

Question 21—Chest examination

_____

_____

Question 22—Abdominal examination

_____

_____

Question 23—Other findings

_____

_____

_____

_____

Question 24—Mobility/gait

Aid used and pattern _____

Pattern _____

Heel strike _____

Stance _____

Stride _____

Other _____

Stairs _____

Question 25—Joint range and muscle strength

Joint range _____

Upper limbs _____

Cervical spine _____

Lower limbs _____

Lumbar spine _____

Muscle strength _____

Upper limbs _____

Cervical spine _____

Lower limbs _____

Lumbar spine _____

Question 26—Getting up from the floor

Pattern: independently/assistance x 1/assistance x 2/unable

Comment: _____

_____

_____

Question 27—Transfers

Bed _____

Chair _____

Toilet _____

Bath (reported) _____

Question 28—Equipment

Equipment already in situ _____

Question 29—Domestic activities of daily living (reported)

Make a hot drink_____

Prepare a meal _____

Washing up_____

Use cooker _____

Cleaning _____

Laundry_____

Shopping _____

Carrying and lifting _____

Question 30—Personal activities of daily living (reported)

Wash and dry self _____

Dress and undress _____

Clothes fastenings _____

Stockings and socks _____

Shoes and slippers _____

Personal care _____

Question 31—Timed unsupported steady stand

Time in seconds for unsupported/single hand/ double hand stand _____

Distance between heels_____

Question 32–180 degree turn _____

Number of steps_____

Time in seconds _____

Question 33—Functional reach_____

Done standing in dominant arm (measured in inches) _____

Question 34—6 meter timed walk

Time in seconds _____

Number of steps_____

Question 35—Single leg stand

Right leg _____

Left leg _____

Question 36—Clothing and footwear hazards

Clothing _____

Footwear_____

Chiropodist: yes/no

Question 37—Pain

Pain: no pain/ongoing chronic pain/acute and intermittent pain/ongoing and acute

Description _____

_____

_____

_____

Question 38—Problem list

_____

_____

_____

Question 39—Action list

_____

_____

_____

Question 40—Likely cause of fall

Musculoskeletal _____

Cardiovascular _____

Environmental _____

Medication _____

Vision _____

Alcohol _____

Other _____

Combination _____

Comments _____

_____

_____

Question 41—Risk factor for falls

Medication _____

Vision _____

Alcohol _____

Postural hypotension _____

Footwear _____

Mobility _____

Medical—neurological _____

Medical—musculoskeletal _____

Medical—cardiovascular _____

Environmental _____

Other _____

Combination _____

Comment _____

_____

_____

Question 42—Planned investigations and/or interventions _____

_____

Question 43—Follow-up arrangements/referrals _____

_____

Question 44—Timings

Physician: _____

Physiotherapist: _____

Nurse: _____

Occupational therapist: _____

Other (please specify): _____

_____

_____