Exercise for preventing falls: a systematic review

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Aims of the systematic review

- To assess effects of exercise on rate of falls
- To tease out the aspects of exercise interventions that are most beneficial
The meta-analysis team

A ProFaNE WP2 project

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Study inclusion criteria

- Published RCTs
- Exercise as the primary intervention being evaluated
- Control group has no intervention designed to prevent falls
Literature search

- Medline, EMBASE, CINAHL until May 2006 using Cochrane falls review search strategy
- Cochrane updated search results
37 RCTs included

- Identified 103 RCTs on exercise and falls prevention
- Excluded 66
  - 48: multifaceted (inc. non-exercise interventions)
  - 1: not fully randomised
  - 2: not published
  - 10: control group had too much exercise
  - 1: ten year follow-up
  - 1: data appears to be from another included study
  - 1: language
  - 2: insufficient data
Included studies

11 “effective” trials
- Wolf 1996
- Buchner 1997
- Campbell 1997
- Robertson 2001
- Day 2002
- Barnett 2003
- Lord 2003
- Schnelle 2003
- Li 2005
- Means 2005
- Skelton 2005

15 “ineffective” trials
- Reinsch 1992
- Mulrow 1994
- Lord 1995
- Ebrahimp 1997
- McMurdoo 1997
- Campbell 1999
- Steinberg 2000
- Carter 2002
- Green, 2002
- Latham 2003
- Wolf 2003
- Morgan 2004
- Bunout 2005
- Campbell 2005
- Korpelainen, 2006

11 “small” trials
- Cerny, 1998
- Rubenstein, 2000
- Schoenfelder, 2000
- Hauer, 2001
- Nowalk, 2001
- Resnick, 2002
- Toulotte, 2003
- Lui-Ambrose, 2004
- Sihvonen, 2004
- Suzuki, 2004
- Protas, 2006
Deriving a common falls outcome measure

- Rate ratios (28 studies) combined with relative risks (7 studies) and hazard ratios (2 studies)
- 4 studies were cluster RCTs (cluster effect estimated for 2 of these)
- 3 studies had 2 intervention groups and 1 control group, control N halved for each comparison
Population

- **Community**
  - 35 subjects

- **Residential Care**
  - 5 subjects

- **Low Risk**
  - 16 subjects

- **High Risk**
  - 24 subjects

- **<75 years**
  - 13 subjects

- **>75 years**
  - 27 subjects

7111 subjects
40 comparisons
Statistical analysis

- Random effects meta-analysis
  - studies are estimating related but not equal treatment effects

- Meta-regression
  - to investigate the heterogeneity (varying intervention effects)
A forest plot

Protective Harmful
Exercise effect RR=0.83, 95% CI=0.75-0.93, 17% reduction

Study name
Barnett
Bunout
Buchner
Campbell, 1997
Campbell, 1999
Campbell, 2005
Carter
Corry
Day
Ebrahim
Green
Hauer
Korpelainen
Latham
Li
Lord, 1995
Lord, 2003
Liu-Ambrose, Resistance
Liu-Ambrose, Agility
McMurdo
Means
Morgan
Mufaw
Nowak, Resist./Endurance
Nowak, Tai Chi
Protas
Reinsch
Resnick
Robertson
Rubenstein
Schoenfelder
Schnelle
Silvonen
Skelton
Steinberg
Suzuki
Toulotte
Wolf, Tai Chi
Wolf, Balance
Wolf
Identifying effective exercise components

Moderate heterogeneity – $I^2 = 57\%$
Balance intensity

DEFINITION

- High challenge balance training = exercise in standing involving:
  - movement of the centre of mass
  - narrowing of the base of support
  - minimising upper limb support
Balance training intensity

Study name
- Bunout
- Buchner
- Carter
- Cemey
- Day
- Ebrahim
- Green
- Latham
- Liu-Ambrose, Resistance
- McMuro
- Means
- Mulrow
- Nowalk, Resist/Endurance
- Nowalk, Tai Chi
- Reinsch
- Resnick
- Rubenstein
- Schoenfelder
- Schnelle
- Steinberg
- Suzuki
- Toulotte
- Wolf, Balance

Low intensity

Rate ratio and 95% CI

High intensity

Balance exercise and falls

Study name
- Barnett
- Campbell, 1997
- Campbell, 1999
- Campbell, 2005
- Hauer
- Korpelainen
- Li
- Lord, 1995
- Lord, 2003
- Liu-Ambrose, Agility
- Morgan
- Protas
- Robertson
- Sihvonen
- Skelton
- Suzuki
- Toulotte
- Wolf, Tai Chi
- Wolf
Balance training intensity

Low challenge

High challenge

RR=1

2%

RR= 0.98
(95%CI 0.84 to 1.14)

Meta regression

Effect of high vs. low :
0.72 (95%CI=0.60 to 0.87)

47% of heterogeneity explained

29%

RR= 0.71
(95%CI 0.63 to 0.80)
Residential status

Study name

Barrett
Buscot
Buchner
Campbell, 1997
Campbell, 1999
Campbell, 2005
Carter
Cerny
Day
Ebrahim
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Hauer
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Resnick
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Rubenstein
Skelton
Steinberg
Suzuki
Wolf, Tai Chi
Wolf, Balance
Wolf

Rate ratio and 95% CI

Community

Nursing home

0.01 0.1 1 10 100

Favours exercise Favours control

Residence, exercise and falls

Meta Analysis
Residential status

**Nursing home**
- RR=1
- 11%
  - RR= 0.89
  - (95%CI 0.42 to 1.90)

**Community**
- 19%
- RR= 0.81
- (95%CI 0.74 to 0.90)

**Meta regression**
- Nursing home vs. community: 1.32 (95%CI=0.89 to 1.94)
- 12% of heterogeneity explained
Risk status among community dwellers

**High risk**
- RR = 0.84
- 16%
- (95% CI 0.74 to 0.95)

**Low risk**
- RR = 0.78
- 22%
- (95% CI 0.66 to 0.92)
Remaining variables explained < 4% of heterogeneity

- Intensity of exercise
  - strength
  - functional tasks
  - endurance
  - walking
  - flexibility

- Exercise program
  - supervision
  - progression
  - tailoring
  - dose
Three examples
Tai Chi

- 256 physically inactive, community-dwelling adults mean age 77 years
- Yang style (24 forms) Tai Chi taught by experienced instructors
- Emphasises multidirectional weight shifting, awareness of body alignment and arm, leg, and trunk movement coordination
- Synchronized breathing integrated into the routine
- New movements progressively introduced
- Musical accompaniment

Source: Li F et al J Gerontology 2005; 60:187
The SW Sydney exercise program

- Population with mean age of 75 years and with a strength or balance impairment
- Weekly exercise classes over four terms (37 classes) within 12 months
- Home exercise program based on the class content
- Conditioning period
  - activities for balance, flexibility and endurance
  - activities for hand-eye and foot-eye coordination
  - strengthening exercises
  - sit-to-stand practice
  - Tai Chi exercises
  - stepping exercises

The Otago Exercise Program

- Comprises home-based balance and strength exercises
- 4-5 sessions for prescribing and progressing the exercises and walking plan
- One hour for first visit and 30 minutes for follow ups
- Exercises sessions take around 30 minutes to complete
- Undertaken 3 times a week with rest days in between
Strengthening exercises

Front Knee Strengthening

Back Knee Strengthening

Side Hip Strengthening

Try and use ankle weights whenever possible. People aged 80 and over will start with 1-2 Kg. Need to be able to do 8-10 reps before fatigue.
Balance exercises

Backwards walking (with/without support)

Ensure person can recover balance using lower limb strategies before prescribing exercise without support.
## Algorithm for exercise prescription

<table>
<thead>
<tr>
<th>POPULATION</th>
<th>PROGRAM</th>
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<tbody>
<tr>
<td>60-80 YEARS – GENERAL POPULATION – LOW RISK</td>
<td>TAI CHI IN GROUPS</td>
</tr>
<tr>
<td>70-80 YEARS AT INCREASED RISK</td>
<td>GROUP BALANCE AND STRENGTH TRAINING</td>
</tr>
<tr>
<td>80 + YEARS AT INCREASED RISK</td>
<td>OTAGO EXERCISE PROGRAM</td>
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Primary conclusions

- Exercise can prevent falls
- It is crucial that balance training is a core component