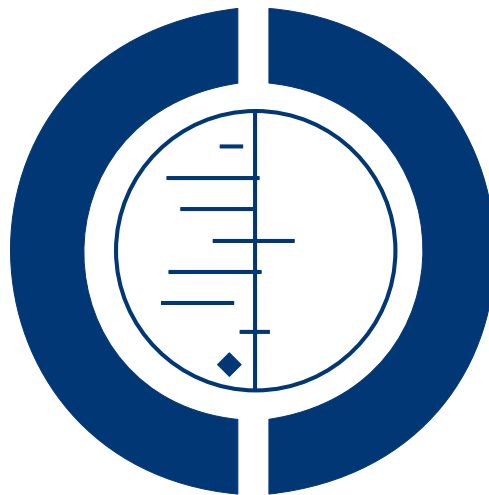


# Exercise for reducing fear of falling in older people living in the community (Review)

Kendrick D, Kumar A, Carpenter H, Zijlstra GAR, Skelton DA, Cook JR, Stevens Z, Belcher CM, Haworth D, Gawler SJ, Gage H, Masud T, Bowling A, Pearl M, Morris RW, Iliffe S, Delbaere K



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## TABLE OF CONTENTS

HEADER . . . . .	1
ABSTRACT . . . . .	1
PLAIN LANGUAGE SUMMARY . . . . .	3
SUMMARY OF FINDINGS FOR THE MAIN COMPARISON . . . . .	4
BACKGROUND . . . . .	9
OBJECTIVES . . . . .	10
METHODS . . . . .	10
RESULTS . . . . .	13
Figure 1. . . . .	15
Figure 2. . . . .	19
Figure 3. . . . .	20
Figure 4. . . . .	22
Figure 5. . . . .	24
DISCUSSION . . . . .	26
AUTHORS' CONCLUSIONS . . . . .	29
ACKNOWLEDGEMENTS . . . . .	29
REFERENCES . . . . .	29
CHARACTERISTICS OF STUDIES . . . . .	42
DATA AND ANALYSES . . . . .	94
Analysis 1.1. Comparison 1 Exercise versus control: primary outcome - fear of falling, post intervention, Outcome 1 Fear of falling as measured by single-item question, falls efficacy, balance confidence and concern about falling, post intervention. . . . .	96
Analysis 1.2. Comparison 1 Exercise versus control: primary outcome - fear of falling, post intervention, Outcome 2 Fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, short term follow-up (< 6 months). . . . .	98
Analysis 1.3. Comparison 1 Exercise versus control: primary outcome - fear of falling, post intervention, Outcome 3 Fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, long term follow-up (6 months and more). . . . .	99
Analysis 2.1. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 1 Type of exercise (as classified using ProFaNE taxonomy). . . . .	100
Analysis 2.2. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 2 Type of control group. . . . .	102
Analysis 2.3. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 3 Recruited participants at increased risk of falls. . . . .	104
Analysis 2.4. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 4 Type of exercise (individual versus group). . . . .	106
Analysis 2.5. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 5 Frequency of exercise. . . . .	108
Analysis 2.6. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 6 Duration of exercise. . . . .	110
Analysis 2.7. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 7 Primary aim of the study. . . . .	112
Analysis 3.1. Comparison 3 Exercise versus control: secondary outcomes, Outcome 1 Occurrence of at least one fall. . . . .	114
Analysis 3.2. Comparison 3 Exercise versus control: secondary outcomes, Outcome 2 Falls rate. . . . .	115

Analysis 3.3. Comparison 3 Exercise versus control: secondary outcomes, Outcome 3 Depression score, post intervention. . . . .	116
Analysis 3.4. Comparison 3 Exercise versus control: secondary outcomes, Outcome 4 Depression score, short-term follow-up (< 6 months). . . . .	117
Analysis 3.5. Comparison 3 Exercise versus control: secondary outcomes, Outcome 5 Physical activity as measured using PASE (Physical Activity Scale for the Elderly). . . . .	118
ADDITIONAL TABLES . . . . .	118
APPENDICES . . . . .	124
CONTRIBUTIONS OF AUTHORS . . . . .	129
DECLARATIONS OF INTEREST . . . . .	129
SOURCES OF SUPPORT . . . . .	130
DIFFERENCES BETWEEN PROTOCOL AND REVIEW . . . . .	130
INDEX TERMS . . . . .	131

[Intervention Review]

# Exercise for reducing fear of falling in older people living in the community

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## ABSTRACT

### Background

Fear of falling is common in older people and associated with serious physical and psychosocial consequences. Exercise (planned, structured, repetitive and purposive physical activity aimed at improving physical fitness) may reduce fear of falling by improving strength, gait, balance and mood, and reducing the occurrence of falls.

### Objectives

To assess the effects (benefits, harms and costs) of exercise interventions for reducing fear of falling in older people living in the community.

### Search methods

We searched the Cochrane Bone, Joint and Muscle Trauma Group Specialised Register (July 2013), the Central Register of Controlled Trials (CENTRAL 2013, Issue 7), MEDLINE (1946 to July Week 3 2013), EMBASE (1980 to 2013 Week 30), CINAHL (1982 to July 2013), PsycINFO (1967 to August 2013), AMED (1985 to August 2013), the World Health Organization International Clinical Trials Registry Platform (accessed 7 August 2013) and Current Controlled Trials (accessed 7 August 2013). We applied no language restrictions. We handsearched reference lists and consulted experts.

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**Exercise for reducing fear of falling in older people living in the community (Review)**

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## Selection criteria

We included randomised and quasi-randomised trials that recruited community-dwelling people (where the majority were aged 65 and over) and were not restricted to specific medical conditions (e.g. stroke, hip fracture). We included trials that evaluated exercise interventions compared with no intervention or a non-exercise intervention (e.g. social visits), and that measured fear of falling. Exercise interventions were varied; for example, they could be 'prescriptions' or recommendations, group-based or individual, supervised or unsupervised.

## Data collection and analysis

Pairs of review authors independently assessed studies for inclusion, assessed the risk of bias in the studies and extracted data. We combined effect sizes across studies using the fixed-effect model, with the random-effect model used where significant statistical heterogeneity was present. We estimated risk ratios (RR) for dichotomous outcomes and incidence rate ratios (IRR) for rate outcomes. We estimated mean differences (MD) where studies used the same continuous measures and standardised mean differences (SMD) where different measures or different formats of the same measure were used. Where possible, we performed various, usually prespecified, sensitivity and subgroup analyses.

## Main results

We included 30 studies, which evaluated 3D exercise (Tai Chi and yoga), balance training or strength and resistance training. Two of these were cluster-randomised trials, two were cross-over trials and one was quasi-randomised. The studies included a total of 2878 participants with a mean age ranging from 68 to 85 years. Most studies included more women than men, with four studies recruiting women only. Twelve studies recruited participants at increased risk of falls; three of these recruited participants who also had fear of falling.

Poor reporting of the allocation methods in the trials made it difficult to assess the risk of selection bias in most studies. All of the studies were at high risk of performance and detection biases as there was no blinding of participants and outcome assessors and the outcomes were self reported. Twelve studies were at high risk of attrition bias. Using GRADE criteria, we judged the quality of evidence to be 'low' for fear of falling immediately post intervention and 'very low' for fear of falling at short or long-term follow-up and all other outcomes.

Exercise interventions were associated with a small to moderate reduction in fear of falling immediately post intervention (SMD 0.37 favouring exercise, 95% confidence interval (CI) 0.18 to 0.56; 24 studies; 1692 participants, low quality evidence). Pooled effect sizes did not differ significantly between the different scales used to measure fear of falling. Although none of the sensitivity analyses changed the direction of effect, the greatest reduction in the size of the effect was on removal of an extreme outlier study with 73 participants (SMD 0.24 favouring exercise, 95% CI 0.12 to 0.36). None of our subgroup analyses provided robust evidence of differences in effect in terms of either the study primary aim (reduction of fear of falling or other aim), the study population (recruitment on the basis of increased falls risk or not), the characteristics of the study exercise intervention or the study control intervention (no treatment or alternative intervention). However, there was some weak evidence of a smaller effect, which included no reduction, of exercise when compared with an alternative control.

There was very low quality evidence that exercise interventions may be associated with a small reduction in fear of falling up to six months post intervention (SMD 0.17, 95% CI -0.05 to 0.38; four studies, 356 participants) and more than six months post intervention (SMD 0.20, 95% CI -0.01 to 0.41; three studies, 386 participants).

Very low quality evidence suggests exercise interventions in these studies that also reported on fear of falling reduced the risk of falling measured either as participants incurring at least one fall during follow-up or the number of falls during follow-up. Very low quality evidence from four studies indicated that exercise interventions did not appear to reduce symptoms of depression or increase physical activity. The only study reporting the effects of exercise interventions on anxiety found no difference between groups. No studies reported the effects of exercise interventions on activity avoidance or costs. It is important to remember that our included studies do not represent the totality of the evidence of the effect of exercise interventions on falls, depression, anxiety or physical activity as our review only includes studies that reported fear of falling.

## Authors' conclusions

Exercise interventions in community-dwelling older people probably reduce fear of falling to a limited extent immediately after the intervention, without increasing the risk or frequency of falls. There is insufficient evidence to determine whether exercise interventions reduce fear of falling beyond the end of the intervention or their effect on other outcomes. Although further evidence from well-

designed randomised trials is required, priority should be given to establishing a core set of outcomes that includes fear of falling for all trials examining the effects of exercise interventions in older people living in the community.

## **PLAIN LANGUAGE SUMMARY**

### **Exercise for reducing fear of falling in older people living in the community**

Many older people are afraid of falling, more so after experiencing a fall. Fear of falling can have a serious impact on an older person's health and life as it often reduces their physical and social activities.

We wanted to find out whether exercise, in the form of a planned, structured, repetitive physical activity aimed at improving physical fitness, helps to reduce fear of falling. Types of exercise interventions include balance training, strength and resistance training and three-dimensional (3D) exercises, such as dance or Tai Chi. Exercise can be provided in various ways. It can involve group sessions where participants are taught in a class by an instructor or individuals may be provided with exercise instruction booklets, DVDs or tapes to enable them to exercise on their own without supervision.

We searched the medical literature up to July 2013 for studies that tested the effects of exercise and reported fear of falling in community-dwelling people (i.e. who live either at home or in places of residence that do not provide nursing care or rehabilitation) aged 65 years and older. The studies compared exercise with no treatment or an alternative intervention, such as education.

#### **Summary of the evidence**

We included 30 studies in the review, with a total of 2878 participants whose average age ranged from 68 to 85 years. Most studies recruited mainly women. Twelve studies recruited participants at increased risk of falls and three of these recruited people who also had fear of falling. All of the studies were at some risk of bias mainly because the participants were aware what group they were in. This lack of blinding may have influenced the study results.

We found low quality evidence from 24 studies that exercise interventions result in a small to moderate reduction in fear of falling immediately after the intervention. Some exploratory analyses did not enable us to determine whether this effect differed in different groups of people, such as those at high risk of falling, or with different exercise interventions, such as group or individual exercise. We are very unsure that the effect of exercise on fear of falling is maintained in the next few months after the end of the intervention.

We only included studies that reported fear of falling, therefore the evidence on our other outcomes (occurrence of falls, depression, anxiety and physical activity) is only a small part of the total evidence of the effects of exercise on these outcomes. However, the evidence from nine studies included in our review showing that exercise reduced the risk and number of falls is consistent with the results of another Cochrane review testing the effects of exercise on preventing falls. The evidence on the other outcomes was far less and none of the included studies reported the effects of exercise interventions on activity avoidance or costs.

#### **Conclusion**

We concluded that exercise interventions in community-dwelling older people probably reduce fear of falling to a limited extent immediately after the intervention, without increasing the risk or frequency of falls. We also concluded that there is not enough evidence to determine whether exercise interventions reduce fear of falling beyond the end of the intervention or their effect on other outcomes. We encourage further research on this topic.

## SUMMARY OF FINDINGS FOR THE MAIN COMPARISON *[Explanation]*

Exercise for reducing fear of falling in older people living in the community						
<p><b>Population:</b> older people living in the community  <b>Setting:</b> community  <b>Intervention:</b> exercise (planned, structured, repetitive and purposive physical activity aimed at improving physical fitness)<sup>1</sup>  <b>Control:</b> no intervention or alternative non-exercise intervention<sup>2</sup></p>						
Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	Control	Exercise				
<p><b>Fear of falling</b><sup>3</sup> Immediately post intervention</p>		<p>The mean fear of falling score<sup>4</sup> in the intervention groups was 0.37 standard deviations higher (0.18 to 0.56 higher) (a higher score indicates less fear of falling)</p>	<p><b>SMD 0.37</b> (0.18 to 0.56)</p>	<p>1692 (24 studies)</p>	<p>⊕⊕○○ <b>low</b><sup>5</sup></p>	<p>0.2 SD represents a small difference, 0.5 SD a moderate difference and 0.8 SD a large difference                      We are unaware of any definitions of minimal clinically important difference for any fear of falling measure<sup>1</sup>                      There was significant heterogeneity of effect sizes, which was attributable mainly to 1 study, <a href="#">Nguyen 2012</a>, having a much larger effect size than other studies. Upon removal of this study, the effect size reduced to SMD 0.24, 95% CI 0.12 to 0.36; 23 studies; 1619</p>

						participants None of the subgroup analyses <sup>6</sup> provided robust evidence of a difference in effect between different subgroups. The possible exception was evidence of a smaller effect, which included no reduction, of exercise when compared with an alternative control <sup>2</sup>
<b>Fear of falling</b> <6 months follow-up		The mean fear of falling score in the intervention groups was 0.17 standard deviations higher (0.05 lower to 0.38 higher) (a higher score indicates less fear of falling)	<b>SMD 0.17</b> (-0.05 to 0.38)	356 (4 studies)	⊕○○○ <b>very low</b> <sup>7</sup>	Very low quality evidence <sup>7</sup> was also available from 3 studies (386 participants) at long-term follow-up (6 or more months post end of the intervention period): SMD 0.20, 95% CI -0.01 to 0.41
<b>Occurrence of at least 1 fall</b> Follow-up: 2 to 12 months	500/1000 <sup>8</sup>	425/1000 (370 to 490)	<b>RR 0.85</b> (0.74 to 0.98)	1113 (9 studies)	⊕○○○ <b>very low</b> <sup>9</sup>	Some studies measured falls using prospective falls diaries, some measured falls retrospectively and in some studies it was unclear whether falls were measured prospectively or retrospectively <b>Note:</b> Studies included in the analysis represent only a subset of studies evaluating the effect of exercise interventions on falls risk



						Very low quality evidence <sup>9</sup> suggests exercise interventions were associated with a significant reduction in the rate of falls (rate ratio 0.68, 95% CI 0.53 to 0.87; 9 studies; 1121 participants)
<b>Depressive symptoms</b> <sup>10</sup>		The mean depression score in the intervention groups was 0.08 standard deviations lower (0.28 lower to 0.13 higher) where a lower score indicates fewer symptoms of depression	<b>SMD -0.08</b> (-0.28 to 0.13)	406 (4 studies)	⊕○○○ <b>very low</b> <sup>9</sup>	0.2 SD represents a small difference, 0.5 a moderate difference and 0.8 a large difference <b>Note:</b> Studies included in the analysis represent only a very small subset of studies evaluating the effect of exercise interventions on symptoms of depression
<b>Anxiety</b>	Mean HADS <sup>11</sup> anxiety score = 4.3 (SD 3.4)	Mean HADS anxiety score = 4.3 (SD 3.9)	Difference between means = 0. No 95% CI reported	77 participants (1 study)	⊕○○○ <b>very low</b> <sup>9</sup>	Anxiety was reported by the subscale of HADS, which ranged from 0 to 21 with a higher score indicating higher symptoms of anxiety <b>Note:</b> This study represents only a subset of studies evaluating the effect of exercise interventions on anxiety
<b>Physical activity</b>		The mean physical activity score in the intervention groups was 3.44 (1.65 lower to 8.54	<b>MD 3.44</b> (-1.65 to 8.54)	547 (4 studies)	⊕○○○ <b>very low</b> <sup>9</sup>	All studies used the Physical Activity Scale for the Elderly (PASE) scale, which ranged from 0 to

		higher) where a higher score indicates greater physical activity		400, with a higher score indicating greater physical activity <b>Note:</b> Studies included in the analysis represent only a subset of studies evaluating the effect of exercise interventions on physical activity
<b>Activity avoidance or restriction</b>	See comment	See comment		No studies reported this outcome

\*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

**CI:** Confidence interval; **HADS:** Hospital Anxiety and Depression Scale; **MD:** mean difference; **RR:** Risk ratio; **SD:** Standard deviation; **SMD:** standardised mean difference

GRADE Working Group grades of evidence

**High quality:** Further research is very unlikely to change our confidence in the estimate of effect.

**Moderate quality:** Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

**Low quality:** Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

**Very low quality:** We are very uncertain about the estimate.

<sup>1</sup>The exercises interventions in the included trials fell into three categories: 3D (Tai Chi, Yoga); gait, balance, co-ordination, functional tasks; and strength and resistance based interventions. They were either supervised or unsupervised activities, delivered in group settings or individually; and varied in duration from up to 12 weeks to over 26 weeks. The majority of exercise interventions were to be performed between one to three times per week.

<sup>2</sup>Twenty of the 30 included studies compared an exercise intervention with no intervention. Five studies used education as the control intervention; two studies used social home visits; one used individualised crafts/games; one used home safety assessment; and one used discussion groups.

<sup>3</sup>Measurement tools for fear of falling included:

FES: 10 questions rated 1 (very confident) to 10 (not confident at all). A higher score indicates a lower perceived self efficacy at avoiding falls.

FES-I: 16 questions rated 1 (not at all concerned) to 4 (very concerned). A higher score indicates a higher concern about falling.

Short FES-I: 7 questions rated 1 (not at all concerned) to 4 (very concerned). A higher score indicates a higher concern about falling.

K-FES: 10 questions rated on a scale from 1 (no confidence) to 10 (extremely confident). A higher score indicates a higher perceived self efficacy at avoiding falls.

MFES: 14 questions rated 0 (not confident at all) to 10 (completely confident). A higher score indicates more confidence at avoiding falls.

ABC: 16 questions. Some studies rated from 0 (no confidence) to 100 (complete confidence), whilst others rated from 0 (no confidence) to 10 (very confident). A higher score indicates higher balance confidence.

Balance Self-Perceptions Test: 12 questions rated 1 (no confidence) to 5 (complete confidence) in performing 12 activities of daily living without fear of loss of balance.

VAS: Participants asked to rate their fear of falling on a scale of 0 to 100 (0 = low, 100 = high fear of falling).

Single item questions:

(a) Participants asked to rate their fear of falling on a scale of 0 to 4 (0 = low, 4 = high fear of falling).

(b) Participants asked to rate their worry about falling on a scale of 1 to 5 (1 = not at all worried, 5 = extremely worried).

<sup>4</sup>Pooled effect sizes did not differ significantly between the different scales used to measure fear of falling (test for subgroup differences:  $\text{Chi}^2 = 5.21$ ,  $\text{df} = 3$ ,  $P$  value = 0.16).

<sup>5</sup>Downgraded by one level because of study limitations, primarily a likelihood of high risk of bias from lack of blinding, and one level because the funnel plot indicated possible publication bias.

<sup>6</sup>We carried out the following subgroup analyses: type of exercise intervention; frequency of exercise; duration of the exercise intervention; group exercises rather than individual exercises; studies which did and did not recruit participants on the basis of increased falls risk; studies whose primary aim was to reduce fear of falling and those with an alternative primary aim; no treatment versus an alternative intervention (e.g. education, social visits, craft activities, discussion groups) control group.

<sup>7</sup>Downgraded by one level because of study limitations, primarily a high likelihood of risk of bias from lack of blinding, one level because of possible publication bias, and one level because of the small number of studies contributing data to this outcome.

<sup>8</sup>Assumed control risk based on median control group risk across studies.

<sup>9</sup>Downgraded by one level because of study limitations, primarily likelihood of high risk of bias from lack of blinding, and two levels for indirectness of evidence. Our review includes only a subset of studies reporting the effect of exercise interventions on this outcome, as studies had to report fear of falling and this outcome to be included in our review.

<sup>10</sup>Measurement tools included for depression:

GDS Scale: 30 questions, range 0 to 30 with higher scores indicating greater symptoms of depression.

GDS 5-item: 5 questions, range 1 to 5 with higher scores indicating greater symptoms of depression.

GDS-20: 20 questions, range 0 to 20 with higher scores indicating greater symptoms of depression.

HADS Depression subscale, range from 0 to 21 with higher scores indicating higher symptoms of depression.

<sup>11</sup>HADS = Hospital Anxiety and Depression Scale.

## BACKGROUND

### Description of the condition

Falls are an important cause of morbidity and premature mortality among community-dwelling adults aged 65 years and older. The consequences of falls can be severe, resulting in long-term disability and substantial reduction in quality of life. Approximately one in three community-dwelling older adults experience at least one fall (including medically attended falls and self reported falls not receiving any medical attention) each year (Fletcher 2004; Gillespie 2012b). This figure increases to two in three for those adults who have a history of a fall or who are afraid of falling (Andresen 2006). Fear of falling is common in older people. A recent systematic review found that the prevalence of fear of falling in 19 studies of community-dwelling older adults ranged from 21% to 85% (Scheffer 2008). An earlier review found the prevalence varied by falls history, ranging from 12% to 65% in community-dwelling older adults who had not fallen and from 29% to 92% in those who had fallen (Legters 2002). A number of risk factors for fear of falling have been identified including old age (Scheffer 2008), female gender (Howland 1993; Scheffer 2008), previous falls (Cumming 2000), the presence of environmental hazards that increase the risk of falls (Legters 2002), dizziness (Howland 1993), visual problems (Wang 2012), poor self-rated health (Cumming 2000), symptoms of depression and generalised anxiety (Legters 2002), poor balance and gait abnormalities (Tinetti 1990), cognitive impairment (Vellas 1997), functional dependence in activities of daily living (Scheffer 2008), living alone and lower levels of economic resources (Kempen 2009; Scheffer 2008). The consequences of fear of falling include falling, restriction or avoidance of daily activities, loss of independence, reduction in social activity, depression and a reduction in quality of life (Delbaere 2010; Legters 2002). Tinetti and Powell defined fear of falling in 1993 as “a lasting concern about falling that leads to an individual avoiding activities that he/she remains capable of performing” (Tinetti 1993). Fear of falling has been conceptualised in different ways and measured using different tools and this, along with differences in characteristics of study populations and study settings, might explain some of the variability in the estimates of this condition (Jung 2008; Zijlstra 2007). While single-item questions have been used to measure fear of falling, they are limited by their inability to measure variability in degrees of fear (Jorstad 2005). The most commonly used measures can be broadly divided into the following conceptualisations: those measuring fear of falling using single-item questions; those measuring ‘falls efficacy’ (a person’s belief in their ability to avoid falling during activity); those measuring confidence in maintaining balance; and those measuring concern or worry about falling during activities.

Examples of tools commonly used to measure falls efficacy include the Falls Efficacy Scale (FES) (Tinetti 1990) and adaptations to the scale (MFES (Hill 1996), rFES (Tinetti 1994)). The most com-

monly used measure of balance confidence is the Activities-specific Balance Confidence scale (ABC) (Powell 1995). Commonly used measures for concern about falling include the international version of the FES in its long (FES-I) (Yardley 2005) and short forms (Short FES-I) (Kempen 2008), and the Modified Efficacy Scale (Hill 1996). The Survey of Activities and Fear of Falling in the Elderly (SAFFE) measures worry about falling, as well as activity restriction (based on the concept that activity avoidance may be an early sign of fear of falling) (Lachman 1998). In their systematic review of psychological outcome measures of falling, Jorstad 2005 highlighted inconsistency and confusion in the application of the various tools that have been used in this area. Contributing to this problem, there are often several variants of tools in use and the names of the scales may not match the construct they measure: e.g. FES-I assesses concerns about falling instead of falls efficacy as its name may suggest (Kempen 2008; Yardley 2005). The large number of different tools highlights the importance of clearly identifying the construct being measured by each tool (Jorstad 2005).

### Description of the intervention

This review is focused on exercise interventions. Exercise is defined as physical activity that is “planned, structured, repetitive, and purposive in the sense that the improvement or maintenance of one or more components of physical fitness is the objective” (CDC 2011) and includes gait, balance, functional, strength, resistance, flexibility, three-dimensional (3D), such as dance or Tai Chi, and endurance training. Exercise interventions may be exercise ‘prescriptions’ or recommendations, done in groups or individually and may be supervised or unsupervised. Exercise prescriptions (e.g. the UK exercise referral scheme, the New Zealand “Green Prescription” or the US “Exercise is Medicine” programme) typically involve a healthcare professional assessment of current physical activity level, a referral to a physical activity specialist or service and an assessment by a physical activity specialist or service to determine a recommended exercise programme. Other exercise interventions include exercise supervised by direct contact with a professional, a trained non-professional or volunteer, or exercise interventions without supervision: e.g. providing exercise instruction booklets, DVDs or tapes for people to use to exercise on their own. We included exercise interventions whether they were primarily aimed at reducing fear of falling or not.

### How the intervention might work

Many factors may contribute to fear of falling, including gait and balance impairment, age-related loss of muscle mass (sarcopenia), activity avoidance, anxiety, risk factors for falling (e.g. visual impairment) and previous falls. There is a complex relationship between fear of falling and falls (Hadjistavropoulos 2007), and ex-

ercise may impact directly on fear of falling or indirectly on factors associated with fear of falling and the risk of falling. Exercise has been shown to be the single most effective strategy to reduce the number of falls in older adults (Sherrington 2008b). Exercise may reduce muscle loss, improve muscle strength, increase endurance, improve gait and balance and improve mood (Bula 2011b; Jung 2008). It may increase the increase the ability to get up following a fall, and may therefore, through these mechanisms, reduce fear of falling (Sherrington 2008b). Exercise may also enable individuals to perform more daily activities without falling, leading to a more positive appraisal of their ability to maintain balance during these activities (Howe 2011).

### Why it is important to do this review

Fear of falling is associated with a range of negative health consequences, including an increased risk of falls (Delbaere 2010). Delbaere 2010 suggested that fear of falling can lead to falls independent of any objective balance impairment. Exercise interventions have been proposed as a promising means for the prevention of falls (Gillespie 2012b), and are recommended in evidence-based guidelines for fall prevention across the world. Several recent reviews have been published on similar topics (Bula 2011b; Gillespie 2012b; Howe 2011; Liu 2009b; McClure 2005; Zijlstra 2007), but few have specifically focused on exercise and its potential effect on fear of falling. A narrative systematic review by Zijlstra and colleagues found that Tai Chi delivered in a group format, home-based exercise interventions and multi-component falls-related programmes (some of which included exercise) reduced fear of falling in community-dwelling older people (Zijlstra 2007). This review also found that only three included studies explicitly aimed to reduce fear of falling. A review by Bula 2011b found exercise interventions targeted at balance confidence risk factors and which decreased activity avoidance to be effective in improving balance confidence. Three Cochrane reviews of exercise interventions in older people do not report the effect of interventions on fear of falling, but do demonstrate that exercise interventions can improve balance (Howe 2011), reduce the risk and rate of falls (Gillespie 2012b) and that progressive resistance strength training improves muscle strength and activities of daily living such as walking and bathing (Liu 2009b). One further review of co-ordinated community-wide multi-strategy initiatives, some of which included the promotion of physical activity or community walking programmes, found that the population-based approach was effective in preventing fall-related injury, but again the review did not report on fear of falling (McClure 2005). This stresses the importance of our review, which aimed to appraise the existing literature for evidence, or the lack of evidence, that exercise reduces fear of falling.

## OBJECTIVES

To assess the effects (benefits, harms and costs) of exercise interventions for reducing fear of falling in older people living in the community.

## METHODS

### Criteria for considering studies for this review

#### Types of studies

We included only randomised and quasi-randomised (method of allocating participants to a treatment that is not strictly random, e.g. by date of birth, hospital record number, alternation) controlled trials. We included studies with cluster allocation, but excluded those with only one or two clusters in each intervention group because randomisation was unlikely to achieve balance in the important prognostic factors between intervention groups.

#### Types of participants

We included trials where the majority of the study population comprised people aged 65 years and over who were 'community-dwelling', i.e. living either at home or in places of residence that do not provide nursing care or rehabilitation. We excluded trials including combined populations (i.e. community-dwelling older people and those receiving nursing or rehabilitation care) if they did not report separate results for community-dwelling adults. We also excluded trials whose populations were restricted to individuals with a specific condition (e.g. stroke or hip fracture). We included trials irrespective of whether the participants were people who had recorded fear of falling or had a history of falling.

#### Types of interventions

We included studies reporting on the effect of exercise interventions, whether an exercise 'prescription' or a recommendation, done in a group or individually and supervised or not. The content of the exercises varied: for example, gait, balance and functional training; strength or resistance training; flexibility training; 3D training such as Tai Chi, Qigong and dance; and endurance training, which comprised aerobic exercise aimed at cardiovascular fitness. We excluded multi-component interventions that combined exercises with other intervention components (such as medication reviews, home hazard assessments, screening for and managing visual impairment, cognitive behavioural interventions and other interventions that aim to address risk factors for falling) due to the difficulty of attributing observed effects to the exercise.

The comparators of interest included no intervention (usual care) and alternative non-exercise intervention, e.g. education. We excluded studies where the comparator treatment might have increased exercise, e.g. provision of lifestyle advice including advice about exercise.

## Types of outcome measures

We included trials that measured fear of falling as a primary or secondary outcome.

### Primary outcomes

The primary outcome was fear of falling, which included measurement using single-item measures and measures of falls efficacy, balance confidence, and concern or worry about falling. Measurement tools for these primary outcomes were ascertained from a systematic review measuring psychological outcomes of fear of falling (Jorstad 2005), and tools developed since that review (Kempen 2008; Yardley 2005). Where reported by the included studies, we used the following:

- Fear of falling as measured by a single-item question.
- Falls efficacy as measured by the Falls Efficacy Scale (FES; Tinetti 1990) and its associated versions, FmES (Hill 1996), rFES (Tinetti 1994), and FES-UK (Parry 2001).
- Balance confidence as measured by the Activities-specific Balance Confidence scale for older adults (ABC) (Powell 1995) (and its UK version ABC-UK (Parry 2001)).
- Concern about falling as measured by the international version of the FES in its long (FES-I) (Yardley 2005) and short forms (Short FES-I) (Kempen 2008), Mobility Efficacy Scale (MES) (Lusardi 1997), aFES (Lusardi 1997), and amFES (Lusardi 1997), and worry about falling measured using the Survey of Activities and Fear of Falling in the Elderly (SAFFE) (Yardley 2002).

### Secondary outcomes

- Occurrence of falls: number or rate of falls, or participants experiencing at least one fall (fallers). Falls were included as a secondary outcome as there may be beneficial effects on falls from exercise but they may also occur as adverse events during exercise.
- Activity avoidance or restriction: the modified SAFFE (Yardley 2002), or single questions asking about activity avoidance (Jorstad 2005).
- Depression: the depression subscale of the Hospital Anxiety and Depression Scale (HADS), the Geriatric Depression Scale (GDS; Yesavage 1983), GDS-5 (Hoyl 1999), GDS-20 (Gottfries 1997), or the Cornell Scale for Depression in Dementia (CSDD) (Rodda 2011).
- Anxiety: Beck Anxiety Inventory, the anxiety subscale of the Hospital Anxiety and Depression Scale (HADS), Penn State Worry Questionnaire and Geriatric Mental State Examination

(Therrien 2011). These scales have been validated for use in older adults.

- Compliance with or adherence to exercise interventions, including measures of physical activity.
- Cost.

## Search methods for identification of studies

### Electronic searches

We searched the Cochrane Bone, Joint and Muscle Trauma Group Specialised Register (July 2013), the Central Register of Controlled Trials (CENTRAL 2013, Issue 7), MEDLINE (1946 to July Week 3 2013), EMBASE (1980 to 2013 Week 30), CINAHL (1982 to July 2013), PsycINFO (1967 to August 2013) and Allied and Complementary Medicine (AMED) (1985 to August 2013). We did not apply any restrictions based on language or publication status.

In MEDLINE, we combined the subject-specific terms with the sensitivity-maximising version of the Cochrane Highly Sensitive Search Strategy for identifying randomised trials (Lefebvre 2011). Search strategies for CENTRAL, MEDLINE, EMBASE, CINAHL, PsycINFO and AMED are shown in Appendix 1.

We searched the WHO International Clinical Trials Registry Platform (accessed 7 August 2013) and Current Controlled Trials (accessed 7 August 2013) for ongoing and recently completed trials.

### Searching other resources

We searched reference lists of existing reviews on fear of falling as well as falls prevention (Bula 2011b; Gillespie 2012b; Sherrington 2008b; Zijlstra 2007), and the reference lists of studies included in the review (see Included studies). We contacted experts in the field and relevant trial authors to identify appropriate unidentified studies (published or unpublished). We contacted the Falls and Bone Section of the British Geriatrics Society for information on unpublished or ongoing studies. We searched conference abstracts from the 55th, 56th and 57th Gerontological Society of America Scientific Meetings (2002 to 2004) and the 2004 Annual Scientific Meeting of the American Geriatrics Society.

### Data collection and analysis

Review authors worked in pairs to independently assess studies for eligibility, to extract data and to assess each study's risk of bias.

### Selection of studies

Pairs of review authors (from DK, AK, HC, RZ, DS, JC, ZS, CB, DH, SG, HG, TM, AB, MP, SI, KD) independently checked all

titles and abstracts retrieved to assess eligibility against inclusion criteria. We obtained full-text copies of all papers considered to be potentially eligible. Disagreements were resolved by discussion between the pairs of authors and, where necessary, a third review author (DK, DS or SI). We contacted authors of primary studies for clarification where necessary. We used a hierarchy of reasons for exclusion, based in turn on the consideration of study design, participants, interventions and outcomes. Usually only the first encountered reason for exclusion is given in the table of [Characteristics of excluded studies](#), except where supplementary reasons were also informative. For clarity, we provide more details of interventions, namely multi-component interventions and comparator treatments that may have increased exercise.

### Data extraction and management

Pairs of members of the review team (as listed above) completed data extraction independently using a standard data extraction form. Disagreements were resolved by discussion between the pairs of review authors and where necessary, a third review author (DK, DS or SI).

### Assessment of risk of bias in included studies

Pairs of members of the review team (as listed above) assessed risk of bias using the tool described in the *Cochrane Handbook for Systematic Reviews of Interventions* ([Higgins 2011a](#)). We reported the following seven domains: random sequence generation; allocation concealment; blinding (participants and personnel); blinding (outcome assessment); incomplete outcome data; selective outcome reporting; and 'other bias' (comparability of treatment and control group at entry, and post-randomisation recruitment bias in studies with cluster allocation). Where necessary, we contacted study authors for clarification. Disagreements were resolved by discussion between the pairs of review authors and where necessary, a third review author (DK, DS or SI).

### Measures of treatment effect

We estimated risk ratios with 95% confidence intervals (CI) for dichotomous data. For continuous data, we estimated mean differences (and 95% CI) where studies reported the same measure in the same format and standardised mean differences (and 95% CI) where different measures were used or where the same measure was presented in different formats. Where cluster-randomised controlled trials are included in the meta-analyses, we adjusted the standard errors of effect sizes for clustering, and entered these into meta-analyses estimating standardised mean differences. Where means and standard deviations are reported for change from baseline scores, we entered these into meta-analyses estimating mean differences not standardised mean differences. One study reported a standard deviation of zero for the FES score at follow-up ([Yoo 2010](#)): we used a standard deviation of 0.00001 to allow data

from this study to be included in the meta-analysis. We estimated pooled incidence rate ratios (and 95% CI) for falls rates using an inverse variance meta-analysis.

We entered raw data as presented in the articles, or as obtained from authors, into the meta-analyses. For falls rates, because most studies did not report the number of falls and person time at risk, we calculated log incidence rate ratios and standard errors from published rate ratios and entered these into the meta-analysis. For two studies ([Weerdesteyn 2006](#); [Wolf 1996](#)), we used data on the number of falls and person time at risk and estimated the log incidence rate ratio and its standard error using Poisson regression in Stata v11.0. [Weerdesteyn 2006](#) provided unpublished data for this analysis; these excluded those from a non-randomised group that were included in analyses in the published paper. For [Wolf 1996](#), we calculated the number of falls and person years at risk for the combined intervention groups from published data. For studies that employed a cross-over design, we used outcome measurement scores prior to the cross-over to ensure the control group still met the review inclusion criteria. For the majority of scales used in the studies, a higher score represents less fear of falling. However, some studies used a scale where a higher score means a higher fear of falling. Therefore, to correct for differences in the direction of the scale, the mean scale score in studies using a higher score to indicate a higher fear of falling was multiplied by -1 to ensure that all scales pointed in the same direction. The standard deviation was not modified in these studies.

### Unit of analysis issues

We adjusted the standard errors for effect sizes of continuous outcome measures to take account of clustering in cluster-randomised trials. For fear of falling measures, we used the intra cluster correlation coefficient (ICC) and its 95% CI calculated from the data of an ongoing UK trial evaluating an exercise intervention for community-dwelling older people, which allocated participants to treatment arm by general practice ([Iliffe 2010b](#)). The standard error of the effect size was inflated by the square root of the design effect, i.e.  $[1 + (m-1) \times \text{ICC}]$ , where  $m$  = average cluster size. For depression measures, we used the ICC from a UK trial of exercise for depression in older care home residents ([Underwood 2013](#)). Where studies were adjusted for clustering, it was not possible to present means and standard deviations for outcome measures in the forest plots because the adjustment for clustering required data on the adjusted standard error of the difference between the means to be entered into the meta-analysis. We have therefore reported means and standard deviations for fear of falling scales in [Table 1](#) and for depression scales in [Table 2](#).

Where studies included more than one intervention arm that met our inclusion criteria, we combined results from intervention arms in the meta-analyses. Where appropriate for subgroup analyses, we made comparisons separately for each intervention arm. For cross-over trials, we incorporated only data from the first period prior to cross-over. Some studies reported outcomes (fear of falling

and depression) at multiple time points. We therefore undertook meta-analyses at several time points including immediately post intervention, short-term follow-up (less than six months post intervention) and long-term follow-up (six months or more post intervention).

### Dealing with missing data

We contacted study authors for missing data. Where standard deviations were not reported, but 95% CI were reported, we divided the CI width by 3.92, and multiplied by the square root of the sample size (Higgins 2011b). We used only the available data and did not impute missing values.

### Assessment of heterogeneity

We assessed heterogeneity between effect sizes of included studies by visual inspection of forest plots and by using the Chi<sup>2</sup> test for heterogeneity (with a P value of < 0.1) and described inconsistency between trials using the percentage of the variability in effect estimates that is due to heterogeneity rather than chance (I<sup>2</sup> statistic).

### Assessment of reporting biases

Where an individual meta-analysis contained at least 10 studies, we assessed publication bias using funnel plots and Egger's test.

### Data synthesis

We combined effect sizes across studies using the fixed-effect model where there was no statistical heterogeneity. Where there was statistically significant heterogeneity that could not readily be explained, we used a random-effects meta-analysis to incorporate heterogeneity among studies. We pooled data across intervention arms for trials that had more than one intervention arm of interest. However, where appropriate for the subgroup analysis, we made comparisons separately for each intervention arm.

### Subgroup analysis and investigation of heterogeneity

Where a minimum of two studies existed, we undertook the following a priori defined subgroup analyses, exploring the effect of exercise interventions on fear of falling immediately post intervention by:

1. type of exercise classified using the ProFaNE taxonomy of interventions (ProFaNE 2011);
2. type of control group (alternative intervention versus no intervention);
3. baseline falls risk (studies recruiting participants at increased risk of falls, e.g. history of falls or other risk factors for falls versus those not recruiting participants on this basis);
4. type (individual versus group), frequency (one to three times per week, four or more times per week) and duration (0 to 12 weeks, 13 to 26 weeks, more than 26 weeks) of exercise;

5. primary aim of the study (to reduce fear of falling versus other primary aim).

We investigated whether effect sizes in subgroups were significantly different by inspecting the overlap of confidence intervals and by using the test for subgroup differences available in Review Manager software (RevMan 2014).

We did not undertake two a priori defined subgroup analyses for reasons explained in [Differences between protocol and review](#).

### Sensitivity analysis

We had planned to undertake sensitivity analyses to explore the robustness of our findings by restricting analyses to studies at low risk of selection bias (those with adequate allocation concealment) and those at low risk of detection bias. We did undertake a sensitivity analysis based on attrition bias (restricting to studies with follow-up on more than 80% of participants). We also undertook three other sensitivity analyses: (a) assessing the effect of removing one study that had a much larger effect size than other studies, (b) assessing the effect of using ABC scores instead of FES scores for two studies that used both scales and (c) assessing the effect of varying the ICC used to adjust standard errors of effect sizes in cluster-randomised controlled trials.

### 'Summary of findings' tables

We have produced a 'Summary of findings' table for fear of falling post intervention. We used the GRADE approach (Chapter 12.2, Higgins 2011a) to assess the quality of evidence related to key outcomes: fear of falling, falls rate, occurrence of at least one fall, depressive symptoms, anxiety and physical activity.

## RESULTS

### Description of studies

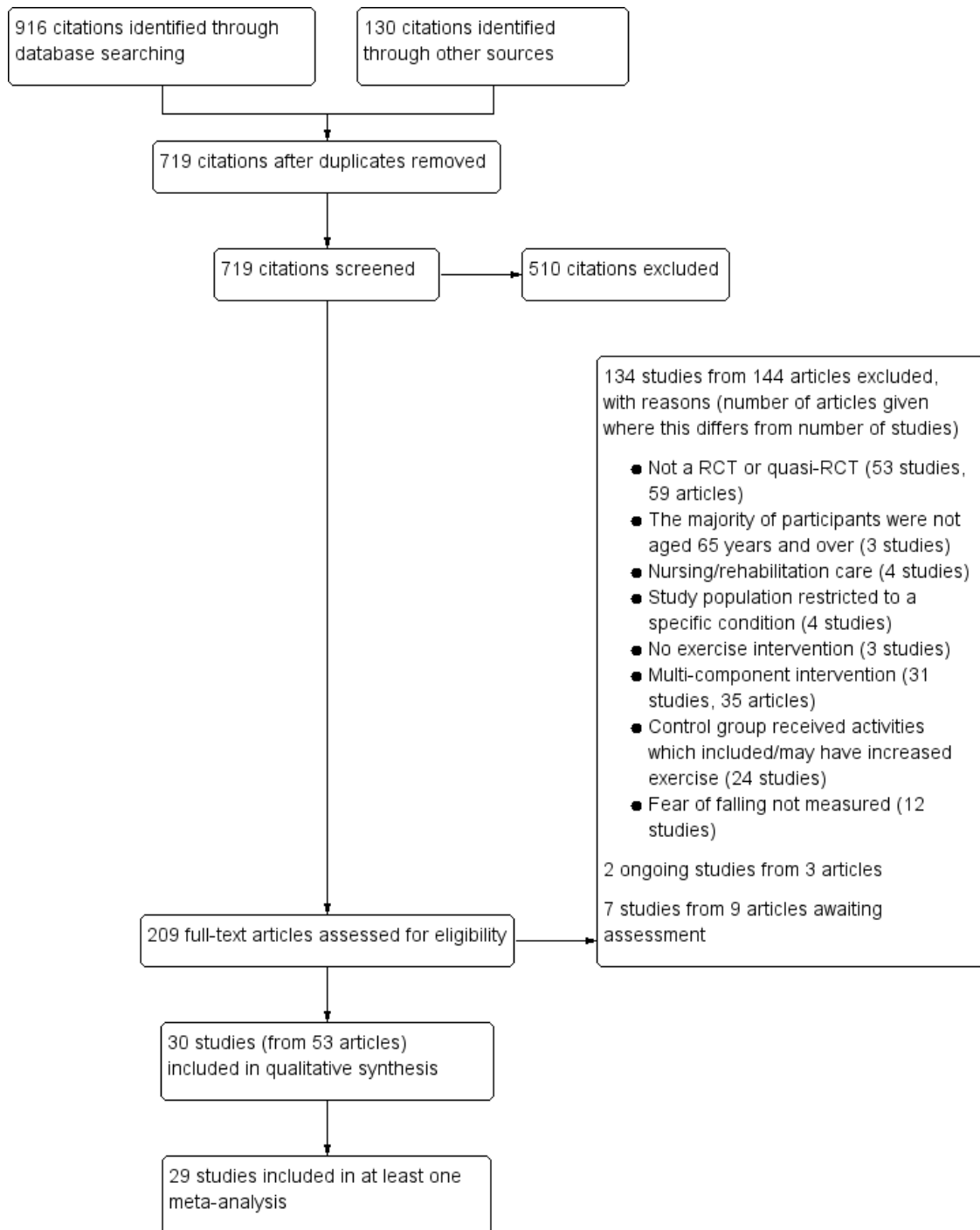
#### Results of the search

The search strategies identified 916 citations from the following databases: Cochrane Bone, Joint and Muscle Trauma Group Specialised Register (24 records); Cochrane Central Register of Controlled Trials (84 records), MEDLINE (186 records), EMBASE (169 records), CINAHL (290 records), PsycINFO (36 records), AMED (23 records), the WHO International Clinical Trials Registry Platform (20 records) and Current Controlled Trials (84 records). We identified a further 130 potentially eligible citations from handsearching reference lists of relevant systematic reviews and included studies and consulting with experts in the field. After examination of the title and abstract from the search results, we identified a total of 209 articles for potential inclusion, for



which we obtained the full texts for more detailed evaluation. From the 209 articles, we included 30 studies (published in 53 articles), excluded 134 studies (published in 144 articles) and two studies (published in three articles) were ongoing. Seven studies (published in nine articles) await classification. A flow diagram summarising the study selection process is shown in [Figure 1](#).

**Figure 1. Study flow diagram**



## Included studies

### Design

Thirty studies have been included in this review (see [Characteristics of included studies](#) for details of these). The majority of the studies were randomised controlled trials ( $n = 29$ ), including two cluster-randomised controlled trials ([Reinsch 1992](#); [Resnick 2008](#)), and two cross-over trials ([Lai 2013](#); [Wallsten 2006](#)). One study was a quasi-randomised trial ([Lajoie 2004](#)).

### Aim

The primary aim of seven studies was to reduce fear of falling ([Freiberger 2012](#); [Halvarsson 2011](#); [Karinkanta 2012](#); [McCormack 2004](#); [Wallsten 2006](#); [Yoo 2010](#); [Zhang 2006](#)). The primary aim of the majority ( $n = 22$ ) of the included studies was to improve balance, physical performance and/or prevent falls ([Barnett 2003](#); [Campbell 1997](#); [Clemson 2010](#); [Haines 2009](#); [Hinman 2002](#); [Lai 2013](#); [Lajoie 2004](#); [Lin 2007](#); [Logghe 2009](#); [Nguyen 2012](#); [Reinsch 1992](#); [Rendon 2012](#); [Sihvonen 2004](#); [Tiedemann 2012](#); [Ullmann 2010](#); [Vogler 2009](#); [Vrantsidis 2009](#); [Weerdesteyn 2006](#); [Westlake 2007](#); [Wolf 1996](#); [Wolf 2001](#); [Yang 2012](#)). One study was aimed at improving self efficacy for exercise, exercise outcome expectations, exercise and overall physical activity ([Resnick 2008](#)).

### Sample sizes

A total of 2878 community-dwelling older adults participated in the 30 included studies. Sample sizes in included studies ranged from 21 participants ([Yoo 2010](#)) to 269 ([Logghe 2009](#)).

### Setting

The included studies were based in 12 countries. Eight studies were conducted in Australia ([Barnett 2003](#); [Clemson 2010](#); [Haines 2009](#); [McCormack 2004](#); [Tiedemann 2012](#); [Vogler 2009](#); [Vrantsidis 2009](#); [Yang 2012](#)), seven in the USA ([Hinman 2002](#); [Reinsch 1992](#); [Rendon 2012](#); [Resnick 2008](#); [Ullmann 2010](#); [Wallsten 2006](#); [Wolf 1996](#)), three in the Netherlands ([Logghe 2009](#); [Weerdesteyn 2006](#); [Wolf 2001](#)), two in Canada ([Lajoie 2004](#); [Westlake 2007](#)), two in Finland ([Karinkanta 2012](#); [Sihvonen 2004](#)), two in Taiwan ([Lai 2013](#); [Lin 2007](#)), one in China ([Zhang 2006](#)), one in Germany ([Freiberger 2012](#)), one in New Zealand ([Campbell 1997](#)), one in South Korea ([Yoo 2010](#)), one in Sweden ([Halvarsson 2011](#)), and one in Vietnam ([Nguyen 2012](#)).

## Participants

Four studies recruited only women ([Campbell 1997](#); [Karinkanta 2012](#); [Sihvonen 2004](#); [Yoo 2010](#)). Of the 26 studies that recruited both sexes, 25 reported the sex of participants, with most of these including a majority of women (ranging from 51% to 89%). The mean age of participants ranged from 68 years to 85 years. In 12 studies the mean age was less than 75 years ([Barnett 2003](#); [Hinman 2002](#); [Karinkanta 2012](#); [Lai 2013](#); [Lajoie 2004](#); [Nguyen 2012](#); [Resnick 2008](#); [Tiedemann 2012](#); [Vrantsidis 2009](#); [Weerdesteyn 2006](#); [Yoo 2010](#); [Zhang 2006](#)); in all other studies the mean age was 75 years or older. Two studies specifically recruited people aged over 75 ([Wolf 2001](#)) and over 80 ([Campbell 1997](#)).

Twelve studies recruited participants who were at increased risk of falls (either because they had previously fallen or because they had other risk factors for falls) ([Barnett 2003](#); [Clemson 2010](#); [Freiberger 2012](#); [Haines 2009](#); [Halvarsson 2011](#); [Lin 2007](#); [Logghe 2009](#); [Vogler 2009](#); [Vrantsidis 2009](#); [Weerdesteyn 2006](#); [Yang 2012](#); [Zhang 2006](#)). Three of these studies recruited participants who had fear of falling in addition to being at increased risk of falls ([Freiberger 2012](#); [Halvarsson 2011](#); [Yang 2012](#)). The inclusion and exclusion criteria for each study are presented in the [Characteristics of included studies](#) table.

## Interventions

Five studies had more than one intervention arm that met the inclusion criteria ([Hinman 2002](#); [Karinkanta 2012](#); [McCormack 2004](#); [Vogler 2009](#); [Wolf 1996](#)). As a result, 36 interventions were reported from the 30 included studies. We classified these interventions according to the fall prevention classification taxonomy developed by ProFaNE ([ProFaNE 2011](#)), with nine (25%) classified as 3D (Tai Chi, Yoga); 19 (53%) classified as gait, balance, coordination, functional tasks; and eight (22%) classified as strength and resistance based interventions. Interventions were also categorised according to whether they were supervised activities ( $n = 27$ ; 75%) or unsupervised activities ( $n = 9$ ; 25%), see [Table 3](#). Additionally, we categorised interventions by whether they were delivered in group settings ( $n = 20$ ; 56%) or individually ( $n = 16$ ; 44%), and according to the duration of the intervention (i.e. up to 12 weeks ( $n = 22$ ; 61%), 13 to 26 weeks ( $n = 7$ ; 19%) and more than 26 weeks ( $n = 7$ ; 19%). The majority ( $n = 32$ ; 89%) of the exercise interventions were to be performed between one to three times per week. Four (11%) exercise interventions were to be carried out four or more times a week. Details are provided in the [Characteristics of included studies](#) table.

## Controls

Twenty of the studies compared an exercise intervention with no intervention (see Table 3). Five studies used education as the control intervention: three on falls prevention (Barnett 2003; Tiedemann 2012; Westlake 2007), one on nutrition (Resnick 2008), and one on a range of topics including medicines, sleep, cognitive impairment and bereavement (Wolf 1996). Two studies used social home visits (Campbell 1997; Vogler 2009), one used individualised crafts/games (Wolf 2001), one used home safety assessment (Lin 2007), and one used discussion groups (Reinsch 1992).

## Outcomes

Seven studies used single-item questions for participants to measure fear of falling. Four of these studies asked participants to rate their fear of falling on a numerical scale: Resnick 2008 used a numerical scale of 0 to 4 (0 = low, 4 = high); Karinkanta 2012 and Wolf 2001 used a visual analogue scale (VAS) from 0 (no fear of falling) to 100 mm (very afraid of falling); and Lin 2007 used a VAS from 0 (no fear) to 10 cm (extremely fearful). One study measured worry about falling on a scale of 1 to 5 (1 = not at all worried, 5 = extremely worried) (Reinsch 1992). Two studies employed a single question with binary or ordinal response for fear of falling: in Barnett 2003 participants were asked if they were afraid of falling (yes/no) and in Sihvonen 2004 participants were asked "Generally speaking are you afraid of falling?" with the response options of "No", "Yes, some" or "Yes, a lot". Falls efficacy was measured by FES in six studies (Campbell 1997; Logghe 2009; Nguyen 2012; Ullmann 2010; Wolf 1996; Zhang 2006), MFES in seven studies (Clemson 2010; Hinman 2002; Lai 2013; McCormack 2004; Vogler 2009; Vratsidis 2009; Yang 2012), and K-FES in one study (Yoo 2010). Nine studies measured balance confidence using ABC (Clemson 2010; Freiburger 2012; Haines 2009; Lajoie 2004; Rendon 2012; Ullmann 2010; Wallsten 2006; Weerdesteyn 2006; Westlake 2007). Two studies used both FES and ABC (Clemson 2010; Ullmann 2010). Concerns about falling were measured by FES-I in one study (Halvarsson 2011) and short FES-I in one study (Tiedemann 2012).

All studies reported fear of falling immediately at the end of the intervention period, apart from Barnett 2003, which reported fear of falling halfway through the one-year intervention period, and Lin 2007, which reported fear of falling at two and four months after the end of the intervention period. Six studies reported fear of falling in the short term (less than six months) post intervention (Clemson 2010; Lin 2007; Vogler 2009; Westlake 2007; Wolf 1996; Wolf 2001). Clemson 2010 reported data at three and six months. We included the three-month data from Clemson 2010 and the two-month data from Lin 2007 in our short-term follow-up (less than six months) analyses. These were most similar to the other studies in the same analyses, which reported data at one or three months. Three studies reported fear of falling in the long term (six months or more post intervention) (Freiburger 2012;

Karinkanta 2012; Logghe 2009). Freiburger 2012 reported fear of falling at two time points in the long term (six months and 18 months post intervention), and we used the six-month scores in the meta-analysis as the other studies in the meta-analysis reported data at nine or 12 months.

Eight studies either did not present data for outcome measures in the format required for meta-analysis (i.e. mean, SDs) or did not report data for their measures of fear of falling (Clemson 2010; Halvarsson 2011; Lajoie 2004; Rendon 2012; Ullmann 2010; Vogler 2009; Wallsten 2006; Weerdesteyn 2006). We were able to obtain the data from study authors for seven of these studies (Clemson 2010; Halvarsson 2011; Lajoie 2004; Ullmann 2010; Vogler 2009; Wallsten 2006; Weerdesteyn 2006), enabling their inclusion in the meta-analyses. Clemson 2010 provided means and SDs for M-FES and ABC scores at baseline, post intervention and three months post intervention. Halvarsson 2011 provided means and SDs for FES-I and GDS-20 scores at baseline and post intervention. Lajoie 2004 provided means and SDs for the ABC score at baseline and post intervention. Ullmann 2010 provided means and SDs for the ABC and FES at baseline and prior to six participants from the control group crossing over into the intervention group. Vogler 2009 provided means and SDs for the MFES and GDS post intervention and at 24 weeks. Wallsten 2006 provided means and SDs for the ABC post intervention. Weerdesteyn 2006 provided means and SDs for ABC post intervention and number of falls and number of participants experiencing at least one fall at seven-month follow-up for the randomised exercise group. We were not able to obtain data in a format suitable for inclusion in the meta-analyses for fear of falling from Rendon 2012, which presented medians and ranges (not SDs) for the ABC and GDS scores at baseline and post intervention.

## Excluded studies

We excluded a total of 134 studies (144 articles) for the following main reasons: they were not RCTs or quasi-RCTs (n = 53); the majority of participants were not aged 65 years and over (n = 3), participants were in nursing or rehabilitation care (n = 4) or the study population was restricted to a specific condition (n = 4); they did not contain an exercise intervention (n = 3), they involved multi-component interventions (n = 31) or it was plausible that the comparator group might have increased exercise (n = 24); or fear of falling was not measured (n = 12). More details are provided in the Characteristics of excluded studies table.

## Ongoing studies

Two ongoing studies (published in three articles) met the review criteria (see Characteristics of ongoing studies). The first study is a multicentre cluster-randomised controlled trial of two exercise intervention groups compared with a no intervention control group in community-dwelling older people aged 65 years and

older in the UK (Ilfie 2010b). Fear of falling will be measured by the Short FES-I. The other ongoing study is a multicentre cluster-randomised controlled trial of a 16-week exercise programme with a focus on falls prevention compared with a no intervention control group in community-dwelling older people in Germany (NCT01032252). Fear of falling will be measured with the German version of the FES-I.

### Studies awaiting classification

Seven studies are awaiting classification (see [Characteristics of studies awaiting classification](#)). It is plausible but unclear whether the comparator group treatment in these studies may have increased exercise and further details are required to enable a decision regarding their inclusion or exclusion. Four studies used aware-

ness or education programmes that included advice about exercise (Arai 2007; Brouwer 2003; Morris 2008; Wolf 2003); one study provided social activities that included walking (Kim 2009b); one study invited all participants (including the control group) to practice exercise techniques before randomisation (Henwood 2008), and one study provided the control group with ethylene vinyl acetate copolymer shoe insoles and explicitly stated that these would improve postural balance (Jorgensen 2013).

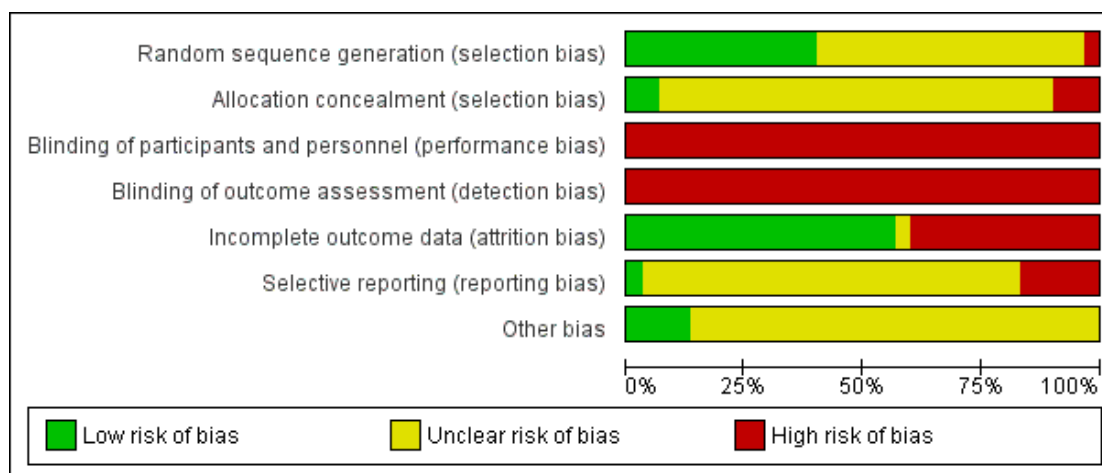
### Risk of bias in included studies

We assessed studies for risk of bias and the findings are reported in the tables of [Characteristics of included studies](#). See [Figure 2](#) for the 'Risk of bias' summary and [Figure 3](#) for the 'Risk of bias' graph.

**Figure 2. 'Risk of bias' summary: authors' judgements about each risk of bias item for each included study**

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Barnett 2003	?	?	+	+	+	?	?
Campbell 1997	+	+	+	+	+	?	+
Clemson 2010	+	+	+	+	+	?	?
Freiberger 2012	+	?	+	+	+	?	?
Haines 2009	+	+	+	+	+	?	?
Halvarsson 2011	?	+	+	+	+	+	+
Hinman 2002	?	?	+	+	+	?	?
Karinkanta 2012	+	?	+	+	+	?	?
Lai 2013	?	?	+	+	+	?	?
Lajoie 2004	+	+	+	+	+	?	?
Lin 2007	?	?	+	+	+	?	?
Logghe 2009	+	?	+	+	+	?	?
McCormack 2004	?	?	+	+	+	?	?
Nguyen 2012	?	?	+	+	+	?	?
Reinsch 1992	?	?	+	+	+	?	?
Rendon 2012	?	?	+	+	+	?	?
Resnick 2008	+	?	+	+	+	?	?
Sihvonen 2004	+	?	+	+	+	?	?
Tiedemann 2012	+	?	+	+	+	?	?
Ullmann 2010	?	?	+	+	+	?	?
Vogler 2009	+	?	+	+	+	?	+
Vrantsidis 2009	?	?	+	+	+	?	?
Wallsten 2006	?	?	+	+	+	?	?
Weerdesteyn 2006	?	?	+	+	+	?	?
Westlake 2007	?	?	+	+	+	?	?
Wolf 1996	+	?	+	+	+	?	?
Wolf 2001	?	?	+	+	+	?	?
Yang 2012	+	?	+	+	+	?	?
Yoo 2010	?	?	+	+	+	?	+
Zhang 2006	?	?	+	+	+	?	?

**Figure 3. 'Risk of bias' graph: authors' judgements about each risk of bias item presented as percentages across all included studies**



### Allocation

Apart from the one quasi-randomised trial, all other studies reported that they allocated participants to the intervention and control groups randomly. We judged the risk of bias in random sequence generation to be 'low' if a random component in the sequence generation process was used (e.g. random number table, computer random number generator, coin tossing, shuffling cards or envelopes, throwing dice) and 'high' if a systematic non-random component was used in the sequence generation process (e.g. allocation by odd or even date of birth, by some algorithm based on date (or day) of admission, by alternation). We judged the risk of bias in random sequence generation to be low in 40% (12/30) of studies (Campbell 1997; Clemson 2010; Freiberger 2012; Haines 2009; Karinkanta 2012; Logghe 2009; Resnick 2008; Sihvonen 2004; Tiedemann 2012; Vogler 2009; Wolf 1996; Yang 2012), high in 3% (1/30) of studies (Lajoie 2004), and unclear in the remaining 57% (17/30) of studies (Barnett 2003; Halvarsson 2011; Hinman 2002; Lai 2013; Lin 2007; McCormack 2004; Nguyen 2012; Reinsch 1992; Rendon 2012; Ullmann 2010; Vrantisidis 2009; Wallsten 2006; Weerdesteyn 2006; Westlake 2007; Wolf 2001; Yoo 2010; Zhang 2006).

We judged the risk of bias in allocation concealment to be low if participants and investigators enrolling participants could not foresee assignment (e.g. sequentially numbered, opaque, sealed envelopes) and high if participants or investigators enrolling participants could possibly foresee assignments (e.g. use of an open ran-

dom allocation schedule). We judged the risk of bias in allocation concealment to be low in 7% (2/30) of studies (Campbell 1997; Haines 2009), high in 10% (3/30) of studies (Clemson 2010; Halvarsson 2011; Lajoie 2004), and unclear in 83% (25/30) of included studies (Barnett 2003; Freiberger 2012; Hinman 2002; Karinkanta 2012; Lai 2013; Lin 2007; Logghe 2009; McCormack 2004; Nguyen 2012; Reinsch 1992; Rendon 2012; Resnick 2008; Sihvonen 2004; Tiedemann 2012; Ullmann 2010; Vogler 2009; Vrantisidis 2009; Wallsten 2006; Weerdesteyn 2006; Westlake 2007; Wolf 1996; Wolf 2001; Yang 2012; Yoo 2010; Zhang 2006). We judged only two studies to be at low risk of bias for both random sequence generation and allocation concealment (Campbell 1997; Haines 2009). We judged the single quasi-randomised controlled trial to be at high risk of bias for both random sequence generation and allocation concealment (Lajoie 2004).

### Blinding

Participants were not blinded to the treatment group allocation (as the intervention was exercise), hence we judged all studies as being at high risk of performance bias. Outcome measurements were self reported so participants completed these knowing their allocation and we therefore judged all studies to be at high risk of detection bias.

### Incomplete outcome data

We judged the risk of attrition bias to be low in 57% (17/30) of studies (Barnett 2003; Campbell 1997; Haines 2009; Halvarsson 2011; Hinman 2002; Karinkanta 2012; Lai 2013; Lajoie 2004; Rendon 2012; Sihvonen 2004; Tiedemann 2012; Ullmann 2010; Vogler 2009; Vrantsidis 2009; Weerdesteyn 2006; Wolf 1996; Zhang 2006), with outcome data in these studies reported for 80% or more of the original sample in each arm of the trial. We judged the risk of attrition bias to be high in 40% (12/30) of studies (Clemson 2010; Freiburger 2012; Lin 2007; Logghe 2009; McCormack 2004; Nguyen 2012; Reinsch 1992; Resnick 2008; Wallsten 2006; Wolf 2001; Yang 2012; Yoo 2010), and unclear in 3% (1/30) of included studies (Westlake 2007).

### Selective reporting

We judged the majority of studies (80%; 24/30) to be at unclear risk of reporting bias because it was not possible to tell from the article if all prespecified outcomes had been reported. We judged 17% (5/30) of studies to be at high risk because data were not reported on all prespecified outcomes (Clemson 2010; Halvarsson 2011; Wallsten 2006; Wolf 1996; Wolf 2001), and we judged the remaining 3% (1/30) to be at low risk because the protocol was available and data were reported for all prespecified outcomes (Logghe 2009).

### Other potential sources of bias

We judged the risk of other bias to be low in 13% (4/30) of studies (Campbell 1997; Halvarsson 2011; Vogler 2009; Yoo 2010), where

the study appeared to be free any other source of bias, and unclear in the remaining 87% (26/30) of included studies.

## Effects of interventions

See: [Summary of findings for the main comparison Exercise for reducing fear of falling in older people living in the community](#)

### Exercise versus control (no intervention or alternative non-exercise intervention)

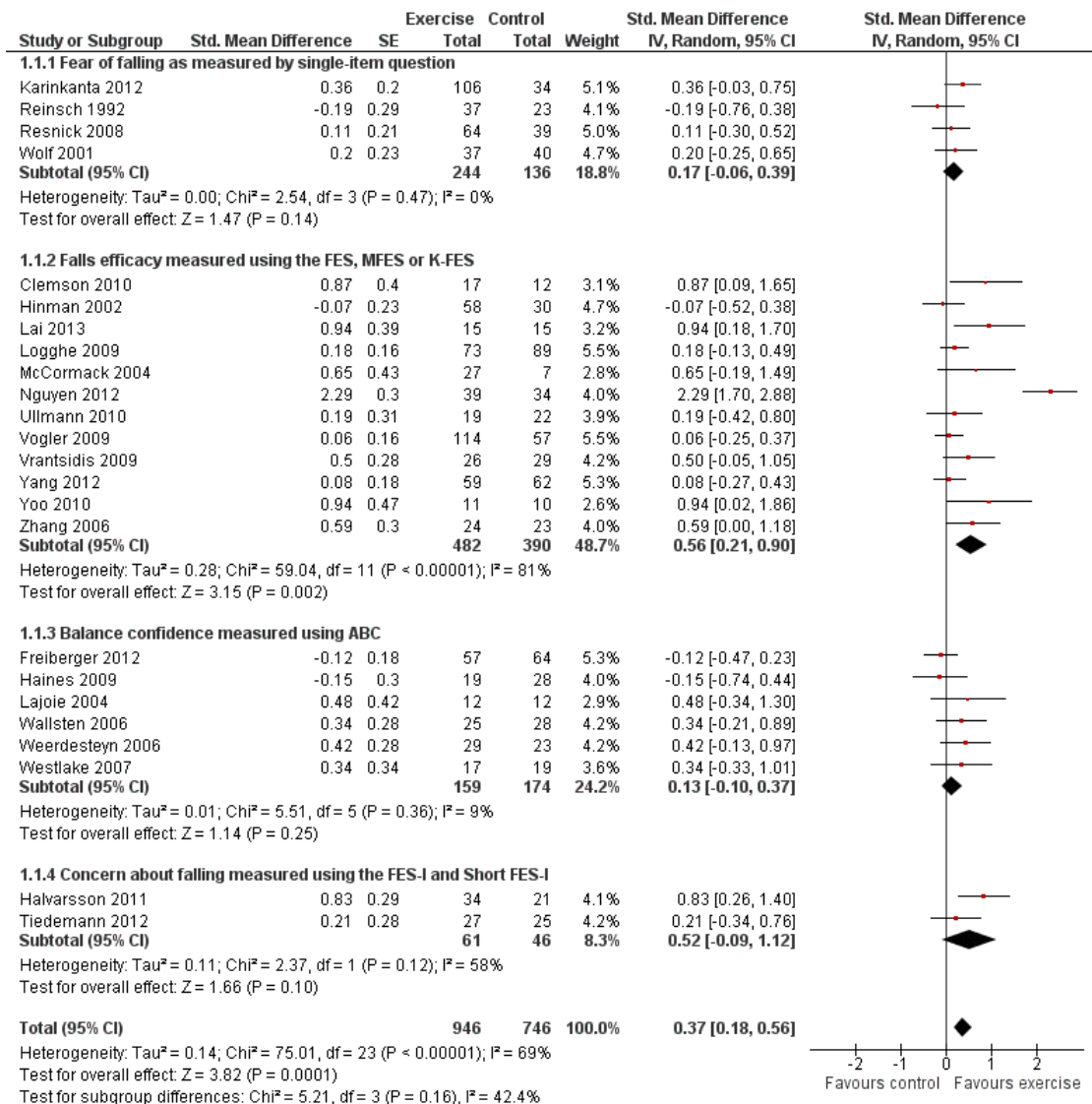
#### Primary outcome: fear of falling

#### Effect of exercise interventions immediately post intervention

We pooled data from 24 studies in a meta-analysis for fear of falling. The means and standard deviations (SDs) for each study are shown in [Table 1](#). Combining effect sizes for all fear of falling scales (Falls Efficacy Scale (FES) (all versions), Activities-specific Balance Confidence (ABC) scale, plus other numerical scales) showed that exercise interventions were associated with a small to moderate and statistically significant reduction in fear of falling (standardised mean difference (SMD) 0.37, 95% confidence interval (CI) 0.18 to 0.56; 24 studies, 1692 participants; [Analysis 1.1](#); [Figure 4](#)). There was significant heterogeneity between effect sizes ( $\text{Chi}^2 = 75.01$ ,  $\text{df} = 23$ ,  $P \text{ value} < 0.00001$ ,  $I^2 = 69\%$ ). Pooled effect sizes did not differ significantly between the different scales used to measure fear of falling (test for subgroup differences:  $\text{Chi}^2 = 5.21$ ,  $\text{df} = 3$ ,  $P \text{ value} = 0.16$ ).



**Figure 4. Forest plot: Exercise versus control: primary outcome - fear of falling, post intervention**



Two studies measured fear of falling using both the FES and ABC (Clemson 2010; Ullmann 2010). We used FES scores in the main analysis and undertook a sensitivity analysis replacing FES scores with ABC scores for these two studies, with similar findings (SMD 0.34, 95% CI 0.15 to 0.53; 24 studies, 1692 participants; analysis not shown).

Two studies were cluster-RCTs (Reinsch 1992; Resnick 2008), for which the standard error of the SMD was inflated as described above using an intraclass correlation coefficient (ICC) (ICC 0.02, 95% CI 0.00 to 0.05) calculated from a cluster-RCT investigating community-based exercise interventions in older people

with randomisation by General Practitioner practice (average cluster size 25) (Iliffe 2010b). A sensitivity analysis showed that using the lower or upper 95% CI for the ICC did not change the results compared with using an ICC of 0.02: the same result (SMD 0.37, 95% CI 0.18 to 0.56) applied with either an ICC of 0 or analysis with an ICC of 0.05.

One study, Nguyen 2012 (73 participants), had a much larger effect size than other studies in the meta-analysis. We undertook a sensitivity analysis excluding this outlier study. Without Nguyen 2012, exercise interventions were still associated with a small to moderate, and statistically significant, improvement in fear of

falling immediately post intervention (SMD 0.24, 95% CI 0.12 to 0.36; 23 studies, 1619 participants). There was no significant heterogeneity between effect sizes after removing [Nguyen 2012](#) from the meta-analysis ( $\text{Chi}^2 = 28.67$ ,  $\text{df} = 22$ ,  $P$  value = 0.15;  $I^2 = 23\%$ ).

Six studies with a total of 666 participants were not included in the meta-analysis. One study was not included because it did not report fear of falling immediately post intervention ([Lin 2007](#); results for 85 participants). Two studies used single-question measures with binary or ordinal responses for measuring fear of falling ([Barnett 2003](#); [Sihvonen 2004](#)). [Barnett 2003](#) (results for 137 participants) reported that the percentage of participants reporting fear of falling did not differ significantly between treatment groups (intervention group = 7.5%, control group = 8.6%,  $P$  value not reported). However, [Sihvonen 2004](#) (results for 27 participants), found a significant reduction from baseline in the intervention group (10% reporting high fear of falling post intervention versus 25% at baseline,  $P$  value = 0.02) but no difference in the control arm (14% at both baseline and post intervention,  $P$  value not reported). [Wolf 1996](#) (results for 165 participants) was not included in the meta-analysis because FES scores were reported grouped into four categories (from 'not at all afraid' to 'very afraid'). This three-arm study found a significant difference in change from baseline between the three groups in an analysis that included data at both post intervention and four months post intervention. In the Tai Chi group, the percentage not at all afraid of falling increased from 43% at baseline to 53% post intervention and reduced to 47% at four-month follow-up; in the balance training group, the percentages at baseline, post intervention and four-month follow-up were 29%, 27% and 33%; and in the control group, these were 44%, 35% and 41%, respectively (reported  $P$  value = 0.046). [Campbell 1997](#) (results for 212 participants) was not included in the meta-analysis as standard deviations (SDs) for the FES were reported only for change from baseline scores. This study reported a significant increase in fear of falling post intervention for the control group compared with the intervention group (difference in mean change from baseline 3.6, 95% CI 0.4 to 6.8,  $P$  value not reported). [Rendon 2012](#) (results for 40 participants) was not included in the meta-analysis as only medians and ranges were reported for the ABC. The study reported significantly improved balance confidence in the intervention group compared with the control group (post intervention median (range) intervention group = 78.8 (55.0 to 96.9), control group = 76.9 (45.0 to 100.0), reported  $P$  value = 0.04).

### **Effect of exercise interventions on fear of falling up to and beyond six months post intervention**

Seven of the studies that reported fear of falling at follow-up times beyond post intervention provided data that could be included in a meta-analysis. Exercise interventions were associated with a small but statistically non-significant reduction in fear of falling at short-term follow-up (less than six months post end of the intervention period) (SMD 0.17, 95% CI -0.05 to 0.38;  $P$  value = 0.12;

four studies; 356 participants; [Analysis 1.2](#)). Two studies could not be included in the meta-analysis. [Westlake 2007](#) reported data at two-month follow-up only for the intervention group. The data from [Wolf 1996](#) at four-month follow-up is reported under the post intervention results above as the analyses combines both time points. At long-term follow-up (six or more months post end of the intervention period), exercise interventions were associated with a small reduction in fear of falling of borderline statistical significance (SMD 0.20, 95% CI -0.01 to 0.41;  $P$  value = 0.06, three studies; 386 participants; [Analysis 1.3](#)). There was no significant heterogeneity between effect sizes at short-term follow-up ( $\text{Chi}^2 = 2.86$ ,  $\text{df} = 3$ ,  $P$  value = 0.41;  $I^2 = 0\%$ ) or long-term follow-up ( $\text{Chi}^2 = 0.78$ ,  $\text{df} = 2$ ,  $P$  value = 0.68;  $I^2 = 0\%$ ).

### **Sensitivity analyses: effect of exercise interventions immediately post intervention**

We did not undertake a sensitivity analysis restricting to studies at low risk of bias from allocation concealment as this applied to only one study that was included in the meta-analysis ([Haines 2009](#)). We were also unable to undertake sensitivity analyses restricting to studies at low risk of detection bias as we judged no studies to be at low risk. Restricting analyses to the 12 studies (802 participants) judged to be at low risk of attrition bias produced similar results (SMD 0.31, 95% CI 0.13 to 0.49; 12 studies, 802 participants; analysis not shown) to the analysis including all studies (SMD 0.37, 95% CI 0.18 to 0.56; 24 studies, 1692 participants; [Analysis 1.1](#)).

### **Subgroup analyses: effect of exercise interventions immediately post intervention**

We performed seven subgroup analyses. We also examined the effect of removing the extreme outlier trial, [Nguyen 2012](#), and illustrate below instances where its removal demonstrated the lack of robustness of findings of potential subgroup differences.

The available evidence did not show that the effect of exercise interventions on fear of falling varied by type of exercise intervention (3D (Tai Chi); gait, balance, co-ordination, functional task exercises; strength and resistance exercises); test for subgroup differences:  $\text{Chi}^2 = 3.46$ ,  $\text{df} = 2$ ,  $P$  value = 0.18; [Analysis 2.1](#)). Two studies were excluded from this subgroup analysis as we used combined data from more than one intervention group in our analysis and the intervention groups provided different types of exercise ([Karinkanta 2012](#); [McCormack 2004](#)).

The effect of exercise interventions on fear of falling may be smaller in studies where the control group received an alternative intervention (e.g. education, social visits, craft activities, discussion groups; SMD 0.11, 95% CI -0.08 to 0.29; six studies, 499 participants) compared with those where the control group received no intervention (SMD 0.48, 95% CI 0.22 to 0.73; 18 studies, 1199 participants) as shown by the test for subgroup differences:  $\text{Chi}^2 = 5.45$ ,

df = 1, P value = 0.02; [Analysis 2.2](#)). Although plausible, these subgroup results should be interpreted with caution as the 95% CI for the subgroup effect sizes overlap and removal of [Nguyen 2012](#) markedly reduces the difference:  $\text{Chi}^2 = 2.83$ , df = 1, P value = 0.09 (analysis not shown).

The available evidence did not show that the effect of exercise interventions on fear of falling differed between studies that did not recruit participants on the basis of increased falls risk (14 studies, 926 participants) and those which did recruit participants at increased risk of falls (11 studies, 857 participants); test for subgroup differences:  $\text{Chi}^2 = 0.85$ , df = 1, P value = 0.36; [Analysis 2.3](#)).

The effect of exercise interventions on fear of falling may be greater where exercise interventions are delivered in groups (SMD 0.49, 95% CI 0.22 to 0.76; 15 studies, 1051 participants) than those delivered to individuals (SMD 0.14, 95% CI -0.06, 0.35; nine studies, 647 participants); test for subgroup differences:  $\text{Chi}^2 = 3.99$ , df = 1, P value = 0.05; [Analysis 2.4](#)). However, these subgroup results should be interpreted with caution as the 95% CI for the subgroup effect sizes overlap, the effect is marginal and removal of [Nguyen 2012](#) markedly reduces the difference:  $\text{Chi}^2 = 1.46$ , df =

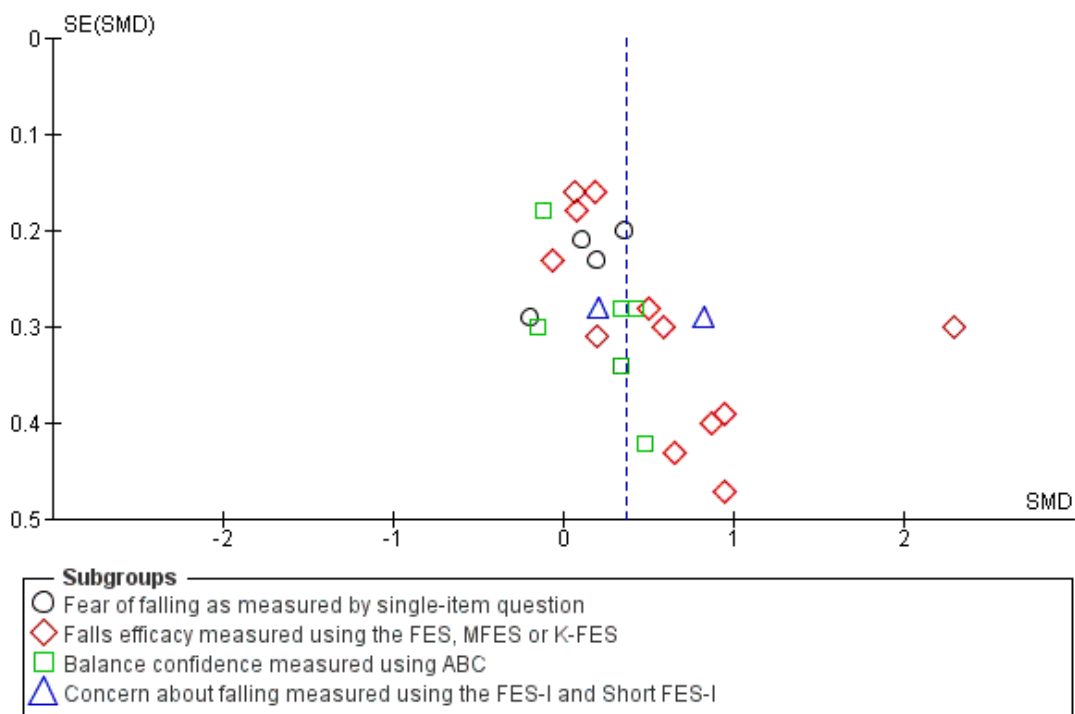
1, P value = 0.23 (analysis not shown).

The available evidence did not show that the effect of exercise interventions on fear of falling varied according to exercise frequency (one to three times per week; four or more times per week); test for subgroup differences:  $\text{Chi}^2 = 0.20$ , df = 1, P value = 0.66; [Analysis 2.5](#)). The same lack of difference between subgroups was observed when subgrouping by duration of interventions (up to 12 weeks; 13 to 26 weeks; more than 26 weeks); test for subgroup differences:  $\text{Chi}^2 = 0.88$ , df = 2, P value = 0.64; [Analysis 2.6](#); and when subgrouping by primary aim of study (to reduce fear of falling; other primary aim); test for subgroup differences:  $\text{Chi}^2 = 0.17$ , df = 2, P value = 0.68; [Analysis 2.7](#).

#### Publication bias: effect of exercise interventions immediately post intervention

The funnel plot for fear of falling post intervention and the Egger's test (bias coefficient 2.98, 95% CI 0.68 to 5.28; P value = 0.01) indicates funnel plot asymmetry suggesting publication bias due to small studies with negative findings that we failed to identify in our review (see [Figure 5](#)). Also of note is that the most extreme data point on the right is that of [Nguyen 2012](#).

**Figure 5. Exercise versus control: primary outcome - fear of falling, post intervention (see for forest plot)**



## Secondary outcomes

For all outcomes described below (occurrence of falls, activity avoidance or restriction, depression, anxiety, exercise compliance or adherence and physical activity) it is important to remember that our included studies do not represent the totality of the evidence of the effect of exercise interventions on these outcomes, as our review only includes studies that measured fear of falling as an outcome. These outcomes have been included in our review because they may help explain why exercise interventions were or were not effective in reducing fear of falling.

## Occurrence of falls

Occurrence of at least one fall was reported in nine studies (Barnett 2003; Campbell 1997; Clemson 2010; Haines 2009; Logghe 2009; Sihvonen 2004; Vogler 2009; Weerdesteyn 2006; Yang 2012). Exercise interventions were associated with a significant reduction in the proportion of participants having at least one fall (risk ratio (RR) 0.85, 95% CI 0.74 to 0.98; nine studies; 1113 participants; Analysis 3.1). There was no significant heterogeneity between effect sizes ( $\text{Chi}^2 = 2.50$ ,  $\text{df} = 8$ ,  $P$  value = 0.96;  $I^2 = 0\%$ ). The follow-up periods in these studies varied from immediately post intervention to 11 months post intervention. Reinsch 1992 (107 participants at baseline) was not included in the meta-analysis because the number of participants for whom falls data were available at follow-up was not reported. This study reported the results of a survival analysis of time to first fall, stating only that there was no significant difference between study groups ( $P$  value = 0.53).

Nine studies reporting data on falls rates were included in the meta-analysis (Barnett 2003; Campbell 1997; Clemson 2010; Freiberger 2012; Haines 2009; Logghe 2009; Sihvonen 2004; Weerdesteyn 2006; Wolf 1996). Exercise interventions were associated with a significantly lower falls rate (IRR 0.68, 95% CI 0.53 to 0.87; nine studies; 1121 participants; Analysis 3.2), but there was significant heterogeneity between effect sizes ( $\text{Chi}^2 = 18.72$ ,  $\text{df} = 8$ ,  $P$  value = 0.02;  $I^2 = 57\%$ ). The follow-up periods in these studies varied from immediately post intervention to 20 months post intervention. One study (Lin 2007; 85 participants) was not included in the meta-analysis as it did not report rate ratios or data from which we could calculate falls rates. This study reported falls rates of 1.6/1000 person years in the intervention group and 1.1/1000 person years in the control group (home safety assessment and modification group). No further figures or  $P$  values are reported.

## Activity avoidance or restriction

No information was provided on activity avoidance or restriction using the modified Survey of Activities and Fear of Falling in the Elderly (SAFFE) or single questions asking about activity avoidance in any of the studies.

## Depression

Depressive symptoms were measured in seven studies, using the Geriatric Depression Scale (GDS) (Rendon 2012; Vogler 2009), GDS-5 (Resnick 2008), GDS-15 (Lin 2007), GDS-20 (Halvarsson 2011), the depression subscale of the Hospital Anxiety and Depression Scale (HADS) (Wolf 2001), and the Center for Epidemiologic Studies - Depression (CES-D) scale (Wolf 1996). Notably, five of these studies had 'active' control interventions. This was education on nutrition in Resnick 2008; education on a range of topics including medicines, sleep, cognitive impairment and bereavement in Wolf 1996; social home visits in Vogler 2009; individualised crafts/games in Wolf 2001; and home safety assessment in Lin 2007.

Four studies reported depression scores immediately post intervention (Halvarsson 2011; Resnick 2008; Vogler 2009; Wolf 2001), as shown in Table 2. Exercise interventions did not appear to reduce depression scores (SMD -0.08, 95% CI -0.28 to 0.13; four studies; 406 participants; Analysis 3.3) and there was no significant heterogeneity between effect sizes ( $\text{Chi}^2 = 5.19$ ,  $\text{df} = 3$ ,  $P$  value = 0.16;  $I^2 = 42\%$ ).

One study was a cluster-RCT (Resnick 2008); the standard error was inflated to account for clustering as described above using the ICC of 0.03 from a cluster-RCT investigating exercise for depression in older care home residents with the GD-15 (Underwood 2013). This trial reported two ICCs, both without 95% CI (an ICC of 0.00 at 12 months and an ICC of 0.03 at six months in participants who were depressed at baseline). We used the ICC of 0.03 in the analysis and undertook a sensitivity analysis using an ICC of zero. Findings were very similar using ICCs of 0.03 (SMD -0.08, 95% CI -0.28 to 0.13; four studies; 186 participants) and zero (SMD -0.09, 95% CI -0.29 to 0.11; four studies; 186 participants); analyses not shown.

Rendon 2012 could not be included in the meta-analysis because the published data were reported as medians and ranges. This study reported no significant difference post intervention between the GDS scores of the exercise and control groups (GDS median (range) in the exercise group was 4.0 (0.0 to 13.0) and in the control group 5.0 (1.0 to 14.0); 40 participants,  $P$  value = 0.09). Three studies (Lin 2007; Vogler 2009; Wolf 2001), all with 'active' control groups, reported results at short-term follow-up (less than six months post intervention). Exercise interventions did not appear to reduce depression scores; these results favoured the no exercise, 'active' control, group (SMD 0.20, 95% CI -0.02 to 0.43; three studies; 327 participants; Analysis 3.4). There was no significant heterogeneity between effect sizes ( $\text{Chi}^2 = 2.55$ ,  $\text{df} = 2$ ,  $P$  value = 0.28;  $I^2 = 22\%$ ).

One study was not included in the meta-analyses immediately post intervention or at short-term follow-up (Wolf 1996). This study (185 participants) measured depression using the CES-D scale and reported no significant difference between treatment groups (CES-D scores and  $P$  values not reported).

## Anxiety

Anxiety was reported by the subscale of the HADS by [Wolf 2001](#) and no significant differences were observed between mean scores in the intervention group and control group immediately post intervention (mean (SD): intervention group:4.3 (3.9); control group 4.3 (3.4), 77 participants, P value > 0.05).

### Compliance with or adherence to exercise interventions

Twenty-one studies reported adherence rates. The definitions of adherence, which varied between studies, are given in the table of [Characteristics of included studies](#). Seventeen studies reported adherence rates over 50% ([Barnett 2003](#); [Freiberger 2012](#); [Hinman 2002](#); [Karinkanta 2012](#); [McCormack 2004](#); [Reinsch 1992](#); [Rendon 2012](#); [Resnick 2008](#); [Sihvonen 2004](#); [Tiedemann 2012](#); [Ullmann 2010](#); [Vogler 2009](#); [Vrantsidis 2009](#); [Weerdesteyn 2006](#); [Westlake 2007](#); [Wolf 1996](#); [Zhang 2006](#)). Six studies reported adherence rates of 90% or higher ([Barnett 2003](#); [Hinman 2002](#); [Sihvonen 2004](#); [Ullmann 2010](#); [Wolf 1996](#); [Zhang 2006](#)). [Hinman 2002](#) partly attributed this high adherence to participants being offered a cash incentive for taking part in the trial. Of those studies reporting adherence rates above 50%, 41% (7/17) were classified as gait, balance, co-ordination or functional task exercises, 18% (3/17) as strength and resistance exercises, 24% as 3D exercises (4/17) and 18% (3/17) had more than one intervention group each with a different type of exercise. This suggests higher adherence rates were not confined to studies evaluating particular types of exercise. Four studies reported adherence rates less than 50% ([Campbell 1997](#); [Haines 2009](#); [Logghe 2009](#); [Yang 2012](#)). Nine studies did not report adherence rates ([Clemson 2010](#); [Halvarsson 2011](#); [Lai 2013](#); [Lajoie 2004](#); [Lin 2007](#); [Nguyen 2012](#); [Wallsten 2006](#); [Wolf 2001](#); [Yoo 2010](#)).

As physical activity can be regarded as a measure of compliance or adherence to exercise interventions, we also report on this. Eight studies measured physical activity in participants using a variety of scales ([Barnett 2003](#); [Campbell 1997](#); [Logghe 2009](#); [Resnick 2008](#); [Sihvonen 2004](#); [Westlake 2007](#); [Yang 2012](#); [Yoo 2010](#)). The Physical Activity Scale for the Elderly (PASE) ([Washburn 1993](#)) was used in four studies ([Barnett 2003](#); [Campbell 1997](#); [Logghe 2009](#); [Westlake 2007](#)), the Yale Physical Activity Survey (YPAS) in two studies ([Resnick 2008](#); [Yoo 2010](#)), and a four-category graded physical activity scale (only activities of daily living, less than three hours per week, three to four hours per week, more than four hours per week) ([Sihvonen 2004](#)) and Human Activity Profile - Adjusted Activity Score (HAP-AAS) ([Yang 2012](#)) were used in the remaining two studies.

Meta-analysis of four studies using the PASE score ([Barnett 2003](#); [Campbell 1997](#); [Logghe 2009](#); [Westlake 2007](#)) showed exercise interventions did not appear to increase physical activity (MD 3.44, 95% CI -1.65 to 8.54; four studies; 547 participants; [Analysis 3.5](#)) and no significant heterogeneity between effect sizes ( $\text{Chi}^2 = 2.04$ ,  $\text{df} = 3$ ,  $P$  value = 0.57;  $I^2 = 0\%$ ). [Barnett 2003](#) reported physical activity at six months into a 12-month intervention. The remaining three studies reported physical activity immediately post in-

tervention.

Three studies not included in the meta-analysis reported physical activity significantly increased in the intervention group compared with the control group post intervention ([Resnick 2008](#); [Sihvonen 2004](#); [Yang 2012](#)). [Resnick 2008](#) (103 participants) reported an intervention group mean of 281 (SD 320) minutes and a control group mean of 199 (SD 257) minutes per week spent in moderate intensity physical activity post intervention ( $P$  value = 0.04), [Sihvonen 2004](#) (27 participants) reported a significant increase in physical activity from baseline in the intervention group but not in the control group (20% more than four hours per week to 45% in intervention group versus 0% doing more than four hours per week in control group at both time points,  $P$  value = 0.004). [Yang 2012](#) (121 participants) reported a significantly higher HAP-AAS score in the intervention group than the control group post intervention (difference between means comparing intervention to control group: 4.57, 95% CI 1.84 to 7.29,  $P$  value = 0.001). [Yoo 2010](#) (21 participants) reported no significant difference in energy expenditure per week between the exercise and control groups (mean (SD) kcal/week 9806 (4062) versus 6068 (2216) respectively,  $P$  value only reported as non-significant).

### Cost

No information was provided on the cost of the interventions in any of the studies.

## DISCUSSION

### Summary of main results

The 30 included studies, which included a total of 1692 participants, investigated a wide variety of interventions using different types of exercise, of varied intensity and duration, in a range of different settings. A summary of the evidence is shown in [Summary of findings for the main comparison](#).

Low quality evidence suggests that exercise interventions are associated with a small to moderate reduction in fear of falling amongst community-dwelling older adults immediately at the end of the intervention period (standardised mean difference (SMD) 0.37, 95% confidence interval (CI) 0.18, 0.56; 24 studies, 1692 participants). Pooled effect sizes did not differ significantly between the different scales used to measure fear of falling. Although none of the sensitivity analyses changed the direction of effect, the greatest reduction in the size of the effect was on removal of an extreme outlier study with 73 participants (SMD 0.24, 95% CI 0.12 to 0.36; 23 studies, 1619 participants).

Subgroup analyses did not provide evidence that the effect of exercise interventions on fear of falling differed by type of exercise intervention, the frequency of exercise or the duration of the exercise intervention. Similarly, subgroup analyses did not provide

evidence that the effect of exercise interventions on fear of falling differed between studies which did and did not recruit participants on the basis of increased falls risk, or between those where the primary aim was to reduce fear of falling and those with an alternative primary aim. It is possible that the small number of studies in some of the subgroups may have resulted in a lack of power to detect differential effects.

Subgroup analysis provided some weak evidence that the effect of exercise interventions on fear of falling was less, including no effect or a small increase, where the control group received an alternative intervention (e.g. education, social visits, craft activities, discussion groups) than where the control group received no intervention. There was also some weak evidence that the effect of exercise interventions on fear of falling is larger where the intervention involved group exercises rather than individual exercises. However, these subgroup results should be interpreted with caution as the 95% CIs for the subgroup effect sizes overlap and there was substantial reduction of the effect upon removal of the above-mentioned outlier study.

There was very low quality evidence from four studies of exercise resulting in either little effect or a small reduction in fear of falling in the short term (less than six months from the end of the intervention) during follow-up. A similar conclusion resulted from long-term data provided by three studies.

Very low quality evidence suggests exercise interventions in these studies that also reported on fear of falling reduced the risk of falling measured either as participants incurring at least one fall during follow-up or number of falls during follow-up. These provide reassurance that reduced fear of falling was not associated with an increased risk of falling. Very low quality evidence from four studies indicated that exercise interventions did not appear to reduce symptoms of depression or increase physical activity. Only one study reported effects of exercise interventions on anxiety, finding no difference between groups. No studies reported the effects of exercise interventions on activity avoidance or costs. It is important to remember that our included studies do not represent the totality of the evidence of the effect of exercise interventions on falls, depression, anxiety or physical activity as our review only includes studies that reported fear of falling.

### **Overall completeness and applicability of evidence**

This is the largest review of the effect of exercise interventions on fear of falling in community-dwelling older people. Where data were not presented in the required format or were missing, the review team attempted to obtain data from trial authors and, as a result, we were able to include unpublished data from seven studies (Clemson 2010; Halvarsson 2011; Lajoie 2004; Ullmann 2010; Vogler 2009; Wallsten 2006; Weerdesteyn 2006). We pooled data from 24 of the 30 included studies (1692 participants) for our primary outcome: fear of falling measured immediately post inter-

vention. Very few studies reported on fear of falling subsequently. As stressed repeatedly, the evidence for our secondary outcomes, such as falls, does not represent the totality of the evidence of the effect of exercise interventions on these outcomes.

We found exercise interventions were associated with a small to moderate reduction in fear of falling. To our knowledge there are no definitions of minimal clinically important differences in fear of falling for the measures used in studies in our review. A minimal clinically important difference is the smallest change in an outcome measure that a patient would find important. Defining this for measures of fear of falling would be difficult. Items in the scales may require different weightings for different individuals and populations as fear, concern or worry about falling may vary in importance across the items included in the scales. For example, fear about falling whilst having a bath or shower or whilst walking around the neighbourhood may have very different impacts on the life of an older person. Consequently it is not possible to consider our findings in terms of a minimal clinically important difference. Although all studies tested exercise in older people living in the community and reported on fear of falling, there was considerable variation in study characteristics. Where there were sufficient data available for discrete subgroups, none of our subgroup analyses provided robust evidence of differences in effect in terms of either the study primary aim (reduction of fear of falling or other aim), the study population (recruitment on the basis of increased falls risk or not), the characteristics of the study exercise intervention, the study control intervention (no treatment or alternative intervention), or the method of outcome measurement. The potential for differences of effect in different populations or from different exercise interventions cannot be ruled out but the currently available evidence is insufficient to provide these insights.

We were also unable to explore the effect of exercise adherence on fear of falling, either during the intervention period or beyond the end of the intervention period due to some studies not measuring adherence and the use of varying definitions by other studies. It is possible that participants in the trials included in our review may have been more physically active and more interested or motivated to participate in an exercise programme than the general population of older people. If this is the case, our findings may overestimate the effect of exercise interventions if they were implemented in a wider population of community-dwelling older people. The majority of the studies in our review come from high-income countries, so our findings may not be generalisable to low- and middle-income countries.

The relationship between fear of falling and falls occurrence is important, because one potential unintended consequence of reducing fear of falling may be increased exposure to activities associated with a higher risk of falls. Our review therefore reported on falls outcomes as well as on fear of falling. While the studies included in our review are only a subset of studies examining the effect of exercise on preventing falls, the results of our analyses are consistent with those of reviews focusing on the prevention of falls

(Gillespie 2012b; Sherrington 2008b).

### Quality of the evidence

Due to the nature of the intervention and outcome measures, blinding of participants and outcome assessors was not possible and therefore we judged all studies to be at high risk of performance and detection biases. Most studies were not reported in sufficient detail to judge the risk of other biases, particularly in terms of selection bias and reporting bias. We judged 12 studies to be at high risk of attrition bias. However, a sensitivity analysis including only the 17 studies at low risk of attrition bias showed similar results for the primary analysis. We downgraded the quality of evidence for all outcomes by one level for study limitations reflecting the high risk of bias from lack of blinding.

The funnel plot and Egger's test for data from our primary outcome of fear of falling immediately post intervention indicated the potential that we had failed to identify and include some small studies with negative findings. This suggests that the findings of our review may overestimate the effect of exercise interventions on reducing fear of falling. We thus downgraded the quality of evidence for fear of falling by a further level for publication bias. We downgraded fear of falling measured at short and long term follow-up after the end of the intervention by one further level because of the small number of studies contributing these data.

We did not downgrade the quality of the evidence for fear of falling immediately post intervention for heterogeneity, including that relating to wide variety of exercise interventions tested in the included studies. As well as drawing on the findings of the subgroup analyses, this decision reflected that the significant heterogeneity between effect sizes in the meta-analysis for our primary outcome measure was mainly due to one outlier study (Nguyen 2012). This evaluated group-based Tai Chi classes lasting for one hour, twice weekly for six months in adults aged 60 to 79 years. There is no obvious explanation for the much larger effect on fear of falling favouring the intervention group than other studies included in our meta-analysis.

We downgraded the quality of evidence for all secondary outcomes by two further levels for indirectness. This is because our review includes only a subset of studies reporting the effect of exercise interventions on these outcomes, as studies had to report fear of falling and these outcomes to be included in our review. Thus these results cannot be considered representative of the effects of the interventions under test.

In consequence, we judged the quality of the evidence for the outcome 'fear of falling immediately post intervention' to be 'low', and the quality of evidence for all other outcomes including fear of falling at short and long-term follow-ups to be 'very low'. Where the quality of evidence is 'low' this suggests further research is very likely to change the estimate of, and confidence in the estimate of, the effect of exercise on those outcomes. Where the quality of evidence is 'very low', there is considerable uncertainty about the

effect of exercise on those outcomes.

### Potential biases in the review process

Since many studies included in our review did not measure fear of falling as a primary outcome, it is likely that our searches failed to identify some studies that measured but did not report fear of falling. To reduce potential bias, we contacted authors of studies that met our criteria for study design, participants and interventions but did not report fear of falling as an outcome measure although they reported on fear of falling at baseline or mentioned it in their methods. We tried also to minimise reporting bias by contacting authors of included studies to obtain unpublished data and were successful in obtaining data for seven studies, enabling their inclusion in the meta-analyses. We tried to minimise publication bias by searches of a range of databases, by examining reference lists of included studies and relevant reviews and by contacting authors and experts in the field of fear of falling and exercise. However, the funnel plot (Figure 5) and the Egger's test (P value = 0.01) indicate funnel plot asymmetry suggesting publication bias from the non-availability of small studies with negative findings. Upon reconsideration of our study selection judgements subsequent to editorial feedback on our review, we identified seven studies (695 participants) where it was unclear whether the treatment in the comparator group may have increased exercise. These are currently awaiting assessment as more details are required on the content of the comparator treatment to decide on inclusion of these studies and to consider the implications of the current decision not to include these studies in terms of introducing bias into the review.

As stipulated in our protocol, we performed sensitivity analyses to check on various decisions that we had made in presenting the data. These suggested that our findings for fear of falling were very similar when we used the Activities-specific Balance Confidence (ABC) scores instead of the Falls Efficacy Scale (FES) scores for two studies that reported both scores and when we varied the intraclass correlation coefficient (ICC) used to adjust the results from cluster-randomised controlled trials. Restricting analyses to studies at low risk of attrition bias also produced similar results to the analysis containing all studies.

### Agreements and disagreements with other studies or reviews

Notably, the narrative and dated (search date January 2006) systematic review by Zijlstra 2007 provided separate conclusions for different types of exercise interventions. Zijlstra 2007 concluded that community-based Tai Chi and home-based exercise interventions reduced fear of falling in community-dwelling older people, but that community-based group exercise and computerised balance training did not. While we categorised our interventions in various ways (Table 3), our primary analysis included all exercise

interventions. Our subgroup analyses did not provide evidence that different types of exercise interventions differed in their effect on fear of falling.

Our review included only a limited subset of the studies included in other reviews evaluating the effect of exercise interventions on the risk and rate of falls. In consequence, our review does not comprise the totality of evidence in this area. However, our findings on exercise interventions are consistent with those of the Cochrane review on preventing falls in older people living in the community (Gillespie 2012b). This found group and home-based exercise programmes containing strength and balance training exercises, including Tai Chi, are effective in preventing falls. A review by Bula 2011b, examining interventions aimed at improving balance confidence in older adults, found the majority of effective interventions included some component of exercise, with no superiority of one type of exercise. Whilst our review did not find evidence of a significant effect of exercise interventions on symptoms of depression, a review by Bridle 2012 found exercise to reduce the severity of symptoms in older people suffering from depression. A Cochrane review including 35 trials (1356 participants) also found exercise had a significant effect, of moderate size, in improving symptoms of depression (Cooney 2013). As well as only a small number of studies included in our review reporting measures of depression, the populations included in studies in the reviews by Bridle 2012 and Cooney 2013 comprised people with pre-existing depression, whereas none of the studies reporting depression as an outcome in our review specifically recruited people with depression.

## AUTHORS' CONCLUSIONS

### Implications for practice

Exercise interventions in community-dwelling older people probably reduce fear of falling to a limited extent immediately after the intervention, without increasing the risk or frequency of falls.

There is insufficient evidence from the included studies to determine whether exercise interventions reduce fear of falling beyond the end of the intervention or their effect on other outcomes.

### Implications for research

Further well-designed randomised trials are required to assess the effect of exercise interventions on fear of falling amongst community-dwelling older people. However, priority should be given to establishing a core set of outcomes that includes fear of falling, and other related outcomes, for all trials examining the effects of exercise interventions in older people living in the community. The variety of the tools used to measure fear of falling is likely to continue to be a problem, but a pragmatic approach is that all trials should be explicit about the tools they use to measure fear of falling and the constructs measured by the tools. Consideration is needed regarding the time of outcome measurement; in particular, outcome should be measured at suitable time points beyond the end of the intervention period. Trials should also measure and clearly define exercise adherence. Discussion in the research community, with consumer and other stakeholder input, is required to identify priorities for future research and trials. This includes informing the decisions on the target population and the exercise interventions to be tested in trials whose primary aim is to reduce fear of falling.

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\* Indicates the major publication for the study

## CHARACTERISTICS OF STUDIES

### Characteristics of included studies *[ordered by study ID]*

#### Barnett 2003

Methods	RCT	
Participants	<p>Country: Australia  n = 163  67% female  Mean age in years (SD) = 75 (5.5)  Study population: recruited from general practice clinics or 2 acute physiotherapy departments  Inclusion criteria: participants were aged 65 years and older recruited from general practice clinics with 1 or more physical performance impairments known to be important risk factors for falls (i.e. lower limb weakness, poor balance and slow reaction time)  Exclusion criteria: cognitive impairments, degenerative conditions or medical condition involving neuromuscular, skeletal or cardiovascular system which could prevent them from taking part in an exercise programme</p>	
Interventions	<p>1. Exercise group (n = 83). Weekly structured exercise group in a community setting, combined with a home exercise programme and written information on practical strategies for avoiding falls. Classes ran for 1 hour, over 4 terms for 1 year (37 classes) and steadily increased in speed and complexity. Class content was designed by a physiotherapist to specifically address physical falls risk factors and was delivered in groups of 6 to 18. Content included stretching, balance, co-ordination, aerobic capacity and muscle strengthening exercises. The home exercise programme was based on the class content with diaries to record participation. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks  2. Control group (n = 80). Provided with the same information about falls prevention, but no alternative 'non-exercise' activity</p>	
Outcomes	<p>Number of falls (recorded by retrospective monthly fall calendars); fear of falling (single-item measure - recorded as % of participants who are afraid of falling); physical activity (Physical Activity Scale for the Elderly (PASE)). Outcomes were measured at baseline and 6 months post baseline. Falls were measured over the 12-month intervention period</p>	
Notes	<p>The outcomes for the study were measured at 6 months into the 12-month trial as this was deemed a sufficient period to achieve the beneficial results of the exercise programme. Adherence: 91% were still attending exercise classes at the end of the trial and performing home exercises at least once a week</p>	
<b><i>Risk of bias</i></b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Unclear risk	No further information provided on sequence generation

**Barnett 2003** (Continued)

Allocation concealment (selection bias)	Unclear risk	“Subjects were randomised in matched blocks (n = 6) after the baseline assessment using consecutively numbered opaque envelopes”. Paper does not say if envelopes were sealed
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Fear of falling, number of falls and PASE were self reported by unblinded participants
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Falls data collected retrospectively by postal survey at the end of each month

**Campbell 1997**

Methods	RCT
Participants	<p>Country: New Zealand  n = 233  100% female  Mean age in years (SD) = 84 (3.3)  Study population: recruited from general practice registers  Inclusion criteria: women aged 80 and over who lived in the community recruited from general practice, able to move around within their own home and not receiving physiotherapy  Exclusion criteria: score &lt; 7 from 10 on the Mental Status Questionnaire (MSQ)</p>
Interventions	<p>1. Exercise group (n = 116). 1-year home-based exercise programme prescribed by a physiotherapist. Exercises took approximately 30 minutes to complete and participants were to complete them at least 3 times a week, and walk outside the home at least 3 times per week. The programme included moderate intensity strengthening exercises with ankle cuff weights (0.5 kg and 1 kg), strength, balance and “active range of movement” exercises. The physiotherapist visited participants 4 times over 2 months prescribing a selection of exercise at appropriate and increasing levels of difficulty, and a walking plan. Participants were telephoned regularly to maintain motivation. ProFaNE taxonomy classification: strength/resistance</p> <p>2. Control group (n = 117). Participants received a social visit from the research nurse 4 times during the first 2 months and telephoned them regularly during the year of follow-up</p>

**Campbell 1997** (Continued)

Outcomes	Number of falls (recorded by monthly fall calendars); falls efficacy (Falls Efficacy Scale (FES)); physical activity (PASE). Outcomes were measured at baseline and post intervention. FES and PASE only presented as % change from baseline
Notes	Adherence: after 1 year 42% were still completing the exercise programme 3 or more times a week

**Risk of bias**

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	The group allocation schedule was developed by a statistician using computer-generated random numbers
Allocation concealment (selection bias)	Low risk	Central allocation (telephone) after all baseline questionnaires and assessments were completed. List held off site by an independent person
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Number of falls, FES and PASE were self reported by unblinded participants
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Low risk	Appears to be free of other sources of bias

**Clemson 2010**

Methods	RCT
Participants	Country: Australia n = 34 47% female Mean age in years (SD) = 82 (6.0) Study population: recruited from the Department of Veterans Affairs Home Front Database and a list from a general medical practice Inclusion criteria: community-dwelling older adults aged 70 years and above who had 2 or more falls or an injurious fall in the past year Exclusion criteria: moderate to severe cognitive problems (> 2 errors on the Short Portable Mental Status Questionnaire); non-conversational English; unable to walk around inde-



	pendently; resident in nursing home or hostel; unstable or terminal medical illness that would preclude planned exercises; neurological conditions that would result in motor performance difficulties (e.g. Parkinson's disease)	
Interventions	1. Lifestyle approach to reducing Falls through Exercise (LiFE) (n = 18). Home-based lifestyle-integrated balance and strengthening exercise programme specifically developed for fall prevention. LiFE was taught in 5 home visits with 2 booster visits over a 3-month period and 2 follow-up phone calls. ProFaNE taxonomy classification: gait, balance, coordination, functional tasks 2. Control (n = 16). No intervention	
Outcomes	Number of falls (recorded by monthly fall calendars); falls efficacy (Modified Falls-Efficacy Scale (MFES)); balance confidence (Activities Specific Balance Confidence Scale (ABC)). Measured at baseline, post intervention and 3 months follow-up	
Notes	Adherence rates not reported MFES and ABC means and SDs obtained through personal communication with author	
<b><i>Risk of bias</i></b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Low risk	Randomisation using a random numbers table and stratifying by age and fall history (1 to 2 falls; $\geq 3$ falls), but no further information provided
Allocation concealment (selection bias)	High risk	Open random allocation schedule. Participants were allocated in order of completion from random number list by an investigator not involved in assessment or intervention
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Number of falls, MFES and ABC were self reported by unblinded participants
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome data are based on > 80% of participants in intervention group, but < 80% for the control group
Selective reporting (reporting bias)	High risk	Stated that adherence was monitored for the exercise group but data are not presented. Protocol not available
Other bias	Unclear risk	The intervention group were able to stand for longer on the tandem stand eyes open test (median 15 seconds) than the control group (median 1.65 seconds) at baseline. This baseline difference was adjusted for in the falls analysis and the results remained significant. The LiFE intervention was developed col-

laboratively by 4 of the authors

**Freiberger 2012**

Methods	RCT	
Participants	<p>Country: Germany  n = 144 (groups 2 and 4 below)  47% female  Mean age in years (SD) = 76 (4.1)  Study population: recruited from a health insurance database  Inclusion criteria: community-dwelling older adults aged 70 to 90 who had fallen in the past 6 months or reported a fear of falling  Exclusion criteria: those who were unable to walk around independently or had cognitive impairment (as noted by a score &lt; 25 on the Digit Symbol Substitution Test (DSST))</p>	
Interventions	<p>1. Strength and Balance Group (SBG) (n = 63). Weight-bearing exercises with dumbbells and balance challenging exercises, stretching, plus sensory training including standing and walking with eyes closed or on unstable surfaces and training in the perception of centre of gravity in relation to the base of support  2. Fitness Group (FG) (n = 64). Strength and balance exercise with endurance training (walking with change of pace and direction and Nordic walking). ProFaNE taxonomy classification: strength/resistance  3. Multifaceted Group (MG) (n = 73). Strength and balance training with fall risk education to address fall-related psychological aspects and cognitive training  4. Control Group (n = 80). No intervention  All active interventions included progressive exercises for upper and lower body strength, standing weight-bearing exercises with dumbbells and balance exercises. Interventions were provided by 2 fall prevention instructors for a period of 16 weeks with 2 1-hour group sessions per week  The intervention group used in the meta-analysis comprised only the FG</p>	
Outcomes	<p>Number of falls (recorded by monthly fall calendars); balance confidence (ABC); measured at post intervention, 6 months and 18 months follow-up. ABC score at 6 months follow-up used in the analysis of fear of falling at 6 months or more post intervention</p>	
Notes	<p>Adherence rates: majority of participants (&gt; 80%) attended at least 24 of the 32 sessions</p>	
<b><i>Risk of bias</i></b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Low risk	A third party not involved in the study applied a computerised random-number generator
Allocation concealment (selection bias)	Unclear risk	A third party not involved in the study applied a computerised random number generator

**Freiberger 2012** (Continued)

Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Number of falls and ABC were self reported by unblinded participants
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome data are based on < 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	No baseline scores for ABC presented. The control group had a greater proportion reporting fear of falling and higher education levels than the intervention group (fitness group) at baseline. Analyses were adjusted for these variables. The majority of falls occurred during sports activities (including cycling and skiing)

**Haines 2009**

Methods	RCT
Participants	<p>Country: Australia  n = 53  60% female  Mean age in years (SD) = 81 (7.7)  Study population: patients of a publicly funded, metropolitan, tertiary hospital  Inclusion criteria: aged 65 years and over, treated on the geriatric rehabilitation medical or surgical units of a local hospital being planned for discharge to the community, gait instability as determined by physiotherapists or walked with a mobility aid  Exclusion criteria: severe cardiac disease, cognitive impairment (determined by Abbreviated Mental Test Score less than 6 out of 10), aggressive behaviour, restricted lower limb weight-bearing status or had been referred for post discharge community rehabilitation services</p>
Interventions	<p>1. Exercise Group (n = 19). A DVD and workbook describing a progressive 2-month home exercise programme based on the Kitchen Table exercise programme containing lower limb strength and balance exercises with 6 types of exercises each with 6 different levels of difficulty. A physiotherapist visited participants at home to help engagement with the DVD and workbook, ensure a safe environment and set appropriate starting level. The physiotherapist also made weekly phone calls for 8 weeks after the first home visit to measure participation in the exercise programme and to give advice on any problems the participants had encountered in attempting the exercise programme. Participants were encouraged to continue the exercise after the 8 weeks. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks  2. Control (n = 34). No intervention</p>

**Haines 2009** (Continued)

Outcomes	Number of falls (recorded by monthly fall calendars); balance confidence (ABC). Measured at baseline and post intervention	
Notes	Adherence: less than 50% were still completing the exercise programme at the end of the trial	
<b>Risk of bias</b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Low risk	Computerised random number generator
Allocation concealment (selection bias)	Low risk	Sequentially numbered, sealed, opaque envelopes (with participant numbers)
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Number of falls and ABC scales were self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Control group had longer length of hospital stay and higher median number of falls than intervention group at baseline

**Halvarsson 2011**

Methods	RCT
Participants	Country: Sweden n = 59 71% female Mean age in years (range) = 77 (67 to 93) Study population: recruited from advertisements in local newspapers Inclusion criteria: community-dwelling older people aged 65 years or older, with a fear of falling and/or an experience of a fall during the previous 12 months. An ability to walk unaided indoors and a mini mental state examination score equal or greater than 24. Recruited by advertisements in local newspapers Exclusion criteria: severely impaired vision or hearing, severe cancer, severe pain, neurological disease or damage with symptoms, dizziness requiring medical care, or heart and

	respiratory symptoms that might affect participation	
Interventions	1. Balance group training (n = 38). Individually adjusted progressive and specific balance training, provided by physiotherapists for 45 minutes 3 times per week for 3 months. The programme was performed at 5 levels, each reflecting different demands on the postural control system. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks 2. Control (n = 21). No intervention	
Outcomes	Concern about falling (FES-International (FES-I); depressive symptoms (Geriatric Depression Scale-20 (GDS-20)). Measured at baseline and post intervention	
Notes	Adherence rates not reported FES-I and GDS-20 means and SDs obtained through personal communication with author	
<b>Risk of bias</b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Unclear risk	Subjects drew an allocation slip from an envelope filled with 20 slips in a 2:1 ratio. No further information given on sequence generation
Allocation concealment (selection bias)	High risk	Participants could possibly see their allocation as they drew the allocation slip themselves from the envelope. No further information provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	FES-I and GDS-20 were self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group
Selective reporting (reporting bias)	High risk	GDS scores not presented. Protocol not available
Other bias	Low risk	Appears to be free of other sources of bias

**Hinman 2002**

Methods	RCT
Participants	Country: USA n = 97 63% female Mean age in years (range) = 72 (63 to 87) Study population: recruited from local community. No further details given Inclusion criteria: able to walk around independently (unassisted or with a walking aid) and be able to follow a structured exercise programme Exclusion criteria: acute neurological or orthopaedic conditions, history of dementia
Interventions	1. Home Exercise (HE) Programme (n = 32). Participants expected to perform a set of 20-minute balance exercises and activities on an independent basis 3 times a week for 4 weeks. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks 2. Computer Balance (CB) Training (n = 34). Biodex balance system which provides an unstable platform that moves in response to changes in the user's centre of mass and tilts up to 20 degrees in every direction. 4-week programme with 8 stability levels, supervised by a research assistant. First 2 weeks consisted of a 10-minute warm-up and then 10 minutes training. Final 2 weeks consisted of a 15 minute warm-up and then 15 minutes training. In the final week, participants were given goggles to obscure their vision during the warm-up exercises. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks 3. Control group (n = 31). No training programme for 4 weeks and advised not to engage in any new exercise or training programmes for the duration of the trial The intervention group used in the analysis comprised the combined HE and CB groups
Outcomes	Falls efficacy (MFES). Measured at baseline and post intervention
Notes	Adherence: over 90% adhered to the exercise programme. Cash incentive offered

***Risk of bias***

<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Unclear risk	Randomly assigned but no further information provided
Allocation concealment (selection bias)	Unclear risk	No information on allocation concealment provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	MFES was self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group

**Hinman 2002** (Continued)

Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Participants received a monetary compensation for their participation in the study, with intervention groups compensated at a higher rate than the control group

**Karinkanta 2012**

Methods	RCT
Participants	<p>Country: Finland  n = 149  100% female  Mean age in years = 73 (2.3)</p> <p>Study population: random population sample invited to express interest in study by post  Inclusion criteria: 70 to 79-year old women living in the city of Tampere, Finland; willingness to participate, full understanding of the study procedures, no history of any illness contraindicating exercise or limiting participation in the exercise programme or of illness affecting balance or bone, no uncorrected vision problems, and taking no medications known to affect balance or bone metabolism (within 12 months before the enrolment)</p> <p>Exclusion criteria: participants were excluded if they did high-intensity exercises more than twice a week or if their femoral-neck T score was lower than -2.5 (i.e. indicating osteoporosis and requiring medical attention)</p>
Interventions	<p>1. A resistance-training (RT) group (n = 37). The resistance training consisted of exercises for large muscle groups with increasing intensity from 50% to 60% of 1-repetition maximum (1RM) to 75% to 80% of 1RM. ProFaNE taxonomy classification: strength/resistance</p> <p>2. A balance-jumping (BJ) group (n = 37). The balance-jumping training comprised modified aerobics and step aerobics including a variety of balance, agility and impact exercises  The degree of difficulty of movements, steps, impacts, and jumps was gradually increased.  ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks</p> <p>3. A combination (CG) group doing resistance and balance-jumping training (n = 38)  . The combination training programme consisted of resistance and balance-jumping training in alternating weeks. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks</p> <p>4. No intervention (n = 37). Participants in the control group were asked to maintain their pre-study level of physical activity during the 12-month trial  The intervention lasted for 3 weekly sessions of 45 minutes for 12 months  The intervention group used in the analysis comprised the combined RT, BJ and CG groups</p>
Outcomes	Fear of falling (visual analogue scale - no fear at all (0) to very great fear (100)). Measured at baseline, post intervention and 12 months

Notes	Adherence: 67% adhered to the exercise programmes	
<b>Risk of bias</b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Low risk	Computer-generated randomisation list
Allocation concealment (selection bias)	Unclear risk	No information provided about allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	VAS was self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data based on > 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Self rated general health slightly better in the intervention group than control group at baseline

**Lai 2013**

Methods	RCT - cross-over design
Participants	Country: Taiwan n = 30 57% female Mean age in years (SD) = 72 (4.6) Study population: recruitment not described Inclusion criteria: community-dwelling older adults aged 65 years and above Exclusion criteria: participants were excluded if they had a neurological condition such as Parkinson's disease, dementia and stroke, or if they had arthritis, vision impairment and cardiovascular disease that impaired walking, or if they were unable to walk without assistance
Interventions	1. Xavix Measured Step System (XMSS) (n = 15) console with 1 step mat and connectors to TV. The XMSS exercise was conducted for 30 minutes, 3 times a week for 6 weeks. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks 2. Control group (n = 15). No intervention for the first 6 weeks, then given XMSS exercises for 6 weeks. The first 6 weeks served as the control



**Lai 2013** (Continued)

Outcomes	Falls efficacy (MFES). Measured at baseline and post intervention, and 6 weeks post intervention (after cross-over)	
Notes	Adherence rates not reported Data were used from the first period prior to cross-over	
<b><i>Risk of bias</i></b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Unclear risk	Randomly assigned but no further information provided
Allocation concealment (selection bias)	Unclear risk	No information provided about allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	MFES was self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Intervention group had higher MFES and Berg Balance Scale scores and lower Timed Up and Go times at baseline than control group

**Lajoie 2004**

Methods	Quasi-randomised trial
Participants	Country: Canada n = 24 83% female Mean age in years (SD) = 71 (not reported) Study population: recruited from the community and from residential care facilities Inclusion criteria: aged 65 or older, able to stand and walk without an aid Exclusion criteria: participants with diabetes, neurological or sensory disorders, recurrent dizziness or unsteadiness, use of medications that may affect balance, joint replacement and medical conditions interfering with daily activities

**Lajoie 2004** (Continued)

Interventions	1. Computerised balance training group (n = 12). 1-hour computerised balance training sessions completed twice per week over an 8-week period. Participants stood on a Kistler force platform and were asked to complete 15 computerised balance tests lasting 1 minute each, with resting periods given after each trial. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks 2. Control group (n = 12). No intervention	
Outcomes	Balance confidence (ABC). Measured at baseline and post intervention	
Notes	Adherence rates not reported ABC means and SDs obtained through personal communication with author	
<b>Risk of bias</b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	High risk	Sequence generated by alternation. The author stated in a personal communication that this was achieved by "First subject was in group 1, second in group 2, third in group 1 etc."
Allocation concealment (selection bias)	High risk	Allocation not concealed. Quasi-randomised study
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	ABC was self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Paper describes only minimal baseline characteristics, so unclear if groups well balanced at baseline

**Lin 2007**

Methods	RCT
Participants	Country: Taiwan n = 100 (groups 1 and 2 only) 51% female Mean age in years (SD) = 77 (not reported) Study population: recruited from clinics and hospitals in rural agricultural area

	Inclusion criteria: community-dwelling older adults aged 65 and older who had required medical attention due to sustaining a fall in the previous 4 weeks Exclusion criteria: none specified
Interventions	Intervention details: 1. Home-based exercise group (n = 50). The intervention consisted of stretching, muscle strengthening and balance training. Participants exercised at home once every 2 weeks under supervision and were instructed to practice these exercises at least 3 times a week during the 4-month intervention period. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks 2. Home safety assessment and modification group (n = 50). Participants were visited by a public health worker to perform a safety assessment on their home environment and given a list of specifically recommended modifications 3. Education group (n = 50). Participants received 1 social visit of 30 to 40 minutes every 2 weeks over the study period, plus pamphlets on falls prevention, including stretching and strengthening exercises to encourage initiation and persistence in activities The intervention group used for this review comprised the home-based exercise group and the control group comprised the home safety assessment and modification group
Outcomes	Fear of falling (visual analogue scale); 15-item Geriatric Depression Scale (GDS); number of falls (self reported). Measured at baseline, and 2 and 4 months post intervention
Notes	Fear of falling was assessed using a 10 cm visual analogue scale, marked with the labels "No fear" and "Extremely fearful" where participants were asked to place a mark on the line at the point representing the extent of their fear Adherence rates not reported

**Risk of bias**

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Block randomised, but no information provided about randomisation sequence generation
Allocation concealment (selection bias)	Unclear risk	No information provided about allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	VAS and GDS-15 self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome data are based on $\geq 80\%$ of participants in control group, but $< 80\%$ in intervention group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all prespecified outcomes have been reported

**Lin 2007** (Continued)

Other bias	Unclear risk	Most baseline characteristics not presented by treatment group so unclear if groups well balanced at baseline
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**Logghe 2009**

Methods	RCT
Participants	Country: Netherlands n = 269 71% female Mean age in years (SD) = 77 (4.7) Study population: recruited from general practices Inclusion criteria: aged 70 years and older living at home and having a high falls risk (defined as 1 or more self reported fall incidents in the year preceding the study or at least 2 self reported risk factors for falling (disturbed balance, mobility problems, dizziness, and the use of benzodiazepines or diuretics)) Exclusion criteria: none specified
Interventions	1. Tai Chi Chuan group (n = 138). Participants received 1 hour of Tai Chi Chuan training twice a week for 13 weeks. Classes were provided by 4 professional Tai Chi Chuan instructors using a predefined protocol. Participants were encouraged to practice at home at least twice a week for 15 minutes. Also received a brochure explaining how to prevent fall incidents in and around the house. ProFaNE taxonomy classification: 3D (Tai Chi, Qi Gong, dance, yoga) 2. Control group (n = 131). No intervention
Outcomes	Number of falls (recorded by monthly fall calendars); falls efficacy (FES); physical activity (PASE). Measured at baseline, post intervention and 9 months follow-up
Notes	Adherence: 47% attended at least 80% of the Tai Chi lessons

***Risk of bias***

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated randomisation list
Allocation concealment (selection bias)	Unclear risk	No information provided on allocation concealment. An independent research assistant performed a pre-stratified block randomisation
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention

**Logghe 2009** (Continued)

Blinding of outcome assessment (detection bias) All outcomes	High risk	Number of falls, FES and PASE were self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome data are based on < 80% of participants in each group at all follow-up time points
Selective reporting (reporting bias)	Low risk	Protocol available. All pre-specified outcomes have been reported
Other bias	Unclear risk	Inconsistency between the number of participants with missing data in flow chart and the denominators reported in the text for falls outcomes

**McCormack 2004**

Methods	RCT	
Participants	Country: Australia n = 43 70% female Mean age in years (SD) = 79 (5.9) Study population: recruited from the community by postal invitation Inclusion criteria: community-dwelling older adults aged 65 years and over Exclusion criteria: participants were excluded if they reported uncontrolled hypertension, heart attack in the previous year, irregular heart beat and if they already belonged to a formal exercise class	
Interventions	1. Conventional Exercise (CE) group (n = 17). Low intensity stretching and conditioning exercises using body weight and light dumbbells as resistance. Performed 2 days per week for 10 weeks with each session approximately lasting 30 to 45 minutes. ProFaNE taxonomy classification: strength/resistance 2. Holistic exercise (HE) group (n = 18). Participants used a Range of Motion (RoM) dance method using the principles of Tai Chi. Performed 2 days per week for 10 weeks with each session approximately lasting 30 to 45 minutes. ProFaNE taxonomy classification: 3D (Tai Chi, Qi Gong, dance, yoga) 3. Control group (n = 8). No intervention The intervention group used in the analysis comprised the combined CE and HE groups	
Outcomes	Falls efficacy (MFES). Measured at baseline and post intervention	
Notes	Adherence: adherence did not differ between groups. Combined adherence over 80% in each group Data on the number of females obtained from personal communication with author	
<b><i>Risk of bias</i></b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>

**McCormack 2004** (Continued)

Random sequence generation (selection bias)	Unclear risk	No information provided about sequence generation
Allocation concealment (selection bias)	Unclear risk	No information provided about allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	MFES was self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome data are based on < 80% of participants in Holistic and Conventional exercise groups, and > 80% of participants in the control group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Very minimal baseline data presented so unclear if groups well balanced at baseline

**Nguyen 2012**

Methods	RCT
Participants	Country: Vietnam n = 96 50% female Mean age in years (SD) = 69 (5.1) Study population: recruitment not described Inclusion criteria: community-dwelling older adults aged 60 to 79 years old. Being able to finish the Mini Mental State Examination (MMSE) with a score greater than 25 and having no experience in Tai Chi Exclusion criteria: serious diseases, such as symptomatic coronary insufficiency, angina, arrhythmia, orthostatic hypotension, and dementia
Interventions	1. Tai Chi (n =48). Participants in the Tai Chi group attended a 60-minute Tai Chi practice session twice a week for 6 months. The session consisted of a 15-minute warm-up and a 15-minute cool-down period. ProFaNE taxonomy classification: 3D (Tai Chi, Qi Gong, dance, yoga) 2. No intervention (n = 48)
Outcomes	Falls efficacy (FES). Measured at baseline, interim and post intervention
Notes	Adherence rates not reported

<i>Risk of bias</i>		
Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomly assigned but no further information provided
Allocation concealment (selection bias)	Unclear risk	No information provided about allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	FES was self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome data are based on > 80% of participants in intervention group but < 80% of participants in the control group
Selective reporting (reporting bias)	Unclear risk	Time periods for interim data not reported. Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	FES slightly higher in control group than intervention group at baseline

**Reinsch 1992**

Methods	Cluster-RCT with randomisation by senior centre
Participants	Country: USA n = 107 (groups 1 and 4 only) and 8 senior centres 89% female Mean age in years (SD) = 75 (7.5) Study population: recruited from 16 senior centres located in low socioeconomic areas Inclusion criteria: aged over 60 living in a senior centre Exclusion criteria: none given
Interventions	Intervention details: 1. Exercise intervention (n = 57). Participants performed the low intensity “stand-up/step-up” exercises, designed to improve strength and balance for 1 hour 3 times per week for 1 year. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks 2. Cognitive-behavioural intervention (n = 51). Participants received health and safety advice to prevent falls, relaxation training and video game playing to improve reaction time 1 hour per week for 1 year 3. Exercise-cognitive intervention (n = 72). 1 meeting per week as per cognitive-behavioural intervention group and 2 meetings per week focusing on exercise, relaxation

**Reinsch 1992** (Continued)

	<p>training and discussion of safety topics for 1 year</p> <p>4. Discussion control group (n = 50). Participants discussed health and discussion topics of interest to older people 1 hour per week for 1 year</p> <p>The intervention group used for this review comprised the exercise group and the control group comprised the discussion group</p>
Outcomes	Fear of falling (measured by 5-point scale (1 = not at all worried to 5 = extremely worried) )
Notes	Adherence: 77% of the exercise group attended at least 67% of the exercise classes

**Risk of bias**

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomly assigned but no further information provided
Allocation concealment (selection bias)	Unclear risk	Senior centres were randomised but no information given on concealment of allocation
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Fear of falling and number of falls self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome data are based on < 80% of participants in the intervention group but > 80% of participants in the control group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Analyses do not appear to be adjusted for clustering

**Rendon 2012**

Methods	RCT
Participants	<p>Country: USA</p> <p>n = 40</p> <p>65% female</p> <p>Mean age in years (SD) = 85 (5.4)</p>



	<p>Study population: recruited from retirement communities</p> <p>Inclusion criteria: community-dwelling adults between 60 and 95 years of age, able to participate in physical activity for 45 to 60 minutes and who verbally reported having normal vision</p> <p>Exclusion criteria: participants with known orthopaedic, neurological or circulatory disorders that would prevent them from participating in the study</p>	
Interventions	<p>1. Virtual reality group (n = 20). Participants used 3 different balance games from the Nintendo® Wii Fit Software package. Participants alternated the exercise game sequence week-to-week during the 18-session intervention (3 times a week for 6 weeks). Each session lasted approximately 35 to 45 minutes. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks</p> <p>2. No intervention (n = 20)</p>	
Outcomes	<p>Balance confidence (ABC); depressive symptoms (Geriatric Depression Scale). Measured at baseline and post intervention</p>	
Notes	<p>Adherence: 80% met the 15 sessions minimum</p>	
<b><i>Risk of bias</i></b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Unclear risk	Randomly assigned but no further information provided
Allocation concealment (selection bias)	Unclear risk	No information provided on allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	ABC and GDS were self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Little baseline data presented. ABC score was higher at baseline in the control group than the intervention group. GDS score was higher at baseline in the intervention group than the control group

**Resnick 2008**

Methods	Cluster-RCT with randomisation by senior centre
Participants	Country: USA n = 166 participants and 13 senior centres 81% female Mean age in years (SD) = 73 (8.2) Study population: recruited from senior centres Inclusion criteria: community-dwelling urban minority older adults aged 60 years and older, having a blood pressure recording less than 200/100, heart rate between 60 to 120, no known recent (within past 6 months) history of heart attack, stroke or new irregular heartbeat Exclusion criteria: not obtaining consent from their primary health care provider
Interventions	1. Senior Exercise Self-efficacy Project (SESEP) group (n = 100). 12 weeks of twice weekly exercise sessions, each lasting between 60 and 90 minutes, and including stretching, resistance and aerobic activities; plus 30 minutes per week of group efficacy-enhancing programme. ProFaNE taxonomy classification: strength/resistance 2. Control (n = 66). Participants provided with twice weekly 60 to 90-minute sessions of nutrition education for 12 weeks
Outcomes	Fear of falling (self rated on a scale of 0 to 4); depressive symptoms (GDS); overall activity (Yale Physical Activity Survey (YPAS)). Measured at baseline and post intervention
Notes	Adherence: mean adherence rate was 77%

***Risk of bias***

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Sequence generated by coin toss
Allocation concealment (selection bias)	Unclear risk	Senior centres were randomised by geographic area using coin toss. No information given on concealment of allocation
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Fear of falling, GDS and YPAS self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome data are based on < 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported

**Resnick 2008** (Continued)

Other bias	Unclear risk	Analyses do not appear to be adjusted for clustering
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**Sihvonen 2004**

Methods	RCT
Participants	Country: Finland n = 28 100% female Mean age in years (SD) = 82 (5.2) Study population: recruited from residential care homes Inclusion criteria: female, aged 70 years or over, living in residential care Exclusion criteria: unable to stand without a walking aid, unable to see visual feedback from a computer screen and unable to follow instructions
Interventions	1. Exercise (n = 20) group. Participants attended 20- to 30-minute long individualised specific balance exercise sessions using a computerised force platform with visual feedback 3 times a week for 4 weeks. ProFaNE taxonomy classification: gait, balance, coordination, functional tasks 2. Control (n = 8) group. No intervention
Outcomes	Number of falls (self reported monthly fall calendar); Fear of falling (single-item measure ("No", "Yes, some", "Yes, a lot")); physical activity (the Senior Fitness Test). Measured at baseline, post intervention and 12-month follow-up
Notes	Adherence: over 90% adhered to the exercise programme

***Risk of bias***

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was done in blocks by drawing lots
Allocation concealment (selection bias)	Unclear risk	No information provided about allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Number of falls and fear of falling were self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group

**Sihvonen 2004** (Continued)

Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Intervention group undertook more physical activity and more reported high fear of falling at baseline than control group

**Tiedemann 2012**

Methods	RCT
Participants	Country: Australia n = 54 80% female Mean age in years (SD) = 68 (7.1) Study population: recruited from advertisements in local newspapers, newsletters and websites Inclusion criteria: participants were eligible if they were community-dwelling, aged 59 years or older, were cognitively intact (defined as a score of $\geq 7$ on the Short Portable Mental Status Questionnaire) and were willing and able to attend 12 weeks of group-based yoga classes Exclusion criteria: having a medical condition that precludes exercise (e.g. unstable cardiac disease, uncontrolled hypertension, uncontrolled metabolic diseases, and large abdominal aortic aneurysm), minimal English language skills, hostel or nursing home resident, and/or current participation in yoga or Tai Chi
Interventions	1. Yoga (n = 27). Participants attended a 1-hour, twice-weekly, group-based yoga class for 12 weeks. Participants were also instructed to practise the poses at home for 10 to 20 minutes on at least 2 days per week. The balance challenge increased over time by gradually increasing the difficulty of the postures performed. ProFaNE taxonomy classification: 3D (Tai Chi, Qi Gong, dance, yoga) 2. Control (n = 27) group. Provided with information about falls prevention
Outcomes	Concern about falling (FES-I). Measured at baseline and post intervention
Notes	Adherence: 70% attended at least 20 out of 24 classes, 30% attended all classes

**Risk of bias**

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated random number schedule
Allocation concealment (selection bias)	Unclear risk	An investigator not involved in recruitment performed a pre-stratified block randomisation using a computer-generated random number schedule. No further information provided on allocation concealment

**Tiedemann 2012** (Continued)

Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	FES-I was self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Higher proportion of control group reported balance as fair or poor than the intervention group at baseline

**Ullmann 2010**

Methods	RCT	
Participants	Country: USA n = 47 70% female Mean age in years (SD) = 76 (7.3) Study population: recruited from senior centres, churches and retirement communities Inclusion criteria: older adults aged 65 years or older Exclusion criteria: participants were screened on the Mini-Mental State Examination and their performance on the Timed Up and Go (TUG). No further information provided	
Interventions	1. Feldenkrais intervention (FG) (n = 25). 1-hour Feldenkrais sessions were held 3 times per week for 5 weeks. Feldenkrais is a mind-body exercise that involves gentle movements carried out in a quiet, non-competitive environment focused on improving balance and mobility. Classes were taught by a certified Feldenkrais teacher. ProFaNE taxonomy classification: 3D (Tai Chi, Qi Gong, dance, yoga) 2. Control group (n = 22). Waiting list control	
Outcomes	Falls efficacy (FES); balance confidence (ABC). Measured at baseline and post intervention	
Notes	Adherence: over 90% adhered to the exercise programme. 6 of the control group crossed over to the FG at the end of the intervention period. Their data are only included prior to cross-over FES and ABC means and SDs obtained through personal communication with author	
<b><i>Risk of bias</i></b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>

**Ullmann 2010** (Continued)

Random sequence generation (selection bias)	Unclear risk	The screening TUG score and age were used to complete the stratified randomisation of participants. No further information provided
Allocation concealment (selection bias)	Unclear risk	No information given on allocation concealment. Persons who expressed a desire to attend the same class (couples, friends and carpool) were allowed to do so in order to facilitate participation. Members of these units were assigned to the same treatment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	FES and ABC were self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	The control group had a lower BMI and had experienced a higher number of falls in the 3 months prior to randomisation than the intervention group

**Vogler 2009**

Methods	RCT
Participants	<p>Country: Australia  n = 180  79% female  Mean age in years (SD) = 80 (7.0)  Study population: inpatients from aged care and rehabilitation services were approached to participate after leaving hospital  Inclusion criteria: older people aged 65 years or older recently discharged from an Aged Care and Rehabilitation hospital, who were medically fit to exercise and had completed hospital-related rehabilitation  Exclusion criteria: participants were excluded if they had medical contraindications to exercise, if they were cognitively impaired (Mini-Mental State Examination score &lt; 24 out of 30), or if they were discharged to a high-care residential facility</p>
Interventions	<p>1. Seated exercises (SE) (n = 60). Prescribed exercises to be performed while sitting on a standard dining chair with cuff weights and exercise bands. Exercises were to be done 3 times a week for 12 weeks, with the physiotherapist visiting 8 times in the 12 weeks to ensure the exercises were being performed correctly and to progress exercise intensity.</p>

	<p>ProFaNE taxonomy classification: strength/resistance</p> <p>2. Weight-bearing exercises (WBE) (n = 60). Prescribed strengthening and resistance exercises to be performed while standing with a chair or bench for support if required. Resistance was provided with weight-loaded waist belts. Exercises were to be done 3 times a week for 12 weeks, with the physiotherapist visiting 8 times in the 12 weeks to ensure the exercises were being performed correctly and to progress exercise intensity. ProFaNE taxonomy classification: strength/resistance</p> <p>3. Control group (n = 60). Received a 1-hour social visit by a research assistant each week for 12 weeks</p> <p>The intervention group used in the analysis comprised the combined SE and WBE groups</p>	
Outcomes	<p>Number of falls (self reported weekly fall calendar); falls efficacy (MFES); depressive symptoms (GDS). Measured at baseline, post intervention and 3 months follow-up</p>	
Notes	<p>Adherence: mean adherence rate was 70% in the seated exercise group, and 62% in the weight-bearing group</p> <p>MFES means and SDs obtained through personal communication with author</p>	
<b>Risk of bias</b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Low risk	Randomisation was performed in blocks of 15 participants by computer-generated random numbers
Allocation concealment (selection bias)	Unclear risk	Allocations for each participant were concealed in opaque envelopes. Unclear if envelopes were sealed or not
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Number of falls, MFES and GDS were self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Low risk	The study appears to be free of other sources of bias

**Vrantsidis 2009**

Methods	RCT
Participants	<p>Country: Australia  n = 62  76% female  Mean age in years (SD) = 75 (8.2)</p> <p>Study population: recruited from advertisements in newspapers, promotion at local community groups and retirement villages and from volunteers in a research database</p> <p>Inclusion criteria: adults aged 55 years or over living at home, in a retirement village or a low-care residential aged-care facility, and who have at least 1 functional impairment (based on the Frenchay Activity Index) or have a history of 1 or more falls in the previous 6 months</p> <p>Exclusion criteria: cognitive impairment (&lt; 7 on the Abbreviated Mental Test Score), inability to understand English, and unable to stand unsupported for at least 1 minute or walk a short distance indoors (minimum 5 metres) without a walking aid</p>
Interventions	<p>1. Exercise group (n = 29). Participants participated in the Getting Grounded Gracefully programme based on the Feldenkrais method to specifically target dynamic balance, postural and turning stability, and weight-shift transfers, which involved 2 40- to 60-minute sessions per week over an 8-week period. Classes were conducted at a community-library meeting group and provided by the programme designer, an experienced Feldenkrais practitioner. ProFaNE taxonomy classification: 3D (Tai Chi, Qi Gong, dance, yoga)</p> <p>2. Control group (n = 33). No intervention</p>
Outcomes	Falls efficacy (MFES). Measured at baseline and post intervention
Notes	<p>Participants included those living in low-care residential homes where they were provided with help with dressing, eating, bathing and other support services such as cleaning, laundry and meals. No nursing care provided</p> <p>Adherence: mean adherence rate was 88%</p> <p>Personal communication with author to confirm participants were not receiving nursing care at the low-care residential facility</p>

**Risk of bias**

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomly ordered opaque envelopes used, but no information provided on how random sequence generated
Allocation concealment (selection bias)	Unclear risk	Participants were randomised to the intervention group or control group by the use of randomly ordered opaque envelopes by a research officer not involved in the assessments. Unclear if envelopes were sealed
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention



**Vrantsidis 2009** (Continued)

Blinding of outcome assessment (detection bias) All outcomes	High risk	FES was self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	A conflict of interest might have been present in that the designer (and supplier) of the Getting Grounded Gracefully programme was the Feldenkrais practitioner in this study and that CDs of the programme were purchased by interested participants at the end of the study

**Wallsten 2006**

Methods	RCT - cross-over design
Participants	Country: USA n = 77 74% female Mean age in years (range) = 81 (61 to 92) Study population: recruited from posted flyers and flyers on bulletin boards in residential facilities Inclusion criteria: older adults (age range 61 to 92 years) living independently in a continuing care retirement community Exclusion criteria: history of hip fracture or replacement, currently enrolled in a balance study, knee replacement, Parkinson's disease, neurological condition which interfered with balance or walking, leukaemia or cancer, using an assistive device to walk 25 feet or further, Mini-Mental State Exam score < 24
Interventions	1. Tai Chi Chuan (TC) group (n = 41). 1-hour twice weekly Tai Chi classes conducted for 20 weeks focusing on gait, balance and strength. ProFaNE taxonomy classification: 3D (Tai Chi, Qi Gong, dance, yoga) 2. Control group (n = 36). No intervention for the first 20 weeks, then given Tai Chi classes for 20 weeks. The first 20 weeks served as the control
Outcomes	Balance confidence (ABC). Measured at baseline, 10 weeks post baseline, post intervention and 5 months follow-up
Notes	Adherence rates not reported Data were used from the first period prior to cross-over ABC means and SDs obtained through personal communication with author

***Risk of bias***

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Patients were "randomised" to a group, but no information provided on how randomisation sequence generated
Allocation concealment (selection bias)	Unclear risk	"After all eligible patients completed the baseline assessments, they were randomised to the early or late groups." No information provided on allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	ABC was self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome data are based on < 80% of participants in each group. Only 46% of participants remained in trial at 40 weeks. Those remaining had significantly higher baseline functional assessment scores than those lost to follow-up
Selective reporting (reporting bias)	High risk	No baseline or follow-up data reported for ABC. Protocol not available
Other bias	Unclear risk	Most baseline data only presented for those with outcome data at specific time points. Unclear if groups well balanced at baseline

Weerdesteyn 2006

Methods	Randomised trial with additional non-randomised group
Participants	Country: The Netherlands n = 58 (groups 1 and 2 only) 72% female Mean age in years (SD) = 74 (5.7) Study population: recruited from advertisements in newspapers Inclusion criteria: community-dwelling older adults aged 65 and over, with at least 1 fall prior to participation and able to walk 15 minutes without the use of a walking aid Exclusion criteria: severe cardiac, pulmonary or musculoskeletal disorders, pathologies associated with increased fall risk (i.e. stroke or Parkinson's disease), osteoporosis and the use of psychotropic drugs
Interventions	1. Exercise group (n = 30). Twice weekly 1.5-hour exercise sessions for 5 weeks comprised of balance, gait and co-ordination training in an obstacle course, walking exercises that stimulated walking in a crowded environment with changes in speed and direction, the practice of fall techniques derived from marital arts. ProFaNE taxonomy classification:

	<p>gait, balance, co-ordination, functional tasks</p> <p>2. Control group (n = 28). No intervention</p> <p>3. Non-randomised group (n = 49). Assigned same exercise as Exercise group above. Non-randomised group participants have been excluded from analyses in this review</p>	
Outcomes	<p>Number of falls (recorded by monthly fall calendars) measured at baseline, 6 months and 7 months follow-up after intervention. Balance confidence (ABC). Measured at baseline and post intervention</p>	
Notes	<p>Adherence: mean attendance rate was 87% for the combined exercise group and non-randomised group</p> <p>ABC means and SDs (excluding non-randomised group) obtained through personal communication with author</p>	
<b>Risk of bias</b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Unclear risk	The following information was obtained from Gillespie 2012. Quote: "Block randomisation (3 blocks of 20) with gender stratification with equal probability for either exercise or control group assignment."
Allocation concealment (selection bias)	Unclear risk	The following information was obtained from Gillespie 2012. Quote: "The group allocation sequence was concealed (to both researchers and participants) until assignment of interventions. We had participants draw a sealed envelope with group allocation ticket from a box containing all remaining envelopes in the block"
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Falls incidence and ABC were self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported

**Weerdesteyn 2006** (Continued)

Other bias	Unclear risk	The intervention group had a significantly higher proportion of fallers at baseline than the control group
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**Westlake 2007**

Methods	RCT
Participants	Country: Canada n = 36 % female not reported Mean age in years (SD) = not reported Study population: recruited from advertisements in newspapers and flyers Inclusion criteria: community-dwelling older adults aged 65 years and older Exclusion criteria: pre-existing major lower extremity pathology neurological disorders or balance difficulties, and health conditions that would prevent participation in the exercise programme
Interventions	1. Exercise group (n = 17). 1-hour sensory specific balance classes were held 3 times per week over an 8-week period, following the FallProof programme which focuses on static and dynamic balance exercises with transitions between different sensory conditions. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks 2. Control group (n = 19). 1-hour falls prevention education group, held once a week for 8 weeks. The education group received information about 'non-exercise' related potential fall risk factors, such as nutrition, environmental hazards and the importance of sleep
Outcomes	Balance confidence (ABC); physical activity (PASE). Measured at baseline and post intervention. Additionally the exercise group were re-assessed at 2 months follow-up
Notes	Adherence: mean adherence rate was 66% Personal communication with author confirmed no exercise information was provided to the control group

***Risk of bias***

<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Unclear risk	Participants were randomised into the exercise or education group. No information given on generation of randomisation schedule
Allocation concealment (selection bias)	Unclear risk	No information provided on allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention

**Westlake 2007** (Continued)

Blinding of outcome assessment (detection bias) All outcomes	High risk	ABC and PASE were self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	44 participants randomised into the exercise or control group. The number per group at baseline is not reported. Outcomes assessed on 17 exercise group and 19 control group participants
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Limited baseline data reported so unable to assess if groups were well balanced at baseline

**Wolf 1996**

Methods	RCT
Participants	<p>Country: USA  n = 200  81% female  Mean age in years (SD) = 76 (4.7)  Study population: recruited by advertisements in newspapers and from an independent living facility  Inclusion criteria: aged 70 years and older, living in unsupervised environments, ambulatory and agreeing to participate weekly for 15 weeks with 4-month follow-up  Exclusion criteria: the presence of debilitating conditions such as cognitive impairments, metastatic cancer, crippling arthritis, Parkinson's disease or major stroke, or profound visual defects that could compromise balance or ambulation</p>
Interventions	<p>1. Computerised Balance Training (BT) group (n = 64). Individual balance training on a computerised force platform. Participants had 1 hour of instruction per week (with approximately 45 minutes individual contact time with an instructor) for 15 weeks. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks  2. Tai Chi Quan (TC) group (n = 72). Classes of Tai Chi Quan focusing on all components of movement that typically becomes limited with ageing. Participants had 2 hours of instruction per week (2 separate sessions) with a total of approximately 45 minutes contact time with an instructor. Participants were encouraged to practice at least 15 minutes twice a day at home. ProFaNE taxonomy classification: 3D (Tai Chi, Qi Gong, dance, yoga)  3. Education group (n = 64). Weekly 1-hour meetings for 15 weeks were held with a gerontological nurse/researcher to discuss a variety of topics such as pharmacological management, sleep disorders, cognitive deficits, coping with bereavement and other issues important to each group  The intervention group used in the analysis comprised the combined BT and TC groups</p>

Outcomes	Number of falls (recorded by weekly fall calendars); falls efficacy (FES) and Center for Epidemiologic Studies - Depression (CES-D) scale. Falls were defined using the FICSIT definition (“unintentionally coming to rest on the ground, floor or lower level”) and the Atlanta site definition (“falls resulting in fractures, dislocation, sprains, bruises, lacerations, scrapes and other medical problems”). Mean and SD for FES presented at baseline and categories of fear of falling (not at all afraid, somewhat afraid, fairly afraid, very afraid of falling) presented at follow-up. Measured at baseline, post intervention and at 4-month follow-up	
Notes	We used falls defined using the FICSIT definition in the meta-analysis. A subset of participants (n = 72) who “tended to be reclusive” were reported on in Wolf 1997. Adherence: over 90% adhered to the exercise programme	
<b>Risk of bias</b>		
<b>Bias</b>	<b>Authors’ judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Low risk	Individuals were assigned to an intervention using a computer-generated, fixed randomisation procedure
Allocation concealment (selection bias)	Unclear risk	No information provided on allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Number of falls and fear of falling were self reported by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on $\geq 80\%$ of participants in each group
Selective reporting (reporting bias)	High risk	Protocol not available. Data only presented for outcomes that differed significantly between groups post intervention or at follow-up
Other bias	Unclear risk	The Tai Chi group had a higher proportion of participants in paid work than the balance training or control group, a higher proportion volunteering than the balance training group and a higher proportion with cataracts than the control group at baseline. The Tai Chi group had a lower mean BMI than the balance training or control group at baseline

**Wolf 2001**

Methods	RCT
Participants	Country: The Netherlands n = 94 73% female Mean age in years (SD) = 84 (5.6) Study population: recruited from 3 residential care facilities and by advertisements in newspapers Inclusion criteria: older adults aged 75 years and older, living independently or in a residential care facility Exclusion criteria: recovering from an acute illness, received physical therapy during the previous month, a Mini-Mental State Examination score < 17, Berg Balance Scale (BBS) score < 52 and impaired balance during functional activities (as determined by a physiotherapist)
Interventions	1. Balance training group (n = 47). Participants received 12 sessions of 30-minute balance training provided by physical and recreational therapists 2 to 3 times per week during a 4- to 6-week period at home or at a physical therapy department. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks 2. Control group (n = 47). Offered individual-orientated activities including handicraft, music, media, board games, discussion groups, memory training and car tours
Outcomes	Fear of falling (visual analogue scale (VAS)); anxiety and depression (Hospital Anxiety and Depression Scale (HADS)). Measured at baseline, post intervention and 1 month follow-up
Notes	Adherence rates not reported

***Risk of bias***

<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Unclear risk	Subjects were randomly assigned to the 2 treatments using sealed envelopes selected by a blindfolded person. No information provided on how randomisation sequence generated
Allocation concealment (selection bias)	Unclear risk	Sealed envelopes selected by a blindfolded person. Unclear if envelopes were sequentially numbered
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	VAS and HADS were self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome data are based on > 80% of participants in the control group, but < 80% in the intervention group

**Wolf 2001** (Continued)

Selective reporting (reporting bias)	High risk	Means and SDs not presented for HADS. Protocol not available
Other bias	Unclear risk	Control group had slightly higher HADS depression scores at baseline than the intervention group

**Yang 2012**

Methods	RCT
Participants	Country: Australia n = 165 44% female Mean age in years (SD) = 81 (6.2) Study population: recruited from advertisements in newspapers, newsletters and presentations to community groups Inclusion criteria: community-dwelling older adults aged 65 years and older, community ambulant, requiring no walking aid, no more than 1 fall in the previous 12 months, having concerns about balance and a mild balance dysfunction Exclusion criteria: participants were excluded if balance performance was within normal limits
Interventions	1. Home-based exercise programme (n = 82). Participants received a 6-month physical therapist prescribed balance and strength home exercise programme based on the Otago Exercise Program and the Visual Health Information Balance and Vestibular Exercise Kit. The programme consisted of a warm-up, balance and strength exercises with a tailored walking programme. All exercises were performed without upper limb support and with ankle weights if able. Participants were instructed to perform exercises taking approximately 20 minutes 5 times per week and a graduated walking programme aiming for at least 30 minutes per day. ProFaNE taxonomy classification: gait, balance, co-ordination, functional tasks 2. Control (n = 83). No intervention
Outcomes	Number of falls (self reported); falls efficacy (MFES); Human Activity Profile - Adjusted Activity Score (HAP-AAS). Measured at baseline and post intervention
Notes	Adherence: 44.1% reported full adherence

***Risk of bias***

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Group allocation schedule was developed by computer-generated random numbers
Allocation concealment (selection bias)	Unclear risk	Group allocation was performed by a researcher who was not involved in recruiting or assessing participants. No further information on allocation concealment provided



**Yang 2012** (Continued)

Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Number of falls, MFES and HAP-AAS were self reported by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome data are based on < 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Groups appeared well balanced at baseline. Those who withdrew from the trial had significantly worse scores on the step test and limit of stability maximum excursion test than those who completed the trial

**Yoo 2010**

Methods	RCT
Participants	Country: South Korea n = 21 100% female Mean age in years (SD) = 71 (2.7) Study population: community volunteers. No further information provided Inclusion criteria: community-dwelling older women aged 65 years and older capable of participating in moderate intensity aerobic and resistance exercises, with no more than 1 risk factor for cardiovascular disease Exclusion criteria: difficulty with activities of daily living (ADL), uncontrolled hypertension, a history of metabolic disorders, irregular menstrual cycles or amenorrhoea, hip or vertebral fracture and currently taking hormones or hormonal medication
Interventions	1. Exercise group (n = 11). Participants were involved in a 12-week supervised walking exercise programme 3 times a week wearing ankle weights (1 kg each) in an outdoor field in a local elementary school. The programme included a 10-minute warm-up without ankle weights, 45 minutes of walking with ankle weights, and a 5-minute cool down without ankle weights. Exercise intensity was maintained at 60% of heart rate reserve (HRR) determined by a heart rate monitor. ProFaNE taxonomy classification: strength/resistance 2. Control group (n = 10). No intervention
Outcomes	Falls efficacy (K-FES), Tideiksaar (1997) Fear of Falling questionnaire Yale Physical Activity score (YPAS). Measured at baseline and post intervention
Notes	Adherence rates not reported

<i>Risk of bias</i>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Unclear risk	Randomly assigned, but no information provided about randomisation sequence generation
Allocation concealment (selection bias)	Unclear risk	No information provided about allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	Tideiksaar Fear of Falling questionnaire and K-FES were self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome data are based on < 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Low risk	Appears to be free of other sources of bias

**Zhang 2006**

Methods	RCT
Participants	<p>Country: China                      n = 49                      47% female                      Mean age in years (SD) = 70 (4.3)                      Study population: selected from a previous study investigating falls among community-dwelling older adults                      Inclusion criteria: community-dwelling older adults aged 60 and older who had a lower ability for maintaining balance (defined as a 1-leg stand time between 5 and 20 seconds) and able to walk around independently                      Exclusion criteria: participants were excluded if they had a 1-leg stance time of less than 5 seconds and were considered at risk to practice Tai Chi Chuan</p>
Interventions	<p>1. Tai Chi Chuan (TC) group (n = 25). Participants attended 1-hour group classes 7 times a week for 8 weeks and were instructed to perform 24 simplified forms of TC. Exercises were performed in a park and taught by experienced TC instructors. If participants could not attend the class, they were asked to complete a home TC programme consisting of 11 easy forms of TC taking approximately 30 minutes to complete. ProFaNE taxonomy classification: 3D (Tai Chi, Qi Gong, dance, yoga)                      2. Control group (n = 24). No intervention</p>

Outcomes	Falls efficacy (FES - translated into Chinese). Measured at baseline and post intervention	
Notes	Adherence: over 90% adhered to the exercise programme	
<b><i>Risk of bias</i></b>		
<b>Bias</b>	<b>Authors' judgement</b>	<b>Support for judgement</b>
Random sequence generation (selection bias)	Unclear risk	Prior to randomisation, the 49 participants were divided into 25 pairs according to sex, experience of falling and exercise habits. Not all pairs were matched for sex or exercise habits. Pairs were then randomly assigned to either the intervention or control group by a coin toss
Allocation concealment (selection bias)	Unclear risk	No information provided about allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded to allocation. Note: blinding not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	High risk	FES was self completed by participants who knew their allocation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are based on > 80% of participants in each group
Selective reporting (reporting bias)	Unclear risk	Protocol not available. Unclear if all pre-specified outcomes have been reported
Other bias	Unclear risk	Participants were selected from a previous study by the authors (Zhang et al 2003)

ABC: Activities-specific Balance Confidence scale

BBS: Berg Balance Scale

BMI: body mass index

FES: Falls Efficacy Scale

FES-I: FES-International

FICSIT: 'Frailty and Injuries: Cooperative Studies of Intervention Techniques' study

GDS: Geriatric Depression Scale

GDS-20: Geriatric Depression Scale-20

HADS: Hospital Anxiety and Depression Scale

HAP-AAS: Human Activity Profile - Adjusted Activity Score

K-FES: Korean version of the FES

LiFE: Lifestyle approach to reducing Falls through Exercise

MFES: Modified Falls-Efficacy Scale

PASE: Physical Activity Scale for the Elderly

RCT: randomised controlled trial  
SD: standard deviation  
TUG: Timed Up and Go  
VAS: visual analogue scale  
XMSS: Xavix Measured Step System  
YPAS: Yale Physical Activity Survey

### Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Bainbridge 2011	Not a RCT or quasi-RCT
Ballard 2004	Multi-component intervention. Participants received strength and balance exercises plus 6 home safety education sessions. Comparator group invited to attend exercise programme for 6 classes
Banez 2008	Not a RCT or quasi-RCT
Batson 2006	Multi-component intervention. Participants received exercise and mental practice of motor imagery. Comparator group were provided with exercise
Bean 2002	Comparator group were assigned to a walking programme
Beyer 2007	Multi-component intervention. Participants were allocated to a multidimensional training programme and behaviour counselling
Bishop 2007	Not a RCT or quasi-RCT
Bishop 2010	Not a RCT or quasi-RCT
Bula 2011a	Not a RCT or quasi-RCT
Bunout 2005	Fear of falling not measured
Chang 2007	Community-dwelling people and nursing home residents. Data not presented separately for community participants
Conroy 2010	Multi-component intervention. Participants invited to attend a falls prevention programme involving a medical review, physiotherapy and occupational therapy treatments
Davis 2011	Not a RCT or quasi-RCT
Davison 2005	Multi-component intervention. The intervention group received medical assessment, physiotherapy and occupational therapy
Delbaere 2006	Not a RCT or quasi-RCT

(Continued)

Devereux 2005	Study population restricted to participants with osteopenia or osteoporosis
Duque 2013	Multi-component intervention. Participants received training on a virtual reality system, an invitation to join an exercise programme, medication review, home visit by an occupational therapist, hearing and visual assessment, nutritional supplements and educational materials on falls prevention. Comparator group participants received the same intervention but with no training on the virtual reality system
Elley 2003	Majority of participants under 65 years old
Elley 2008	Multi-component intervention. Exercise group referred to optometrist, podiatrist, physical therapist and occupational therapist
Faber 2006	Participants recruited from low and high-level care nursing centres
Faes 2011	Multi-component intervention. Physical and psychological interventions provided
Foley 2009	Not a RCT or quasi-RCT
Gillespie 2012	Not a RCT or quasi-RCT
Gitlin 2006	Multi-component intervention. Participants provided with physical and occupational therapy
Greendale 2009	Study population restricted to participants with adult-onset hyperkyphosis
Hagedorn 2010	Comparator group received resistance, balance and physical fitness training
Hakim 2003	Not a RCT or quasi-RCT
Hakim 2004	Not a RCT or quasi-RCT
Hakim 2010	Not a RCT or quasi-RCT
Harling 2008	Not a RCT or quasi-RCT
Harmer 2008	Not a RCT or quasi-RCT
Hartmann 2009	Not a RCT or quasi-RCT
Hess 2005	Not a RCT or quasi-RCT
Hinrichs 2009	Not a RCT or quasi-RCT
Huang 2011	Multi-component intervention. Tai Chi with cognitive behavioural strategies
Hugel 2000	Not a RCT or quasi-RCT
Inokuchi 2007	Not a RCT or quasi-RCT

(Continued)

ISRCTN05350123	Comparator group received strength and balance exercises
ISRCTN05545178	Comparator group received strength and balance exercises
ISRCTN21695765	Nursing home residents
ISRCTN48015966	Multi-component intervention. Intervention group received general guidance for physical activity, guidance for adequate nutrition, individually tailored or group training of strength and balance, treatment of illnesses increasing the risk of falling, review of medications, home hazard assessment and modification
ISRCTN67535605	Multi-component intervention. Intervention group received strength and balance training, community falls prevention rehabilitation and medical and social care
ISRCTN75134517	Multi-component intervention. Intervention group received exercise training in combination with cognitive training. Comparator group received exercise training
ISRCTN89512790	No exercise intervention reported. Health coaching programme using face to face and telephone coaching sessions
Iwamoto 2009	Fear of falling not measured
Jansson 2004	Not a RCT or quasi-RCT
Juarbe 2009	Not a RCT or quasi-RCT
Jury 2009	Not a RCT or quasi-RCT
Kelsey 2010	Not a RCT or quasi-RCT
Kemmler 2010	Comparator group received a wellness programme of low-intensity walking and strength and balance exercises. Fear of falling not measured
Kerse 2010	Multi-component intervention. Intervention group received exercises on a Green Prescription and motivational interviewing techniques from exercise specialists. Fear of falling not measured
Kim 2009a	Intervention did not include exercise
Kim 2011	Study population restricted to community-dwelling women aged 70 or older with multiple symptoms of geriatric syndrome (MSGs) including functional decline, urinary incontinence and fear of falling
Kuo 2011	Not a RCT or quasi-RCT
Kuptniratsaikul 2011	Not a RCT or quasi-RCT
Kuramoto 2006	Not a RCT or quasi-RCT

(Continued)

Kwok 2011	Multi-component intervention. All participants given home safety and modification advice in addition to their exercise. Comparator group provided with a gym-based rehabilitation programme and home exercise
Kwon 2011	Not a RCT or quasi-RCT
Lee 2010	Not a RCT or quasi-RCT
Leininger 2006	Comparator group were provided with 4 1-hour presentations on osteoporosis and exercise in older adults, including discussion and handouts over a 10-week period
Li 2005	Comparator group were provided with a stretching exercise programme for 1 hour, 3 times a week, for 26 weeks
Li 2010	Intervention did not include exercise
Lin 2008	Not a RCT or quasi-RCT
Liu 2007	Comparator group provided with seated exercises
Liu 2008	Not a RCT or quasi-RCT
Liu 2009a	Not a RCT or quasi-RCT
Liu 2010	Not a RCT or quasi-RCT
Lord 1995	Fear of falling not measured
Lord 2005	Multi-component interventions. The extensive intervention group received group exercises and strategies for maximising vision and sensation. The minimal intervention group received home exercise sheets and written advice about how to maximise their vision and take precautions for loss of peripheral sensation
Luukinen 2007	Study population restricted to participants with $\geq 1$ risk factor for falling ( $\geq 2$ falls in previous year, loneliness, poor self rated health, poor visual acuity, poor hearing, depression, poor cognition, impaired balance, impaired chair rise and slow walking speed)
Maginnis 1999	Not a RCT or quasi-RCT
Mahoney 2007	Multi-component intervention. Intervention group provided with exercise, falls risk assessment and medication review
Marchetti 2005	Not a RCT or quasi-RCT
McCulloch 2002	Fear of falling not measured
McKinley 2008	Comparator group provided with walking exercises for 2 hours, 2 times per week, for 10 weeks
McMurdo 1997	Multi-component intervention. Intervention group exercised and took calcium supplements

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Mihay 2006	Comparator group provided with strength training exercises 3 times a week for 18 months
Miller 2010	Not a RCT or quasi-RCT
Morgan 2004	Fear of falling not measured
Nagai 2011	Not a RCT or quasi-RCT
NCT00037167	Fear of falling not measured
NCT00140322	Multi-component intervention. Intervention group received a comprehensive health assessment combined with tailored risk reduction strategies such as strength and balance exercises
NCT00217360	Multi-component intervention. Intervention participants received a “customised multifactorial falls prevention program”
NCT00323596	Multi-component intervention. Strength and balance training, plus falls risk factor assessment followed by a comprehensive geriatric assessment and treatment
NCT00483275	Multi-component intervention. Intervention included fall prevention programme with alfacalcidol and calcium, patient education and a mobility programme
NCT00805220	Comparator group participated in a walking programme
NCT00986466	Multi-component intervention. Participants received exercise and vitamin D supplementation
NCT01006967	Comparator group received a standard programme of physical therapy for gait and balance
NCT01313481	Comparator group performed strength and balance exercises 3 times a week for 12 weeks
NCT01523600	Comparator group received wellness education, which consisted of supervised group training done once a week with the focus on stretching and flexibility exercises
Nitz 2004	Comparator group received balance training strategies
Obuchi 2004	Comparator group provided with treadmill exercises. Fear of falling not measured
Oh 2012	Multi-component intervention. Before randomisation, all participants attended 3 educational classes that discussed falling, osteoporosis and bone fracture. Comparator group were provided with daily stretch exercises
Robertson 2001a	Fear of falling not measured
Robertson 2001b	Not a RCT or quasi-RCT
Romero 2010	Not a RCT or quasi-RCT
Rosendahl 2006	Multi-component intervention. Participants provided with exercise and protein-enriched energy supplement



(Continued)

Rosie 2007	Comparator group performed low-intensity knee extension exercises daily for 6 weeks
Rubenstein 2000	Fear of falling not measured
Schwartz 2002	Not a RCT or quasi-RCT
Sherrington 2008a	Not a RCT or quasi-RCT
Sherrington 2014	Multi-component intervention. Participants provided with home exercises and a 32-page booklet about fall prevention. The booklet contained information about risk factors for falls, environmental modification for falls risk reduction and what to do after a fall
Shigematsu 2008	Comparator group provided with strength and balance training
Shumway-Cook 1997	Not a RCT or quasi-RCT
Silsupadol 2009	Comparator group provided with balance training exercises
Simmons 1996	Fear of falling not measured
Singh 2012	Majority of participants under 65 years old
Sipe 2009	Comparator group provided with resistance exercises 3 days a week for 12 weeks
Snow 1999	Not a RCT or quasi-RCT
Southard 2004	Not a RCT or quasi-RCT
Southard 2006	Multi-component intervention. Intervention group received balance retraining exercises and efficacy training (including discussion of group fears, introduction to home safety and an opportunity to practise any skill that is difficult or avoided secondary to fear). Comparator group provided with balance retraining exercises
Spink 2011	Not a RCT or quasi-RCT
Suzuki 2004	Fear of falling not measured
Sze 2008	Not a RCT or quasi-RCT
Szturm 2011	Comparator group provided with strength and balance exercises, assessment of walking aids, a gait re-education programme and an unsupervised walking programme
Taggart 2002	Not a RCT or quasi-RCT
Takai 2010	Nursing home residents
Talley 2008	Not a RCT or quasi-RCT

(Continued)

Tennstedt 1998	Multi-component intervention. Participants received group discussions focused on self efficacy, cognitive restructuring and exercise
Tousignant 2012	Comparator group provided with strength and walking exercises
Underwood 2011	Multi-component intervention. Care home staff received depression awareness and physical activity training. Intervention participants received a twice weekly exercise group
Van Haastregt 2007	Not a RCT or quasi-RCT
Vind 2010	Multi-component intervention. Participants received personalised exercises and medical treatment
Voukelatos 2007	Fear of falling not measured
Williams 2002	Multi-component intervention. Intervention participants received a 16-week balance and mobility exercise group with a self efficacy intervention. Comparator group provided with balance and mobility exercises
Williams 2010	Not a RCT or quasi-RCT
Williams 2010a	Not a RCT or quasi-RCT
Woo 2007	Fear of falling not measured
Wrisley 2006	Majority of participants under 65 years old
Wu 2010	Comparator group provided with Tai Chi exercises
Yamada 2011	Not a RCT or quasi-RCT
Yamada 2011a	Comparator group provided with strength and balance training exercises each week
Yan 2009	Not a RCT or quasi-RCT
Zilstra 2007	Not a RCT or quasi-RCT

RCT: randomised controlled trial

## Characteristics of studies awaiting assessment [ordered by study ID]

### Arai 2007

Methods	RCT
Participants	Country: Japan n = 171 % female not reported Mean age in years (SD) = 74.1 (not reported) Study population: recruited via advertisements in publications and clubs for the elderly Inclusion criteria: community-dwelling, aged $\geq 65$ , ambulatory with or without assisting devices Exclusion criteria: cerebrovascular or cardiovascular accidents reported within the past 6 months, acute liver problems or the active phase of chronic hepatitis, diabetes mellitus with a history of hypoglycaemic attack, or with fasting levels of plasma glucose concentrations of 200 mg/dl or higher, or with complications such as retinopathy or nephropathy, systolic blood pressure above 180 mm Hg or diastolic blood pressure above 110 mm Hg at rest, diagnosis of severe heart disease or an acute orthopaedic problem, diagnosis of dementia or depression made by a medical doctor, or an inability to understand and follow the instructions of the research staff; restriction of physical activities by a medical doctor
Interventions	1. Exercise group (n = 86). Group-based resistance and balance training for 1.5 hours, twice weekly, for 3 months 2. Control group (n = 85). Health education group for 1.5 hours, twice a month, for 3 months. Lectures included "Knowledge of Resistance Training"
Outcomes	Falls efficacy (FES - translated into Japanese, with the degree of confidence in accomplishing tasks based on a scale of 1 to 4 rather than 1 to 10). Measured at baseline and post intervention
Notes	-

### Brouwer 2003

Methods	RCT
Participants	Country: Canada n = 38 74% female Mean age in years (SD) = 77.1 (5.1) for exercise group, 78.0 (5.5) for control Study population: recruited through newspaper and radio advertisements seeking individuals fearful of falling Inclusion criteria: seniors living independently with a lasting concern about falling causing them to avoid or curtail activities they felt they were capable of doing Exclusion criteria: coexisting conditions affecting balance (e.g. neuropathy, vestibular deficits, mobility limiting arthritis, pre-existing neurological conditions), not being able to commit to an 8-week intervention
Interventions	1. Exercise group (n = 17). Group-based low-resistance exercises and weight shifting activities, and a 40-minute, twice weekly home programme of exercises and stretches 2. Control group (n = 17). Group-based education programme focused on identifying and reducing risk factors for falls. Topics included "the importance of good nutrition and activity" Both groups were delivered by a physiotherapist for 1 hour, weekly, for 8 weeks
Outcomes	Balance confidence (ABC). Measured at baseline, post intervention and 6 weeks follow-up. Adherence to exercise intervention measured by class attendance and participant log books

**Brouwer 2003** (Continued)

Notes	38 participants randomised but 4 withdrew during study. Number of participants randomised to each group before the withdrawals not reported
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**Henwood 2008**

Methods	RCT
Participants	Country: Australia n = 67 54% female Mean age in years (SD) = 71.2 (1.3) for high-velocity training group, 69.6 (1.1) for strength training group, 69.3 (1.0) for control Study population: recruited by newspaper advertisement Inclusion criteria: independently living, community-dwelling, aged 65 to 84 Exclusion criteria: acute or terminal illness, unstable or ongoing cardiovascular and/or respiratory disorder, neurological or musculoskeletal disease or impairment, resistance training experience within the previous 12 months, the inability to commit to a period of time equivalent to the duration of the study
Interventions	1. High-velocity training group (n = 23). High-velocity varied resistance exercises 2. Strength training group (n = 22). Constant resistance exercises 3. Control group (n = 22). Non-training group Participants in the exercise interventions trained twice weekly for 24 weeks
Outcomes	Balance confidence (ABC); physical activity (PASE). Measured at baseline and post intervention
Notes	All participants were invited to attend 2 familiarisation sessions, during which exercise techniques were demonstrated and practised, before baseline assessments and randomisation

**Jorgensen 2013**

Methods	RCT
Participants	Country: Denmark n = 58 69% female Mean age in years (SD) = 75 (6) Study population: recruited through advertisements in local newspapers, senior citizens' clubs, and senior society organisations Inclusion criteria: $\geq 65$ , self reported balance poor to average (on a discrete scale: good, average, poor), capability of understanding verbal instructions Exclusion criteria: orthopaedic surgery within the previous 6 months, acute illness within the previous 3 weeks, physiotherapy within the previous month, poor visual acuity (not capable of seeing the visual features on the TV screen)
Interventions	1. Exercise group (n = 28). Biofeedback-based Nintendo Wii training for 35 (SD 5) minutes, twice weekly, for 10 weeks 2. Control group (n = 30). Daily use of ethylene vinyl acetate copolymer shoe insoles for 10 weeks. Participants were

**Jorgensen 2013** (Continued)

	explicitly informed that the use of insoles was expected to increase sensory inputs from the feet to the central nervous system, resulting in an improved postural balance
Outcomes	Concern about falling (short FES-I). Measured at baseline and post intervention
Notes	Study record reported at - NCT01371253. 10 weeks of Nintendo Wii Fit balance training improved postural balance and muscle strength in elderly individuals. <a href="http://clinicaltrials.gov/show/NCT01371253">http://clinicaltrials.gov/show/NCT01371253</a> (accessed 1 August 2013)

**Kim 2009b**

Methods	RCT
Participants	Country: USA n = 24 92% female Mean age in years (SD) = 72.5 (6.8) in balance training group, 72.0 (5.5) in weight training group, 76.5 (8.3) in control Study population: recruited from the local community via advertisements Inclusion criteria: older adults, no history of the formal weight and balance exercises in the past 6 months, current exercises (such as walking, running, swimming, dancing, gardening, tennis and golf) do not particularly target weight lifting and balance control, current exercises that target improved muscle strength and balance do not exceed more than 30 minutes a week in total Exclusion criteria: physical problems (i.e. hip, knee, ankle problems)
Interventions	1. Balance training group (n = 6) 2. Weight training group (n = 6) 3. Control group (n = 6). Social activities (picnics, bingo, shopping and park visits). Activities that required physical performance were not included in the control group activities, except for walking The groups met for 50 to 60 minutes, 3 times weekly, for 8 weeks
Outcomes	Fear of falling (on a scale from 1 to 10 (10 being high)). Measured at baseline and post intervention
Notes	24 participants randomised, but 5 withdrew and 1 participant's data were eliminated because his physical abilities were exceptionally superior to the other participants' physical abilities. Number of participants randomised to each group before the withdrawals and data elimination not reported

**Morris 2008**

Methods	RCT
Participants	Country: USA n = 26 100% female Mean age in years (SD) = 76.1 (6.4) Study population: recruited from among the current users of any of the activities sponsored by a hospital supported senior wellness programme Inclusion criteria: willingness to participate after full understanding of the elements and risks involved, completion of a health history form and a signed informed consent form

**Morris 2008** (Continued)

	Exclusion criteria: advanced osteoporosis, hip replacement, glaucoma, Parkinson's disease, common occurrences of dizziness, any surgery within the past year
Interventions	1. Group-based yoga exercises (n = 10) 2. Group-based balance training exercises (n = 10) 3. Control group (n = 6). Fall risk awareness group. Topics included "exercise" and "walking/healthy feet" All groups met for 1 hour, twice weekly, for 8 weeks
Outcomes	Falls efficacy (FES); balance confidence (ABC). Measured at baseline, every other week, post intervention and at 1 month follow-up. Adherence to exercise interventions measured by class attendance
Notes	-

**Wolf 2003**

Methods	RCT
Participants	Country: USA n = 311 94% female Mean age in years (SD) = 80.9 (6.6) for Tai Chi group, 80.8 (5.8) for wellness education group Study population: recruited from congregate living facilities Inclusion criteria: $\geq 70$ , transitioning to frailty, fallen at least once in the past year Exclusion criteria: major unstable cardiopulmonary diseases (ischaemic chest pain, unaccustomed shortness of breath, shortness of breath with mild exertion, recurrent syncopal episodes, orthopnoea, paroxysmal nocturnal dyspnoea, palpitations, tachycardia, claudication or severe pitting ankle oedema), cognitive impairment defined as a Mini-Mental State Examination (MMSE) score of less than 24, contraindications to physical exercise, such as major orthopaedic conditions (e.g. severe lumbar spine, hip, knee, or ankle arthritis that limits exercise capability), restricted to a wheelchair; terminal cancer; or evidence of any other progressive or unstable neurological or medical condition
Interventions	1. Exercise group (n = 158). Group-based Tai Chi, for 60 to 90 minutes, twice weekly, for 48 weeks 2. Control group (n = 153). Wellness education programme for 1 hour, weekly, for 48 weeks. Topics included "exercise and balance"
Outcomes	Falls efficacy (FES); balance confidence (ABC); depression (CES-D). Measured at baseline and every 4 months for 12 months during a 48-week intervention. Number of falls (recorded by weekly forms). Adherence to exercise intervention measured by class attendance
Notes	Fear of falling sub-study reported at - Sattin R, Easley K, Wolf S, Chen Y, Kutner M. Reduction in fear of falling through intense tai chi exercise training in older, transitionally frail adults. <i>Journal of American Geriatrics Society</i> 2005;53:1168-78

ABC: Activities-specific Balance Confidence scale

CES-D: Center for Epidemiologic Studies - Depression scale

FES: Falls Efficacy Scale

FES-I: FES-International

RCT: randomised controlled trial

SD: standard deviation

## Characteristics of ongoing studies [ordered by study ID]

### Iliffe 2010b

Trial name or title	Multicentre cluster-randomised trial comparing a community group exercise programme with home based exercise with usual care for over 65s in primary care
Methods	Cluster-RCT
Participants	N = 1200 Setting: UK Inclusion criteria: community-dwelling older adults aged 65 and over, able to walk around independently indoors and outdoors (with or without a walking aid) and not undergoing long term physiotherapy Exclusion criteria: 3 or more falls in the previous year ("frequent fallers"), resting BP > 180/100 mm Hg, uncontrolled arrhythmia, critical aortic stenosis, very severe vestibular disturbances, psychiatric conditions, significant cognitive impairment (unable to follow simple instructions), acute medical problems such as pneumonia or acute rheumatoid arthritis, hip/knee replacement in past 3 months, stroke/transient ischaemic attacks in the last 6 months or not living independently (e.g. residential or nursing care)
Interventions	1. Home-based exercise programme (n = 400). Otago Exercise Programme (OEP) consists of 30-minute leg muscle strengthening and balance retraining exercises progressing in difficulty performed at least 3 times per week, for 24 weeks. Participants also advised to walk at least twice per week for up to 30 minutes at a moderate pace 2. Community-based exercise programme (FaME) (n = 400). 1-hour group exercise class in a local community centre, and 2 30-minute home exercise sessions (based on the OEP) per week, for 24 weeks. Participants also advised to walk at least twice per week for up to 30 minutes at a moderate pace 3. Treatment as usual (TAU). No intervention
Outcomes	Number and type of falls (fall diary); fear of falling (FES-I); balance confidence (ConfBal); quality of life (Older People's QOL Questionnaire (OPQOL); SF-12); economic analysis
Starting date	June 2008
Contact information	Prof Steve Iliffe Department of Primary Care & Population Health University College London Rowland Hill Street London NW3 2PF United Kingdom
Notes	Recruitment completed. Study end date May 2013

**NCT01032252**

Trial name or title	Prevention of falls in community-dwelling older adults by a standardized assessment of fall risks in the general practitioner setting and through implementation of a network for effective individual reduction on fall risks
Methods	RCT
Participants	N = 378 Setting: Germany Inclusion criteria: community-dwelling adults aged 65 years and older with an increased risk of falling, as seen by history of falls, fear of falling, chair rise > 10 seconds, TUG > 10 seconds and subjective and objective balance deficits Exclusion criteria: older people not living independently, or suffering from physical or mental restrictions that do not allow the participation in an exercise programme or the assessment of risk of falling
Interventions	1. Exercise group. 16-week exercise programme performed once a week for 60 minutes. Exercises include strength/power training, balance/gait training, behavioural aspects, perceptual and functional training 2. Control group. No intervention
Outcomes	Number of falls and falls rates (fall diary); fear of falling (FES-I); quality of life (EuroQol)
Starting date	April 2009
Contact information	Dr Monika Siegrist Department of Medicine Division of Prevention and Sports Medicine Technische Universität Munich 80809 Germany
Notes	Study has been completed March 2012. Data expected to be published spring or summer 2013 (as per email from Chief Investigator received January 2013)

BP: blood pressure

RCT: randomised controlled trial

TUG: Timed Up and Go



## DATA AND ANALYSES

### Comparison 1. Exercise versus control: primary outcome - fear of falling, post intervention

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Fear of falling as measured by single-item question, falls efficacy, balance confidence and concern about falling, post intervention	24	1692	Std. Mean Difference (Random, 95% CI)	0.37 [0.18, 0.56]
1.1 Fear of falling as measured by single-item question	4	380	Std. Mean Difference (Random, 95% CI)	0.17 [-0.06, 0.39]
1.2 Falls efficacy measured using the FES, MFES or K-FES	12	872	Std. Mean Difference (Random, 95% CI)	0.56 [0.21, 0.90]
1.3 Balance confidence measured using ABC	6	333	Std. Mean Difference (Random, 95% CI)	0.13 [-0.10, 0.37]
1.4 Concern about falling measured using the FES-I and Short FES-I	2	107	Std. Mean Difference (Random, 95% CI)	0.52 [-0.09, 1.12]
2 Fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, short term follow-up (< 6 months)	4	356	Std. Mean Difference (IV, Fixed, 95% CI)	0.17 [-0.05, 0.38]
3 Fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, long term follow-up (6 months and more)	3	386	Std. Mean Difference (IV, Fixed, 95% CI)	0.20 [-0.01, 0.41]

### Comparison 2. Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Type of exercise (as classified using ProFaNE taxonomy)	22		Std. Mean Difference (Random, 95% CI)	Subtotals only
1.1 3D (Tai Chi)	7	483	Std. Mean Difference (Random, 95% CI)	0.60 [0.09, 1.12]
1.2 Strength/resistance	4	416	Std. Mean Difference (Random, 95% CI)	0.08 [-0.18, 0.34]
1.3 Gait, balance, co-ordination, functional tasks	11	619	Std. Mean Difference (Random, 95% CI)	0.27 [0.05, 0.50]
2 Type of control group	24	1698	Std. Mean Difference (Random, 95% CI)	0.37 [0.18, 0.56]

2.1 Alternative intervention (e.g. social group, education, etc)	6	499	Std. Mean Difference (Random, 95% CI)	0.11 [-0.08, 0.29]
2.2 No intervention	18	1199	Std. Mean Difference (Random, 95% CI)	0.48 [0.22, 0.73]
3 Recruited participants at increased risk of falls	25	1783	Std. Mean Difference (Random, 95% CI)	0.38 [0.19, 0.57]
3.1 Studies not recruiting participants on the basis of increased risk of falls	14	926	Std. Mean Difference (Random, 95% CI)	0.44 [0.14, 0.74]
3.2 Studies recruiting participants at increased risk of falls	11	857	Std. Mean Difference (Random, 95% CI)	0.27 [0.06, 0.48]
4 Type of exercise (individual versus group)	24	1698	Std. Mean Difference (Random, 95% CI)	0.37 [0.18, 0.56]
4.1 Group exercises	15	1051	Std. Mean Difference (Random, 95% CI)	0.49 [0.22, 0.76]
4.2 Individual exercises	9	647	Std. Mean Difference (Random, 95% CI)	0.14 [-0.06, 0.35]
5 Frequency of exercise	24	1698	Std. Mean Difference (Random, 95% CI)	0.37 [0.18, 0.56]
5.1 1 to 3 times per week	20	1339	Std. Mean Difference (Random, 95% CI)	0.38 [0.15, 0.61]
5.2 4 or more times per week	4	359	Std. Mean Difference (Random, 95% CI)	0.30 [0.01, 0.58]
6 Duration of exercise	24	1698	Std. Mean Difference (Random, 95% CI)	0.37 [0.18, 0.56]
6.1 Up to 12 weeks	17	968	Std. Mean Difference (Random, 95% CI)	0.32 [0.16, 0.48]
6.2 13 to 26 weeks	5	530	Std. Mean Difference (Random, 95% CI)	0.52 [-0.13, 1.17]
6.3 More than 26 weeks	2	200	Std. Mean Difference (Random, 95% CI)	0.13 [-0.41, 0.66]
7 Primary aim of the study	24	1698	Std. Mean Difference (Random, 95% CI)	0.37 [0.18, 0.56]
7.1 To reduce fear of falling	7	471	Std. Mean Difference (Random, 95% CI)	0.42 [0.13, 0.72]
7.2 Other primary aim (e.g. balance improvement, fall prevention, etc)	17	1227	Std. Mean Difference (Random, 95% CI)	0.34 [0.10, 0.59]

### Comparison 3. Exercise versus control: secondary outcomes

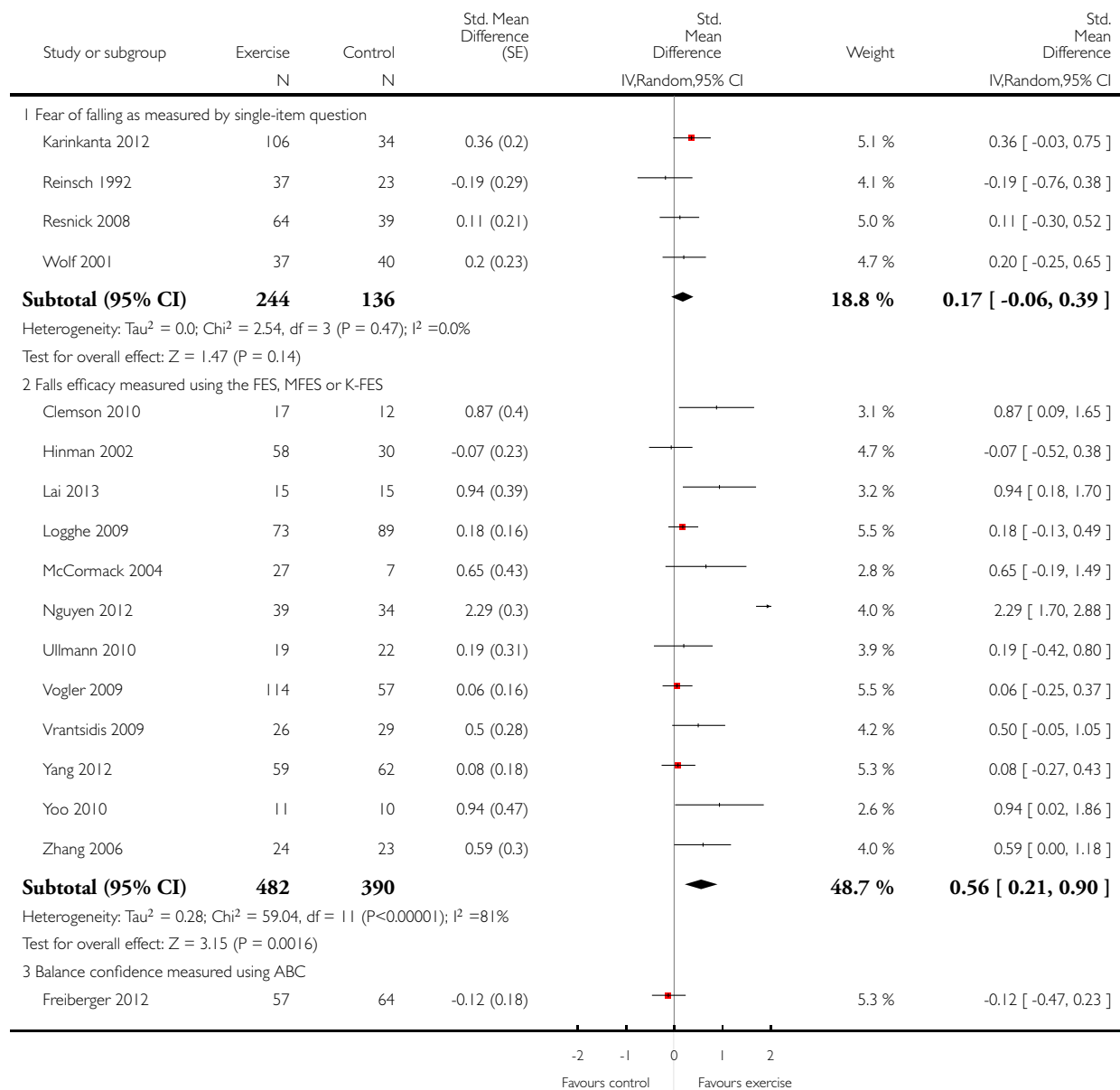
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Occurrence of at least one fall	9	1113	Risk Ratio (IV, Fixed, 95% CI)	0.85 [0.74, 0.98]
2 Falls rate	9	1121	Rate Ratio (Random, 95% CI)	0.68 [0.53, 0.87]
3 Depression score, post intervention	4	406	Std. Mean Difference (Fixed, 95% CI)	-0.08 [-0.28, 0.13]
4 Depression score, short-term follow-up (< 6 months)	3	327	Std. Mean Difference (IV, Fixed, 95% CI)	0.20 [-0.02, 0.43]
5 Physical activity as measured using PASE (Physical Activity Scale for the Elderly)	4	547	Mean Difference (IV, Fixed, 95% CI)	3.44 [-1.65, 8.54]

**Analysis 1.1. Comparison 1 Exercise versus control: primary outcome - fear of falling, post intervention, Outcome 1 Fear of falling as measured by single-item question, falls efficacy, balance confidence and concern about falling, post intervention.**

Review: Exercise for reducing fear of falling in older people living in the community

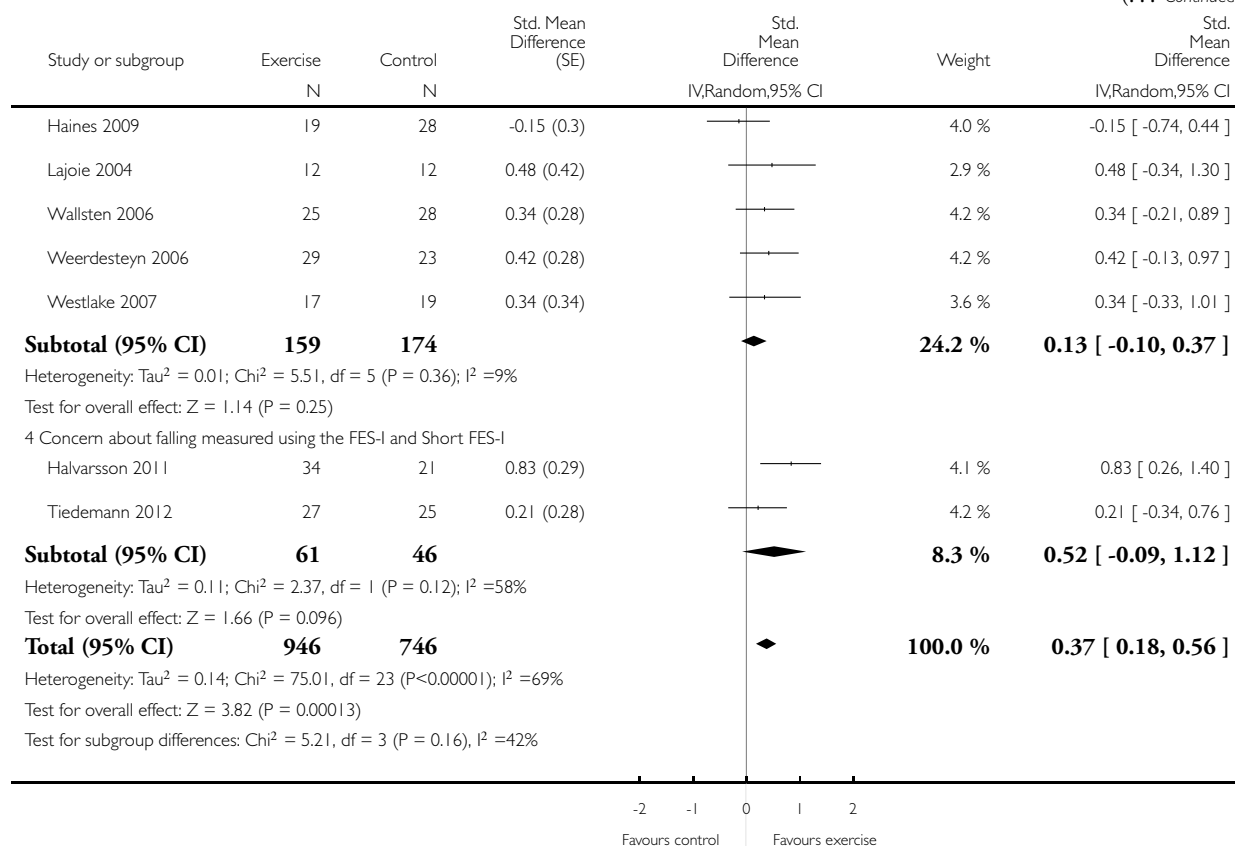
Comparison: 1 Exercise versus control: primary outcome - fear of falling, post intervention

Outcome: 1 Fear of falling as measured by single-item question, falls efficacy, balance confidence and concern about falling, post intervention



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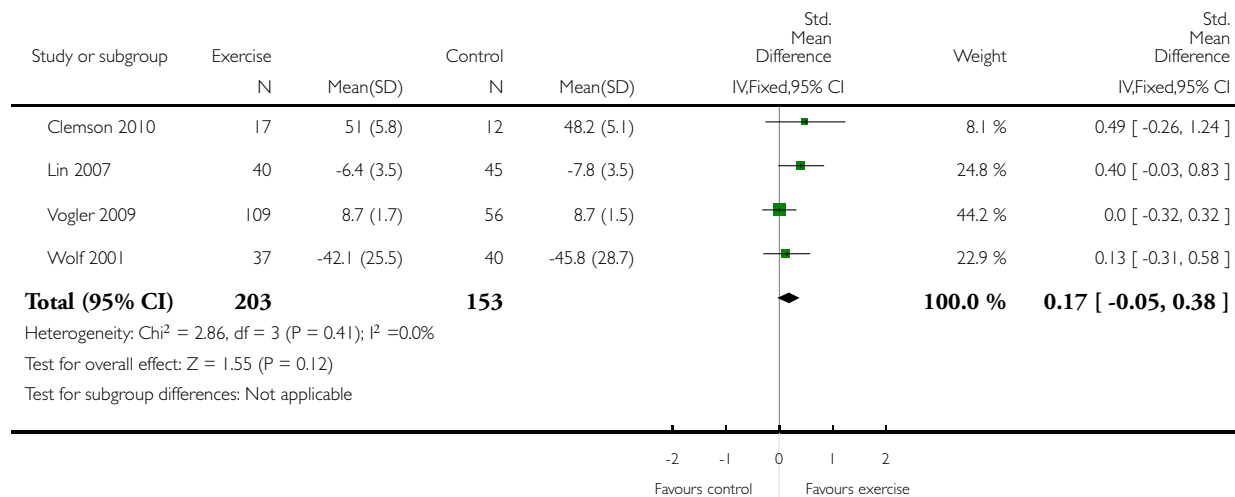


**Analysis 1.2. Comparison 1 Exercise versus control: primary outcome - fear of falling, post intervention, Outcome 2 Fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, short term follow-up (< 6 months).**

Review: Exercise for reducing fear of falling in older people living in the community

Comparison: 1 Exercise versus control: primary outcome - fear of falling, post intervention

Outcome: 2 Fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, short term follow-up (< 6 months)

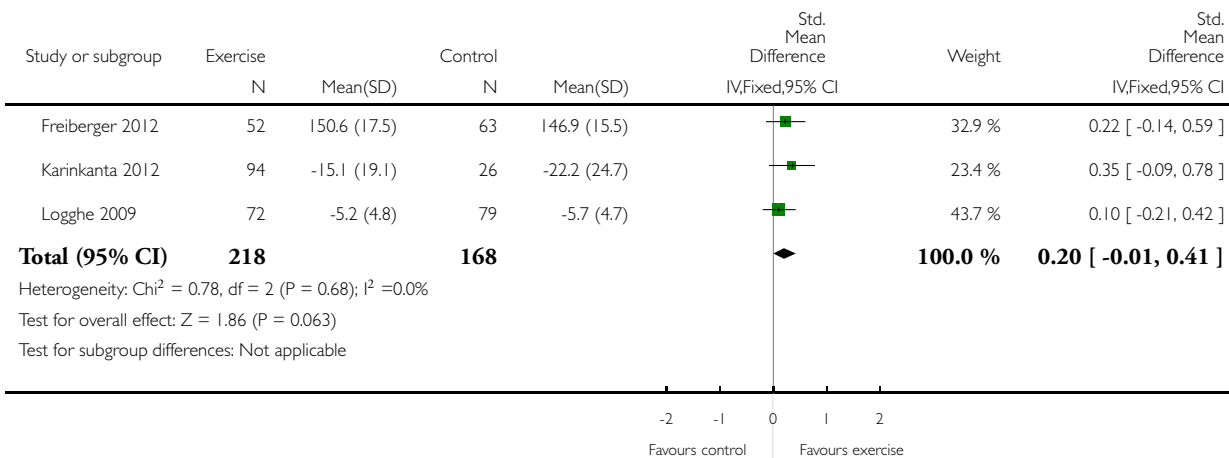


**Analysis 1.3. Comparison 1 Exercise versus control: primary outcome - fear of falling, post intervention, Outcome 3 Fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, long term follow-up (6 months and more).**

Review: Exercise for reducing fear of falling in older people living in the community

Comparison: 1 Exercise versus control: primary outcome - fear of falling, post intervention

Outcome: 3 Fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, long term follow-up (6 months and more)

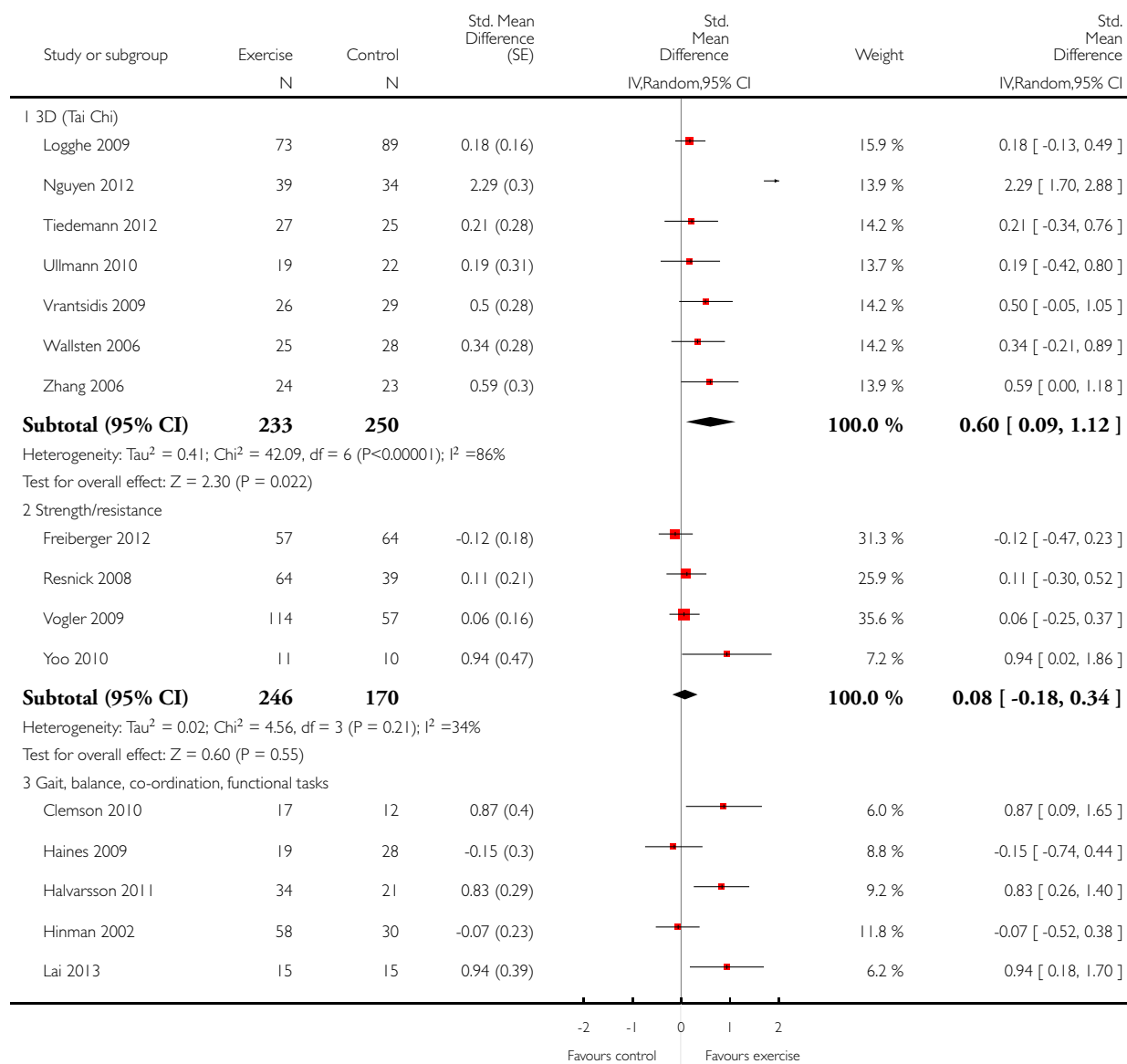


**Analysis 2.1. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 1 Type of exercise (as classified using ProFaNE taxonomy).**

Review: Exercise for reducing fear of falling in older people living in the community

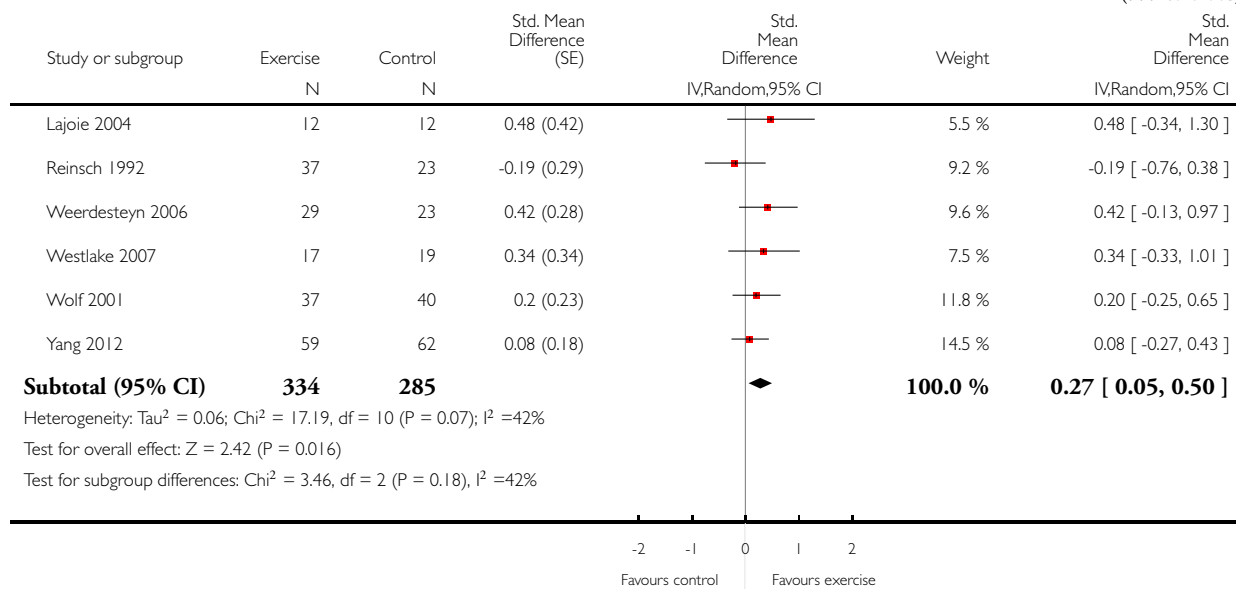
Comparison: 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention

Outcome: 1 Type of exercise (as classified using ProFaNE taxonomy)



(Continued . . .)

(... Continued)



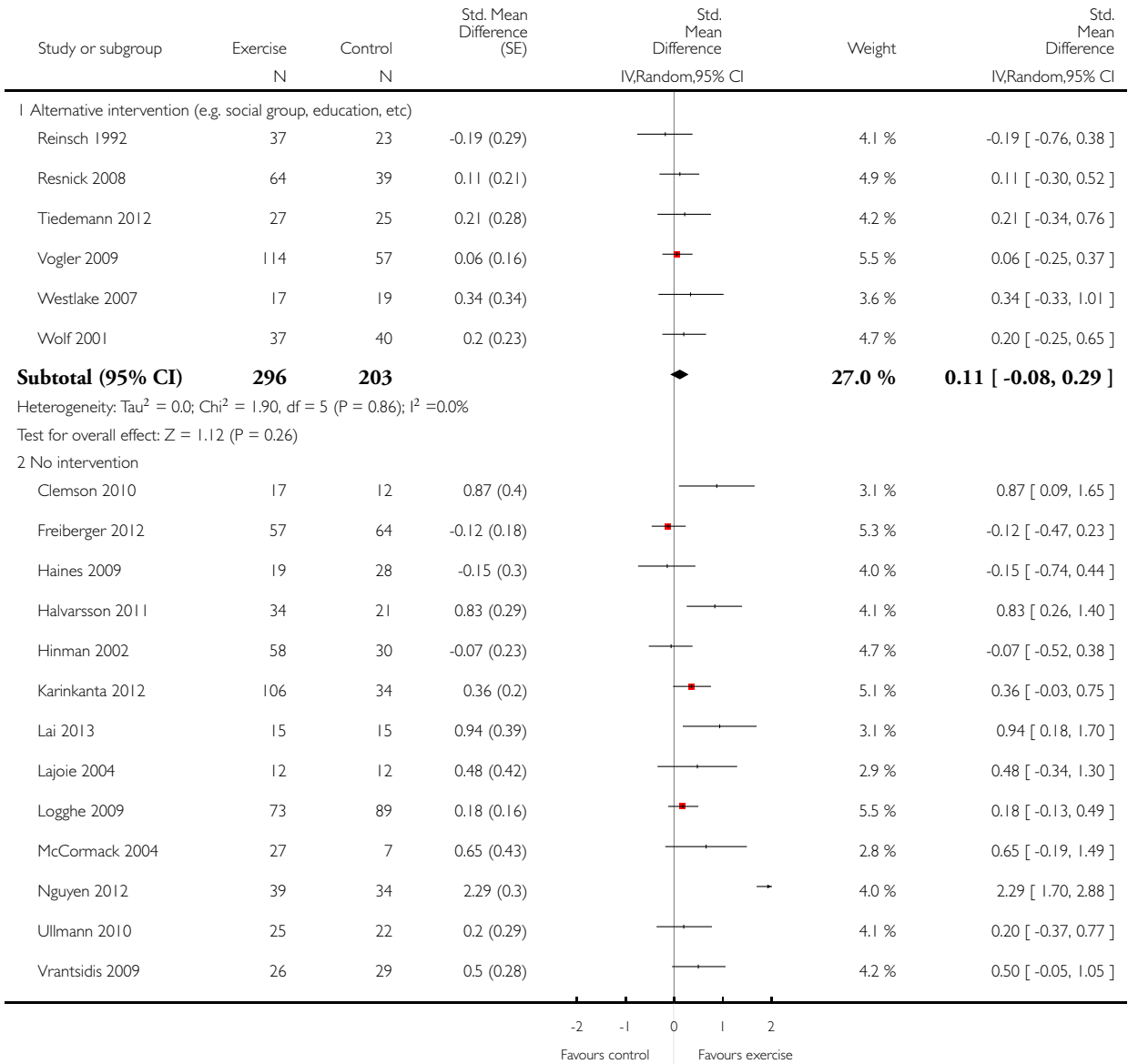


**Analysis 2.2. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 2 Type of control group.**

Review: Exercise for reducing fear of falling in older people living in the community

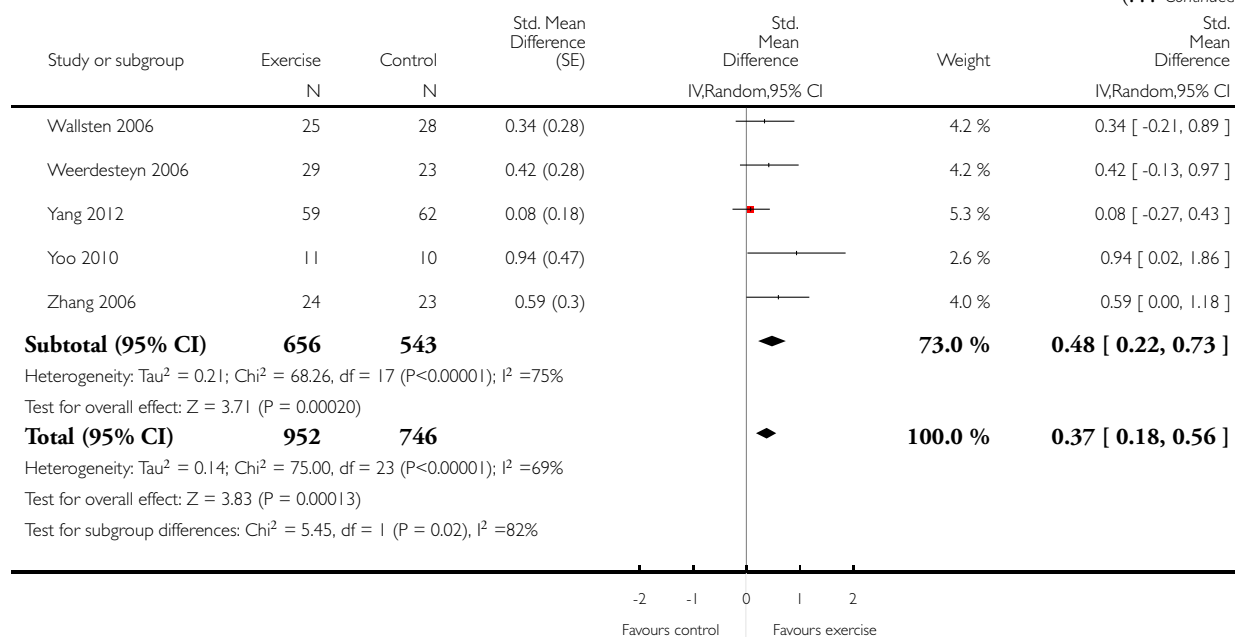
Comparison: 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention

Outcome: 2 Type of control group



(Continued ...)

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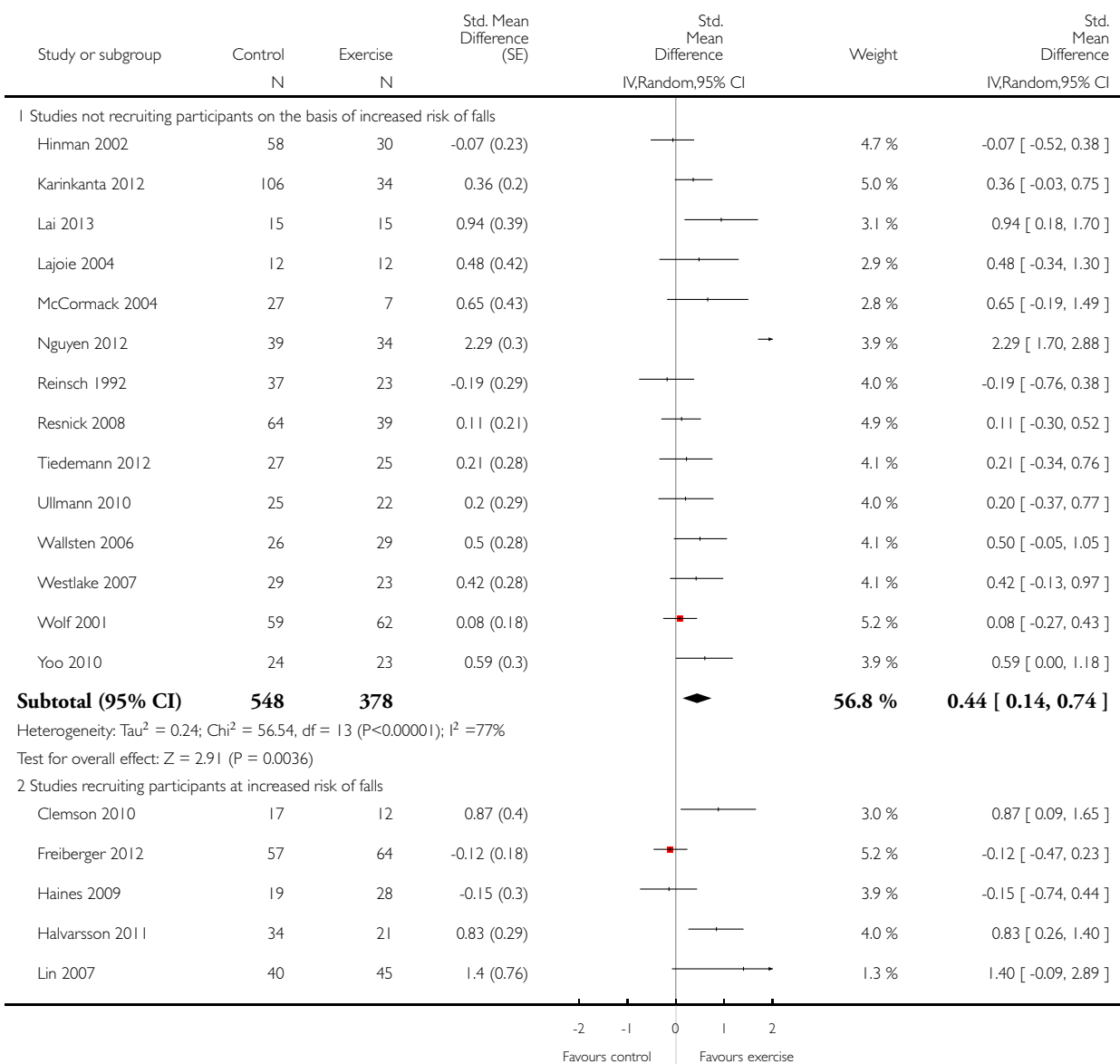


**Analysis 2.3. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 3 Recruited participants at increased risk of falls.**

Review: Exercise for reducing fear of falling in older people living in the community

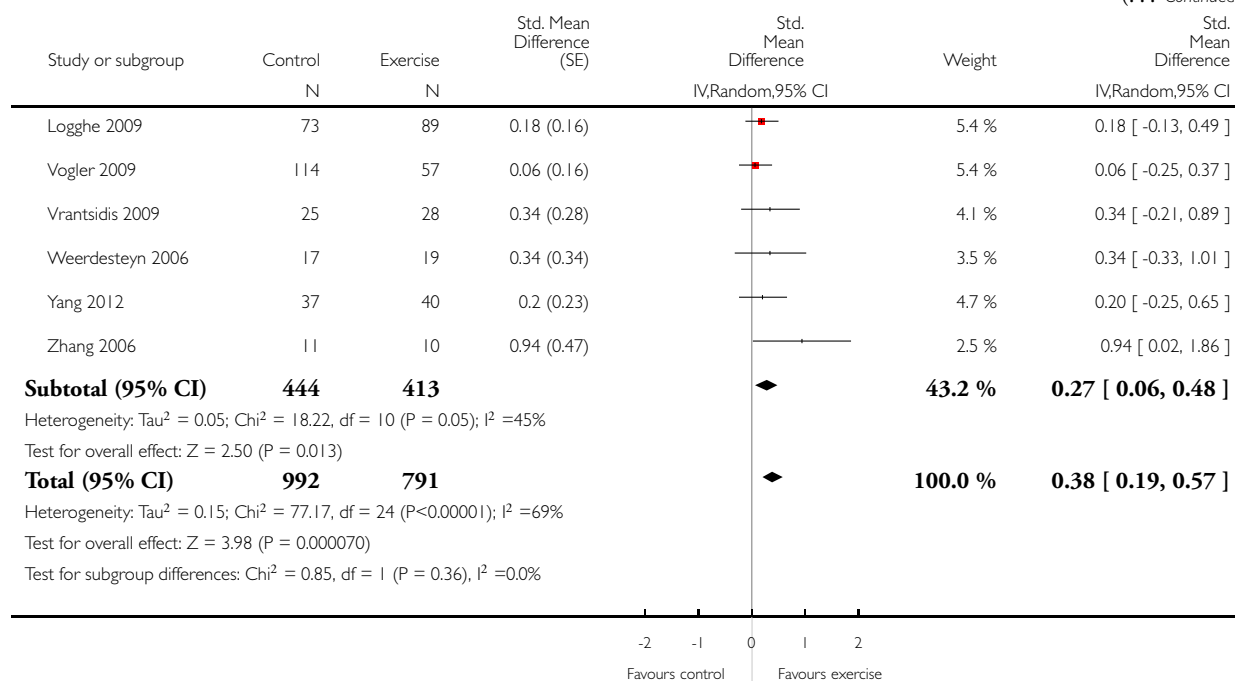
Comparison: 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention

Outcome: 3 Recruited participants at increased risk of falls



(Continued ...)

(... Continued)

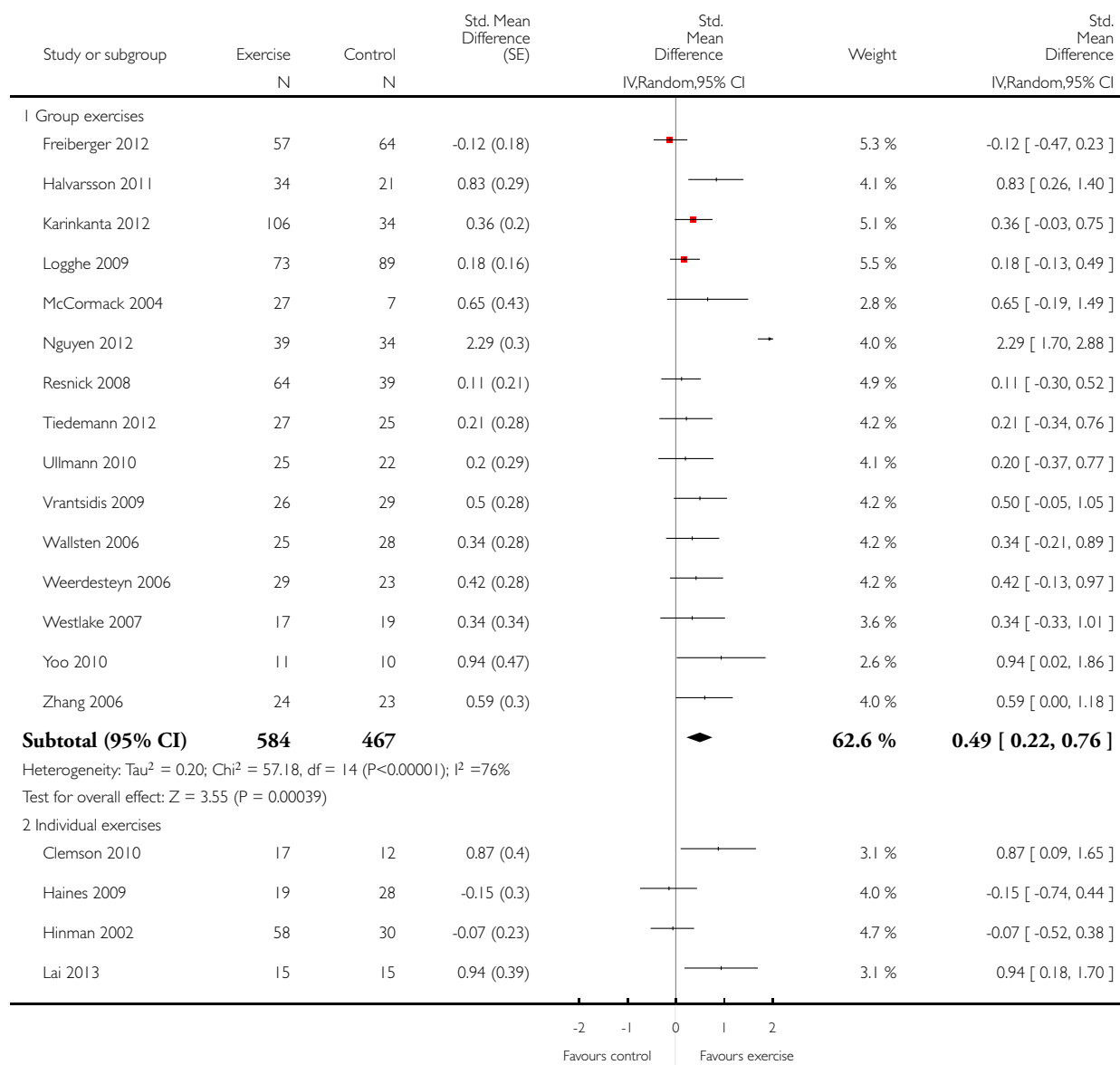


**Analysis 2.4. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 4 Type of exercise (individual versus group).**

Review: Exercise for reducing fear of falling in older people living in the community

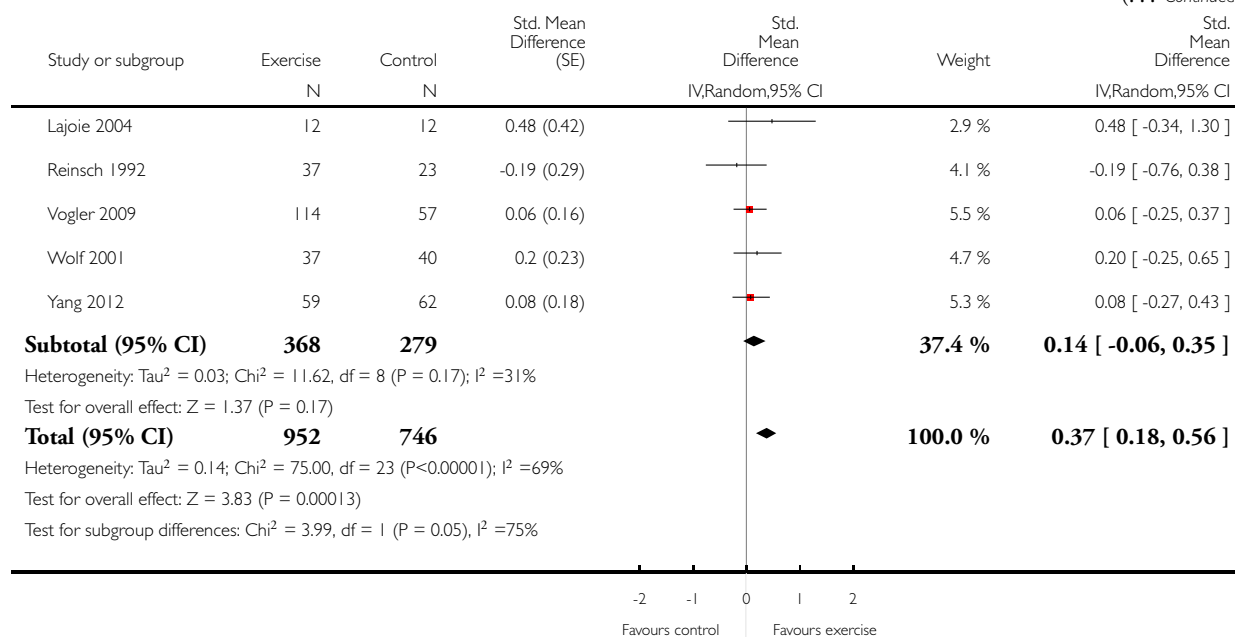
Comparison: 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention

Outcome: 4 Type of exercise (individual versus group)



(Continued ...)

(... Continued)

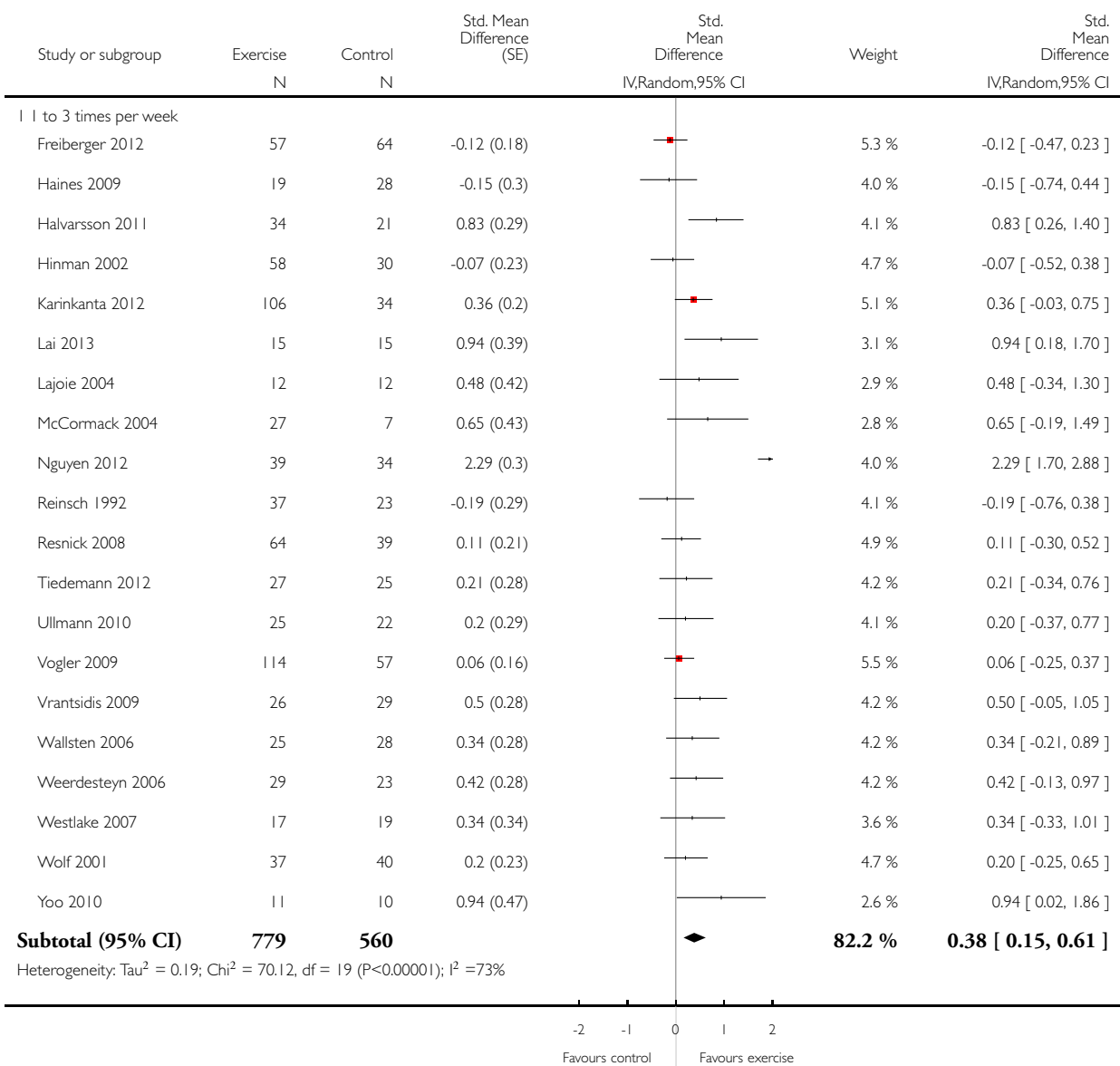


**Analysis 2.5. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 5 Frequency of exercise.**

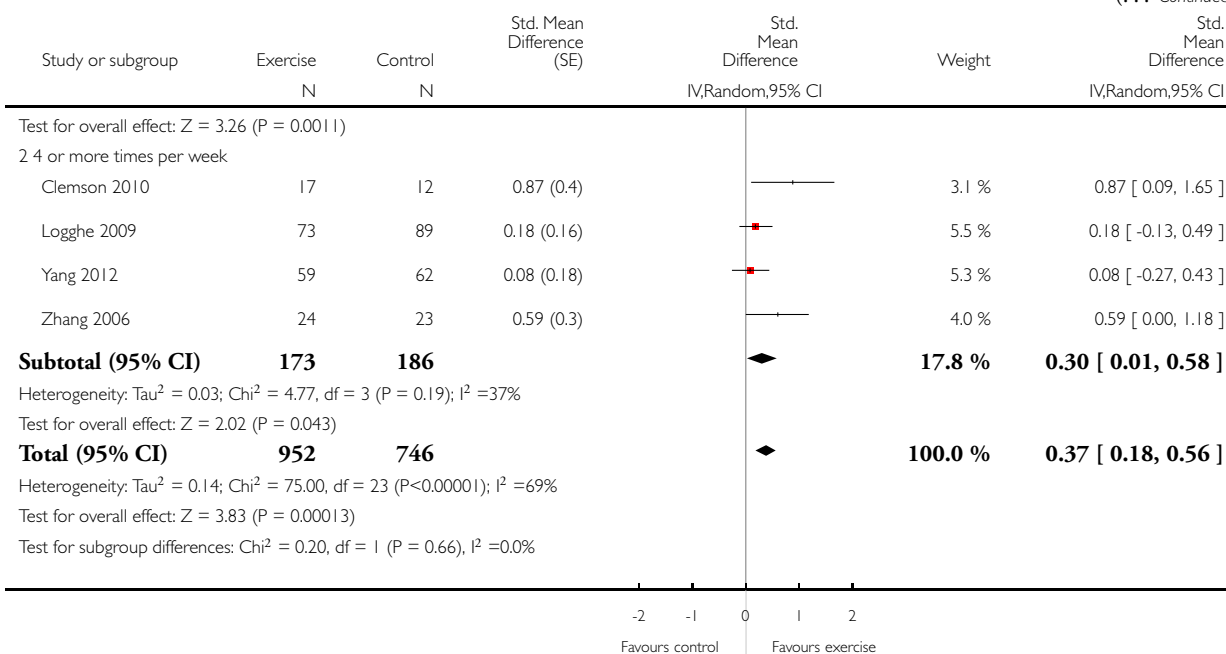
Review: Exercise for reducing fear of falling in older people living in the community

Comparison: 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention

Outcome: 5 Frequency of exercise



(... Continued)



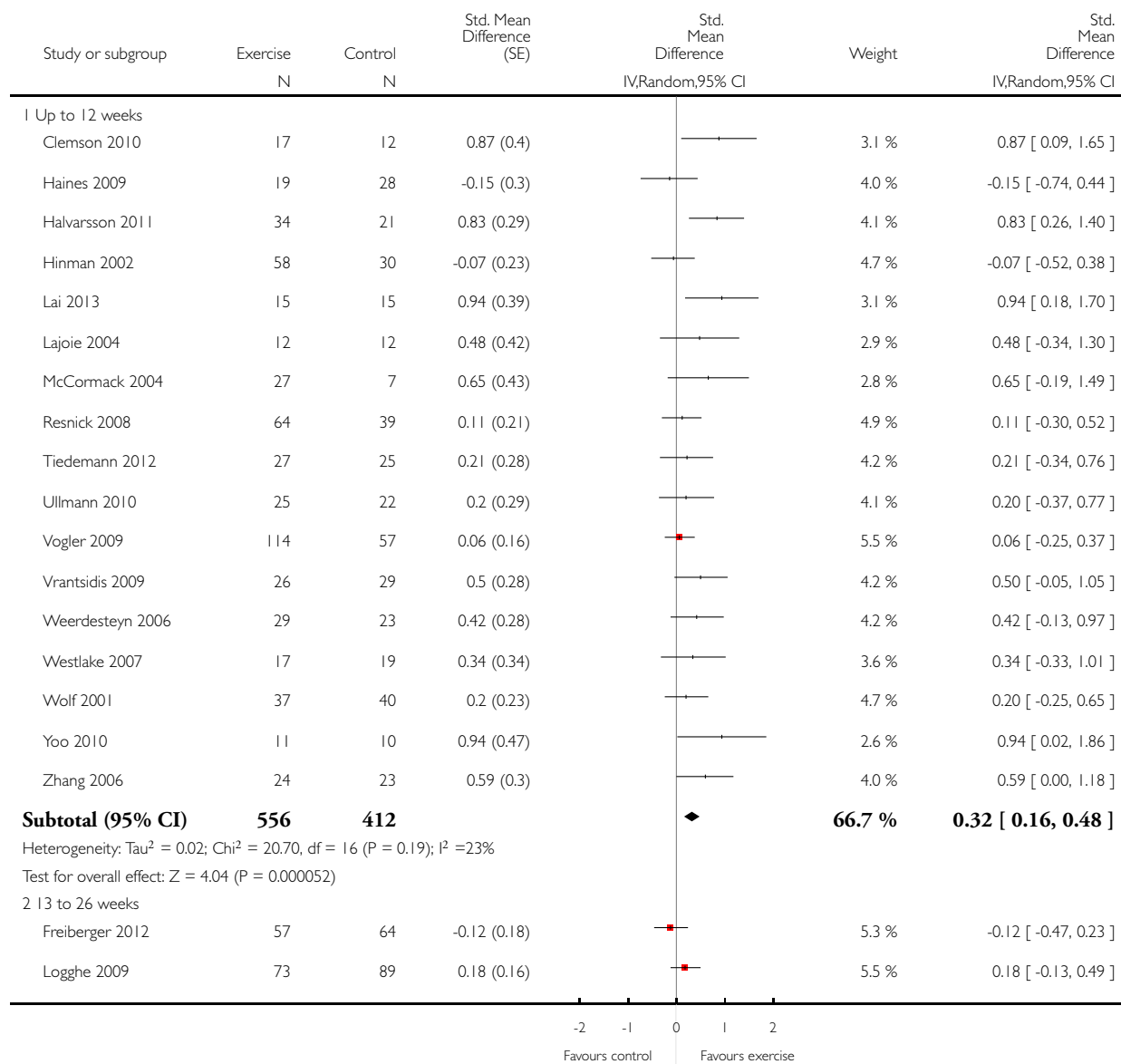


**Analysis 2.6. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 6 Duration of exercise.**

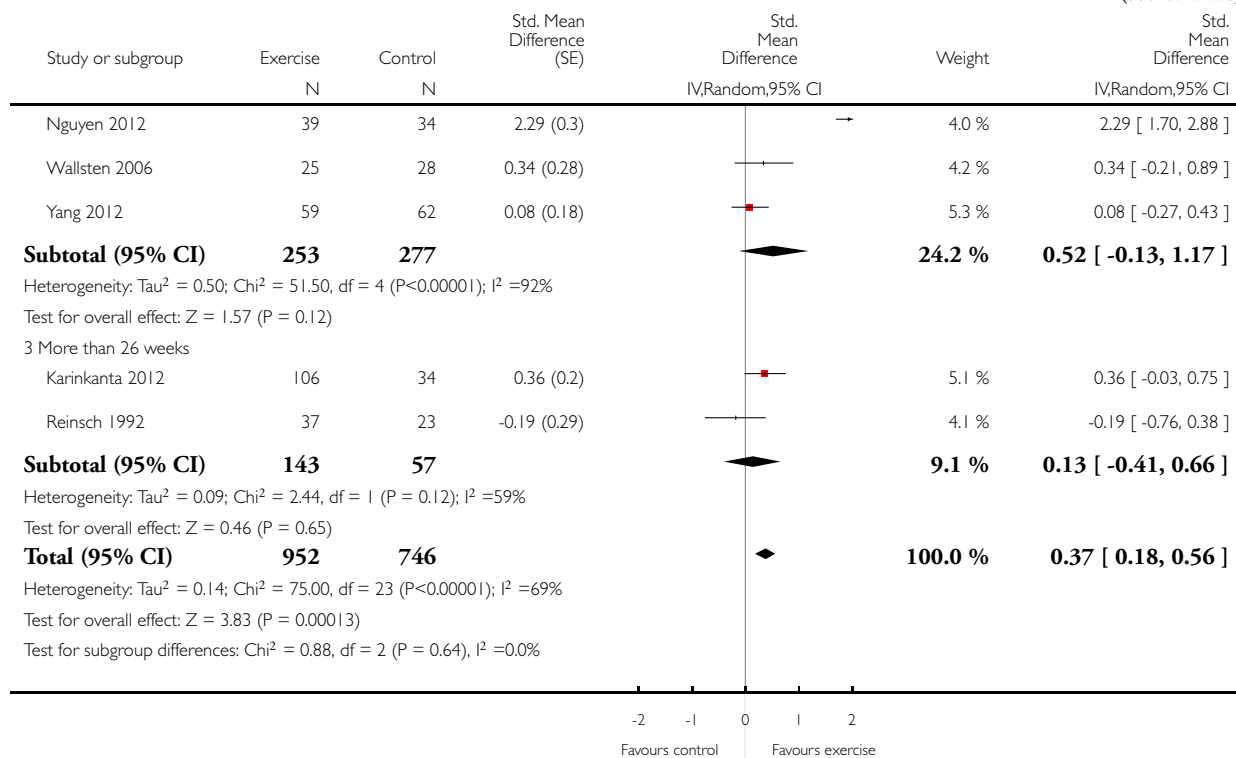
Review: Exercise for reducing fear of falling in older people living in the community

Comparison: 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention

Outcome: 6 Duration of exercise



(... Continued)

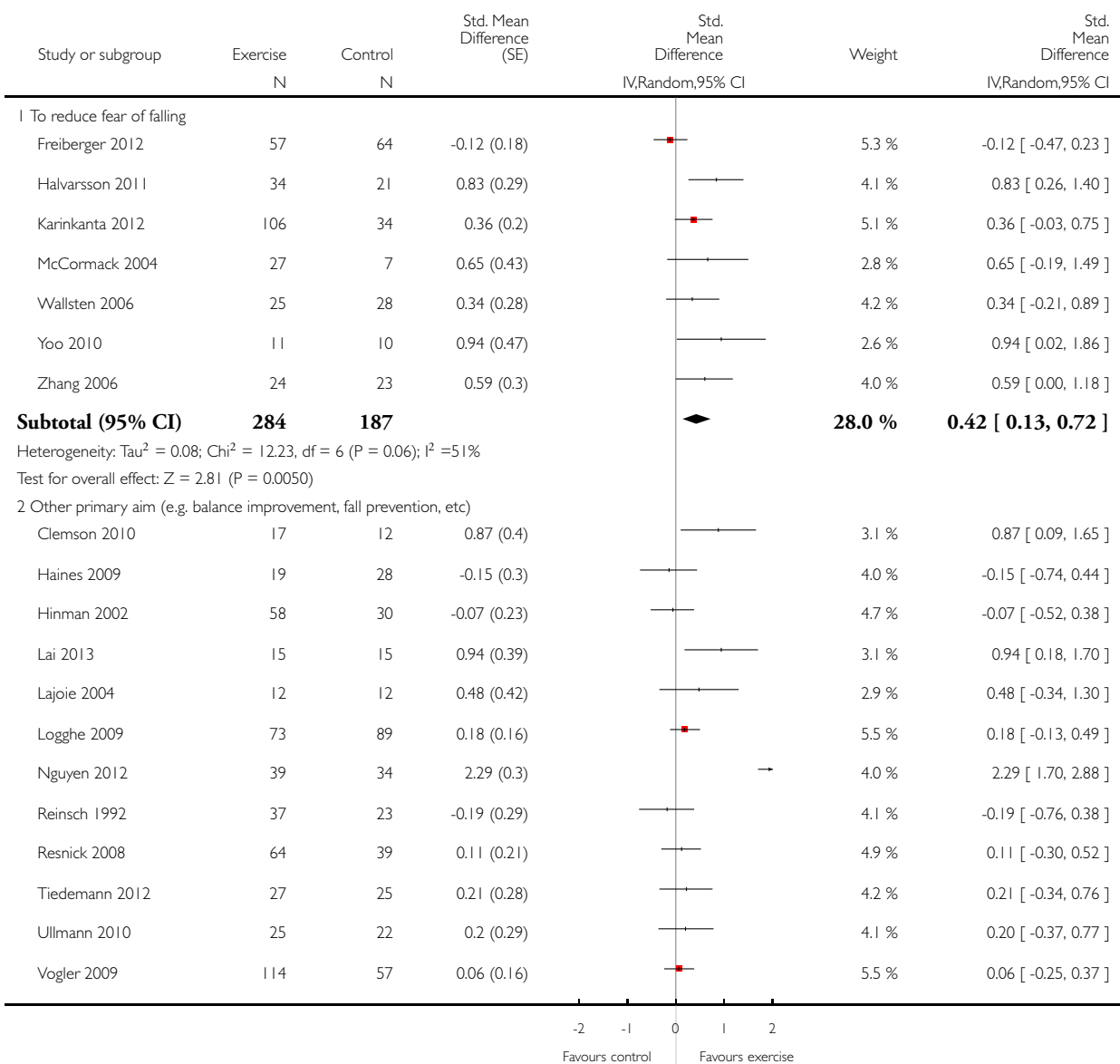


**Analysis 2.7. Comparison 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention, Outcome 7 Primary aim of the study.**

Review: Exercise for reducing fear of falling in older people living in the community

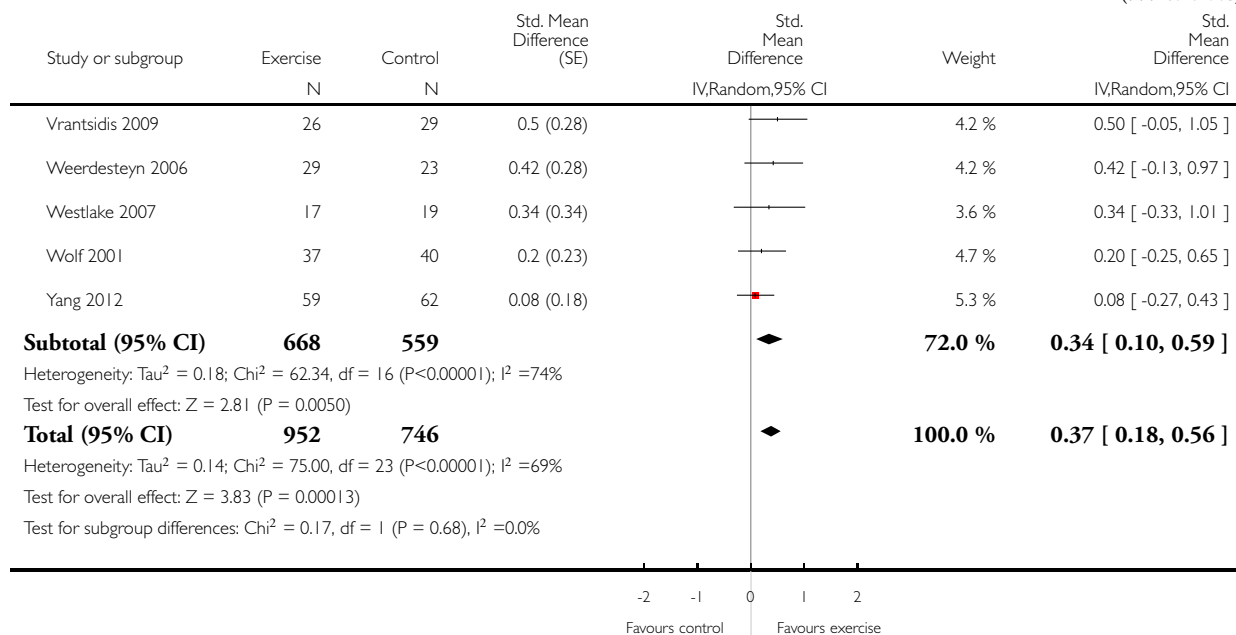
Comparison: 2 Exercise versus control: subgroup analysis for fear of falling as measured by single-item questions, falls efficacy, balance confidence and concern about falling, post intervention

Outcome: 7 Primary aim of the study



(Continued ...)

(... Continued)

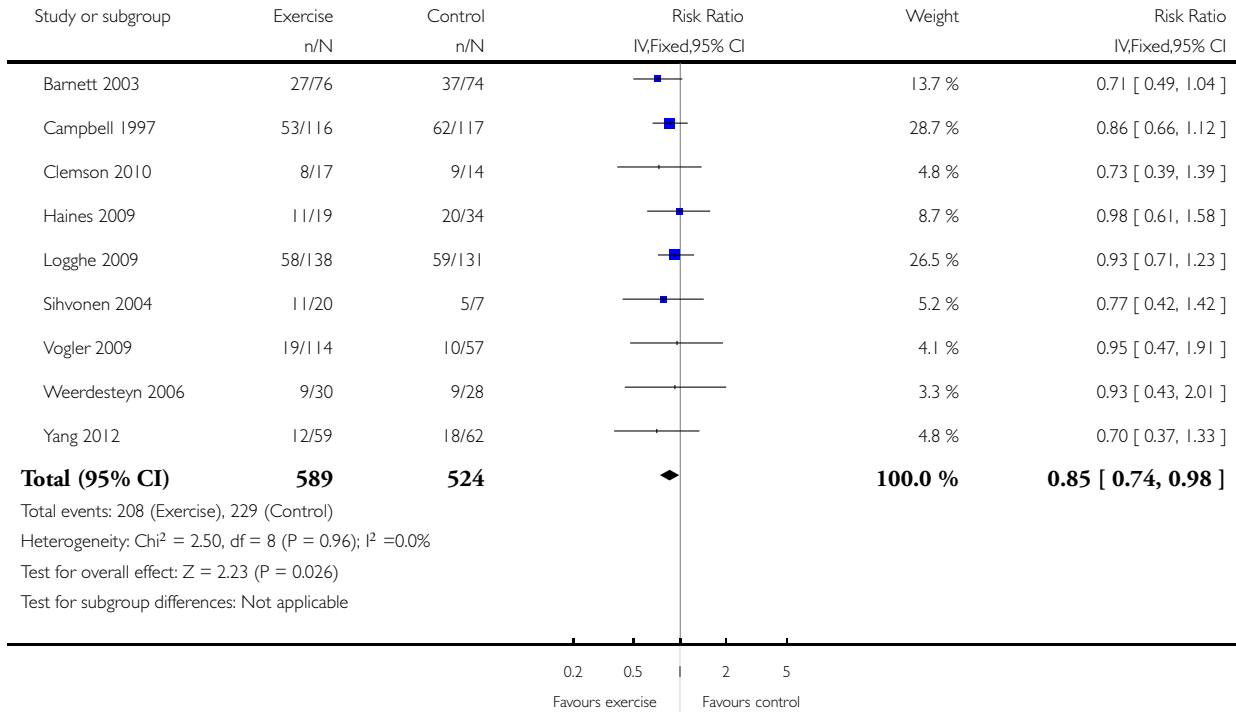


### Analysis 3.1. Comparison 3 Exercise versus control: secondary outcomes, Outcome 1 Occurrence of at least one fall.

Review: Exercise for reducing fear of falling in older people living in the community

Comparison: 3 Exercise versus control: secondary outcomes

Outcome: 1 Occurrence of at least one fall

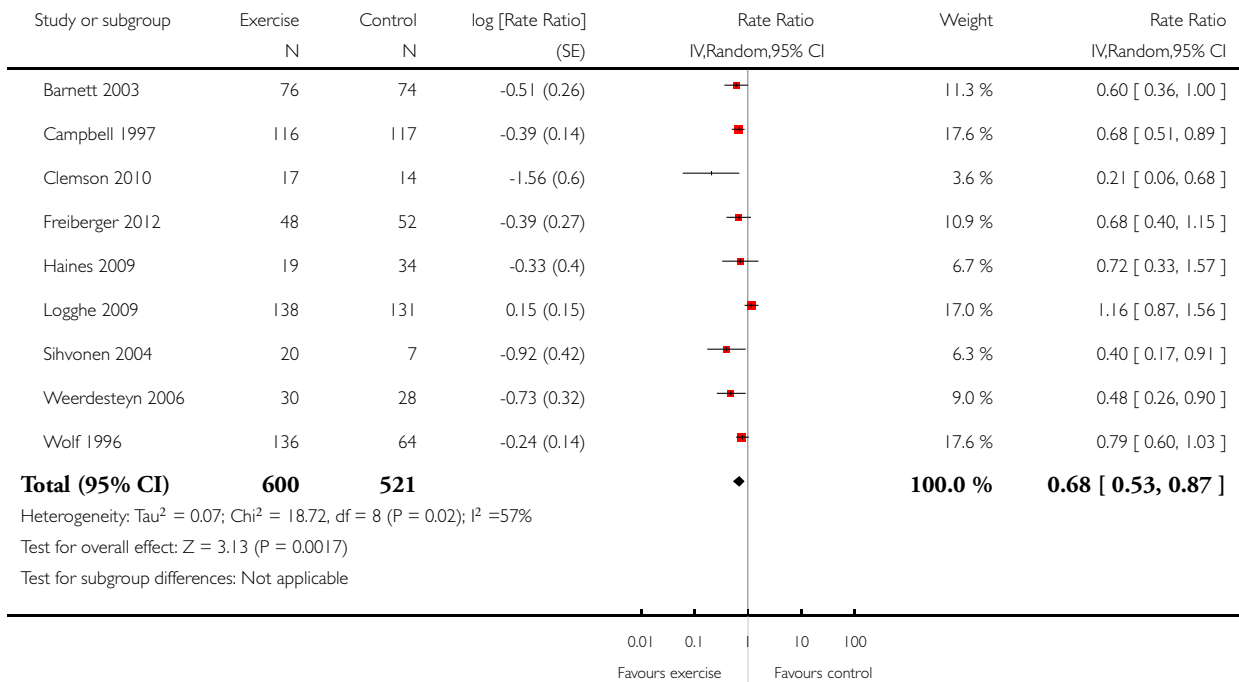


### Analysis 3.2. Comparison 3 Exercise versus control: secondary outcomes, Outcome 2 Falls rate.

Review: Exercise for reducing fear of falling in older people living in the community

Comparison: 3 Exercise versus control: secondary outcomes

Outcome: 2 Falls rate

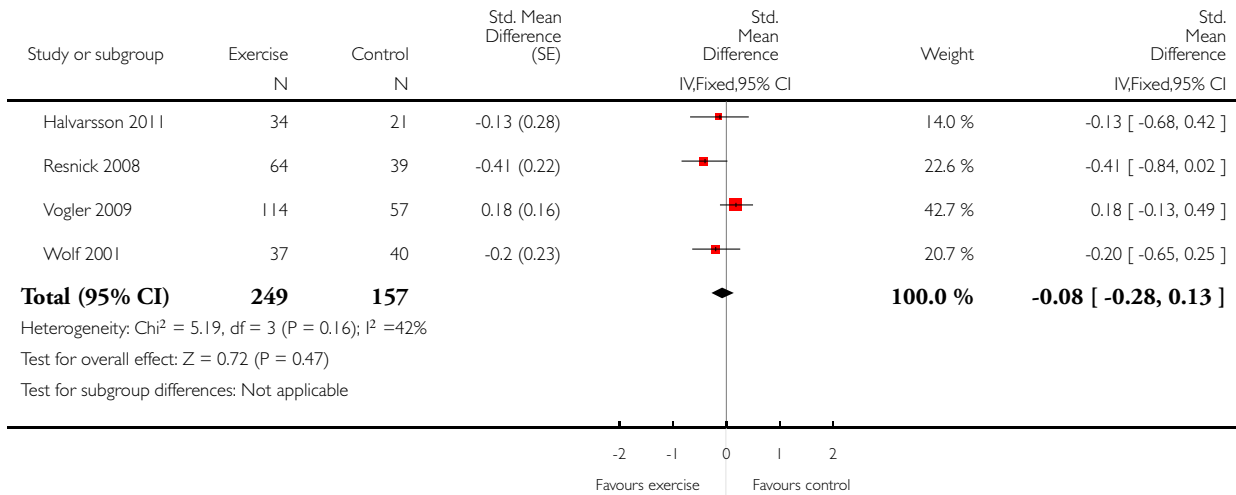


### Analysis 3.3. Comparison 3 Exercise versus control: secondary outcomes, Outcome 3 Depression score, post intervention.

Review: Exercise for reducing fear of falling in older people living in the community

Comparison: 3 Exercise versus control: secondary outcomes

Outcome: 3 Depression score, post intervention

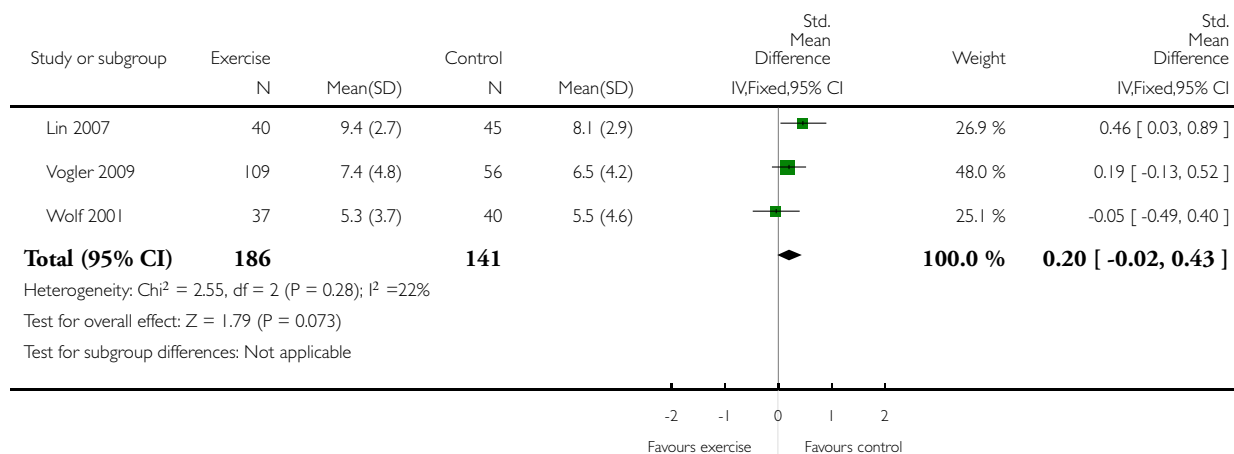


**Analysis 3.4. Comparison 3 Exercise versus control: secondary outcomes, Outcome 4 Depression score, short-term follow-up (< 6 months).**

Review: Exercise for reducing fear of falling in older people living in the community

Comparison: 3 Exercise versus control: secondary outcomes

Outcome: 4 Depression score, short-term follow-up (< 6 months)



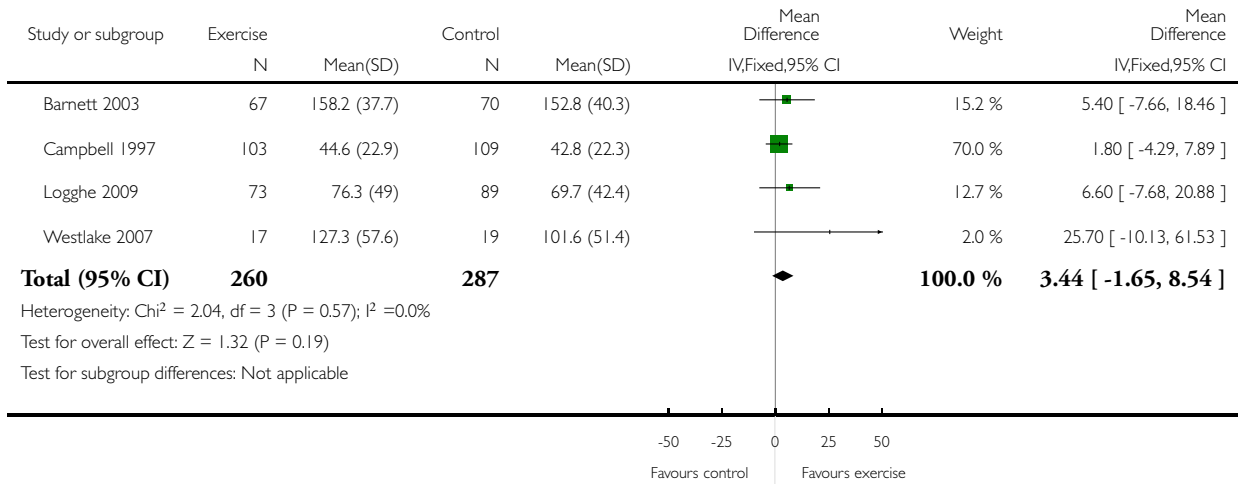


**Analysis 3.5. Comparison 3 Exercise versus control: secondary outcomes, Outcome 5 Physical activity as measured using PASE (Physical Activity Scale for the Elderly).**

Review: Exercise for reducing fear of falling in older people living in the community

Comparison: 3 Exercise versus control: secondary outcomes

Outcome: 5 Physical activity as measured using PASE (Physical Activity Scale for the Elderly)



**ADDITIONAL TABLES**

**Table 1. Means and SDs for fear of falling scales entered as SMD and SE into the meta-analysis**

Study	Time point	Scale	Scale direction	Intervention group mean	Intervention group SD	Intervention group number of participants	Control group mean	Control group SD	Control group number of participants
Clemson 2010	Post intervention	MFES	High score = low FOF	49.4	6.1	17	42.6	9.4	12
Clemson 2010	Post intervention	ABC	High score = low FOF	995.3	377.9	17	805.0	297.1	12
Freiberger 2012	Post intervention	ABC	High score = low FOF	148.6	16.8	57	150.3	12.4	64
Haines 2009	Post intervention	ABC	High score = low FOF	5.3	2.0	19	5.6	2.0	28

**Table 1. Means and SDs for fear of falling scales entered as SMD and SE into the meta-analysis** (Continued)

Halvarsson 2011	Post intervention	FES-I	High score = high FOF	-22.6	6.1	34	-28.9	9.3	21
Hinman 2002	Post intervention	MFES	High score = low FOF	134.6	10.9	58	135.4	14.1	30
Karinkanta 2012	Post intervention	100 mm VAS	High score = high FOF	-10.7	15.7	106	-16.9	21.2	34
Lai 2013	Post intervention	MFES	High score = low FOF	136.0	6.1	15	116.4	27.9	15
Lajoie 2004	Post intervention	ABC	High score = low FOF	92.0	8.0	12	82.5	26.0	12
Logghe 2009	Post intervention	FES	High score = high FOF	-4.9	4.4	73	-5.8	5.3	89
McCormack 2004	Post intervention	MFES	High score = low FOF	9.1	1.5	27	8.1	2.4	7
Nguyen 2012	Post intervention	FES	High score = high FOF	-35.2	5.9	39	-51.4	8.1	34
Resnick 2008	Post intervention	Participants asked to rate fear of falling on a scale of 0 to 4 (0 = low, 4 = high)	High score = high FOF	-1.6	1.8	64	-1.8	1.8	39
Reinsch 1992	Post intervention	Participants asked to rate worry about falling on a scale of 1 to 5 (1 = not at all worried, 5 = extremely)	High score = high FOF	-1.5	0.8	44	-1.7	1.3	42

**Table 1. Means and SDs for fear of falling scales entered as SMD and SE into the meta-analysis** (Continued)

		worried)							
Tiedemann 2012	Post intervention	FES-I	High score = high FOF	-9.8	4.5	27	-10.6	3.2	25
Ullmann 2010	Post intervention	FES	High score = low FOF	9.3	1.4	19	9.0	1.7	22
Ullmann 2010	Post intervention	ABC	High score = low FOF	83.5	13.5	19	86.4	10.6	22
Vogler 2009	Post intervention	MFES	High score = low FOF	8.6	1.8	114	8.5	1.8	57
Vrantsidis 2009	Post intervention	MFES	High score = low FOF	8.6	1.6	26	7.7	1.9	29
Wallsten 2006	Post intervention	ABC	High score = low FOF	76.2	20.3	25	70.5	12.3	28
Weerdesteijn 2006	Post intervention	ABC	High score = low FOF	76.3	13.4	29	69.7	17.8	23
Westlake 2007	Post intervention	ABC	High score = low FOF	85.7	9.5	17	79.1	24.2	19
Wolf 2001	Post intervention	100 mm VAS	High score = high FOF	-38.6	29.7	37	-44.7	29.9	40
Yang 2012	Post intervention	MFES	High score = low FOF	9.2	1.2	59	9.1	1.4	62
Yoo 2010	Post intervention	K-FES	High score = low FOF	100.0	0.0	11	95.4	6.8	10
Zhang 2006	Post intervention	FES	High score = low FOF	78.3	4.0	24	75.3	5.9	23

ABC: Activities-specific Balance Confidence scale

FES: Falls Efficacy Scale

FES-I: FES-International

FOF: fear of falling

K-FES: Korean version of the FES

MFES: Modified Falls-Efficacy Scale

VAS: visual analogue scale

**Table 2. Means and SDs for depression scales entered into meta-analyses as SMD and SE**

Study	Time point	Scale	Scale direction	Intervention group mean	Intervention group SD	Intervention group number of participants	Control group mean	Control group SD	Control group number of participants
Halvarsson 2011	Post intervention	GDS-20	Higher score = greater symptoms of depression	2.7	2.4	34	3	2	21
Resnick 2008	Post intervention	GDS 5-item	Higher score = greater symptoms of depression	0.41	0.79	64	0.79	1.1	39
Vogler 2009	Post intervention	GDS	Higher score = greater symptoms of depression	7.2	4.49	114	6.4	4.3	57
Wolf 2001	Post intervention	HADS-Depression	Higher score = greater symptoms of depression	4.8	3.85	37	5.6	4.01	40

GDS: Geriatric Depression Scale

HADS: Hospital Anxiety and Depression Scale

**Table 3. Exercise type classified using the ProFaNE taxonomy of interventions (ProFaNE 2011)**

Study	Exercise type classified using the ProFaNE taxonomy of interventions (ProFaNE 2011)	Control Type	Supervised activity?	Group setting?

**Table 3. Exercise type classified using the ProFaNE taxonomy of interventions (ProFaNE 2011) (Continued)**

Barnett 2003	Gait, balance, co-ordination, functional tasks	Education (falls prevention)	Supervised	Group
Campbell 1997	Strength/resistance	Social visits	Unsupervised	Individual
Clemson 2010	Gait, balance, co-ordination, functional tasks	No intervention	Unsupervised	Individual
Freiberger 2012	Strength/resistance	No intervention	Supervised	Group
Haines 2009	Gait, balance, co-ordination, functional tasks	No intervention	Unsupervised	Individual
Halvarsson 2011	Gait, balance, co-ordination, functional tasks	No intervention	Supervised	Group
Hinman 2002	Home exercise programme: gait, balance, co-ordination, functional tasks	No intervention	Supervised	Individual
Hinman 2002	Computerised balance training: gait, balance, co-ordination, functional tasks	No intervention	Unsupervised	Individual
Karinkanta 2012	Resistance training: strength/resistance	No intervention	Supervised	Group
Karinkanta 2012	Balance jumping: gait, balance, co-ordination, functional tasks	No intervention	Supervised	Group
Karinkanta 2012	Combined resistance and balance jumping: gait, balance, co-ordination, functional tasks	No intervention	Supervised	Group
Lai 2013	Gait, balance, co-ordination, functional tasks	No intervention	Supervised	Individual
Lajoie 2004	Gait, balance, co-ordination, functional tasks	No intervention	Supervised	Individual
Lin 2007	Gait, balance, co-ordination, functional tasks	Home safety assessment	Supervised	Individual
Logghe 2009	3D (Tai Chi, Qi Gong, dance, yoga)	No intervention	Supervised	Group

**Table 3. Exercise type classified using the ProFaNE taxonomy of interventions (ProFaNE 2011) (Continued)**

McCormack 2004	Holistic exercise: 3D (Tai Chi, Qi Gong, dance, yoga)	No intervention	Supervised	Group
McCormack 2004	Conventional exercise: strength/resistance	No intervention	Supervised	Group
Nguyen 2012	3D (Tai Chi, Qi Gong, dance, yoga)	No intervention	Supervised	Group
Reinsch 1992	Gait, balance, co-ordination, functional tasks	Discussion group	Unsupervised	Individual
Rendon 2012	Gait, balance, co-ordination, functional tasks	No intervention	Supervised	Individual
Resnick 2008	Strength/resistance	Education (nutrition)	Supervised	Group
Sihvonen 2004	Gait, balance, co-ordination, functional tasks	No intervention	Unsupervised	Individual
Tiedemann 2012	3D (Tai Chi, Qi Gong, dance, yoga)	Education (falls prevention)	Supervised	Group
Ullmann 2010	3D (Tai Chi, Qi Gong, dance, yoga)	No intervention	Supervised	Group
Vogler 2009	Seated exercise: strength/resistance	Social visits	Unsupervised	Individual
Vogler 2009	Weight-bearing exercise: strength/resistance	Social visits	Unsupervised	Individual
Vrantsidis 2009	3D (Tai Chi, Qi Gong, dance, yoga)	No intervention	Supervised	Group
Wallsten 2006	3D (Tai Chi, Qi Gong, dance, yoga)	No intervention	Supervised	Group
Weerdesteyn 2006	Gait, balance, co-ordination, functional tasks	No intervention	Supervised	Group
Westlake 2007	Gait, balance, co-ordination, functional tasks	Education (falls prevention)	Supervised	Group
Wolf 1996	Tai chi: 3D (Tai Chi, Qi Gong, dance, yoga)	Education (gerontology)	Supervised	Group

**Table 3. Exercise type classified using the ProFaNE taxonomy of interventions (ProFaNE 2011) (Continued)**

Wolf 1996	Computerised balance training: gait, balance, co-ordination, functional tasks	Education (gerontology)	Supervised	Individual
Wolf 2001	Gait, balance, co-ordination, functional tasks	Crafts/games	Supervised	Individual
Yang 2012	Gait, balance, co-ordination, functional tasks	No intervention	Unsupervised	Individual
Yoo 2010	Strength/resistance	No intervention	Supervised	Group
Zhang 2006	3D (Tai Chi, Qi Gong, dance, yoga)	No intervention	Supervised	Group

Five studies had two or more arms with exercise interventions. Each intervention arm is described separately in the table.

## APPENDICES

### Appendix I. Search strategies

#### The Cochrane Library (Wiley Online Library)

- #1 MeSH descriptor: [Aged] this term only (208)
- #2 ((old\* or aged or elder\* or geriatric\* or senior\*) near/5 (people or person\* or adult\*)):kw,ti,ab (171550)
- #3 #1 or #2 (171638)
- #4 MeSH descriptor: [Exercise] this term only (8610)
- #5 MeSH descriptor: [Exercise Therapy] this term only (4820)
- #6 MeSH descriptor: [Exercise Movement Techniques] this term only (87)
- #7 MeSH descriptor: [Physical Education and Training] this term only (1238)
- #8 MeSH descriptor: [Walking] explode all trees (2175)
- #9 MeSH descriptor: [Postural Balance] this term only (1141)
- #10 MeSH descriptor: [Resistance Training] this term only (782)
- #11 MeSH descriptor: [Tai Ji] this term only (178)
- #12 MeSH descriptor: [Breathing Exercises] this term only (477)
- #13 MeSH descriptor: [Dance Therapy] this term only (28)
- #14 (exercis\* or training):kw,ti,ab (51483)
- #15 balance near/3 (reeducation or re-education or retraining or re-training):ti,ab,kw (14)
- #16 (aerobic near/1 exercis\*):ti,ab,kw (1385)
- #17 #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 (52890)
- #18 MeSH descriptor: [Accidental Falls] this term only and with qualifiers: [Prevention & control - PC] (610)
- #19 MeSH descriptor: [Fear] this term only (763)
- #20 (fright\* or fear\* or afraid):ti,ab,kw (2563)
- #21 #19 or #20 (2563)

#22 #18 and #21 (70)  
 #23 (fear\* or fright\* or afraid) near/5 fall\*:ti,ab,kw (145)  
 #24 "fear of falling":ti,ab,kw (121)  
 #25 ("Falls Efficacy Scale" or "Mobility Efficacy Scale" or "Survey of Activities and Fear of Falling in the Elderly"):ti,ab,kw 31  
 #26 "University of Illinois at Chicago Fear of Falling Measure" or "SAFFE" or "UICFM":ti,ab,kw (Word variations have been searched)0  
 #27 "Activities Specific Balance Confidence Scale" or "Confidence in Maintaining Balance Scale" or "CON-Fbal":ti,ab,kw (Word variations have been searched) (15)  
 #28 #22 or #23 or #24 or #25 or #26 or #27 (177)  
 #29 #3 and #17 and #28 (84)

## MEDLINE (Ovid Online)

1 Aged/ (2296985)  
 2 (old\$ or aged or elder\$ or geriatric\$ or senior\$) adj5 (people or adult\$ or person\$1).tw. (122481)  
 3 1 or 2 (2336369)  
 4 Exercise/ (66495)  
 5 Exercise therapy/ (25373)  
 6 Exercise Movement Techniques/ (353)  
 7 "Physical Education and Training"/ (11702)  
 8 Walking/ (19465)  
 9 Postural Balance/ (14173)  
 10 Resistance Training/ (2878)  
 11 Tai Ji/ (579)  
 12 Breathing Exercises/ (2697)  
 13 Dance Therapy/ (206)  
 14 (exercis\$ or training).tw. (377131)  
 15 (balance adj3 (retraining or re-training or reeducation or re-education)).tw. (41)  
 16 (aerobic adj exercise\$).tw. (4523)  
 17 or/4-16 (438843)  
 18 \*Accidental Falls/pc [Prevention & Control] (3335)  
 19 \*Fear/ (12030)  
 20 (fright\$ or fear\$ or afraid).tw. (49908)  
 21 19 or 20 (52676)  
 22 18 and 21 (189)  
 23 ((fear\$ or fright\$ or afraid) adj5 fall\$).tw. (780)  
 24 "fear of falling".tw. (667)  
 25 ("Falls Efficacy Scale" or "Mobility Efficacy Scale" or "Survey of Activities and Fear of Falling in the Elderly" or "University of Illinois at Chicago Fear of Falling Measure" or "SAFFE" or "UICFM" or "Activities Specific Balance Confidence Scale" or "Confidence in Maintaining Balance Scale" or "CON-Fbal").tw. (267)  
 26 or/22-25 (951)  
 27 3 and 17 and 26 (415)  
 28 Randomized controlled trial.pt. (379376)  
 29 Controlled clinical trial.pt. (88638)  
 30 randomized.ab. (276583)  
 31 placebo.ab. (149709)  
 32 Drug therapy.fs. (1726877)  
 33 randomly.ab. (193902)  
 34 trial.ab. (288497)  
 35 groups.ab. (1243213)  
 36 or/28-35 (3217356)  
 37 exp Animals/ not Humans/ (4002688)  
 38 36 not 37 (2738483)  
 39 38 and 27 (186)



## EMBASE (Ovid Online)

- 1 aged/ (2174749)
- 2 ((old\$ or aged or elder\$ or geriatric\$ or senior\$) adj5 (people or adult\$ or person\$1)).tw. (149531)
- 3 1 or 2 (2237738)
- 4 exercise/ (168031)
- 5 Kinesiotherapy/ (22205)
- 6 Physical Education/ (9724)
- 7 Walking/ (34132)
- 8 Body equilibrium/ (10805)
- 9 Resistance training/ (4218)
- 10 Tai Chi/ (1199)
- 11 Breathing exercise/ (4199)
- 12 Music therapy/ (3992)
- 13 (exercis\$ or training).tw. (475514)
- 14 (balance adj3 (retraining or re-training or reeducation or re-education)).tw. (61)
- 15 (aerobic adj exercise\$).tw. (6108)
- 16 or/4-15 (584260)
- 17 Falling/pc [Prevention] (2860)
- 18 Fear/ (33833)
- 19 (fright\$ or fear\$ or afraid).tw. (63252)
- 20 18 or 19 (71927)
- 21 17 and 20 (118)
- 22 ((fear\$ or fright\$ or afraid) adj5 fall\$).tw. (1050)
- 23 "fear of falling".tw. (891)
- 24 ("Falls Efficacy Scale" or "Mobility Efficacy Scale" or "Survey of Activities and Fear of Falling in the Elderly").tw. (226)
- 25 ("University of Illinois at Chicago Fear of Falling Measure" or "SAFFE" or "UICFFM").tw. (17)
- 26 ("Activities Specific Balance Confidence Scale" or "Confidence in Maintaining Balance Scale" or "CON-Fbal").tw. (151)
- 27 21 or 22 or 23 or 24 or 25 or 26 (1278)
- 28 3 and 16 and 27 (454)
- 29 Randomized controlled trial/ (351774)
- 30 Clinical trial/ (886237)
- 31 Controlled clinical trial/ (402939)
- 32 Randomization/ (62859)
- 33 Single blind procedure/ (17953)
- 34 Double blind procedure/ (116581)
- 35 Crossover procedure/ (37887)
- 36 Placebo/ (222408)
- 37 Prospective study/ (244222)
- 38 ((clinical or controlled or comparative or placebo or prospective\$ or randomi#ed) adj3 (trial or study)).tw. (709691)
- 39 (random\$ adj7 (allocat\$ or allot\$ or assign\$ or basis\$ or divid\$ or order\$)).tw. (173367)
- 40 ((singl\$ or doubl\$ or trebl\$ or tripl\$) adj7 (blind\$ or mask\$)).tw. (156631)
- 41 (cross?over\$ or (cross adj1 over\$)).tw. (67196)
- 42 ((allocat\$ or allot\$ or assign\$ or divid\$) adj3 (condition\$ or experiment\$ or intervention\$ or treatment\$ or therap\$ or control\$ or group\$)).tw. (220755)
- 43 RCT.tw. (12160)
- 44 or/29-43 (1841794)
- 45 Case Study/ or Abstract Report/ or Letter/ (899731)
- 46 44 not 45 (1804535)
- 47 28 and 46 (169)

## CINAHL (EBSCO)

S1 MH Aged (422,300)

S2 TX (old\$ or aged or elder\$ or geriatric\$ or senior\$) N5 (people or person\$) (4,243)  
 S3 S1 or S2 (424,084)  
 S4 MH Exercise (26,588)  
 S5 MH Therapeutic Exercise (12,810)  
 S6 (MH "Physical Education and Training") (1,651)  
 S7 MH Walking (11,671)  
 S8 MH Balance, Postural (7,728)  
 S9 MH Tai chi (1,095)  
 S10 MH Breathing Exercises (1,242)  
 S11 MH Dance Therapy (259)  
 S12 TX (exercis\$ or training) 112,307  
 S13 TX (balance N5 (retraining or re-training or reeducation or re-education)) (43)  
 S14 TX "aerobic exercise\$" 1,661  
 S15 S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14 (163,166)  
 S16 (MH "Accidental Falls/PC") (5,413)  
 S17 MH Fear (6,436)  
 S18 TX (fright\$ or fear\$ or afraid) (17,271)  
 S19 S17 or S18 (17,271)  
 S20 S16 and S19 (204)  
 S21 TX "fear of falling" 537  
 S22 TX ("Falls Efficacy Scale" or "Mobility Efficacy Scale" or "Survey of Activities and Fear of Falling in the Elderly") 344  
 S23 TX ("University of Illinois at Chicago Fear of Falling Measure" or "SAFFE" or "UICFFM") (19)  
 S24 TX ("Activities Specific Balance Confidence Scale" or "Confidence in Maintaining Balance Scale" or "CON-Fbal") 183  
 S25 S20 or S21 or S22 or S23 or S24 (930)  
 S26 S3 and S15 and S25 (410)  
 S27 (MH "Clinical Trials+") (164,114)  
 S28 (MH "Evaluation Research+") (19,640)  
 S29 (MH "Comparative Studies") (72,606)  
 S30 (MH "Crossover Design") (10,719)  
 S31 PT Clinical Trial (74,252)  
 S32 (MH "Random Assignment") (35,304)  
 S33 S27 or S28 or S29 or S30 or S31 or S32 (260,433)  
 S34 TX ((clinical or controlled or comparative or placebo or prospective or randomi?ed) and (trial or study)) (451,035)  
 S35 TX (random\* and (allocat\* or allot\* or assign\* or basis\* or divid\* or order\*)) (62,517)  
 S36 TX ((singl\* or doubl\* or trebl\* or tripl\*) and (blind\* or mask\*)) (685,831)  
 S37 TX ( crossover\* or 'cross over' ) or TX cross n1 over (13,447)  
 S38 TX ((allocat\* or allot\* or assign\* or divid\*) and (condition\* or experiment\* or intervention\* or treatment\* or therap\* or control\* or group\*)) (78,624)  
 S39 S34 or S35 or S36 or S37 or S38 (1,051,116)  
 S40 S33 or S39 (1,114,460)  
 S41 S26 and S40 (290)

### PsycINFO (Ovid Online)

1 "fear of falling".mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (377)  
 2 ("Falls Efficacy Scale" or "Mobility Efficacy Scale" or "Survey of Activities and Fear of Falling in the Elderly" or "University of Illinois at Chicago Fear of Falling Measure" or "SAFFE" or "UICFFM" or "Activities Specific Balance Confidence Scale" or "Confidence in Maintaining Balance Scale" or "CONFbal").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (285)  
 3 48 or 49 or 50 (4556)  
 4 randomised controlled trial.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (7473)  
 5 controlled clinical trial.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (913)

- 6 Clinical trial.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (8051)
- 7 exp Clinical trials/ or exp Experimental Design/ (46361)
- 8 randomiz\*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (40199)
- 9 single blind procedure.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (4)
- 10 double blind procedure.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (137)
- 11 crossover procedure.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (10)
- 12 placebo.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (29770)
- 13 prospective study.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (7750)
- 14 trial.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (66178)
- 15 or/52-62 (150453)
- 16 23 and 39 and 51 and 63 (36)

### **AMED (Ovid Online)**

- 1 aged.mp. [mp=abstract, heading words, title] (15703)
- 2 exp Aged/ or exp Aged 80/ or exp Frail Elderly/ (10876)
- 3 1 or 2 (15919)
- 4 exercis\$.mp. (20198)
- 5 exp Exercise/ or exp Weight Training/ or exp Leisure Activities/ or exp Recreation/ or exp Dancing/ or exp Gardening/ or exp "Play and Playthings"/ or exp Physical Fitness/ or exp Retirement/ or exp Sports/ or exp Athletics/ or exp Baseball/ or exp Bicycling/ or exp Boxing/ or exp Football/ or exp Golf/ or exp Gymnastics/ or exp Jogging/ or exp Martial Arts/ or exp Feng Shui/ or exp Tai Chi/ or exp Tai Ji/ or exp Riding/ or exp Skiing/ or exp Soccer/ or exp Swimming/ or exp Tennis/ (13323)
- 6 exercise therapy.mp. [mp=abstract, heading words, title] (5673)
- 7 exercise movement techniques.mp. [mp=abstract, heading words, title] (15)
- 8 exp Physical education/ or exp Resistance training/ or exp Physical training/ (1280)
- 9 Physical fitness/ (1791)
- 10 exp Kinematics/ or exp Balance/ (21995)
- 11 exp Tai chi/ or exp Exercise therapy/ or Muscle strength/ or tai chi.mp. (10592)
- 12 exp Muscle strength/ or exp Breathing exercises/ or breathing exercises.mp. (6022)
- 13 Dance therapy/ (111)
- 14 kinesiotherapy.mp. (23)
- 15 or/4-14 (45641)
- 16 fall\$.mp. [mp=abstract, heading words, title] (3295)
- 17 exp Accidental falls/ (1435)
- 18 16 or 17 (3295)
- 19 fear.mp. [mp=abstract, heading words, title] (1285)
- 20 exp Fear/ (325)
- 21 afraid.mp. (62)
- 22 fright.mp. (12)
- 23 19 or 20 or 21 or 22 (1394)
- 24 18 and 23 (204)
- 25 ("Falls Efficacy Scale" or "Mobility Efficacy Scale" or "Survey of Activities and Fear of Falling in the Elderly").mp. [mp=abstract, heading words, title] (53)
- 26 ("University of Illinois at Chicago Fear of Falling Measure" or "SAFFE" or "UICFFM").mp. [mp=abstract, heading words, title] (3)
- 27 ("Activities Specific Balance Confidence Scale" or "Confidence in Maintaining Balance Scale" or "CONFbal").mp. [mp=abstract, heading words, title] (51)
- 28 fear of falling.mp. [mp=abstract, heading words, title] (184)
- 29 24 or 25 or 26 or 27 or 28 (271)
- 30 randomised controlled trial.mp. [mp=abstract, heading words, title] (1909)
- 31 controlled clinical trial.mp. [mp=abstract, heading words, title] (309)
- 32 Clinical trial.mp. [mp=abstract, heading words, title] (1645)
- 33 randomiz\*.mp. [mp=abstract, heading words, title] (7694)
- 34 single blind procedure.mp. [mp=abstract, heading words, title] (0 Advanced)

35 double blind procedure.mp. [mp=abstract, heading words, title] (4)  
36 crossover procedure.mp. [mp=abstract, heading words, title] (0 Advanced)  
37 placebo.mp. [mp=abstract, heading words, title] (2419)  
38 prospective study.mp. [mp=abstract, heading words, title] (1337)  
39 trial.mp. [mp=abstract, heading words, title] (7754)  
40 exp clinical trials/ or exp randomised controlled trials/ (3318)  
41 or/30-40 (14476)  
42 3 and 15 and 29 and 41 (23)

## CONTRIBUTIONS OF AUTHORS

DK had the initial idea for undertaking the review, drafted the protocol, supervised the conduct of the review, adjudicated on papers for inclusion, data extraction and 'Risk of bias' assessment, supervised analyses, interpreted data, contributed to drafting the review and is the guarantor of the review.

AK supervised the review team, co-ordinated and assisted with data extraction, database management, assessment of papers, data extraction and meta-analyses and led the drafting of the review.

HC helped draft the protocol, assisted with data extraction, assessment of papers and drafting of the review.

JRC, ZS, DH, CB, SG, HG, TM, DS, AB and MP assisted with the data extraction and assessment of papers and checked reference lists for additional studies.

RM contributed to drafting the protocol, provided statistical advice and interpreted data.

SI contributed to drafting the protocol, adjudicated on papers for inclusion, data extraction and 'Risk of bias' assessment and interpreted data.

RZ contributed to developing the search strategy, screened papers for inclusion, organised retrieval of papers, checked data extraction and 'Risk of bias' assessment of papers and interpreted data.

KD assisted with organising retrieval of papers, identified potential unidentified studies as an expert consultant, undertook data extraction and assessment of papers and checked reference lists for additional studies.

All authors contributed to drafting the review by critically reviewing for intellectual content.

## DECLARATIONS OF INTEREST

Several co-authors of this review are involved in the NIHR HTA-funded PROACT65+ study (Ilfiffe 2010a). The study is a multicentre cluster-randomised trial comparing a community group exercise programme with home-based exercise with usual care to increase physical activity for people aged 65 and over in primary care. The trial may be included in future versions of the review.

Denise Kendrick: coinvestigator on NIHR HTA-funded PROACT65+ study (Ilfiffe 2010a)

Arun Kumar: researcher on NIHR HTA-funded PROACT65+ study (Ilfiffe 2010a)

Hannah Carpenter: researcher on NIHR HTA-funded PROACT65+ study (Ilfiffe 2010a)

G A Rixt Zijlstra: none known

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Richard W Morris: senior statistician on NIHR HTA-funded PROACT65+ study (Ilfiffe 2010a)

Steve Ilfiffe: principal investigator on NIHR HTA-funded PROACT65+ study (Ilfiffe 2010a)

Kim Delbaere: none known

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Salary support for TM

### External sources

- No sources of support supplied

## DIFFERENCES BETWEEN PROTOCOL AND REVIEW

We made substantial edits to the Background.

To improve clarity, we changed the terminology for the overall intervention to “exercise interventions” from “prescribed or provided exercise” as described in the protocol.

In the primary outcomes section, we subdivided ‘falls efficacy’ into two categories (‘falls efficacy’ and ‘concern about falling’) because some falls efficacy scales (e.g. FES-I, amFES, Modified Efficacy Scale) measure “concern” or “worry” (e.g. SAFFE) about falling as opposed to falls efficacy.

Since physical activity can be regarded as a measure of compliance or adherence to exercise interventions, we reported on this.

We did not undertake a subgroup analysis for age group based on a cut-off of 75 years. This was because only two studies restricted recruitment to participants aged 75 years and over and the remaining studies included participants aged 75 and over; hence it was not possible to identify distinct age groups for a subgroup analysis. We also did not undertake a subgroup analysis for baseline fear of

falling. This was because only two studies specified a fear of falling as an inclusion criterion, in both cases the criterion was a history of falls or fear of falling, and baseline fear of falling scores appeared similar to studies that did not have fear of falling as an inclusion criterion. One study included concern about falling as an inclusion criterion, but the prevalence of this appeared similar to studies not specifying this as an inclusion criteria. Therefore it was not possible to identify distinct groups based on fear of falling for a subgroup analysis. In addition, the protocol stated we would use sensitivity analyses to explore the effect of the primary aim of the study (to reduce fear of falling or other primary aim). We undertook a subgroup analysis instead of a sensitivity analysis, as we considered this more appropriate for this purpose.

We undertook a sensitivity analysis for fear of falling excluding the data from [Nguyen 2012](#), as this study had a much larger effect size than other studies included in the meta-analysis. We also undertook sensitivity analyses using the upper and lower 95% CI for intra class correlation coefficients where we adjusted studies for clustering. Two studies measured fear of falling using both the FES and ABC. We used FES scores in the main analysis and undertook a sensitivity analysis replacing FES scores with ABC scores for these two studies.

## **INDEX TERMS**

### **Medical Subject Headings (MeSH)**

\*Exercise; \*Independent Living; Accidental Falls [\*prevention & control]; Fear [\*psychology]; Postural Balance; Randomized Controlled Trials as Topic; Resistance Training; Tai Ji; Yoga

### **MeSH check words**

Aged; Aged, 80 and over; Female; Humans; Male